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BEDROCK GEOLOGIC MAP OF THE ALLENSVILLE QUADRANGLE, HUNTINGDON AND MIFFLIN COUNTIES, PENNSYLVANIA

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Bedrock Geology of the Allensville Quadrangle, Huntingdon and Mifflin Counties, Pennsylvania

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UNIT DESCRIPTIONS

ORDOVICIAN

Axemann Formation

The Axemann Formation crops out along the axis of the Jacks Mountain Anticline in a small area on the east edge of the quadrangle. It underlies an area of 0.75 mi^2. On the adjacent Belleville quadrangle, the formation is at least 1000 feet thick. The upper approximately 500 feet are exposed in the Allensville quadrangle.

The Axemann Formation consists of interbedded, vaguely laminated medium-gray cherty limestone with interbeds of laminated dolostone that weathers to a very light gray. It is thin to thick bedded with platy layers. Layering is mostly discontinuous with uneven surfaces. Fossils found in the unit include stromatolites, crinoids, gastropods, and burrows.

It is exposed at several small outcrops along Kishacoquillas Creek. The best exposures are at 40°34’20”N 77°45’50W (Station 4139) where about 15 feet of section are exposed, and at 40°34’52”N 77°45’34”W (Station 4129) where about 20 feet of section are exposed.

Bellefonte Formation

The Bellefonte Formation crops out in the Kishacoquillas Valley on the flanks and plunging nose of the Jacks Mountain Anticline. It is approximately 1250 feet thick. The formation mainly underlies cultivated fields on discontinuous rolling low hills that occupy much of the central portion of Kishacoquillas Valley, adjacent to low areas underlain by the Loysburg Formation.

It consists of light-to-medium-gray, aphanitic to crystalline dolostone. Weathered surfaces show laminated layers with local gently curving surfaces that may be stromatolites. Layers are 4 inches to 2 feet thick. Deep solution features along joint surfaces are common in weathered outcrops. Some layers contain redeposited quartz in blebs up to 1 inch in diameter.

Outcrops showing an appreciable thickness are rare. Most natural outcrops expose less than 5 feet of section..

At 40°32’37”N 77°47’06”W (Station 3942), on a hillside behind a barn, approximately 50 feet of steeply south dipping dolostone is exposed with deep, extensively weathered solution cavities that follow joints. At 40°33’32”N 77°46’31”W (Station 4178) about 20 feet of finely laminated dolostone with crystalline infilling and 2-3 inches of highly fragmented infilling is exposed in an old quarry in the lower part of the unit.

Its contact with the Axemann Formation is probably conformable and gradational.

Loysburg Formation

The Loysburg Formation crops out in the Kishacoquillas Valley, on the flanks of the Jacks Mountain Anticline, where the anticline plunges to the southwest, and along an unnamed fault. It is about 475 feet thick. The formation mainly underlies cultivated fields in lowland between low hills that underlie the Loysburg Formation's overlying and underlying formations.

The lower member consists of light-gray weathering medium-gray limestone interbedded with very light-gray weathering dolostone. This unit contains "tiger stripes" which, on weathered surfaces, are irregular, horizontal, very light gray bands, and irregular, mainly vertical extensions connecting the horizontal bands, in a darker- weathering light-gray limestone.

The upper member of the formation consists of interbedded medium dark-gray laminated and non-laminated dolostone and limestone in thin (2-3 inches) to thick (3 feet) layers. In some outcrops, layers are platy. Weathered surfaces on some limestone layers exhibit small, apparently highly fragmented fossil debris, interbedded with layers having recrystallized calcite that are finely laminated and non-fossil bearing. Dolostone units are laminated and thick. The upper portion is only seen in small outcrops. It was not possible to delineate the members on the map because outcrops are widely spaced, and there is insufficient float or difference in topographic expression to allow interpolation between them. The contact of the Loysburg with the Bellefonte Formation is probably conformable and gradational. It is best seen at 40°33'56"N 77°45'31"W (Station 5031).

Coburn through Hatter Formations, undifferentiated

These units crop out in the Kishacoquillas Valley, underlying cultivated fields along its north side and underlying mainly colluviated slopes along it south side. The mapped unit contains, in ascending order, the Hatter, Snyder, Benner, Nealmont, Salona, and Coburn formations, which were defined by other workers in fully exposed outcrops that are not on the Allensville quadrangle. Total thickness of all the units is about 850 feet. The units were mapped together because the defined stratigraphic differences do not produce distinctive topographic expression, lithologic uniqueness, soil color, or float material that allow accurate definition of the formations or structural relationships.

Natural outcrops are rare. Existing outcrops are primarily very small, mostly in cultivated fields, excavated along roadways and in a few small quarries located in the lower third of the mapped unit.

The lower one-third of the mapped unit consists of medium- to medium-dark-gray limestone in layers 1 inch to 3 feet thick, some with lighter-weathering clasts. Layering appears to be anastomosing. Some layers have widely dispersed body fossils, whereas others contain abundant body fossils. Many thin layers consist of highly fragmented fossil debris. Fossils include crinoids, trilobites (*Cryptolithus)*, brachiopods, cephalopods, gastropods, stromatolites, ostracods, bryozoa, coral, and pelecypods. Some layers exhibit small solution "holes". Small caves form along joints. The upper two-thirds of the mapped unit along the north side of the Jacks Mountain Anticline underlies a low topographic ridge with extremely rare, very small outcrops. Bedding layers are thin, with lumpy weathered surfaces. The float scattered in cultivated fields is mostly small, angular to rounded, platy, non-fossiliferous hand specimens of medium-gray, aphanitic limestone. The contact with the Loysburg Formation was not observed, but is probably gradational.

A good exposure is at Whitehall School (40°35’12”N 77°46’17”W, Station 4896) where about 40 feet of section are exposed. The most extensive exposure is at an inactive quarry (40°33’28”N 77°48’15”W, Station 3889) where Rones (1969) measured the section.

Reedsville Formation

The Reedsville Formation crops out on the flanks of the Kishacoquillas Valley and on valley-facing slopes of Jacks and Stone Mountains. It is exposed in numerous small borrow pits along the lower slopes of Jacks and Stone Mountains in the medial portion of the formation. Exposures of the lowermost and uppermost portions are much rarer. It is about 1800 feet thick.

The Antes Member is at the base of the formation. Its contact with the Coburn Formation is sharp and conformable. It consists of very dark-gray to black claystone with interbeds of resistant clayey limestone. This unit may be missing along the detachment zone at the base of the Reedsville. It is best exposed at low water in the bed of the westernmost stream discharging from Kings Hollow, 40o33’38”N 77o48’32”W (Station 4825).

The lower portion of the Reedsville Formation consists of medium-dark to dark-gray claystone weathering into “pencils”. Zones of siderite nodules are present. Thin zones of silty claystone define layering that is otherwise difficult to ascertain. It is well exposed at the Peachy Shale Pit, 40o35’19”N 77o47’01”W. At this pit, joints with secondary mineralization are common.

The medial portion contains the bulk of the Reedsville Formation and consists of medium dark gray spheriodal weathering claystone, with rare discontinuous zones of fossils and rare interbeds of medium light-gray silty claystone.

The upper portion of the formation consists of interbedded light-to-medium-gray shaly claystone and thin (1 inch to 3 inch) to thick bedded (3 feet) crossbedded sandstone. Many sandstone interlayers are highly fossiliferous, calcareous, and very fine grained; some have highly calcareous zones of fossil debris. Fossils found include brachiopods, crinoids, gastropods, bryozoa, trilobites (Cryptolithus), ostracods, and cephalopods. About 150 feet of section are exposed at 40o30’30”N 77o48’57”W (Station 5124).

Bald Eagle Formation

The Bald Eagle Formation crops out on the Kishacoquillas Valley-facing slopes of Jacks and Stone Mountains. It forms a steep, distinct topographic bench below the Juniata Formation that is easily visible. Its lower portion consists of thick to massively bedded gray-to-reddish-gray to brownish-gray, fine-grained, prominently crossbedded sandstone; its upper portion consists of interbedded medium- to very coarse-grained sandstone with quartz pebble conglomerate (the Lost Run Member). The Lost Run Member was not mapped separately because of insufficient outcrop. The sandstone contains shale clasts as well as quartz pebbles. At 40°35’22”N 77°47’56”W (Station 4931), it contains pyritic concretions.

The contact of the Bald Eagle with the Juniata Formation was established as the uppermost resistive bed forming the prominent, mappable topographic ridge, which results in a considerably thinner unit than elsewhere reported, with a maximum thickness in the Allensville quadrangle of 250 feet. Elsewhere where exposures of this contact are visible, the contact is disputed.

Along Allensville Road below the Lost Run Member, the Bald Eagle Formation is well exposed with interbedded thin to thick bedded, crossbedded, fine-grained non-quartzitic sandstone, with shale and hackly-weathering siltstone interbeds. Bedding in the sandstone ranges from 3 inches to 4 feet. The contact with the underlying Reedsville Formation is selected at the

uppermost sandstone layers that contain brachiopods and other fossils. At this section approximately 100 feet is exposed.

Juniata Formation

The Juniata Formation underlies steep to gentle slopes along Jacks and Stone Mountains extending from just below the crests of these mountain toward the axis of the Jacks Mountain Anticline. Its thickness is about 1100 feet. It consists of grayish-red, fine-grained sandstone with well-developed crossbedding. Included are interbedded red claystone units. The lower part, directly above the Bald Eagle Formation, is yellowish-gray sandstone.

Mapping the upper contact is based on observing that grayish-red non-quartzitic float is present below the mountain crest. Mapping of the lower contact is based on mapping of the topographical ridge underlain by the upper conglomerate portion (Lost Run Member) of the Bald Eagle Formation. The contact was not observed, but is probably gradational.

At 40°37’26N 77°45’23”W (Station 4084), approximately 200 feet of grayish-red, fine- to medium-grained non-quartzitic sandstone is exposed in the bed of a forest road. This is the only outcrop of Juniata Formation observed in the quadrangle. At this outcrop, layering ranges from 3 inches to 8 inches. Light grayish-red claystone clasts are included in some layers. Weathering of the layers produced rounded edges, unlike the sharp-edged quartzite and sandstone layers in the overlying and underlying formations.

SILURIAN

Tuscarora Formation

The highly resistant Tuscarora Formation crops out on the crests of Jacks and Stone Mountains, exposing the lower portion of the formation. It forms very steep slopes on the southeast and northwest flanks of these mountains, respectively, where abundant colluvium with large boulders blankets their flanks and covers the underlying bulk of the estimated 700 feet thickness. Where exposed, the Tuscarora consists of light-gray to white, rarely pale red and greenish-gray fine- to coarse-grained quartzite with interbedded shale. Generally a maximum of 40 feet of section is exposed. The quartzite is very hard, well-cemented, crossbedded and, in exposure of its lower portions, contains dispersed pebbles. Small pits where siderite nodules weathered out are common. The trace fossils *Arthrophycus* and *Skolithos* are present but not common. Bedding is mostly thick.

Its contact with the underlying Juniata Formation was not observed but is probably conformable and interbedded. The contact is at, or near, the crests of Jacks and Stone Mountains, based on float and reddish soils that are present on the slopes opposite to the direction of dip, below the crestal outcrops.

Allensville Road, which crosses Stone Mountain, and Jacks Mountain Road offer excellent, accessible outcrops.

Cotter (1982) provides a thorough description of the Tuscarora Formation in central Pennsylvania, including a detailed description of the outcrops on Jacks Mountain Road.

Rose Hill Formation

The Rose Hill Formation crops out on the southeast flank of Jacks Mountain and the northwest flank of Stone Mountain, where it underlies steep slopes and is wholly covered with colluvium derived from the Tuscarora Formation. It is about 1000 feet thick.
Where exposed, the Rose Hill Formation is a light-olive-gray to grayish-red and pale-brown claystone with interbeds of thin very fine-grained sandstone with manganese staining. The substantial iron-rich resistant sandstone beds found elsewhere in Pennsylvania are not present.

Because of the colluvium cover, only two outcrops were seen on the Allensville quadrangle. These exposures reveal less than 20 feet of section. The most accessible exposure, at 40°31'03"N 77°47'07"W (Station 3479), is a shale pit on the southeast flank of Jacks Mountain, on the north side of Jacks Mountain Road. Another shale pit on the northwest flank of Stone Mountain at 40°30'54"N 77°52'11W (Station 4807), is adjacent to a gated private road.
The contact of the Rose Hill Formation with the Tuscarora Formation was not observed, but is probably conformable and gradational. The contact is at a sharp break in slope caused by the contrast in hardness between the formations and is easily mapped on stereographic photos.

Keefer Formation

The Keefer Formation is a light-gray to yellowish-brown, very fine- to coarse- grained, fossiliferous, siliceous sandstone that is locally hematitic. Northwest of Stone Mountain it is conglomeratic. It is well-bedded with beds thin to thick and crossbedded. It is found only on the southeast flank of Jacks Mountain and the northwest flank of Stone Mountain. On both mountains, it is covered with colluvium and only float was seen. The float is distinguished from float derived from the Tuscarora Formation, with which it is commonly intermixed, by the abundant fossils it contains. The most common fossils are crinoids and brachiopods. It is a resistant unit, and forms low ridges visible on stereo photographs. Mapping was based on topographic expression and highest float found. It is about 70 feet thick. Its contact with the Rose Hill Formation was not observed, but is probably conformable.

Bloomsburg and Mifflintown Formations, undifferentiated

The Bloomsburg and Mifflintown Formations crop out low on the southeast flank of Jacks Mountain and on the northwest flank of Stone Mountain, where they underlie steep slopes. The Bloomsburg Formation is predominantly grayish-red claystone. It contains some sandstone, thin, impure limestone and grayish-green shale. The sandstone unit (Moyer Ridge Member) in the upper one-third of the formation has beds 2 to 3 feet thick and contains vertical joints resealed with quartz, some of which is crystalline. It contains vertical *Skolithos* burrows. The sandstones of the Moyer Ridge Member are harder than the overlying Wills Creek Formation and the underlying claystones. Consequently, the Moyer Ridge Member has a topographic expression that assists in mapping local geologic structure. While the Moyer Ridge Member is distinctive, outcrops are too few to map it separately. Claystones exhibit hackly weathering caused by cleavage, making determination of bedding difficult. The Mifflintown Formation is greenish-gray shale interbedded with medium-gray, fossiliferous limestone. While the formations are distinct, no outcrops of the Mifflintown Formation were observed because of colluvium cover, so the two units are combined in this quadrangle for mapping purposes. The nature of their contact is not known. The contact with the Keefer Formation is sharp. Combined thickness is about 800 feet.

There are several exposures of the lower Bloomsburg Formation along an unnamed gully on the southwest flank of Jacks Mountain. Interbedded claystones and limestones are present in the Bloomsburg in this gully. The outcrops begin at 40°31'50"N 77°45'23"W. The Moyer Ridge Member is best exposed on the quadrangle at 40°34'49"N 77°49'56"W (Station 3588) in an inactive quarry that is about 200 feet southwest of the intersection of Martin Road and Flat Road. It is well exposed in a shale pit on East Branch Road about 600 feet north of the quadrangle boundary.

Wills Creek Formation

The Wills Creek Formation crops out low on the southeast flank of Jacks Mountain, on the northwest flank of Stone Mountain, and on the northern edge of the quadrangle. On the mountain flanks, it occupies steep, colluvium-covered slopes. Because of the colluvium cover, only one exposure was found on Jacks Mountain, and none on Stone Mountain. Topography at its northern outcrop is hilly, with relief of about 150 feet. Outcrops on the northern edge of the quadrangle are sparse and generally small.

The formation consists of greenish-gray shaly to platy claystones with interbeds of very fine-grained light-olive-gray non-calcareous sandstone and local limestone. Sandstone is most common in the upper part of the formation, and forms low ridges that were observed on the flanks of Jacks and Stone Mountains. In the adjacent Belleville quadrangle, the lower part of the formation contains siltstone layers and red shale resembling the Bloomsburg Formation. These were not seen on the Allensville quadrangle because of colluvium cover, but are probably present. It is moderately well- bedded, with fissile to thick beds. The claystones are commonly highly cleaved. The formation is about 600 feet thick. The contact with the Bloomsburg Formation is transitional.

The best outcrop on the quadrangle is on the south side of Blue Lick Hollow, behind a farm equipment storage shed, at 40°37'22"N 77°52'19"W (Station 4174). About 15 feet are exposed.

Tonoloway Formation

The Tonoloway Formation crops out in a valley on the axis of a 3rd order breached anticline within the unnamed synclinorium in the southeast part of the quadrangle, low on the southeast flank of Jacks Mountain, and on the flanks and axis of the Broad Top Synclinorium. The valley in the synclinorium has low relief. Relief is also low in the area underlain by the Tonoloway Formation on the southeast flank of Jacks Mountain. Slopes along the same crop become steep and colluvium-covered to the southwest. On the southeast side of the Broad Top Synclinorium the Tonoloway Formation occupies steep, colluvium-covered slopes. Along the axis of the Broad Top Synclinorium and on its northwestern limb, slopes are moderately steep and outcrops are common.

The Tonoloway Formation consists of thinly laminated limestones and dolostones. Dolostones are most common in its lower portions. Fossils are sparse, although brachiopods, ostracods and one coral were observed. Bedding ranges from thick (3-5 feet) to platy with argillaceous partings. It is commonly extensively folded into complex 4th and 5th order folds. In structurally complex areas, some layers within the normal sedimentary sequence consist of highly fragmented carbonate with small solution cavities and secondary calcite crystals. These layers appear to be solution breccia. Elsewhere in Pennsylvania, mud cracks are common. Only one example of this sedimentary structure was noted on the Allensville quadrangle. While the

Tonoloway Formation elsewhere in Pennsylvania is karstic, the only sinkholes found on the Allensville quadrangle are along the northwest flank of Stone Mountain. Many of these are associated with an inferred fault. The contact with the Wills Creek Formation was not observed but is probably gradational. Thickness is about 700 feet.

The Tonoloway Formation is nowhere on the quadrangle fully exposed. About 20 feet are exposed along Standing Stone Creek across from its confluence with the creek draining Murphy Hollow. It is extensively exposed along Rte. 26 about 3000 feet south of Summit School Road. A substantial outcrop is on a rib south of Blue Lick Hollow, and there are numerous exposures in the usually dry creek bed that parallels Summit School Road.

SILURIAN AND DEVONIAN

Keyser Formation

The Keyser Formation crops out on the flanks of a 3rd order anticline within the unnamed synclinorium in the southeast part of the quadrangle, low on the southeast flank of Jacks Mountain, and on the flanks and axis of the Broad Top Synclinorium. It underlies moderate slopes in the quadrangle's southeast and Jacks Mountain areas, and steep slopes on the flanks of the Broad Top Synclinorium. The Keyser Formation is moderately well exposed in small outcrops in the Allensville quadrangle.

The Keyser Formation is a dark-gray, fossiliferous, crystalline limestone with thinly-laminated limestone in its upper portion that resembles the Tonoloway Formation. Fossils found in the formation include brachiopods, ostracods, gastropods, coral, and bryozoa. It is well-bedded, with beds flaggy to thick. Some beds are massive. A few clastic beds up to 1.5 feet thick were observed. The basal nodular limestone found elsewhere in Pennsylvania is not present northwest of Stone Mountain, and is uncommon in the rest of the quadrangle. Calcite-filled fractures are common. Below the contact with the Old Port Formation on East Branch Road, the Keyser Formation is a calcilutite in layers 1 inch to 3 feet thick with laminae and sparse fossils. It is platy bedded in layers separated by thick beds. Its contact with the Tonoloway Formation is sharp. While few sinkholes were found in the Keyser, on the western edge of the quadrangle there is a closed depression that covers about ½ square mile that extends onto the Donation quadrangle and includes the mapped Keyser. The formation is about 170 feet thick.

The upper portion of the Keyser Formation is well exposed along East Branch Road near the intersection with Barr Road at 40°36'47"N 77°49'02"W (Station 3718). Almost all exposures are small. There are no quarries of any significant size on the quadrangle.

DEVONIAN

Old Port Formation

Lower Member. The lower member of the Old Port Formation crops out in four belts in the unnamed synclinorium in the southeast part of the quadrangle and on the flanks and axis of the Broad Top Synclinorium. It commonly underlies steep slopes adjacent to the Ridgeley Member. It forms the crests of Orebank and Bald Ridges and caps several hilltops on the northwest side of the Broad Top Synclinorium.

At the top of the lower member is the Shriver chert, seen only as float in several places. No outcrops were observed. It is a dark-gray to black chert that weathers to light gray to white or yellow-brown. It is thin, probably 25 feet thick or less. Below the Shriver chert, the formation is dominantly a dark gray, massive limestone. Eight miles east of the eastern border of the Allensville quadrangle, on the newly constructed Lewistown Route 22-522 bypass, a road cut in the Old Port Formation revealed thin beds of very fine-grained sandstone, shale, chert, and siltstone in the limestone. These lithologies were not observed in the Allensville quadrangle, but are probably present. The road cut is now paved over. Limestone in the lower Old Port Formation is well-bedded, fossiliferous, crystalline calcarenite. Bedding surfaces exposed on East Branch Road west of Barr Road exhibit widely spaced anastomosing fractures. Layers immediately above the contact with the Keyser Formation contain chert blebs and locally extensive "ropy" chert in a 3 feet thick zone. Fossils are commonly siliceous. Brachiopods, crinoids, bryozoa, ostracods, gastropods, and *tentaculites* were found. The limestones are karstic. Sinkholes are common, and Rupert Cave, located about one mile west-southwest of Spring Run Church, has over 7,000 feet of mapped passage. The member is about 200 feet thick.

Outcrops are common, but nowhere is it fully exposed. About 50 feet of section are exposed near Dry Run where it cuts through Rocky Ridge. Its contact with the underlying Keyser Formation is present on Barr Road near its intersection with East Branch Road. The contact is marked by the presence of tubular chert.

Ridgeley Member: The Ridgeley Member crops out on the flanks and axis of the Broad Top Synclinorium and within the structurally complex unnamed synclinorium in the southeast part of the quadrangle. Its hardness is highly variable. Where it is cemented by silica, it forms high crags. Numerous crags are exposed on Rocky Ridge and on the northwest flank of the Broad Top Synclinorium. Southeast of Orebank Ridge, where the sandstone is calcite-cemented, it lies topographically below the underlying Shriver chert of the Old Port Formation.

The Ridgeley Member consists of fine- to very coarse-grained, white and light gray to buff, fossiliferous sandstone. Fossils are dominantly brachiopods. Some crinoids and gastropods are also found. In the northwest portion of the quadrangle, granules to small pebbles are dispersed in the sandstone. At Martins Gap and along Rocky Ridge, it exhibits extensive large "holes" where material has weathered out. It is medium to thick bedded, with a thickness of 75 feet. In some places it exhibits ductile deformation that obliterates bedding. In nearby Mapleton Depot, immediately southwest of the Allensville quadrangle, it is quarried for glass sand.

The Ridgeley Member is an excellent marker unit for mapping due to its distinctive lithology and commonly prominent narrow ridges. Its contact with the underlying Shriver chert was not directly observed and is assumed to be gradational. The best exposure of the Ridgeley Member seen is just west of the Allensville quadrangle, on Wesley Chapel Road. The member forms a dip slope here, and approximately half of the unit is exposed. Both hard and soft lithologies are exhibited. Hunters Rock on Wesley Chapel Road is a crag about 60 feet high exhibiting prominent cross-bedding.

Onondaga Formation

The Onondaga Formation is present on the flanks and axis of the Broad Top Synclinorium and is inferred to underlie the axes of three 3rd order synclines within the structurally complex unnamed synclinorium in the southeast part of the quadrangle. The synclines are north of Bald Ridge and south of Dunmire and Orebank Ridges. On the southeast flank of the Broad Top Synclinorium, where dips are steep to overturned, the Onondaga

Formation generally occupies steep, colluvium-covered slopes. On the northwest flank, where dips are lower, slopes are gentler. In the southeast part of the quadrangle, near Dunmire and Orebank Ridges, slopes underlain by the Onondaga Formation are steep and colluvium-covered. The Onondaga Formation is rarely exposed in the Allensville quadrangle because of the thinness of the unit and low resistance to erosion. Only one outcrop was observed in the southeast area. Small outcrops were found on the flanks of the Broad Top Synclinorium.

The Onondaga Formation has two members. The lower member is the Needmore shale, a medium- to medium-light-gray, generally calcareous shale that commonly has pencil cleavage caused by the intersection of bedding and cleavage. Layering in most outcrops is obscure. Weathered surfaces exhibit iron staining. It contains a few fossils; brachiopods and trilobites were found. It is about 80 feet thick. The upper member is the Selinsgrove limestone. The upper 10 feet contain dark- to medium-gray, argillaceous limestone beds up to 6 inches thick interbedded with cleaved(?) claystone. Bedding surfaces contain small round solution features. Southeast of Garrett Knob there are four sinkholes, up to 20 feet in diameter and 10 feet deep, developed in the Selinsgrove limestone. The size of the sinkholes implies a thickness of at least 20 feet., for a total formation thickness of 100 feet. Fossils are sparse, but brachiopods, coral, trilobites and burrows were seen. The member is too thin, with too few outcrops, to map separately.

While the contact with the Ridgeley Member of the Old Port Formation was not observed, it is probably sharp and conformable. The best outcrops are at 40°35’34” N 77°50’07”W (Station 4605), along Rte. 26 100 yards west of Jackson Corner where thin limestones are interbedded in the shales, and in Martins Gap.

Marcellus Formation

The Marcellus Formation is present on the flanks and axis of the Broad Top Synclinorium and is inferred to underlie the axes of two 3rd order synclines southeast of Orebank and Dunmire Ridges that are within the structurally complex unnamed synclinorium in the southeast part of the quadrangle. Because the Marcellus is easily eroded, it underlies low areas and is commonly covered with colluvium. The two valley floors it underlies in the unnamed synclinorium are completely covered with colluvium to the extent that not even float was observed. Its presence is inferred from dips of the flanking Ridgeley Member of the Old Port Formation and unit thicknesses. Colluvium covering the formation in the Broad Top Synclinorium area is commonly thin enough to find float and small outcrops of the underlying Marcellus lithologies.

The Marcellus Formation consists of fissile grayish-black to black carbonaceous clay shale. It contains abundant pyrite, particularly near its base. Although bentonites are contained within the formation, none were observed in outcrop in the Allensville quadrangle. Limestone occurs locally and may be seen in an outcrop at 40°35’28”N 77°51’13”W (Station 4705), located about 3000 feet southeast of Jackson Corner. Although it is only about 70 feet thick, its distinctive lithology makes it an excellent marker unit.

Its contact with the Selinsgrove Member of the Onondaga Formation is sharp and conformable. It is well exposed at 40°35’34” N 77°50’07”W (Station 4605) along the East Branch of Standing Stone Creek where 15 feet of the Selinsgrove Member and 25 feet of the Marcellus Formation are exposed. The largest exposure is a borrow pit about 1000 feet southwest of the intersection of East Branch Road and Allensville Road at 40°35’47”N 77°50’02”W (Station 4694).

Mahantango Formation

The Mahantango Formation underlies portions of the west-central and northwestern portion of the Allensville quadrangle along the Broad Top Synclinorium. The formation supports low, indistinct hills and topographically distinct ridges such as Brush Ridge near the western boundary of the quadrangle. Natural exposures are rare. Most observable exposures are in small to moderate size borrow pits which reveal that the absence of exposures is the result of all slopes being covered by thick colluvium of pencil-shaped claystone fragments. The principal lithology of the Mahantango Formation is sparsely fossiliferous, medium-dark-gray claystone that weathers to olive gray. Cleavage is prominent in most claystone layers and obscures the regional strike and dip of the rocks. Structural attitudes are provided by a few widely dispersed layers of micaceous, sparsely fossiliferous, dark-gray weathering to olive-gray, very fine-grained sandstone layers. Stratigraphic units approximately 25-40 feet thick of thin to thick bedded, dark gray, very fine-grained, sparsely fossiliferous sandstone support Brush Ridge and a paralleling lower ridge along Dry Run.

The uppermost claystones of the Mahantango are abundantly fossiliferous and provide a distinctive lithology that marks the upper contact of the formation with the overlying Harrell Formation. The upper contact is exposed along the private road described below in the Harrell Formation along Standing Stone Creek. Here the upper one foot of the Mahantango is a hard, dark gray limestone (the Tully limestone) that is profusely fossiliferous with fossils similar to those in the immediately underlying claystones.

The lower contact of the Mahantango Formation with the underlying Marcellus Formation is nowhere exposed on the quadrangle. Elsewhere the contact is a gradational contact marked by a grading upward from the black fissile Marcellus Formation to very dark gray to dark gray non-fissile claystones. The formation is about 1000 feet thick.

The best exposures of the formation are in the moderately sized borrow pit along Martin Gap Road, at 40°34’34”N 77°51’14”W (Station 4459) and in natural exposures along Dry Run at 40°33’02”N 77°52’15”W (Station 4021) and at 40°32’56”N 77°52’10”W (Station 4461) where it has eroded a gap in Brush Ridge.

Harrell Formation

The Harrell Formation is present only in the west-central portion of the Allensville quadrangle, underlying and paralleling the Brallier Formation along its outcrop belt in the Broad Top Synclinorium. The Harrell occupies a distinctive lower slope marked by a discernable slope angle change at the base of the Brallier Formation. Only two outcrops of the Harrell Formation were observed in the quadrangle. The Harrell Formation principally consists of fissile, black, shaly claystone which grades upward in the medial and upper portions to very dark gray to dark gray claystones with interbeds of black shale. Throughout its outcrop belt the formation is largely obscured by colluvium from the overlying Brallier Formation. The base of the formation is mapped at a reversed topographic slope underlain by the uppermost Mahantango Formation and also identified by the change in lithology from black fissile claystone to dark gray, non-fissile, abundantly fossiliferous claystones.

An 80% complete section of the Harrell Formation was observed just west of the western boundary of the Allensville quadrangle on the hill slope west of Dry Run along a private road, between 40°32’54”N 77°52’31”W and 40°32’41”N 77°52’37”W. The exposed section consists of deeply weathered fissile black claystones, weathering to gray and dark-brownish-gray

claystones. The formation's black shales are interbedded with very dark to dark-gray claystones in the medial and upper portions. It is 100 feet thick.

The lower portion of the Harrell is exposed along a second private road at 40°34'05"N 77°52'24"W (Station 5673) above the outcrops of the Mahantango Formation on the steep hillslope paralleling Standing Stone Creek just north of where the creek course is a sharp "U" near the western boundary of the Allensville quadrangle. At this locality the lower Harrell is underlain by the Tully limestone and abundantly fossiliferous Mahantango Formation claystones. The lower contact is sharp and conformable.

Brallier Formation

The Brallier Formation is present only in the west-central portion of the Allensville quadrangle. The stratigraphically youngest unit of the quadrangle occupies the shallowly dipping sides and axis of the Broad Top Synclinorium. The Brallier supports topographic ridges with steep slopes. Few outcrops are seen, except along ridge tops and along constructed roads and trails. Here, outcrops in the Brallier consist of thin, planar bedded to flaggy, light-olive-gray micaceous siltstone and interbedded olive-gray, very fine-grained sandstone in layers 1 to 2 inches thick. Interbedded with these outcrops are light-olive-gray shaly claystones that make up the bulk of the approximately 150 feet of section present in the quadrangle. The basal contact with the underlying Harrell Formation is sharp and conformable, but rarely seen due to extensive colluvium that is derived from, and mantles the steep slopes underlain by, the lower Brallier. The base of the formation was mapped at a prominent break in slope at the top of the underlying Harrell Formation.

The base of the formation was observed along a private road leading downward from the ridge top to Dry Run immediately west of the western quadrangle boundary at 40°32'51"N 77°52'34"W (Station 4450). At this locality a two-foot thick, olive-gray, very fine-grained sandstone marks the base of the Brallier. Above the formation base at this locality the principal lithologies are fissile, dark to very-dark-gray, laminated claystones with minor interbedded siltstones until near the top of the slope where zones of very planar bedded, flaggy, fine-grained sandstones appear.

STRUCTURE

Folds are the dominant geologic structures in the Allensville quadrangle. The folds are all sizes, from 1st order (wavelength > 10 miles) to 5th order (hand specimen size) (Nickelsen, 1963). General trends of the folds are northeast-southwest. The folds plunge to the southwest, away from the Juniata culmination. This culmination, which is east of the quadrangle, is a transverse belt that extends approximately north-south from western Perry County to southwestern Clinton County and encompasses the structurally highest portions of all the anticlines (Gwinn, 1970). First order folds are the Broad Top Synclinorium, which traverses the northwest portion of the quadrangle, the Jacks Mountain Anticline, which crosses the middle of the quadrangle, and part of the northwest flank of an unnamed 1st order synclinorium that is in the southeast portion of the quadrangle. Many smaller folds, from 3rd to 5th order, occur within the major folds.

Several major faults traverse the area. The pre-Alleghanian Orogeny Antes-Coburn Detachment Fault is exposed in the Kishacoquillas Valley (Nickelsen, 1988). It separates two mechanically dissimilar lithologies, the underlying carbonate sequence and the overlying

sequence of shales, siltstone, and sandstones. The Bearpen Hollow Fault, a splay thrust fault originating in the Antes-Coburn Detachment Fault (Nickelsen, 1988), is in the northeast corner of the quadrangle. The Stone Mountain Duplex, which consists of discrete blocks that have been rotated so that their bedding strikes north of the ridge trend, is located south of 40°32'30"N (Nickelsen, 1988). A reverse fault in the Kishacoquillas Valley and two thrust faults, one in the Kishacoquillas Valley, and one on the northwest flank of Stone Mountain, are present.

Most claystones display cleavage, which is prominent in the Reedsville and Mahantango formations.

Folds

The folds in the Allensville quadrangle are flexural-slip folds. Beds do not change in thickness across the folds, indicating little deformation within individual beds. Within each fold limb, limited outcrops imply bed attitude is constant, with no bending except in the fold hinges. Consequently, the width of the hinge is narrow compared to the dimensions of the fold. This geometry is characteristic of the Ridge and Valley structural province in Pennsylvania (Nickelsen, 1963). Slickensides are commonly seen on bedding surfaces, indicating that the principal deformational mechanism was slip of the bedding surfaces between the beds.

The dominant fold in the quadrangle is the Jacks Mountain Anticline. It is a breached anticline. Ordovician carbonates are exposed along its axis in the Kishacoquillas Valley. The Silurian-age Tuscarora Formation is on the crests of the mountains flanking the valley, about 1000 feet above the valley floor. Dips on the southeast side of the axis of the anticline are significantly steeper than those on the northwest side, up to the crest of Stone Mountain. Northwest of the crest, dips are similar those on the southeast side of the anticline. Smaller folds are found on the flanks of the valley in the Reedsville Formation and throughout the valley. Because outcrops are generally small, few of the smaller folds are seen, but they are probably common. A cluster of 4th order anticlines is seen along Kishacoquillas Creek southwest of Waynesburg Road, where a small dome is also present. The anticlinal axis plunges to the southwest, so progressively older rocks are exposed on its axis to the northeast. A 5th order anticline with prominent south dipping cleavage is revealed in a small shale pit at 40°36'16"N 77°46'26"W (Station 5465). It is in the Reedsville Formation and may be related to the Bearpen Hollow folded thrust fault.

The southwest plunge of the Broad Top Synclinorium results in the youngest rocks in the quadrangle, the Brallier Formation, being exposed along its axis on the western border of the quadrangle. Dips are steeper on its southeast flank and there are smaller folds contained within it. Overturning of fold limbs occurs north and west of Garret Knob. A non-continuous exposure of the Ridgeley Member just west of Garret Knob has some beds overturned, while some are upright. The exposure defines the south flank of a 4th order syncline whose axis plunges south in the areas of overturning without affecting the linearity of the exposure. A 5th order syncline in the Wills Creek Formation is visible at 40°37'27"N 77°49'01W (Station 4381).

There are three 3rd order anticlines and three 3rd order synclines in the southeast portion of the quadrangle that are on the northwest flank of an unnamed 1st order synclinorium. The axis of the synclinorium is southeast of the Allensville quadrangle. Dips are steep to overturned. The multitude of 3rd order folds is probably related to ductility of the Upper Silurian to Middle Devonian rocks exposed. The valley underlain by the 3rd order syncline south of Orebank Ridge is flat-bottomed, sloping to the southwest. Because the area is covered with colluvium, no exposures were seen, and it is not known if the flatness is a function of structure. There is no

uniformity of direction of plunge of the axes of the 3rd order folds. Some plunge to the northeast, some to the southwest. No lower order folds were seen, but that is probably a consequence of a lack of large outcrops.

Faults

The most significant fault in the quadrangle is the Antes-Coburn Detachment Fault, which is at or near the contact between the Antes Member of the Reedsville Formation and the Coburn Formation (Nickelsen, 1988). It separates two mechanically dissimilar lithologies, the underlying 2-mile-thick carbonate sequence and the overlying 5-mile-thick sequence of shales, siltstone, and sandstones. Gwinn (1970) determined that the underlying carbonates were shortened twice as much as the overlying shales, siltstone and sandstones.

The detachment fault is best seen at the Reedsville exit of US 322, on the Burnham quadrangle. Only one exposure of the fault is seen on the Allensville quadrangle, at 40°33'37"N 77°48'32"W (Station 4825). Here Coburn Formation limestones are exposed in a creek bed. Twenty-five feet northwest in the creek bed is a shear zone in black claystone of the Antes Member, striking N74E with vertical beds. The shear zone is interpreted to be the physical expression of the detachment fault. Twenty-five feet northwest of the shear zone, shallowly northwest-dipping Antes is exposed.

South of Rockville, the mapped trace of the fault cuts out half of the carbonates of the Coburn-Hatter sequence. Where the fault is inferred from float, it is common to see Reedsville shale, not the Antes Member, adjacent to the Coburn Formation.

The crest of Stone Mountain south of 40°32'30"N exhibits an uneven, knobby form. This area is the Stone Mountain duplex, which consists of discreet fault-bound blocks of the Tuscarora, Juniata and Bald Eagle formations that have been rotated so that their bedding strikes at an acute angle north of the ridge trend. For a complete description refer to Nickelsen (1988, p. 101-102). Each block is in a zone that is bounded on both sides by thrusts or steep reverse faults. Pre-folding imbricate faults that strike parallel to bedding in the blocks cause multiple duplications of the Bald Eagle-Tuscarora section. Nickelsen interpreted that the Stone Mountain duplex was localized to the Juniata-Tuscarora-Rose Hill sequence and that a separate duplex affected the Reedsville-Bald Eagle-Juniata sequence. We have reinterpreted, based on available data, that it is more appropriate to represent the pre-folding imbricate faults that are seen rotating the Bald Eagle, Juniata, and Tuscarora formations as one duplex.

The Bearpen Hollow Fault is a refolded thrust fault that cuts off the southwest end of an unnamed ridge underlain by the resistant rocks of the Bald Eagle Formation, 0.6 miles west of the unincorporated community of Rockville. Traced to the northeast from the cutoff, the Bearpen Hollow Fault cuts upward in stratigraphic section until in the adjoining McAlevys Fort quadrangle it also cuts off the Tuscarora Formation exposed on Stone Mountain. Although colluvium hides the trace of the fault south of Rockville, it is mapped northeastward from the cutoff of the unnamed ridge to a mapped repeat of the Coburn-Hatter carbonates at the east border of the quadrangle.

A reverse fault is in the Kishacoquillas Valley, southeast of the anticlinal axis and parallel to it. The fault extends from the southern border of the quadrangle to one-half mile west of the eastern quadrangle boundary**.** A thrust fault in the valley, mapped by Nickelsen (1988), is north of and parallel to the anticlinal axis and extends from the southern border of the quadrangle to Sharpsburg. A second thrust fault is on the northwest flank of Stone Mountain. It was not directly observed, but inferred from having to fit 2700 feet of stratigraphic section into a space

1700 feet wide. A line of sinkholes that are oriented parallel to regional strike is interpreted to be the location of the fault.

Cleavage

Most claystones cropping out in the quadrangle exhibit prominent cleavage. Formations in which cleavage was seen are the Reedsville, Wills Creek and Mahantango formations. The Bloomsburg Formation commonly also has prominent cleavage, but not enough of it was seen to characterize it. Pencil cleavage is common in claystones from the Reedsville and Mahantango formations.

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Table 1. Planar measurements.

Station	Latitude	Longitude	Strike	Dip	Description		Station	Latitude	Longitude	Strike	Dip	Description
4759	40.60516	-77.86277	115	17	Inclined		5037	40.55778	-77.77097	32	26	Inclined
4761	40.60646	-77.86172	47	52	Inclined		5040	40.55604	-77.76898	35	38	Inclined
4764	40.60515	-77.87434	53	14	Inclined		5044	40.55958	-77.76950	53	28	Inclined
4767	40.60162	-77.86087	178	10	Inclined		5046	40.56029	-77.76888	32	19	Inclined
4770	40.60645	-77.87221	13	6	Inclined		5047	40.55873	-77.76837	48	32	Inclined
4771	40.60851	-77.87011	55	9	Inclined		5048	40.55717	-77.76794	38	44	Inclined
4774	40.60724	-77.86908	125	9	Inclined		5050	40.55463	-77.77023	38	32	Inclined
4775	40.60967	-77.85983	220	11	Inclined		5051	40.55299	-77.77431	36	37	Inclined
4777	40.60646	-77.86050	90	9	Inclined		5053	40.53519	-77.81383	200	15	Inclined
4779	40.60783	-77.86219	128	46	Inclined		4114	40.61378	-77.86374	225	68	Inclined
4793	40.61465	-77.84976	228	80	Inclined		4117	40.61610	-77.86013	42	77	Inclined
4794	40.61634	-77.85273	60	22	Inclined		4119	40.61280	-77.86994	70	15	Inclined
4795	40.61643	-77.85378	215	39	Inclined		4120	40.61264	-77.87187	200	40	Inclined
4796	40.61697	-77.85469	234	30	Inclined		4135	40.57627	-77.76868	228	24	Inclined
4798	40.60888	-77.85511	42	35	Inclined		4136	40.57522	-77.76820	220	21	Inclined
4800	40.60822	-77.85426	35	75	Inclined		4137	40.57024	-77.76304	220	21	Inclined
4807	40.51511	-77.86981	193	60	Inclined		4138	40.57106	-77.76303	70	39	Inclined
4810	40.61941	-77.84626	52	12	Inclined		4139	40.57227	-77.76377	61	24	Inclined
4812	40.61977	-77.84850	55	76	Inclined		4140	40.57150	-77.77106	238	9	Inclined
4814	40.61986	-77.85036	218	12	Inclined		4142	40.57169	-77.76643	170	12	Inclined
4817	40.61443	-77.85976	67	32	Inclined		4143	40.57336	-77.76830	222	20	Inclined
4824	40.55913	-77.80576	205	24	Inclined		4144	40.57236	-77.76705	245	19	Inclined
4825	40.56040	-77.80891	212	38	Inclined		4146	40.56535	-77.77181	74	39	Inclined
4746	40.60105	-77.85801	139	36	Inclined		4147	40.56674	-77.77206	63	19	Inclined
4751	40.60831	-77.85745	167	27	Inclined		5396	40.52892	-77.80168	41	48	Inclined
4827	40.55388	-77.79845	185	5	Inclined		5399	40.53128	-77.80423	46	32	Inclined
4829	40.52652	-77.81623	230	26	Inclined		5400	40.53089	-77.80598	235	11	Inclined
4722	40.58931	-77.87177	75	36	Inclined		5402	40.53236	-77.79951	46	50	Inclined
4685	40.58447	-77.87449	48	18	Inclined		5403	40.53513	-77.79539	46	47	Inclined
4686	40.58560	-77.87460	52	37	Inclined		5405	40.53899	-77.79652	62	10	Inclined
4687	40.57356	-77.86443	50	23	Inclined		5407	40.53914	-77.79498	51	30	Inclined
4688	40.57279	-77.86952	122	13	Inclined		5408	40.53848	-77.79401	37	53	Inclined
4692	40.59906	-77.83108	40	57	Inclined		5410	40.54498	-77.82643	215	23	Inclined
4700	40.59545	-77.84018	0	0	Horizontal		5411	40.51886	-77.82029	40	38	Inclined
4714	40.59233	-77.86957	65	22	Inclined		5412	40.52122	-77.81519	60	51	Inclined
4717	40.59240	-77.87368	80	19	Inclined		5413	40.51105	-77.83054	56	28	Inclined
4719	40.59400	-77.87460	80	15	Inclined		5415	40.50971	-77.82979	63	31	Inclined
4702	40.59544	-77.84318	52	37	Inclined		5418	40.54625	-77.80981	190	7	Inclined
4709	40.59518	-77.87037	70	15	Inclined		5425	40.53540	-77.80897	25	10	Inclined
4711	40.59398	-77.86711	52	23	Inclined		5428	40.53596	-77.80608	184	11	Inclined
4734	40.59754	-77.87280	50	16	Inclined		5431	40.53466	-77.80482	276	7	Inclined
4735	40.59665	-77.87362	70	14	Inclined		5435	40.53717	-77.80185	220	13	Inclined
4831	40.52576	-77.81799	242	36	Inclined		5439	40.53159	-77.82473	55	68	Inclined
4832	40.58043	-77.77724	236	21	Inclined		5442	40.52988	-77.82897	224	38	Inclined
4835	40.58007	-77.77546	242	36	Inclined		5443	40.56483	-77.78976	208	21	Inclined
4839	40.58219	-77.77900	232	41	Inclined		5444	40.56599	-77.79041	215	23	Inclined
4840	40.57683	-77.77734	227	18	Inclined		5445	40.56539	-77.79212	245	12	Inclined
4842	40.57767	-77.77952	217	25	Inclined		5449	40.54185	-77.81792	213	17	Inclined
4855	40.57688	-77.78127	265	32	Inclined		5450	40.54044	-77.81911	220	10	Inclined
4858	40.57578	-77.78035	240	29	Inclined		5460	40.52967	-77.83157	218	27	Inclined
4860	40.57250	-77.78115	215	35	Inclined		5462	40.53317	-77.83646	227	26	Inclined
4862	40.57522	-77.78679	214	58	Inclined		5467	40.56527	-77.79438	211	20	Inclined
4863	40.58011	-77.79040	250	36	Inclined		4820	40.52238	-77.83812	40	42	Inclined

Table 1. Planar measurements.

Station	Latitude	Longitude	Strike	Dip	Description		Station	Latitude	Longitude	Strike	Dip	Description
4865	40.57682	-77.79673	222	23	Inclined		5483	40.52183	-77.83272	210	19	Inclined
4866	40.57786	-77.79874	185	8	Inclined		5487	40.51853	-77.82176	47	34	Inclined
4869	40.56980	-77.80390	220	23	Inclined		5553	40.50017	-77.85533	215	60	Inclined
4872	40.56763	-77.79514	230	21	Inclined		5568	40.54018	-77.80054	45	0	Horizontal
4873	40.56540	-77.79904	222	25	Inclined		5571	40.53333	-77.80439	70	18	Inclined
4886	40.59981	-77.75149	225	28	Inclined		5572	40.53306	-77.80656	185	8	Inclined
4887	40.59815	-77.75189	234	27	Inclined		5573	40.53353	-77.80827	214	12	Inclined
4888	40.59288	-77.75610	232	22	Inclined		5576	40.58384	-77.84785	226	51	Inclined
4889	40.59498	-77.75644	237	35	Inclined		5578	40.57727	-77.84776	190	45	Inclined
4890	40.59547	-77.75605	251	28	Inclined		5590	40.58304	-77.84538	220	35	Inclined
4892	40.59199	-77.76123	245	25	Inclined		3350	40.50840	-77.77027	40	90	Vertical
4895	40.58616	-77.76847	256	32	Inclined		5673	40.56800	-77.87340	0	0	Horizontal
4914	40.59261	-77.79285	250	23	Inclined		5684	40.56345	-77.86826	170	24	Inclined
4918	40.59320	-77.79448	232	32	Inclined		5693	40.55377	-77.87238	195	5	Inclined
4921	40.58448	-77.80279	213	21	Inclined		5703	40.55962	-77.87142	198	37	Inclined
4928	40.57817	-77.80006	217	26	Inclined		5704	40.55978	-77.87217	200	68	Inclined
4929	40.58745	-77.80302	205	15	Inclined		5705	40.55812	-77.87330	185	57	Inclined
4931	40.58940	-77.79894	237	22	Inclined		5706	40.55712	-77.87341	195	33	Inclined
4932	40.59074	-77.79957	228	24	Inclined		5707	40.55462	-77.87496	197	30	Inclined
4933	40.59093	-77.79768	218	28	Inclined		5775	40.51268	-77.84828	217	52	Inclined
4941	40.59475	-77.76538	258	28	Inclined		3777	40.55420	-77.83879	183	35	Inclined
4944	40.58033	-77.80223	241	21	Inclined		3779	40.55261	-77.84007	215	33	Inclined
4946	40.58178	-77.79234	222	22	Inclined		3780	40.54829	-77.84319	215	14	Inclined
4947	40.56702	-77.80197	227	52	Inclined		3806	40.59984	-77.75144	242	34	Inclined
4949	40.56283	-77.81193	218	21	Inclined		3808	40.59981	-77.75439	240	29	Inclined
4958	40.56091	-77.80218	208	26	Inclined		3813	40.60202	-77.85690	0	0	Horizontal
4959	40.55976	-77.80182	208	20	Inclined		3815	40.60325	-77.85763	0	0	Horizontal
4962	40.55707	-77.79904	201	33	Inclined		3816	40.60383	-77.85794	158	23	Inclined
4966	40.55675	-77.80310	187	18	Inclined		3817	40.59367	-77.82069	212	50	Inclined
4968	40.55554	-77.80644	205	17	Inclined		3818	40.50028	-77.87083	205	25	Inclined
4978	40.55152	-77.80013	190	10	Inclined		3819	40.50161	-77.87031	204	45	Inclined
4980	40.55258	-77.79972	200	22	Inclined		3820	40.50267	-77.86992	180	30	Inclined
4988	40.55296	-77.80819	187	18	Inclined		3821	40.50433	-77.86942	155	25	Inclined
4990	40.55056	-77.80811	202	16	Inclined		3822	40.50603	-77.86864	202	35	Inclined
4991	40.54995	-77.81039	214	22	Inclined		3824	40.50700	-77.86806	153	35	Inclined
4992	40.54702	-77.80808	235	8	Inclined		3825	40.50861	-77.86753	198	30	Inclined
4952	40.55422	-77.80647	195	17	Inclined		3827	40.51039	-77.86683	171	29	Inclined
4997	40.55231	-77.80435	190	22	Inclined		3828	40.51200	-77.86647	196	55	Inclined
5000	40.55125	-77.80591	222	17	Inclined		3830	40.51397	-77.86586	160	28	Inclined
5003	40.55066	-77.81262	188	39	Inclined		3831	40.51556	-77.86531	190	24	Inclined
5007	40.54551	-77.81213	211	17	Inclined		3837	40.52778	-77.85900	180	26	Inclined
5009	40.55076	-77.81745	206	20	Inclined		3838	40.52911	-77.85822	182	22	Inclined
5011	40.53880	-77.81469	218	9	Inclined		3839	40.52994	-77.85767	184	28	Inclined
5012	40.53979	-77.81097	226	12	Inclined		3948	40.52300	-77.83189	0	0	Horizontal
5013	40.53897	-77.80960	225	4	Inclined		3952	40.52670	-77.81199	48	27	Inclined
5018	40.57297	-77.75148	65	45	Inclined		3957	40.52919	-77.81277	215	19	Inclined
5027	40.56646	-77.75556	48	40	Inclined		3958	40.60087	-77.82351	33	62	Inclined
5030	40.56595	-77.75851	40	53	Inclined		3963	40.60357	-77.81939	32	32	Inclined
4459	40.57622	-77.85392	215	44	Inclined		3966	40.60543	-77.81656	72	72	Inclined
4461	40.54900	-77.86952	197	50	Inclined		3975	40.60850	-77.81146	190	17	Inclined
4465	40.55691	-77.86197	180	35	Inclined		3978	40.60705	-77.81204	208	50	Inclined
4466	40.60961	-77.81627	25	54	Overturned		3985	40.61342	-77.81501	55	43	Inclined
4467	40.60797	-77.81863	24	90	Vertical		3986	40.61407	-77.81469	57	43	Inclined

Table 1. Planar measurements.

Station	Latitude	Longitude	Strike	Dip	Description		Station	Latitude	Longitude	Strike	Dip	Description
4468	40.60603	-77.82090	220	54	Inclined		4132	40.57955	-77.76126	229	34	Inclined
4471	40.60528	-77.81963	47	44	Inclined		4134	40.58001	-77.76301	232	12	Inclined
4473	40.60584	-77.81841	60	43	Inclined		3841	40.53253	-77.85575	160	18	Inclined
4477	40.60708	-77.81800	214	60	Inclined		3842	40.53392	-77.85489	181	25	Inclined
4483	40.60764	-77.81592	52	62	Inclined		3844	40.53492	-77.85367	161	40	Inclined
4485	40.60836	-77.81400	69	14	Inclined		3846	40.53686	-77.85211	199	30	Inclined
4495	40.62487	-77.80273	70	33	Inclined		3847	40.53931	-77.85019	192	39	Inclined
4500	40.62142	-77.80278	145	14	Inclined		3849	40.54089	-77.84906	208	25	Inclined
4502	40.60789	-77.82793	32	48	Inclined		3851	40.54258	-77.84789	177	26	Inclined
4507	40.61128	-77.83406	103	11	Inclined		3852	40.50058	-77.86617	151	52	Inclined
4510	40.61504	-77.83572	110	8	Inclined		3853	40.50178	-77.86575	177	70	Inclined
4513	40.61458	-77.83626	55	11	Inclined		3854	40.50300	-77.86486	156	54	Inclined
4514	40.61400	-77.83722	270	15	Inclined		3855	40.50397	-77.86419	166	52	Inclined
4519	40.61125	-77.83777	135	24	Inclined		3856	40.51136	-77.86158	177	55	Inclined
4520	40.60949	-77.83568	79	28	Inclined		3857	40.52153	-77.85481	197	25	Inclined
4522	40.61135	-77.83698	10	12	Inclined		3858	40.52350	-77.84936	212	28	Inclined
4524	40.59626	-77.84378	45	37	Inclined		3859	40.52717	-77.84594	213	25	Inclined
4526	40.56966	-77.87380	155	19	Inclined		3860	40.53014	-77.84417	231	21	Inclined
4539	40.56700	-77.87220	190	10	Inclined		3863	40.53022	-77.84169	227	27	Inclined
4541	40.60425	-77.83376	32	36	Inclined		3864	40.54164	-77.83039	202	22	Inclined
4542	40.60611	-77.83396	67	18	Inclined		3865	40.54878	-77.82514	217	20	Inclined
4544	40.60204	-77.83382	59	50	Inclined		3866	40.55200	-77.82300	213	25	Inclined
4547	40.60229	-77.83564	40	48	Inclined		3868	40.53578	-77.81639	207	11	Inclined
4550	40.60571	-77.83699	74	18	Inclined		3869	40.50322	-77.85667	77	7	Inclined
4551	40.60575	-77.83700	70	20	Inclined		3871	40.50914	-77.84572	234	20	Inclined
4553	40.61246	-77.80988	38	84	Overturned		3873	40.51050	-77.84667	235	70	Overturned
4557	40.59794	-77.84068	85	7	Inclined		3875	40.52575	-77.82869	203	24	Inclined
4558	40.59696	-77.84270	144	26	Inclined		3876	40.52800	-77.82631	248	68	Inclined
4560	40.59747	-77.83892	74	46	Inclined		3878	40.52972	-77.81606	214	21	Inclined
4562	40.62495	-77.83896	215	23	Inclined		3880	40.51400	-77.82422	51	40	Inclined
4582	40.61481	-77.84270	178	8	Inclined		3881	40.51161	-77.82739	44	55	Inclined
4586	40.61460	-77.84484	176	8	Inclined		3882	40.50950	-77.82467	47	47	Inclined
4589	40.61668	-77.84081	60	35	Inclined		3885	40.54553	-77.78347	280	35	Inclined
4592	40.61485	-77.84148	104	32	Inclined		3886	40.54114	-77.80856	188	8	Inclined
4593	40.61320	-77.84179	184	49	Inclined		3887	40.54211	-77.80944	204	10	Inclined
4594	40.61434	-77.84010	185	26	Inclined		3889	40.55781	-77.80411	213	23	Inclined
4596	40.61197	-77.82207	96	18	Inclined		3890	40.56081	-77.80739	188	25	Inclined
4598	40.60283	-77.85212	58	4	Inclined		3891	40.56633	-77.80414	207	25	Inclined
4599	40.58710	-77.85059	205	25	Inclined		3892	40.57047	-77.79503	237	28	Inclined
4605	40.59288	-77.83519	198	25	Inclined		3895	40.58831	-77.78233	225	20	Inclined
4609	40.59609	-77.82962	0	0	Horizontal		3900	40.58714	-77.77064	225	25	Inclined
4611	40.60293	-77.85392	25	34	Inclined		3901	40.56714	-77.76961	67	25	Inclined
4612	40.60485	-77.85454	73	23	Inclined		3902	40.56592	-77.76842	39	20	Inclined
4617	40.60581	-77.85245	128	18	Inclined		3904	40.58353	-77.76506	225	30	Inclined
4620	40.59754	-77.85697	123	15	Inclined		3905	40.59111	-77.75456	231	16	Inclined
4622	40.59666	-77.86059	0	0	Horizontal		3907	40.57739	-77.75478	50	19	Inclined
4623	40.60567	-77.82504	92	18	Inclined		3909	40.56725	-77.75903	52	48	Inclined
4624	40.60396	-77.82190	215	46	Inclined		3912	40.55475	-77.77969	63	10	Inclined
4625	40.60471	-77.82319	22	54	Overturned		3913	40.55111	-77.77164	39	55	Inclined
4628	40.60476	-77.82594	76	35	Inclined		3914	40.54978	-77.77961	55	40	Inclined
4629	40.60351	-77.82590	50	36	Inclined		3917	40.54439	-77.78347	59	45	Inclined
4630	40.60297	-77.82421	212	51	Inclined		3918	40.54300	-77.78494	58	50	Inclined
4633	40.60014	-77.82808	240	90	Vertical		3919	40.54536	-77.78658	52	47	Inclined

Table 1. Planar measurements.

Station	Latitude	Longitude	Strike	Dip	Description
4635	40.60934	-77.82453	65	33	Inclined
4636	40.59486	-77.86483	48	22	Inclined
4637	40.58574	-77.87125	73	16	Inclined
4641	40.58392	-77.86945	23	24	Inclined
4566	40.59443	-77.84337	40	19	Inclined
4634	40.59608	-77.83386	240	55	Inclined
4614	40.60778	-77.85311	50	28	Inclined
4646	40.60936	-77.83923	165	6	Inclined
4649	40.60558	-77.84459	204	21	Inclined
4651	40.60393	-77.84429	0	0	Horizontal
4652	40.60579	-77.84769	125	21	Inclined
4152	40.56939	-77.77305	185	17	Inclined
4123	40.58513	-77.75323	232	20	Inclined
4124	40.58635	-77.76165	234	19	Inclined
4126	40.58584	-77.75519	222	22	Inclined
4127	40.58710	-77.75641	212	23	Inclined
4128	40.58275	-77.76332	214	14	Inclined
4130	40.58183	-77.75937	55	11	Inclined
2570	40.62111	-77.75242	42	70	Overturned
2571	40.62189	-77.75419	45	71	Overturned
2880	40.51886	-77.75431	48	57	Inclined
2940	40.50381	-77.75025	220	60	Inclined
2943	40.50500	-77.75164	72	43	Inclined
2945	40.51156	-77.75175	48	49	Inclined
2974	40.50861	-77.75033	240	62	Overturned
2975	40.50894	-77.75067	50	90	Vertical
2976	40.50986	-77.75172	28	45	Inclined
3068	40.56922	-77.75169	55	36	Inclined
3155	40.51378	-77.75531	70	90	Vertical
3172	40.51522	-77.75558	90	43	Overturned
3173	40.51336	-77.75236	225	55	Inclined
3341	40.51066	-77.76786	230	90	Vertical
3351	40.50667	-77.77481	45	90	Vertical
3352	40.50772	-77.77594	222	56	Inclined
3385	40.51368	-77.75814	55	79	Overturned
3390	40.51182	-77.76230	43	82	Overturned
3403	40.50960	-77.76243	223	52	Inclined
3405	40.50890	-77.76948	50	90	Vertical
3413	40.51214	-77.76504	50	74	Inclined
3416	40.51366	-77.76240	48	72	Inclined
3418	40.51446	-77.76106	50	68	Inclined
3442	40.50931	-77.75271	45	63	Inclined
3443	40.50875	-77.75381	43	50	Inclined
3451	40.50155	-77.76095	52	50	Inclined
3452	40.50064	-77.76224	30	49	Inclined
3453	40.50247	-77.75979	50	57	Inclined
3456	40.50462	-77.75670	45	52	Inclined
3435	40.61008	-77.75013	200	21	Inclined
3439	40.61098	-77.75631	205	60	Inclined
3440	40.60610	-77.76593	232	60	Inclined
3472	40.58334	-77.77167	250	24	Inclined
3479	40.51737	-77.78535	43	58	Inclined
3480	40.51299	-77.77686	45	0	Horizontal
3921	40.53103	-77.79122	43	38	Inclined
3923	40.59281	-77.76114	222	26	Inclined
3924	40.57100	-77.82900	193	41	Inclined
3925	40.60897	-77.77164	64	65	Overturned
3928	40.61067	-77.77578	193	26	Overturned
3929	40.61378	-77.77667	215	60	Inclined
3930	40.61350	-77.77611	215	30	Inclined
3932	40.61200	-77.77394	39	29	Overturned
3934	40.61125	-77.77258	58	25	Overturned
3936	40.61333	-77.77144	69	50	Overturned
3939	40.52175	-77.86236	355	20	Inclined
3940	40.52403	-77.86136	165	30	Inclined
3941	40.52592	-77.86036	148	25	Inclined
3944	40.61272	-77.77281	55	32	Overturned
3946	40.54531	-77.75542	45	50	Inclined
3947	40.54667	-77.75367	45	45	Inclined
4153	40.61378	-77.86132	195	36	Inclined
4157	40.60834	-77.85982	62	18	Inclined
4163	40.61018	-77.85742	63	50	Inclined
4164	40.61295	-77.85845	48	61	Inclined
4171	40.60738	-77.86692	90	11	Inclined
4172	40.62475	-77.86003	217	13	Inclined
4173	40.62240	-77.86465	35	20	Inclined
4174	40.62277	-77.87207	60	17	Inclined
4177	40.56211	-77.77513	59	24	Inclined
4178	40.55888	-77.77521	15	21	Inclined
4179	40.55984	-77.77304	45	20	Inclined
4180	40.55707	-77.77813	55	9	Inclined
4181	40.55585	-77.77924	20	3	Inclined
4182	40.56549	-77.76962	66	30	Inclined
4183	40.56409	-77.77107	55	36	Inclined
4184	40.56719	-77.76633	60	19	Inclined
4185	40.56832	-77.76701	78	28	Inclined
4187	40.57675	-77.75936	218	15	Inclined
4188	40.57622	-77.75832	350	10	Inclined
4189	40.57514	-77.75990	212	16	Inclined
4191	40.57489	-77.75894	60	22	Inclined
4192	40.57411	-77.75783	38	16	Inclined
4195	40.57307	-77.75545	50	35	Inclined
4196	40.57205	-77.75420	55	41	Inclined
4197	40.57430	-77.75529	63	42	Inclined
4198	40.56998	-77.75367	52	50	Inclined
4200	40.56481	-77.75711	55	36	Inclined
4242	40.62359	-77.85102	35	90	Vertical
4244	40.62109	-77.84611	40	64	Inclined
4245	40.61777	-77.84193	0	0	Horizontal
4246	40.62314	-77.84616	217	65	Inclined
4236	40.62117	-77.84891	215	60	Inclined
4238	40.62443	-77.84798	24	36	Inclined
4239	40.62348	-77.84902	36	61	Inclined
4249	40.62113	-77.83774	201	21	Inclined
4252	40.62240	-77.84122	5	20	Inclined
4253	40.62258	-77.84172	214	38	Inclined

Table 1. Planar measurements.

Station	Latitude	Longitude	Strike	Dip	Description
3481	40.51356	-77.77297	55	46	Inclined
3491	40.50087	-77.75233	60	40	Inclined
3504	40.54396	-77.75705	40	51	Inclined
3505	40.53750	-77.76539	43	46	Inclined
3507	40.53920	-77.76312	44	50	Inclined
3508	40.54056	-77.76158	45	45	Inclined
3509	40.54198	-77.75979	60	60	Inclined
3510	40.50317	-77.75203	40	90	Vertical
3535	40.50062	-77.78535	213	19	Inclined
3537	40.50202	-77.78529	220	64	Inclined
3548	40.50449	-77.78017	222	50	Inclined
3554	40.50357	-77.78791	35	64	Inclined
3575	40.61407	-77.75421	232	82	Inclined
3579	40.61836	-77.75381	52	90	Vertical
3581	40.61658	-77.76620	30	50	Overturned
3584	40.56592	-77.83061	207	22	Inclined
3586	40.57154	-77.82683	202	29	Inclined
3588	40.58021	-77.83216	212	52	Inclined
3590	40.57287	-77.84984	208	54	Inclined
3591	40.57205	-77.84955	207	57	Inclined
3592	40.61259	-77.75369	52	20	Inclined
3594	40.61180	-77.75277	295	1	Inclined
3595	40.60949	-77.75191	0	0	Horizontal
3636	40.52271	-77.75507	52	65	Inclined
3638	40.52478	-77.75590	55	54	Inclined
3641	40.52683	-77.75582	55	44	Inclined
3643	40.52810	-77.75828	50	61	Inclined
3653	40.51426	-77.76882	220	49	Inclined
3655	40.51605	-77.77076	52	58	Inclined
3658	40.52771	-77.75280	75	38	Inclined
3662	40.52957	-77.75585	50	38	Inclined
3663	40.53055	-77.75625	40	42	Inclined
3666	40.53186	-77.75576	48	58	Inclined
3670	40.53310	-77.75309	48	47	Inclined
3679	40.52027	-77.76437	55	45	Inclined
3686	40.57412	-77.82478	195	75	Inclined
3688	40.57671	-77.82271	203	33	Inclined
3690	40.57866	-77.82202	217	43	Inclined
3694	40.58199	-77.81827	210	42	Inclined
3705	40.60071	-77.82109	38	83	Overturned
3711	40.60266	-77.81866	215	77	Inclined
3712	40.59570	-77.82647	212	40	Inclined
3713	40.61228	-77.81789	65	33	Inclined
3715	40.61208	-77.81984	95	21	Inclined
3718	40.61315	-77.81744	93	39	Inclined
3765	40.56596	-77.83057	207	21	Inclined
3766	40.56413	-77.83173	203	44	Inclined
3769	40.56277	-77.83257	202	25	Inclined
3771	40.56213	-77.83336	235	32	Inclined
3773	40.55777	-77.83609	216	25	Inclined
3776	40.55540	-77.83796	193	23	Inclined
4653	40.60476	-77.84824	52	18	Inclined
4656	40.60775	-77.85091	86	7	Inclined
4258	40.62156	-77.86566	55	25	Inclined
4259	40.61582	-77.87276	45	10	Inclined
4260	40.61429	-77.87443	42	16	Inclined
4261	40.61686	-77.87244	35	15	Inclined
4262	40.62003	-77.87031	75	4	Inclined
4263	40.61408	-77.86867	80	12	Inclined
4264	40.61553	-77.86872	233	41	Inclined
4267	40.50321	-77.84037	28	38	Inclined
4269	40.51381	-77.82806	55	27	Inclined
4273	40.61879	-77.82385	28	57	Inclined
4345	40.61237	-77.83601	252	71	Inclined
4346	40.61820	-77.81138	63	31	Inclined
4675	40.59929	-77.85119	54	4	Inclined
4678	40.59514	-77.85150	80	12	Inclined
4680	40.59420	-77.85754	80	13	Inclined
4672	40.60458	-77.83176	54	47	Inclined
4674	40.60132	-77.83897	54	12	Inclined
4896	40.58673	-77.77152	217	20	Inclined
4897	40.58435	-77.78248	219	31	Inclined
4905	40.57908	-77.80234	216	23	Inclined
5056	40.55363	-77.77113	47	13	Inclined
5060	40.55239	-77.77169	45	46	Inclined
5061	40.55254	-77.77367	43	35	Inclined
5062	40.55589	-77.77539	40	20	Inclined
5063	40.55511	-77.77467	40	0	Horizontal
5064	40.55643	-77.77329	52	14	Inclined
5065	40.55520	-77.77222	32	23	Inclined
5074	40.55502	-77.78188	35	7	Inclined
5076	40.53812	-77.79182	37	45	Inclined
5078	40.54687	-77.78403	35	62	Inclined
5081	40.54623	-77.78692	57	26	Inclined
5084	40.56372	-77.75809	52	40	Inclined
5087	40.56302	-77.76269	60	40	Inclined
5088	40.56262	-77.76514	55	28	Inclined
5089	40.56175	-77.76337	33	36	Inclined
5090	40.56122	-77.76258	40	54	Inclined
5092	40.56118	-77.75414	42	42	Inclined
5093	40.54439	-77.77346	46	64	Inclined
5094	40.54498	-77.76819	20	27	Inclined
5096	40.54526	-77.76422	35	32	Inclined
5097	40.54818	-77.76440	40	57	Inclined
5098	40.55238	-77.76247	50	43	Inclined
5099	40.55547	-77.75867	55	53	Inclined
5101	40.55692	-77.75422	44	55	Inclined
5102	40.55495	-77.75722	65	35	Inclined
5106	40.53139	-77.78389	45	34	Inclined
5107	40.53901	-77.77886	45	51	Inclined
5108	40.53150	-77.78760	38	53	Inclined
5109	40.53146	-77.79240	48	60	Inclined
5489	40.52500	-77.82860	220	41	Inclined
5490	40.52409	-77.82832	210	20	Inclined
5491	40.51685	-77.83518	210	15	Inclined
5492	40.51759	-77.83361	215	19	Inclined

Table 1. Planar measurements.

Station	Latitude	Longitude	Strike	Dip	Description		Station	Latitude	Longitude	Strike	Dip	Description
4659	40.60777	-77.84751	40	9	Inclined		5496	40.52057	-77.81715	22	27	Inclined
4665	40.59912	-77.84357	50	26	Inclined		5499	40.52228	-77.81751	210	16	Inclined
4325	40.54508	-77.86314	220	80	Inclined		5500	40.52159	-77.81893	43	23	Inclined
4328	40.57661	-77.85759	0	0	Horizontal		5501	40.50459	-77.84212	56	20	Inclined
4330	40.61070	-77.82791	51	40	Inclined		5504	40.50502	-77.84484	227	32	Inclined
4331	40.60671	-77.83102	57	36	Inclined		5505	40.50608	-77.84438	110	16	Inclined
4334	40.62445	-77.83263	35	29	Inclined		5506	40.50612	-77.84193	217	18	Inclined
4338	40.62145	-77.83247	8	26	Inclined		5476	40.52826	-77.83611	238	17	Inclined
4340	40.62057	-77.83259	205	15	Inclined		5479	40.52093	-77.83139	230	25	Inclined
4342	40.62046	-77.83395	0	0	Horizontal		5480	40.52102	-77.82918	219	25	Inclined
4292	40.54504	-77.86472	207	31	Inclined		5472	40.53006	-77.82381	114	10	Inclined
4294	40.54248	-77.86448	185	36	Inclined		5519	40.51351	-77.83836	230	22	Inclined
4308	40.53466	-77.87098	215	59	Inclined		5520	40.51374	-77.83731	215	18	Inclined
4310	40.53374	-77.87239	210	44	Inclined		5525	40.50219	-77.84370	53	16	Inclined
4312	40.53595	-77.87026	200	52	Inclined		5529	40.53438	-77.82267	222	53	Inclined
4314	40.53795	-77.86900	197	35	Inclined		5530	40.50813	-77.85802	198	45	Inclined
4315	40.54000	-77.86866	188	39	Inclined		5532	40.50333	-77.85665	325	12	Inclined
4318	40.54112	-77.86731	202	30	Inclined		5535	40.51664	-77.84085	66	39	Inclined
4321	40.54327	-77.86564	185	38	Inclined		5538	40.51634	-77.83958	235	18	Inclined
4275	40.61925	-77.81053	53	51	Inclined		5539	40.51100	-77.84584	338	72	Inclined
4278	40.62155	-77.82689	50	12	Inclined		5541	40.50968	-77.84898	220	15	Inclined
4279	40.62083	-77.82592	44	10	Inclined		5292	40.55413	-77.78573	115	7	Inclined
4280	40.61343	-77.82395	46	16	Inclined		5295	40.55569	-77.78561	165	7	Inclined
4281	40.62238	-77.86287	202	36	Inclined		5296	40.56282	-77.79237	220	22	Inclined
4283	40.62116	-77.86047	48	22	Inclined		5302	40.54355	-77.79850	200	9	Inclined
4284	40.61981	-77.86130	250	16	Inclined		5312	40.54441	-77.80552	212	12	Inclined
4286	40.61781	-77.82051	55	35	Inclined		5314	40.54767	-77.82134	209	24	Inclined
4289	40.61154	-77.82662	60	19	Inclined		5318	40.54542	-77.81601	231	20	Inclined
4290	40.61266	-77.82526	47	29	Inclined		5319	40.53682	-77.80632	250	9	Inclined
4366	40.62482	-77.81704	62	24	Inclined		5320	40.53287	-77.81387	215	16	Inclined
4368	40.62178	-77.81487	52	32	Inclined		5322	40.53108	-77.81068	210	17	Inclined
4370	40.61861	-77.80903	242	50	Inclined		5323	40.53054	-77.80940	209	16	Inclined
4371	40.62216	-77.81044	90	20	Inclined		5331	40.52525	-77.79197	45	61	Inclined
4375	40.62029	-77.81400	45	32	Inclined		5333	40.52625	-77.79061	25	33	Inclined
4379	40.62260	-77.81489	46	50	Inclined		5343	40.53910	-77.78625	54	47	Inclined
4386	40.61764	-77.81287	52	52	Inclined		5344	40.54198	-77.79037	228	30	Inclined
4387	40.61567	-77.81518	65	65	Inclined		5346	40.54128	-77.79218	47	53	Inclined
4388	40.61942	-77.86478	205	52	Inclined		5348	40.54145	-77.79362	352	14	Inclined
4397	40.60760	-77.81249	190	16	Inclined		5366	40.52554	-77.82248	196	20	Inclined
4398	40.60797	-77.81170	161	11	Inclined		5372	40.52394	-77.82452	215	11	Inclined
4414	40.61201	-77.81270	48	30	Overturned		5376	40.52635	-77.81791	225	20	Inclined
4416	40.61054	-77.81286	35	42	Overturned		5377	40.52520	-77.81298	58	21	Inclined
4418	40.61031	-77.81111	63	25	Inclined		5378	40.52533	-77.81387	57	29	Inclined
4424	40.61166	-77.81085	55	36	Overturned		5112	40.52835	-77.79450	50	47	Inclined
4427	40.60933	-77.83242	55	11	Inclined		5113	40.52702	-77.79240	50	43	Inclined
4437	40.53768	-77.86671	198	34	Inclined		5114	40.52350	-77.80029	52	52	Inclined
4438	40.53690	-77.87000	200	35	Inclined		5116	40.52489	-77.81038	67	30	Inclined
4441	40.53771	-77.87007	195	43	Inclined		5118	40.51352	-77.80710	52	44	Inclined
4455	40.54847	-77.87292	200	37	Inclined		5119	40.51474	-77.80707	40	40	Inclined
3989	40.58794	-77.78369	242	26	Inclined		5121	40.51622	-77.81028	48	56	Inclined
3991	40.58949	-77.78390	235	10	Inclined		5124	40.50864	-77.81619	45	61	Inclined
3992	40.58938	-77.78611	225	5	Inclined		5125	40.51042	-77.81178	56	45	Inclined
3994	40.58778	-77.78790	235	5	Inclined		5129	40.60315	-77.78862	212	27	Inclined

Table 1. Planar measurements.

Station	Latitude	Longitude	Strike	Dip	Description		Station	Latitude	Longitude	Strike	Dip	Description
3995	40.59472	-77.79218	198	45	Inclined		5133	40.60485	-77.78848	235	25	Inclined
3997	40.59630	-77.79331	210	33	Inclined		5136	40.58026	-77.80376	193	18	Inclined
3998	40.58481	-77.83802	212	54	Inclined		5137	40.52040	-77.85352	205	32	Inclined
4006	40.58067	-77.84170	217	45	Inclined		5159	40.56936	-77.81860	187	60	Inclined
4015	40.54790	-77.86189	197	42	Inclined		5162	40.57066	-77.81813	202	36	Inclined
4019	40.54658	-77.86419	195	33	Inclined		5168	40.51897	-77.85793	185	38	Inclined
4020	40.54711	-77.86606	197	48	Inclined		5171	40.51378	-77.86061	205	37	Inclined
4021	40.55058	-77.87075	175	53	Inclined		5175	40.57822	-77.80581	207	24	Inclined
4023	40.62211	-77.86081	55	15	Inclined		5177	40.57111	-77.81731	225	19	Inclined
4025	40.61803	-77.76415	42	33	Overturned		5178	40.57103	-77.81513	195	17	Inclined
4026	40.61355	-77.77005	60	45	Overturned		5180	40.57109	-77.81240	210	23	Inclined
4027	40.60977	-77.77642	55	20	Overturned		5181	40.53146	-77.84515	223	27	Inclined
4029	40.61291	-77.77463	220	25	Inclined		5183	40.53199	-77.84605	190	23	Inclined
4032	40.61557	-77.83936	145	42	Inclined		5184	40.53232	-77.84666	185	15	Inclined
4038	40.61625	-77.83754	0	0	Horizontal		5189	40.52900	-77.84784	225	25	Inclined
4040	40.61971	-77.83729	183	4	Inclined		5190	40.53260	-77.84379	225	23	Inclined
4043	40.61267	-77.77854	233	38	Inclined		5193	40.55087	-77.82577	200	10	Inclined
4047	40.61870	-77.77057	215	46	Inclined		5197	40.55128	-77.82954	200	29	Inclined
4050	40.61596	-77.77446	220	44	Inclined		5202	40.54948	-77.83247	185	38	Inclined
4053	40.62177	-77.76808	222	45	Inclined		5210	40.54388	-77.83624	227	25	Inclined
4054	40.61128	-77.78029	228	37	Inclined		5222	40.54282	-77.83308	226	27	Inclined
4055	40.59749	-77.79429	205	49	Inclined		5225	40.55139	-77.77971	95	28	Inclined
4056	40.55047	-77.82366	222	33	Inclined		5226	40.55342	-77.77650	40	33	Inclined
4058	40.55279	-77.82270	205	29	Inclined		5229	40.55229	-77.77707	35	30	Inclined
4059	40.55456	-77.82193	195	18	Inclined		5230	40.55159	-77.77668	145	28	Inclined
4060	40.55578	-77.82160	220	33	Inclined		5238	40.54315	-77.78964	45	36	Inclined
4061	40.55781	-77.82068	220	17	Inclined		4845	40.56323	-77.79727	215	25	Inclined
4063	40.55655	-77.82119	215	20	Inclined		5253	40.54115	-77.79898	210	12	Inclined
4069	40.56223	-77.85514	30	50	Overturned		5256	40.54226	-77.79683	0	0	Horizontal
4073	40.56024	-77.84789	208	50	Inclined		5258	40.54431	-77.79455	190	6	Inclined
4076	40.59412	-77.86060	160	15	Inclined		5260	40.55960	-77.79517	195	10	Inclined
4080	40.61837	-77.85820	52	63	Inclined		5263	40.55825	-77.79705	185	24	Inclined
4081	40.61768	-77.85717	210	85	Inclined		5266	40.55190	-77.79516	205	19	Inclined
4085	40.62405	-77.75700	25	90	Vertical		5268	40.55207	-77.79192	195	8	Inclined
4093	40.62238	-77.75541	288	41	Inclined		5269	40.55603	-77.78869	96	16	Inclined
4095	40.61965	-77.76118	52	38	Overturned		5273	40.55687	-77.79120	231	5	Inclined
4101	40.61090	-77.85577	265	38	Inclined		5274	40.55637	-77.79231	226	24	Inclined
4102	40.61036	-77.85583	225	52	Inclined		5276	40.55630	-77.79417	122	8	Inclined
4103	40.60928	-77.85626	260	10	Inclined		5277	40.55519	-77.79391	109	16	Inclined
4107	40.61737	-77.85900	268	36	Inclined		5279	40.55878	-77.79012	145	10	Inclined
4109	40.61558	-77.86044	38	50	Inclined		5285	40.55778	-77.78800	105	10	Inclined
4906	40.58255	-77.80272	204	23	Inclined		5288	40.55762	-77.79299	342	7	Inclined
4908	40.58592	-77.80443	205	14	Inclined		5289	40.55828	-77.78400	105	5	Inclined
4910	40.59230	-77.79138	230	10	Inclined		5394	40.52787	-77.80207	45	45	Inclined
5034	40.55699	-77.76985	43	35	Inclined							

Department of Conservation and Natural Resources
Michael DiBerardinis, Secretary

Commonwealth of Pennsylvania
Edward G. Rendell, Governor

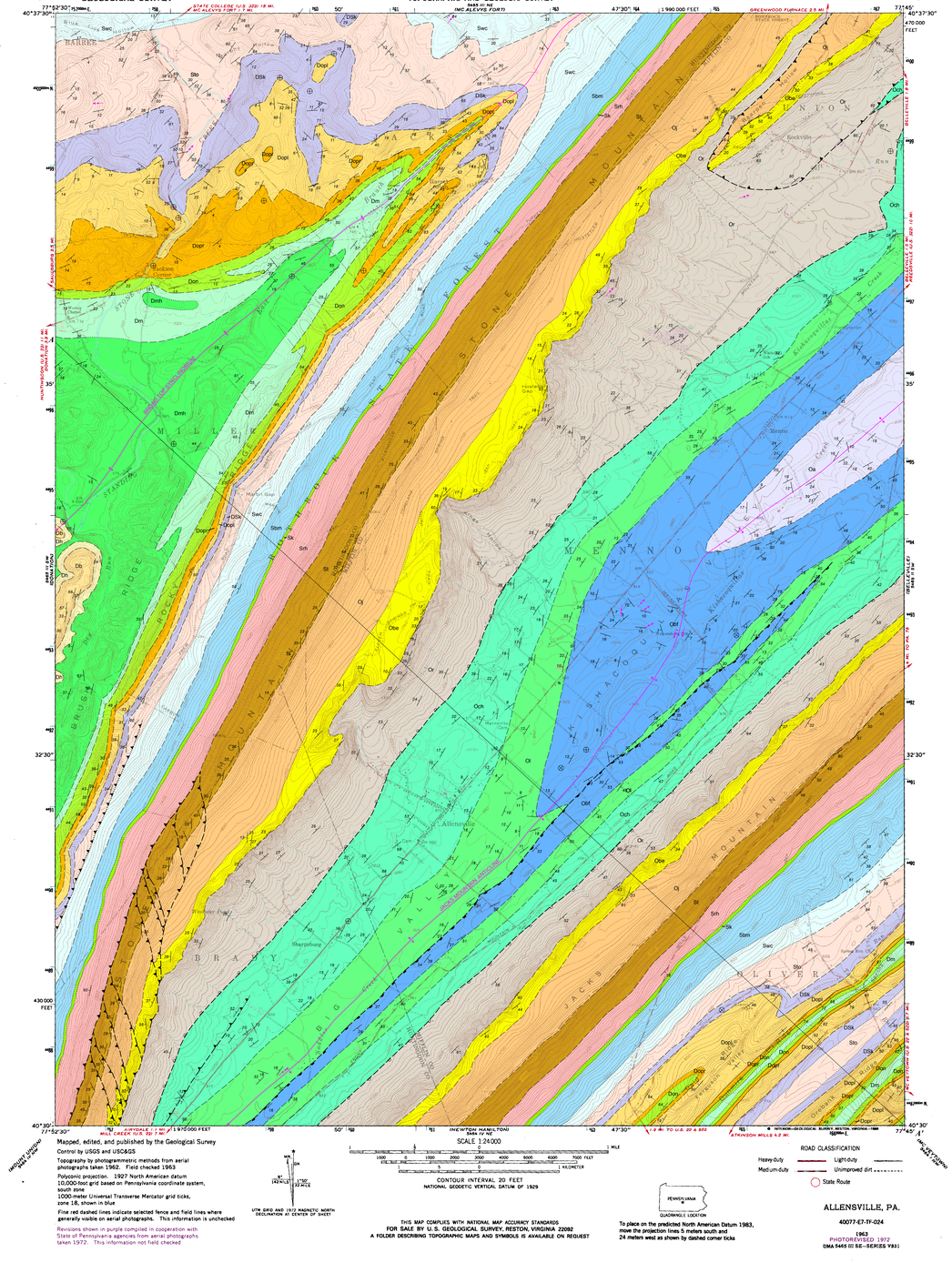
Topographic and Geologic Survey
Jay B. Parrish, Director

Open File Report OFBM 07-02.0

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
TOPOGRAPHIC AND GEOLOGIC SURVEY

ALLENSVILLE QUADRANGLE
PENNSYLVANIA
7.5 MINUTE SERIES (TOPOGRAPHIC)



Mapped, edited, and published by the Geological Survey

Control by USGS and USC&GS

Topography by photogrammetric methods from aerial photographs taken 1962. Field checked 1963

Polyconic projection. 1927 North American datum
10,000-foot grid based on Pennsylvania coordinate system, south zone
1000-meter Universal Transverse Mercator grid ticks, zone 18, shown in blue

Fine red dashed lines indicate selected fence and field lines where generally visible on aerial photographs. This information is unchecked

Revisions shown in purple compiled in cooperation with State of Pennsylvania agencies from aerial photographs taken 1972. This information not field checked

UTM GRID AND 1972 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24000

CONTOUR INTERVAL 20 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U. S. GEOLOGICAL SURVEY, RESTON, VIRGINIA 22092
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

ROAD CLASSIFICATION
Heavy-duty — Light-duty
Medium-duty — Unimproved dirt
State Route

PENNSYLVANIA
QUADRANGLE LOCATION

To place on the predicted North American Datum 1983, move the projection lines 5 meters south and 24 meters west as shown by dashed corner ticks

ALLENSVILLE, PA.
40077-E7-TF-024
1962
PHOTOREVISED 1972
DMA 5465 III SE–SERIES V831

BEDROCK GEOLOGY OF THE ALLENSVILLE QUADRANGLE, HUNTINGDON AND MIFFLIN COUNTIES, PENNSYLVANIA

by
THOMAS A. McELROY and DONALD M. HOSKINS
2007

EXPLANATION

GEOLOGIC DESCRIPTION	UNIT	ENVIRONMENTAL CHARACTERISTICS[1]
Light-olive-gray shaly claystones, interbedded with thin, planar bedded to flaggy, light-olive-gray micaceous siltstone and 1- to 2-inch thick layers of olive-gray, very fine-grained sandstone. It is about 150 feet thick. The basal contact with the underlying Harrell Formation is sharp and conformable, but rarely seen due to extensive colluvium that is derived from, and mantles, the steep slopes underlain by the lower Brallier. Its outcrop is limited to two hilltops on the axis of the Broad Top Synclinorium.	BRALLIER FORMATION Db	Well yields should be adequate for domestic use. The remote, limited area of outcrop make it unlikely formation will be exploited for high-demand use. Water may be hard with high concentrations of iron and manganese. Stability is fair to good. Steep cuts can be maintained except in weathered shale. Excavation is easy to moderately difficult. It should be excavated to sound Good source of road material and random fill.
Deeply weathered fissile black claystones, weathering to gray and dark-brownish-gray claystones. Black shales are interbedded with very dark to dark-gray claystones in the medial and upper portions. It is 100 feet thick. The contact with the Mahantango Formation is sharp and conformable. Its outcrop is limited to two hilltops on the axis of the Broad Top Synclinorium.	HARRELL FORMATION Dh	Well yields should be adequate for domestic use. The remote, limited area of outcrop make it unlikely formation will be exploited for high-demand use. Water may be hard with high concentrations of iron and manganese. Stability is fair. Considerable shale-chip rubble forms in exposed cuts. Cuts parallel to bedding have poor stability. Unweathered rock is easy to moderately difficult to excavate. Good source of subgrade and light-duty road surfacing because of uniformity of material and relative ease of excavation
Sparsely fossiliferous, medium-dark-gray claystone that weathers to olive gray. Cleavage is prominent in most claystone layers. Stratigraphic units approximately 25-40 feet thick of thin to thick bedded, dark gray, very fine-grained, sparsely fossiliferous sandstone support Brush Ridge and a paralleling lower ridge along Dry Run. The uppermost claystones of the Mahantango Formation are abundantly fossiliferous. Along Standing Stone Creek the upper one foot of the Mahantango is a hard, dark gray limestone, profusely fossiliferous with fossils similar to those in the immediately underlying claystones (the Tully limestone). It is about 1000 feet thick. The lower contact of the Mahantango Formation with the underlying Marcellus Formation is nowhere exposed on the quadrangle. Elsewhere the contact is gradational, marked by a grading upward from the black fissile Marcellus Formation to very dark gray to dark gray non-fissile claystones. Its outcrop is on the axis and flanks of the Broad Top Synclinorium.	MAHANTANGO FORMATION Dmh	Well yields are adequate for domestic use. Wells in valleys can supply adequate yields for high-demand uses. Limited water quality data suggest good quality. Stability is low to moderate in cut slopes. Excavation is moderately easy using heavy equipment. Blasting is required only in deep cuts. Foundation support strength is moderate, suitable for heavy structures if excavated to sound bedrock. Drilling rates are relatively rapid. Used locally for shale aggregate and common fill. Some parts may have potential for structural clay products and lightweight aggregate.
Fissile grayish-black to black carbonaceous clay shale. Pyrite is abundant, particularly near the base. Limestone occurs locally. It is about 70 feet thick. Its contact with the Selinsgrove limestone of the Onondaga Formation is sharp and conformable. It crops out on the flanks of the Broad Top Synclinorium and within the structurally complex unnamed synclinorium in the southeast part of the quadrangle.	MARCELLUS FORMATION Dm	Well yields are adequate for domestic use and may be adequate for high-demand applications. Water quality may be poor, with high iron and manganese and a hydrogen sulfide odor. Cut slope stability is low to moderate. Steep slopes tend to deteriorate rapidly. It is moderately easy to excavate in most places using heavy equipment. Foundation support strength is suitable for heavy structures if excavated to sound bedrock. Drilling rates are rapid. Used locally for shale aggregate and common fill.
Selinsgrove limestone (upper member): Upper 10 feet is dark- to medium-gray, argillaceous limestone beds up to 6 inches thick interbedded with cleaved(?) claystone. Bedding surfaces contain small round solution features. Fossils are sparse, but brachiopods, coral, trilobites and burrows were seen. It is about 20 feet thick. *Needmore shale* (lower member): Medium- to medium-light-gray, generally calcareous shale that commonly has pencil-cleavage caused by the intersection of bedding and cleavage. Layering in most outcrops is obscure. Weathered surfaces exhibit iron staining. It contains a few fossils; brachiopods and trilobites were found. It is about 80 feet thick. The formation is too thin, with too few outcrops, to map the members separately. The contact of the Needmore shale with the Ridgeley Member of the Old Port Formation is sharp and conformable. It crops out on the flanks of the Broad Top Synclinorium and within the structurally complex unnamed synclinorium in the southeast part of the quadrangle.	ONONDAGA FORMATION Don	Limited data suggest adequate yield for domestic use. There are no data available for high-demand wells. One water-quality sample indicates good quality water, although Geyer and Wilshusen (1982) indicate that iron and hydrogen sulfide may be problems. Cut slope stability is low to moderate. Excavation using heavy equipment is easy in the shale and moderately difficult in the limestone. Blasting may be required to excavate the limestone. Foundation support strength is moderate to high, and is generally suitable for heavy structures if excavated to sound bedrock. Drilling rates are moderate to rapid. Poor to fair source of common fill. The upper limestone has been quarried on a very limited scale.
Ridgeley Member: Fine- to very coarse-grained, white and light gray to buff, fossiliferous sandstone. Fossils are dominantly brachiopods. Some crinoids and gastropods are also found. In the northwest portion of the quadrangle, granules to small pebbles are dispersed in the sandstone. It is medium to thick bedded, with a thickness of 75 feet. Where it is cemented by silica, it forms high crags. Southeast of Orebank Ridge, where the sandstone is calcite-cemented, it lies topographically below the underlying Shriver chert of the Old Port Formation. It crops out on the flanks of the Broad Top Synclinorium and within the structurally complex unnamed synclinorium in the southeast part of the quadrangle. Its contact with the underlying Shriver chert was not directly observed and is assumed to be gradational.	OLD PORT FORMATION — RIDGELEY MEMBER Dopr	Well yields are adequate for domestic use. Where the Ridgeley is leached of carbonate, primary porosity can provide high yields. Water quality is good. Cut slope stability is moderate to high in unleached sandstone. Leached sandstone can be weak. Excavation is easy to difficult. Foundation strength is moderate to high. Drilling rates are slow to rapid. The Ridgeley Member is a source of glass sand.
Lower Member: At the top of the lower member is the Shriver chert, seen only as float in several places. It is a dark-gray to black chert that weathers to light gray to white or yellow-brown. It is thin, probably 25 feet thick or less. Below the Shriver chert, the formation is dominantly dark gray, massive limestone. Limestone in the lower Old Port Formation is well-bedded, fossiliferous, crystalline calcarenite. Bedding surfaces exposed on East Branch Road west of Barr Road exhibit widely spaced anastomosing fractures. Layers immediately above the contact with the Keyser Formation contain chert beds and locally extensive "rops" chert in a 3 feet thick zone. Fossils are commonly silicecous. Brachiopods, crinoids, bryozoa, ostracods, gastropods, and *tentaculites* were found. The limestones are karstic. Its contact with the Keyser Formation is conformable and marked by the presence of tubular chert. It crops out on the flanks of the Broad Top Synclinorium and within the structurally complex unnamed synclinorium in the southeast part of the quadrangle. It is about 200 feet thick.	OLD PORT FORMATION — LOWER MEMBER Dopl	Well yields are adequate for domestic use. Water quality is good. Stability is low in cut slopes in the shale. It is moderately high in the other lithologies, if they are unweathered. Shale and fractured siltstone can generally be removed using medium to heavy equipment. Unweathered siltstone and limestone require blasting. Foundation support is moderate to high, and is suitable for heavy structures if excavated to sound bedrock. The limestones may develop sinkholes. Drilling rates are slow to moderate. Siltstone is a fair source of aggregate and common fill. The limestone has been quarried.
Dark-gray, fossiliferous, crystalline limestone with thinly-laminated limestone in its upper portion that resembles the Tonoloway Formation. Fossils include brachiopods, ostracods, gastropods, coral, and bryozoa. It is well-bedded, with beds flaggy to thick. Some beds are massive. A few clastic beds up to 1.5 feet thick were observed. The basal nodular limestone found elsewhere in Pennsylvania is not present northwest of Stone Mountain, and is uncommon in the rest of the quadrangle. Chert-filled fractures are common. Below the contact with the Old Port Formation on East Branch Road, the Keyser Formation is a calcilutite in layers 1 inch to 3 feet thick with laminae and sparse fossils. It is platy bedded in layers separated by thick beds. Its contact with the Tonoloway Formation is sharp. It crops out on the flanks of the Broad Top Synclinorium and within the structurally complex unnamed synclinorium in the southeast part of the quadrangle. It is about 170 feet thick.	KEYSER FORMATION DSk	Wells yields are adequate for domestic use and may be adequate for high-demand uses. Water is generally hard but otherwise of good quality. Stability is moderate in cut slopes. Block falls may be a serious problem if bedding is undercut. Excavation is very difficult. Blasting is required in most places. Foundation strength is moderate to high and suitable for most heavy structures. The bedrock surface should be investigated for sinkholes, pinnacles, and clay pockets. Drilling rates are moderate. Solution cavities may cause borehole caving or drill-bit deflection. Good source of crushed stone for aggregate. Formerly used extensively in the production of lime.
Thinly laminated limestones and dolostones. Dolostones are most common in the lower portions. Fossils are sparse, although brachiopods, ostracods and one coral were observed. Bedding ranges from thick (3-5 feet) to platy with argillaceous partings. It is commonly extensively folded into complex 4th and 5th order folds. In structurally complex areas, some layers within the normal sedimentary sequence consist of highly fragmented carbonate with small solution cavities and secondary calcite crystals. These layers appear to be solution breccia. While the Tonoloway Formation elsewhere in Pennsylvania is karstic, the only sinkholes found on the Allensville quadrangle are along the northwest flank of Stone Mountain. Many of these are associated with an inferred fault. The contact with the Wills Creek Formation was not seen, but is probably gradational. Thickness is about 700 feet. It crops out on the flanks of the Broad Top Synclinorium and within and on the northwest flank of the structurally complex unnamed synclinorium in the southeast part of the quadrangle.	TONOLOWAY FORMATION Sto	Well yields are adequate for domestic and high-demand uses. Water is commonly hard and high in dissolved solids. Stability is generally moderate in cut slopes. Rockfalls may occur along joints or bedding planes. Excavation is moderate to difficult using heavy equipment. Deep excavation in unweathered rock requires blasting. Foundation support is moderate to high if excavated to sound bedrock. The bedrock surface should be investigated for sinkholes, pinnacles, and clay pockets. Drilling rates are moderate. The sides of large-diameter holes tend to cave badly. Potential source of crushed stone.
Greenish-gray shaly to platy claystones with interbeds of very fine-grained light-olive-gray non-calcareous sandstone and local limestone. Sandstone is most common in the upper part of the formation, and forms low ridges that were observed on the flanks of Jacks and Stone Mountains. In the adjacent Belleville quadrangle, the lower part of the formation contains siltstone layers and red shale resembling the Bloomsburg Formation. These were not seen on the Allenville quadrangle because of colluvium cover, but are probably present. It is moderately well-bedded, with fissile to thick beds. The claystones are commonly highly cleaved. The contact with the Bloomsburg Formation is transitional. It crops out on the northern edge of the quadrangle, on the northwest flank of Stone Mountain and on the southeast flank of Jacks Mountain. It is about 600 feet thick.	WILLS CREEK FORMATION Swc	Well yields are adequate for domestic use. Wells in valleys can supply adequate yields for high-demand uses. Water quality may be poor, with high acidity, iron, dissolved solids, and sulfates. Stability in cut slopes is low to moderate. Slopes deteriorate rapidly because of the susceptibility of argillaceous and calcareous rocks to physical and chemical weathering. Excavation is easy to difficult using heavy equipment, depending upon the degree of weathering. Deep cuts require blasting. Foundation support is adequate for heavy structures if excavated to sound bedrock. Drilling rates are moderate to rapid. Poor to fair source of common fill.
The Bloomsburg Formation is predominantly grayish-red claystone, with some sandstone, thin, impure limestone and grayish-green shale. The sandstone unit (Moyer Ridge Member) in the upper one-third of the formation has beds 2 to 3 feet thick and contains vertical joints resealed with quartz, some of which is crystalline. It contains vertical *Skolithos* burrows. While the Moyer Ridge Member is distinctive, outcrops are too few to map it separately. Claystones exhibit hackly weathering caused by cleavage, making determination of bedding difficult. The Mifflintown Formation is greenish-gray shale interbedded with medium-gray, fossiliferous limestone. While the formations are distinct, no outcrops of the Mifflintown Formation were observed because of colluvium cover, so the two units are combined in this quadrangle for mapping purposes. The nature of their contact is not known. The contact with the Keefer Formation is sharp. The Bloomsburg and Mifflintown Formations crop out on the northwest flank of Stone Mountain and on the southeast flank of Jacks Mountain. Combined thickness is about 800 feet.	BLOOMSBURG AND MIFFLINTOWN FORMATIONS, UNDIFFERENTIATED Sbm	Well yields are adequate for domestic use. Water from the Bloomsburg Formation may be hard, with high concentrations of iron and manganese. Water from the Mifflintown Formation is generally of good quality, but hard. Stability in cut slopes in the Bloomsburg Formation is low to moderate. Sandstone and siltstone intervals are susceptible to block falls where bedding is undercut. Excavation is moderately easy to difficult using heavy equipment. Blasting may be required where hard sandstones and siltstones are encountered. Foundation support strength is generally suitable for heavy structures if it is excavated to sound bedrock. Drilling rates are moderate to rapid. Stability in cut slopes in the Mifflintown Formation is low to moderate. Debris and rock falls may occur in excavations. Excavation is relatively easy to difficult using heavy equipment. Limestone may require blasting. Foundations support strength is generally suitable for heavy structures. Drilling rates are moderate to rapid. The Bloomsburg Formation is an excellent source of material for the manufacture of brick and probably other structural clay products. The Mifflintown Formation is a good source of road material, fill, and possible brick and expanded aggregate.

EXPLANATION (cont.)

GEOLOGIC DESCRIPTION	UNIT	ENVIRONMENTAL CHARACTERISTICS[1]
Light gray to yellowish-brown, very fine to coarse grained, fossiliferous, siliceous sandstone that is locally hematitic. Northwest of Stone Mountain it is conglomeratic. It is well bedded with beds thin to thick and crossbedded. It is found only on the southeast flank of Jacks Mountain and the northwest flank of Stone Mountain. On both mountains it is covered with colluvium and only float was seen. It is about 70 feet thick. Its contact with the Rose Hill Formation was not seen, but is probably conformable.	KEEFER FORMATION Sk	No data for wells drilled only into the Keefer Formation are available. Yields should be adequate for domestic use. Low pH and high iron are possible. Stability in cut slopes is moderately high. Block falls may occur where bedding is undercut. Excavation is difficult, requiring blasting, except where it is is thoroughly leached. Foundation support strength is moderate to high, and suitable for heavy structures if excavated to sound bedrock. Drilling rates are moderate. Except where it is thoroughly leached, a good source of rock fill, riprap, and rock protection.
Where exposed, the Rose Hill Formation is a light-olive-gray to grayish-red and pale-brown claystone with interbeds of thin very fine-grained sandstone with manganese staining. The substantial iron-rich resistant sandstone beds found elsewhere in Pennsylvania are not present. It crops out only on the southeast flank of Jacks Mountain and the northwest flank of Stone Mountain and is wholly covered with colluvium derived from the Tuscarora Formation. It is about 800 feet thick. Its contact with the Tuscarora Formation is conformable and gradational.	ROSE HILL FORMATION Srh	Well yields are adequate for domestic use. Water may be hard, and commonly has high concentrations of iron and manganese. Stability in cut slopes is low to moderately high. Rockslides and block falls can be a serious problem where bedding is undercut. Excavation is relatively easy using heavy equipment in shale and siltstone, but can be difficult in sandstones, which may require blasting. Foundation support strength is moderate to high, and suitable for heavy structures if excavated to sound bedrock. Drilling rates are high in shale and siltstone, and slow to moderate in sandstone and limestone. The shale is a good source for manufacturing common brick and shale aggregate.
Light-gray to white, rarely pale red and greenish-gray fine- to coarse-grained quartzite with interbedded shale. Generally a maximum of 40 feet of section is exposed. The quartzite is very hard, well-cemented, crossbedded and, in exposure of its lower portions, contains dispersed pebbles. Small pits where siderite nodules weathered out are common. The trace fossils *Arthrophycus* and *Skolithos* are present but not common. Bedding is mostly thick. It may be obscured by crossbedding. It is about 700 feet thick. It crops out on the crests of Jacks and Stone Mountains. Its contact with the Juniata Formation is conformable and interbedded.	TUSCARORA FORMATION St	Well yields are adequate for domestic use. Water quality is good, but may be acidic. There are few data available because of mountainous terrain. Stability in cut slopes greater than 25 degrees is moderate to high, but subject to serious block falls if the bedding or jointing is undercut. Excavation is extremely difficult, requiring blasting. Foundation support strength is high, suitable for the heaviest structures if it is excavated to sound bedrock. Drilling rates are very slow. Good source of riprap and natural building stone.
Grayish-red, fine-grained sandstone with well-developed crossbedding. Included are interbedded red claystone units. The lower part, directly above the Bald Eagle Formation, is yellowish-gray sandstone. At the one outcrop seen on the quadrangle, layering ranges from 3 inches to 8 inches. Light grayish-red claystone clasts are included in some layers. The contact with the Bald Eagle Formation was not observed, but is probably gradational. Its thickness is about 1100 feet. It crops out on the northwest flank of Jacks Mountain and the southeast flank of Stone Mountain.	JUNIATA FORMATION Oj	Well yields are adequate for domestic use, and possibly for high-demand use. Water is commonly hard, with high iron. Cut slope stability is good. Excavation is difficult. Foundation support strength is good, if excavated to sound bedrock. Drilling rates are slow. Good source of road material, riprap, and building stone.
The upper portion consists of interbedded medium- to very coarse-grained sandstone with quartz pebble conglomerate (Lost Run Member). The Lost Run Member was not mapped separately because of insufficient outcrop. The lower portion of the formation consists of thick to massively bedded gray-to-reddish-gray to brownish-gray, fine-grained, prominently crossbedded sandstone. The sandstone contains shale clasts as well as quartz pebbles. Its contact with the Reedsville Formation is gradational. Its maximum thickness is about 250 feet. It crops out on the northwest flank of Jacks Mountain and the southeast flank of Stone Mountain, where it forms a distinct bench.	BALD EAGLE FORMATION Obe	Well yields are adequate for domestic use, and possibly for high-demand use. Limited data suggest the water may be high in iron, manganese, and lead. Cut slope stability is good. Excavation is difficult. Foundation support strength is good, if excavated to sound bedrock. Drilling rates are slow. Good source of road material, riprap, embankment facing, and fill.
The upper portion consists of interbedded light-to-medium-gray shaly claystone and thin (1 inch to 3 inch) to thick bedded (1 foot) crossbedded sandstone. Many sandstone interlayers are highly fossiliferous, calcareous, and very fine grained; some have highly calcareous zones of fossil debris. The medial portion contains the bulk of the Reedsville Formation and consists of medium dark gray spheroidal weathering claystone, with rare discontinuous zones of fossils and rare interbeds of medium light-gray silty claystone. The lower portion consists of medium-dark to dark-gray claystone weathering into "pencils". Zones of siderite nodules are present. Thin zones of silty claystone define layering that is otherwise difficult to ascertain. The Antes Member is at the base of the formation. It consists of very dark-gray to black claystone with interbeds of resistant clayey limestone. The Reedsville Formation crops out on the lower northwest flank of Jacks Mountain and the lower southeast flank of Stone Mountain. Its contact with the Coburn Formation is sharp and conformable. It is about 1,800 feet thick.	REEDSVILLE FORMATION Or	Well yields are adequate for domestic use, and possibly for high-demand use. Water quality is generally good, but iron and manganese concentrations may be high. Cut slope stability is fair. Foundation support strength is good, if excavated to sound bedrock. Drilling rates are fast. Good source of road material and fill.
The mapped unit contains, in descending order, the Coburn, Salona, Nealmont, Benner, Snyder and Hatter formations. Differentiating these units in the field is impractical because of lack of outcrop, similarities of lithology, and absence of distinctive topographic expression. Float scattered in cultivated fields shows the upper two-thirds of the mapped unit to be non-fossiliferous, medium-gray, aphanitic limestone. Bedding layers are thin, with lumpy weathered surfaces. The lower one-third of the mapped unit consists of medium- to medium-dark-gray limestone in layers 1 inch to 3 feet thick, some with lighter-weathering clasts. Layering appears to be anastomosing. Some layers have widely dispersed body fossils, whereas others contain abundant body fossils. Many thin layers consist of highly fragmented fossil debris. Fossils include crinoids, trilobites (*Cryptolithus*), brachiopods, cephalopods, gastropods, stromatolites, ostracods, bryozoa, coral, and pelecypods. Total thickness of all the formations is approximately 850 feet. The units crop out on the northwest and southeast sides of the Kishacoquillas Valley. The contact with the Loysburg Formation was not seen, but is probably gradational.	COBURN THROUGH HATTER FORMATION, UNDIFFERENTIATED Och	Well yields are adequate for domestic use. Units below the Nealmont Formation may have yields adequate for high-demand use. Water is generally hard, and may have high iron, manganese and dissolved solids. Because much of the land underlain by these units is used for agriculture, high nitrate is possible. Cut slope stability is good, except for steeply dipping beds inclined toward construction. Foundation support strength is good, if excavated to sound bedrock. Sites should be investigated for possible collapse areas. Excavation is difficult. Bedrock pinnacles are a special problem. Drilling rates are moderate. Good source of road material and fill.
The upper member consists of interbedded medium dark-gray laminated and non-laminated dolostone and limestone in thin (2-3 inches) to thick (3 feet) layers. In some outcrops, layers are platy. Weathered surfaces on some limestone layers exhibit small, apparently highly fragmented fossil debris, interbedded with layers having recrystallized calcite that are finely laminated and non-fossil bearing. Dolostone units are laminated and thick. The lower member consists of light-gray weathering medium-gray limestone interbedded with very light-gray weathering dolostone. This unit contains "tiger stripes" which, on weathered surfaces, are irregular, horizontal, very light gray bands, and irregular, mainly vertical extensions connecting the horizontal bands, in a darker- weathering light-gray limestone. Because of lack of exposure, similarities of limestone lithology, and absence of distinctive topographic expression, the members are not mappable in this quadrangle. It is about 475 feet thick. Its contact with the Bellefonte Formation is probably conformable and gradational. It crops out in the Kishacoquillas Valley.	LOYSBURG FORMATION Ol	Well yields may be adequate for high-demand use. Water quality is generally good, but it may be hard and is easily contaminated. Cut slope stability is good, except for steeply dipping beds inclined toward construction. Foundation support strength is good, if excavated to sound bedrock. Sites should be investigated for possible collapse areas. Excavation is difficult. Bedrock pinnacles are a special problem. Drilling rates are moderate. Good source of road material and fill.
Light-to-medium-gray, aphanitic to crystalline dolostone. Weathered surfaces show laminated layers with local gently curving surfaces that may be stromatolites. Layers are 4 inches to 2 feet thick. Deep solution features along joint surfaces are common in weathered outcrops. Some layers contain redeposited quartz in blebs up to 1 inch in diameter. It is approximately 1250 ft thick, and crops out in the Kishacoquillas Valley. Its contact with the Axemann Formation is probably conformable and gradational.	BELLEFONTE FORMATION Obf	Well yields are adequate for domestic use. Wells in valleys can supply adequate yields for high-demand uses. Water is hard. Because much of the land underlain by the Bellefonte Formation is used for agriculture, high nitrate is possible. Cut slope stability is good, unless the depth of cut is extreme. Foundation stability is good, but a construction site should be investigated thoroughly for solution openings. Excavation is difficult. Bedrock pinnacles are a special problem. Drilling rates are moderate. Good source of road material, riprap, building stone, embankment facing, and fill.
Interbedded, vaguely laminated medium-gray cherty limestone with interbeds of laminated dolostone that weathers to a very light gray. It is thin to thick bedded with platy layers. Layering is mostly discontinuous with uneven surfaces. Fossils found in the unit include stromatolites, crinoids, gastropods, and burrows. It is at least 1000 feet thick, which is twice as thick as reported elsewhere in Pennsylvania. The upper 500 feet are exposed on the Allensville quadrangle. It crops out in the Kishacoquillas Valley, in the east-central part of the quadrangle.	AXEMANN FORMATION Oa	Well yields are adequate for domestic and high-demand use. Water quality is generally good. Because much of the area underlain by the Axemann Formation is used for agriculture, high nitrate is possible. Cut slope stability is good, but steeply dipping beds inclined toward a cut may require moderate to gentle slopes. Foundation support strength is good, if excavated to sound bedrock. Sites should be investigated for possible collapse areas. Excavation is difficult. Bedrock pinnacles are a special problem. Drilling rates are moderate. Good source of road material and fill.

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Geology based on field mapping by T. A. McElroy and D. M. Hoskins 2005-2007.

The base map has been modified from U. S. Geological Survey digital raster graphic (DRG) file of the Allensville 7.5-minute quadrangle (1972), Universal Transverse Mercator (UTM) projection, Zone 18 north, NAD 1927.

Digital map production by T. G. Whitfield and T. A. McElroy.

This report has been prepared in accordance with the open-file reporting standards of the Bureau of Topographic and Geologic Survey. It has not undergone external peer review.

This map is part of the open-file report referenced by the report number in the upper right corner of the map. The entire open-file report can be obtained from the Bureau of Topographic and Geologic Survey website:

http//www.dcnr.state.pa.us/topogeo

[1] Blue type refers to groundwater characteristics, red type to engineering characteristics, and black type to mineral resources

Groundwater and engineering characteristics are from:

Flesger, G. M., McElroy, T. A., and Moore, M. E., 2004, Hydrogeologic and well-construction characteristics of the rocks of Pennsylvania: Pennsylvania Geological Survey, 4th ser., Water Resource Report 69, CD-Rom.

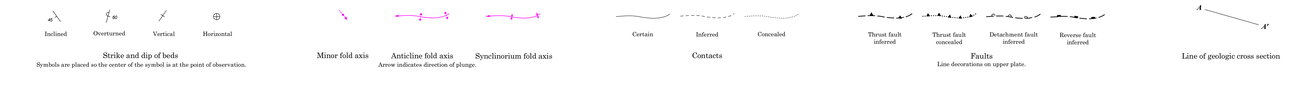
Geyer, A. R. and Wilshusen, J. P., 1982, Engineering characteristics of the rocks of Pennsylvania, Pennsylvania Geological Survey, 4th ser., Environmental Geology Report 1, 300p.

Taylor and others, 1982, Groundwater resources of the Juniata River basin, Pennsylvania, Pennsylvania Geological Survey, 4th ser., Water Resource Report 54, 131p.

Duplex faults on Stone Mountain modified from:

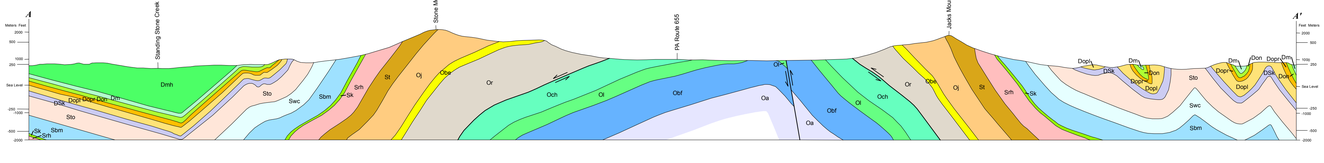
Nickelsen, R. P., 1988, Structural evolution of folded thrusts and duplexes on a first-order anticlinorium in the Valley and Ridge Province of Pennsylvania: Geological Society of America Special Paper 222, p. 97-105.

SYMBOLS



CROSS SECTION

(Horizontal scale same as map scale; no vertical exaggeration)



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