# Map Unit Properties Table: Marsh-Billings-Rockefeller National Historical Park

**Gray-shaded rows indicate geologic map units included within the digital geologic data but are not mapped within the park. Colors in the age column are U.S. Geological Survey standard colors.**

| Age | | Unit Name (Symbol) | Features and Description | Erosion Resistance | Suitability for Infrastructure and Potential Geologic Hazards | Cultural Resources | Paleontological Resources | Mineral Occurrence | Habitat | Geologic Significance and Miscellaneous Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| HOLOCENE | Surficial Geologic Units | Fill (***fi***)<br>peat and muck (***pm***)<br>alluvium (***al***)<br>alluvial fan (***af***)<br>fluvial terrace (***ft***) | Unit ***fi*** contains various materials used to form rail beds and embankments, fill low-lying areas and provide foundation for road beds. Unit ***pm*** contains organic sediments, silt, and clay primarily in wetlands and swamps. Unit ***al*** consists of fine sand, silt, and gravel associated with riverways. Unit ***af*** is composed of gravel, sand, and silt in poorly sorted, gently to moderately sloping deposits along the base of steep slopes and at stream junctions. Unit ***ft*** consists of fine sand, silt, gravel, and cobbles on perched terraces above the modern stream floodplains. Unit is generally less than 5 m (15 ft) thick and forms flat to gently sloping lands.<br><br>Units ***pm***, ***al***, and ***ft*** are mapped within the park. | Very low to moderate for ***fi*** | Units ***pm*** and ***al*** are associated with low-lying areas prone to flooding and aquifer discharge areas like seeps and springs and should be avoided for infrastructure. Units ***af***, ***ft***, and ***al*** can be a fair to good aquifer if sufficiently thick. Permeability varies in ***af***. Unit ***af*** occurs along the base of steep slopes and is associated with some slumping (mass movement). Unit ***ft*** may be prone to failure on banks above streams. Unit ***ft*** can be sufficiently thick to support conventional septic systems; however, percolation rates are locally variable and ephemerally wet areas are not uncommon. | Forms modern surface and may contain cultural remains associated with the history of the site. | Marl associated with the Pogue is fossiliferous, containing veined leaves, twigs, grass stems; may also contain bivalves and gastropods. Peat and muck may be fossiliferous. | Sand, gravel, silt, clay, cobbles | Units ***pm*** and ***al*** are associated with wetland and riparian habitats. Unit ft supports deep soils (well drained loams suitable for agriculture) | Units record the modern history of land use and landform evolution throughout the Holocene in the park area. Marsh and swamp deposits contain a detailed environmental record of paleoclimate and sedimentation conditions. |
| PLEISTOCENE | Surficial Geologic Units | Outwash (***ow***)<br>kame (***ka***)<br>kame terrace (***kt***)<br>ground moraine (***gm***)<br>till (***ti***)<br>thin till (***tt***) | Unit ***ow*** consists of well-sorted gravels and sands forming gently sloping to flat lands with deposits typically greater than 5 m (15 ft) thick. These deposits collected at the front of melting glacial ice. Unit ***ka*** contains stratified and unstratified sand, gravel, and boulders with variable silt contents. These deposits collected in depressions within melting glacial ice. Units ***ka*** and ***gm*** imperceptibly grade into each other. Unit ***kt*** consists of stratified and unstratified gravel, sand, boulders, and some silt in flat to nearly flat landforms and deposits typically greater than 10 m (33 ft) thick. Kame terraces accumulated at 262 m (860 ft) and 274 m (900 ft) elevation locally; they formed in flowing water at the margin of glacial ice. Unit ***gm*** contains a wide range of deposits from stratified and well-sorted sand and gravel to unstratified and poorly sorted silt, sand, gravel, and boulders. These deposits fall out as glacial ice melts. Unit ***ti*** contains hardpan silt, boulders, gravel, and sand in unsorted, unstratified deposits. Thickness of this unit is generally greater than 3 m (10 ft) and outcrops of boulders and glacial erratics are common. Unit ***tt*** consists of hardpan silt, boulders, gravel, and sand with thicknesses of less than 3 m (10 ft).<br><br>Units ***kt***, ***ti***, and ***tt*** are mapped within the park. | Low to moderately low | Units ***ow*** and ***kt*** have intermediate to high permeability. Unit ***ka*** can be a fair aquifer if thick enough and of sufficient areal extent. Slopes at the edges of ***kt*** and ***gm*** may pose mass wasting issues and stability concerns. Percolation rates associated with ***kt*** are suitable for conventional septic systems. ***kt*** is a good local aquifer; however, aquifer recharge areas are prone to contamination from infiltration. Unit ***gm*** has low to high permeability and can be a fair aquifer limited by variable thickness, sediment types, and sedimentary structures. Units ***ti*** and ***tt*** have low permeability and ***ti*** forms unstable slopes for excavations. Unit ***ti*** is prone to significant slope failure along streams and can act as an aquitard to groundwater flow. Unit ***tt*** is also prone to instability and sliding, especially where in contact with the bedrock. | Where units are exposed at the surface, may contain historical or American Indian artifacts. | Plant fossils may exist in postglacial ponds. | Units ***ow***, ***kt***, and ***ka*** have high gravel and sand resource potential. Glacial erratics may contain minerals of interest from Canada. | Units ***ka*** and ***gm*** form rolling, hilly lands with variable drainage to support upland forests. Loose and uncompacted ***gm*** forms a veneer over the underlying compacted till and bedrock. Unit ***ti*** tends to support poorly drained soils and perched water tables. Units ***tt*** and ***ti*** have rock outcrops commonly and ***tt*** forms ledges. | Units record Pleistocene Ice Age glacial advances and retreats across the landscape. Unit ***ow*** forms as glacial melt water deposits. Unit ***ka*** forms as glacial deposits in streams, slumps, and deposition from ice. Unit ***kt*** forms along the ice contact as melt water and sediment flow deposits. Unit ***gm*** forms as ice contact sediment flow, melt water, and ice deposited sediments. Units ***tt*** and ***ti*** formed as a variety of ice-derived deposits beneath the glacier. |
| UNKNOWN | Linear Geologic Units | Thick quartz vein (***qv***) | Unit contains localized veins of coarsely crystalline quartz. | Moderate to moderately high | Unit is too localized to impact infrastructure development. | Unit may have provided tool or trade material. | None | Quartz | Unit forms coarse-grained residuum. | Quartz veins originally deposited during percolation of super-heated fluids through fractures in the bedrock. |
| MESOZOIC ERA | Linear Geologic Units | Basalt dike (***MZb***) | Unit consists of dark gray basalt, an igneous rock. A dike is a discrete intrusion that cuts across preexisting bedrock fabrics such as bedding. In outcrop, the unit appears tan-colored and dikes cut across the fabric of surrounding bedrock. | Moderately high | Unit is probably too localized to impact infrastructure development, but may act as an aquitard at depth. | Unit may have provided tool or trade material. | None | Basalt, feldspar phenocrysts | Unit may weather to produce iron, magnesium, and/or calcium rich soils. | Unit records intrusive igneous activity in the area during the Mesozoic as Pangaea rifted apart. |
| DEVONIAN | Linear Geologic Units | Granite sill (***Dbg***) | Unit contains two-mica granite (igneous rock) that appears light-colored in outcrop. Unit forms a sill that intruded parallel to the fabric of the surrounding bedrock. | Moderately high to high | Unit may contain enough potassium to produce radon-rich regolith during weathering processes. Such regolith should be avoided for basements and foundations. | None documented | None | Granite, mica | Unit may weather to produce calcium-rich soils. | Unit records igneous intrusive activity in the Devonian Period during Appalachian mountain building. |

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| DEVONIAN | Gile Mountain Formation: (*Dg*)<br>calc-silicates horizon (*Dgc*)<br>hornblende fascicle schist (*Dgh*) | Unit ***Dg*** contains metamorphosed rocks including garnet schist with individual quartzite beds that can reach more than 1 m (3 ft) thick. Unit contains calc-silicate (***Dgc***) and hornblende-fascicle schist (***Dgh***) horizons.<br><br>Units ***Dg*** and ***Dgc*** are mapped within the park. | Moderately high | Not enough carbonate present to pose any karst-related hazards. In areas where schistosity is pronounced, unit may be prone to sliding where the slope is parallel with the foliation (schistosity). | Crystals may have provided trade material. | None documented. | Staurolite, kyanite, garnet, quartzite | Units may weather to form calcium-rich soils. | Units record mixed depositional environments during the Devonian, and deformation and metamorphism throughout the late Paleozoic. |
| SILURIAN | Standing Pond Volcanics: (*Ssp*)<br>calc-silicates horizon (*Sspc*) | Unit ***Ssp*** consists of metamorphosed rocks, including dark, blackish-green amphibolite, feldspar-amphibole gneiss, quartzose granofels, and localized calc-silicate (***Sspc***) horizons and schist. This unit forms a prominent marker bed in the area, whose ropy map pattern demonstrates the remarkable amount of deformation these rocks sustained throughout mountain-building events.<br><br>Unit ***Ssp*** is mapped within the park. | Moderately high | Heterogeneous nature of units may render then unstable on exposed slopes. Not enough carbonate present to pose any karst-related hazards. | Crystals may have provided trade material. | None documented. | Unit contains giant amphibolite fascicles and garnets up to 5 cm (2 in.) across called garbenschiefer. | Units may weather to form calcium-rich soils. | Units record mixed depositional environments during the Silurian, and deformation and metamorphism throughout the late Paleozoic. Granofels (with little to no foliation) may represent metamorphism only from heating, in the absence of directed stress. |
| | Waits River Formation:<br>>50% calc-silicates (*Sw*)<br>Mt Tom Member (*Swm*)<br>Mt Tom Member, calc-silicates horizon (*Swmc*)<br>10 to 50% calc-silicates (*Sws*)<br>rusty schist (*Swr*) | Unit ***Sw*** contains metamorphosed rocks, including garnet-bearing schist interlayered with >50% (of the whole unit composition) blocky, brown-weathering calc-silicate (a metamorphic rock that contains calcite and calcium-bearing silicate minerals) sandy marble. ***Swm*** consists of schist with less than 10% calc-silicate-bearing layers and relatively common graded beds near the top of the formation. ***Swmc*** contains more abundant blue gray calc-silicate-bearing interlayers than ***Swm***. ***Swmc*** weathers to blocky, brown-colored outcrops. ***Sws*** is schist with less than 50% blue gray sandy marble (calc-silicates). ***Swr*** consists of fine-grained schist, which weathers to a rusty-colored outcrop.<br><br>Units ***Swm*** and ***Sws*** are mapped within the park. | Moderate | Calc-silicate members may be prone to dissolution and cause some weakness in the rock column. Units may be prone to sliding if exposed (weathered) on a slope and schistosity fabric is parallel to the slope. Marble layers (calc-silicates) are more permeable than schists. Well production depends on orientation of layering (vertical layers can be less productive than horizontal layers). | Crystals may have provided trade material. | None documented. | ***Sw*** contains sandy marble, garnet, staurolite, and kyanite. | Units may weather to form calcium-rich soils. | Units record mixed depositional environments during the Silurian, and deformation and metamorphism throughout the late Paleozoic. Units were easily abraded by glaciers during the Pleistocene forming rounded hills veneered with till. |
| | Northfield Formation: (*Sn*)<br>calc-silicates horizon (*Snc*) | Unit ***Sn*** contains metamorphosed sedimentary rocks, including phyllite and schist that appears dark gray to black and is garnetiferous (porphyroblasts). Rare thin quartzite and calc-silicate beds (***Snc***) occur locally. ***Sn*** exhibits a foliation defined by the biotite crystals, which lay across the trend. ***Snc*** consists of sandy, calc-silicate blue-gray-colored marble. ***Snc*** contains distinctive garnet "carbuncles" in blocky, brown-weathered outcrops. | Moderately high | Not enough carbonate present to pose any karst-related hazards. Inherent foliation in phyllites and schists may render the units prone to rockfall and sliding when units are undercut or exposed on moderate to steep slopes. | Crystals may have provided trade material. | None documented. | Quartzite, sericite, biotite, garnet (in porphyroblasts up to 3 mm [0.25 in.] across), graphite, marble, and iron sulfides. | Units may weather to form calcium-rich soils. | Units record mixed depositional environments during the Silurian, and deformation and metamorphism throughout the late Paleozoic. |
| | Shaw Mountain Formation (*Ss*) | Unit occurs as isolated outcrops of quartz conglomerate. | High | Unit may be prone to blockfall and sliding when undercut on moderate to steep slopes. Fractures in unit may provide groundwater conduits for the bedrock aquifer. | None documented. | None documented. | Quartz conglomerate | Unit may form ledges and steep slope habitats. | ***Ss*** occurs on the west slopes of Long Hill. |
| ORDOVICIAN | Barnard Gneiss (*Ob*) | Unit contains metamorphic rocks, such as felsic gneiss interlayered with dark-colored amphibole and biotite gneiss. | Moderately high | Unit may be prone to block fall if undercut or exposed on moderate to steep slopes. Unit is suitable for most forms of infrastructure development unless heavily weathered or fractured. Investigate for radon potential. Well-jointed portions of this unit can make good aquifers. | None documented. | None | Gneiss, amphibole, biotite | Unit may weather to form iron, and calcium-rich soils | Unit records a history of volcanism, deformation, and metamorphism since the Ordovician. Orientation of jointing (two dominant sets oriented east-west and northeast) possibly controlled the orientation of the Ottauqhechee River and the location of glacially scoured pockets in bedrock. |

Bedrock Geologic Units