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

Saratoga National Historical Park

GRI Ancillary Map Information Document

Produced to accompany the Geologic Resources Inventory (GRI) Digital Geologic Data for Saratoga National Historical Park

sara_geology.pdf

Version: 9/1/2015

Geologic Resources Inventory Ancillary Map Information Document for Saratoga National Historical Park

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Geologic Resources Inventory Map Document

Saratoga National Historical Park, New York

Document to Accompany Digital Geologic-GIS Data

sara_geology.pdf

Version: 9/1/2015

This document has been developed to accompany the digital geologic-GIS data developed by the Geologic Resources Inventory (GRI) program for Saratoga National Historical Park, New York (SARA).

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

National Park Service (NPS) Geologic Resources Inventory (GRI) Program staff have assembled the digital geologic-GIS data that accompanies this document.

For information about the status of GRI digital geologic-GIS data for a park contact:

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About the NPS Geologic Resources Inventory Program

Background

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

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

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

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

Products

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

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

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

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

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

GRI geologic-GIS data is also available online at the NPS Data Store Search Application: http://irma.nps.gov/App/Reference/Search. To find GRI data for a specific park or parks select the appropriate park (s), enter “GRI” as a Search Text term, and then select the Search Button.

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

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

GRI Digital Maps and Source Map Citations

The GRI digital geologic-GIS maps for Saratoga National Historical Park, New York (SARA):

GRI Digital Surficial Geologic Map of Saratoga National Historical Site and Vicinity, New York (*GRI MapCode SARA*)

Produced using the following source map,

De Simone, David, 2015, Surficial Geologic Map of Saratoga National Historical Park and Vicinity, New York: De Simone Geological Investigations, 1:24,000 scale surficial map. (*GRI Source Map ID 76029)*

The georeferencing RMS values completed by the GRI for each of the four 7.5' quadrangle map images provided by the source author was around 5 meters or 16.4 feet, and thus are less than 50% United States National Map Accuracy standards for a 1:24,000 scale map. Users can thus assume mapped geologic features are within United States National Map Accuracy standards of 12.2 meters or 40 feet for a 1:24,000 scale map.

GRI Digital Bedrock Geologic Map of Saratoga National Historical Site and Vicinity, New York (GRI MapCode SABR)

Produced using the following source map,

De Simone, David, 2015, Bedrock Geologic Map of Saratoga National Historical Park and Vicinity, New York: De Simone Geological Investigations, 1:62,500 scale bedrock map. (*GRI Source Map ID 76030)*

In georeferencing map images provided by the source map author for the bedrock map there were significant georeferencing inaccuracies using the provided 7.5' quadrangle tics and hand-drawn road intersections distributed across the map. As such the accuracy of mapped bedrock features is more questionable, and more equal to features mapped at 1:62,500 scale. United States National Map Accuracy standards for this scale specifies features are within 31.75 meters or 104'. The bedrock map should thus provide more of a general location for mapped bedrock units, mapped faults, and the inference of pre-glacial bedrock valley thalweg features.

GRI Digital Surficial Geologic Map of Saratoga National Historical Park

Surficial Map Unit List

The surficial geologic units present in the digital geologic-GIS data produced for Saratoga National Historical Park, New York (SARA) are listed below. Units are listed with their assigned unit symbol and unit name (e.g., Qf - Fill). Units are listed from youngest to oldest. No description for water is provided. Information about each geologic unit is also presented in the GRI Geologic Unit Information (SARAUNIT) table included with the GRI geologic-GIS data. Source unit symbols were changed in this document and in the GRI digital geologic-GIS data so that unit symbols conform to more traditional geologic map units symbols of unit age (upper case symbol) followed by a (lower case) unit name designation (e.g., F was changed to Qf). Unit symbols and/or names in unit descriptions were not edited (e.g., F, a unit symbol on the source map, is used within unit descriptions, and not changed to the GRI unit symbol of Qf for this unit).

Cenozoic Era

Quaternary Period

Holocene Epoch
Qf - Fill
Qm - Muck
Qal - Alluvium
Qaf - Alluvial fan
Qft - Fluvial terrace

Pleistocene Epoch
Qds - Dune sand
Qld - Lake delta
Qls - Lake sand
Qlc - Lake clay
Qow - Outwash
Qof - Outwash fan
Qkd - Kame delta
Qk - Kame
Qtb - Till, thick or blanket
Qtv - Till, thin or veneer

Precambrian to Paleozoic Eras

Precambrian and Cambrian-Ordovician Periods?

R - Rock outrcop

Surficial Map Unit Descriptions

Descriptions of all surficial map units, generally listed from youngest to oldest, are presented below. Before each unit description the source map unit symbol, name and age is listed (e.g., F - Fill (Holocene)). This was done to denote source map unit symbols and names so that units could be better identified in surficial source map references.

Qf - Fill (Holocene)

F - Fill (Holocene)
Variable materials used as artificial fill along rail beds, road beds, embankments and low lying areas. Only a few major continuous areas of fill are shown on the map that includes the extensive railroad complex west of Mechanicville. The map would be cluttered by showing numerous smaller areas of fill. You can correctly infer some of these unmarked areas of fill by noting the thin elevated areas along railroad tracks; railroad grades are typically raised to make them level and elevate them above the 100 year flood plain. Approaches to bridges and overpasses are other areas of extensive fill. Low areas of roads where culverts have been installed are also smaller areas of fill. (*GRI Source Map ID 76029)* (Saratoga NHP Surficial Map).

Qm - Muck (Holocene)

PM/M - Muck (Holocene)
Organic sediment, mostly silt and clay in wetlands and swamps; can include peat; low lying flat lands prone to flooding. The map shows large and continuous areas of muck along the flood plains of the major waterways. In addition, some closed depressions with wetlands in upland areas have been marked as muck. For simplicity, many small wetland areas are not delineated. (*GRI Source Map ID 76029)* (Saratoga NHP Surficial Map).

Qal - Alluvium (Holocene)

AL - Alluvium (Holocene)
Stream flood plains; fine sand, silt and gravel of river channel, bar, and bank areas; river bottom lands; variable permeability but usually intermediate to low; often wet sites and prone to flooding; can be good aquifer if sufficiently thick. The flood plain sediment along the Hudson River has a typical grain size from very fine sand to silt. Alluvium dominates the flood plains of the major waterways - Hudson River, Batten Kill, Hoosic River and Fish Creek. Smaller tributary streams that have sections of flood plain with alluvium that are wide enough and continuous enough to show at the scale of the map are marked. However, smaller and discontinuous areas of alluvium along these minor tributaries are too narrow at the map scale to show. (*GRI Source Map ID 76029)* (Saratoga NHP Surficial Map).

Qaf - Alluvial fan (Holocene)

AF - Alluvial Fan (Holocene)
Tributary stream deposits; gravel, silt and sand, often poorly sorted; gently to moderately sloping lands located at the base of steep slopes and at stream junctions; variable permeability but usually intermediate to low; fair aquifer if sufficiently thick and permeable.

Some of the minor tributary streams have deposited small alluvial fans where they emerge from the uplands onto the flood plains of the Hudson River, for example. These fans may have been deposited during the early Holocene when sea level was still rising due to glacier melting. The small streams have typically downcut through these fans to erode to base level along the Hudson River flood plain during later Holocene through to the present. (*GRI Source Map ID 76029)* (Saratoga NHP Surficial Map).

Qft - Fluvial terrace (Holocene)

FT - Fluvial Terrace (Holocene)
Old flood plains; fine sand, silt and gravel generally less than 5 meters thick overlying other material; flat

to gently sloping lands; variable permeability but usually intermediate; old stream terrace deposits above the flood plain; soils are often deep, well drained loams suitable for agriculture; water table may be sufficiently deep to allow for conventional septic systems; perc rates may be locally variable and wet areas are not uncommon; banks above streams may be prone to failure; fair aquifer. Excellent gravel and sand sources.

There are some extensive fluvial terraces along the major waterways that include the Hudson River, Batten Kill, Hoosic River and Fish Creek. The highest terraces along the Hudson River are likely from late glacial periods of high discharge that flowed from the Champlain Lowland into the Hudson Lowland through an outlet known as the Fort Ann Outlet and Channels. Commercial gravel mining in one of these terraces has revealed the cobbles carried during this major glacial event from ca 12,200 years ago.

A slightly older and shorter period of high discharge came down the Mohawk Valley and part of this flow came through a complex of channels now occupied by Round Lake, Ballston Lake, Saratoga Lake and their outlet creeks. The Anthony Kill and Fish Creek show evidence of the high discharge that eroded their valleys through much or all of the glacial deposits and into bedrock. The current creeks are too small to have eroded these valleys and are known as under-fit streams. Lower fluvial terraces along the Hudson record Holocene alluviation on a flood plain that was primarily eroded by the high discharge Fort Ann outflow event.

Fluvial terraces along the Batten Kill and Hoosic River are at many levels and record the downcutting of these streams through glacial deposits to erode to the base level of the Hudson River. These terraces likely date from throughout the Holocene with the highest terraces being the oldest and lower terraces the youngest. (*GRI Source Map ID 76029)* (Saratoga NHP Surficial Map).

Qds - Dune sand (Pleistocene)

DS - Dune Sand (Pleistocene)
Wind blown sand with arcuate through elongate dune forms; the sand is well sorted and of fine to medium grain size, typically deposited on exposed lake sand plains and along beaches; permeable and excessively well drained; a fair aquifer due to limited thickness and aerial extent; prone to wind and water erosion and fires; typically vegetated with fire adapted species such as the pitch pine and scrub oak ecological system.

Dune sand occurs to some extent on areas marked as lake sand and lake delta but those areas are not typified by dune landforms. Areas marked as dune sand are dominated by dune landforms and the classical windblown sand grain size and high degree of sorting. Dunes date from the latter part of the last glacial cycle. The source sand for the dunes was lake and delta deposits along glacial lake shorelines. The glacial lakes went through a stepped lowering of level. Each lowering of the lake level resulted in narrower lake. The exposed lake shore was formerly shallow water of lake sand or deltas. A prevailing northwest wind blew the unvegetated sand and collected it into dunes of several types. Some dunes form long, linear or longitudinal dunes arranged parallel to the prevailing wind. Some dunes form long, linear ridges arranged approximately perpendicular to the wind and are termed transverse dunes. Some dunes are isolated or barchan dunes with a horn-shaped end and rounded, steeper and higher opposing end. Still other dunes are a complex mixing of the above types. By the latest glacial times and into the Holocene, the lands became sufficiently vegetated and the time of dune formation came to an end.

The largest areas of dune sand stretch across much of the Quaker Springs quadrangle and the Northwest portion of the Mechanicville quadrangle. These exist because the lake bottom was always shallower here versus in the Hudson Valley. Also, the glacial Hudson River deposited a lot of sand into the lakes through Glens Falls, Hudson Falls and Fort Edward. The prevailing lake currents carried this sand southward through Quaker Springs. (*GRI Source Map ID 76029)* (Saratoga NHP Surficial Map).

Qld - Lake delta (Pleistocene)

LD - Lake Delta (Pleistocene)
Stream deposits of gravel and sand accumulated in a lake with topset and foreset beds marking lake level; all are fan deltas in the mapped region; well sorted stratified sand and gravel or sand; usually well drained and thick deposits which make good unconfined aquifers. These landforms are highly valuable as gravel and sand resources.

The Batten Kill and Hoosic River deposited large deltas into the Hudson Valley glacial lakes. The Hoosic River deposited 2 notable deltas into 2 lakes. The higher delta and lake was Lake Albany II. That delta was partly eroded when the lake lowered and a new delta was deposited into the succeeding lake, Lake Quaker Springs. Both deltas were extensively eroded as time went on and the lakes drained in steps to lower lakes and finally to the time of the great high discharge flows from the Champlain Lowland. The Batten Kill deposited one major and beautiful delta into Lake Quaker Springs that has only been slightly modified by later erosion. (*GRI Source Map ID 76029)* (Saratoga NHP Surficial Map).

Qls - Lake sand (Pleistocene)

LS - Lake Sand (Pleistocene)
Well sorted laminated fine to medium sand underlying plains; prone to gullying and headward erosion; moderately good aquifer if thick, poor if thin.

Lake sand was deposited in the shallower portions of the glacial lake bottoms. The sand may overlie finer lake silt and clay, especially when the glacial lakes lowered and formerly deep lake bottom became shallow. An area of lake sand extends south from the Batten Kill delta and records the southward prevailing current in the glacial lakes that resulted from the prevailing northwest wind.

Dunes exist in portions of the lake sand map areas. However, these dunes do not dominate the landscape. Rather, the land is primarily level with minor or no dunes. (*GRI Source Map ID 76029)* (Saratoga NHP Surficial Map).

Qlc - Lake clay-silt (Pleistocene)

LC - Lake Clay (Pleistocene)
Fine grained varved or thinly laminated deposits of silt and clay accumulated in the deeper portions of lake basins; gravel and sand lenses may be present within the sequence especially near the bottom where melt water streams coming from the glacier may have deposited this coarse sediment into the bottom of the lake; prone to landslides and gullying; poorly drained and a poor aquifer.

Lake clay and silt dominate the deep Hudson Valley axis where the thickness commonly exceeds 100 feet. The landform is of an exposed lake bottom plain. Deltas of the Batten Kill and Hoosic River partly extend over lake clay and silt. The lake clay and silt drape over the underlying topography. Thus, there are places where till or rock may protrude above the lake plain. (*GRI Source Map ID 76029)* (Saratoga NHP Surficial Map).

Qow - Outwash (Pleistocene)

OW - Outwash (Pleistocene)
Outwash & outwash fan; glacial melt water deposits of well sorted gravel and sand; gently sloping to flat lands which may be pitted due to melted ice blocks; outwash fans occupy topographic setting similar to alluvial fans; intermediate to high permeability; high gravel-sand resource potential. There are fairly small

areas of OW and OF in the mapped area. (*GRI Source Map ID 76029)* (Saratoga NHP Surficial Map).

***Unit has the same unit description as unit Qof (below).*

Qof - Outwash fan (Pleistocene)

OF - Outwash (Pleistocene)
Outwash & outwash fan; glacial melt water deposits of well sorted gravel and sand; gently sloping to flat lands which may be pitted due to melted ice blocks; outwash fans occupy topographic setting similar to alluvial fans; intermediate to high permeability; high gravel-sand resource potential. There are fairly small areas of OW and OF in the mapped area. (*GRI Source Map ID 76029)* (Saratoga NHP Surficial Map).

***Unit has the same unit description as unit Qow (above).*

Qkd - Kame delta (Pleistocene)

KD - Kame Delta (Pleistocene)
Lake delta with proximal ice contact facies displaying deformation of sediments; gravel and sand to sand, stratified; may have diamicton beds; generally well sorted within individual beds; well drained soils; typically thick deposits; high gravel and sand resource potential; good to excellent aquifer.

One area of kame delta is marked in the eastern portion of the Schaghticoke quadrangle along the Hoosic River. This is an older and higher delta that likely resulted from both river and ice sources. The elevation of this single kame delta coincides with the oldest and highest glacial lake, Lake Albany I. (*GRI Source Map ID 76029)* (Saratoga NHP Surficial Map).

Qk - Kame (Pleistocene)

K - Kame (Pleistocene)
Undifferentiated hummocky to flatter terrain; glacial deposits from streams, slumps and deposition by ice; stratified and unstratified sand, gravel and boulders with variable silt; rolling, hilly lands to individual hills; intermediate to high permeability; high gravel-sand resource potential; fair to good aquifer limited by variable thickness and aerial extent. Some of these deposits may be deltaic in origin but do not display a deltaic landform. Other areas marked kame underlie lake clay and silt and represent former melt water streams that issued from the glacier and deposited subaqueous fans of sediment. These fans were later buried by deep water accumulations of lake clay and silt. Smaller areas of kame along the flanks of rock and till ridges and hills represent deposition from melt water streams along these higher elevation areas. They are generally quite small. (*GRI Source Map ID 76029)* (Saratoga NHP Surficial Map).

Qtb - Till, thick or blanket (Pleistocene)

T - Till, thick or blanket (Pleistocene)
Ice derived deposits of hardpan silt, boulders, gravel and sand which are unsorted and unstratified and deposited beneath the glacier; may contain deformed stratified units that may be re-deposited diamictons from subaqueous or subglacial flows; thickness greater than 3 meters (10 feet) but rock outcrops may be common; surface boulders or erratics are common; smoothed and streamlined hills in the valley and gently undulating slopes on the lower mountain flanks to nearly flat plains dotted with erratics; low permeability; unstable slopes in excavations; prone to significant slope failures along stream banks. Till mapped as thick must be verifiable as thick from well logs or exposures. Rock or ledge exposures are infrequent but may occur. (*GRI Source Map ID 76029)* (Saratoga NHP Surficial Map).

Qtv - Till, thin or veneer (Pleistocene)

TT - Till, thin or veneer (Pleistocene)
Ice derived deposits of hardpan silt, boulders, gravel and sand which are unsorted and unstratified and deposited beneath the glacier; thickness less than 3 meters (10 feet) with rock outcrops or ledge frequent; surface boulders or erratics are common; moderate to steep mountain slopes and summit areas; low permeability; steep slopes are unstable and slides are common. (*GRI Source Map ID 76029)* (Saratoga NHP Surficial Map).

R - Rock outrcop (Precambrian-Cambrian-Ordovician)

R - Rock Outcrop (Precambrian-Cambrian-Ordovician)
Exposed areas of ledge/outcrop or areas mostly ledge/outcrop; includes areas of predominantly outcrop with patches of till or slump/slide debris; outcrop areas directly recharge bedrock aquifers; poor sites for septic systems; slopes are generally stable except steep very slopes where rock slides and rock falls may occur. Please consult the accompanying bedrock map for details of the rock types in the map area. (*GRI Source Map ID 76029)* (Saratoga NHP Surficial Map).

GRI Digital Bedrock Geologic Map of Saratoga National Historical Park

Bedrock Map Unit List

The bedrock geologic units present in the digital geologic-GIS data produced for Saratoga National Historical Park, New York (SARA) are listed below. Units are listed with their assigned unit symbol and unit name (e.g., Ota - Taconic Allochthon). Units are listed from youngest to oldest. In the case of many Hudson Lowland units the difference in units is more changes in unit lithology components than it is in the age of units as many of these units are considered contemporaneous (i.e., deposited at or near the same time). Information about each geologic unit is also presented in the GRI Geologic Unit Information (SARAUNIT) table included with the GRI geologic-GIS data. Source unit symbols were changed in this document and in the GRI digital geologic-GIS data so that unit symbols conform to more traditional geologic map units symbols of unit age (upper case symbols) followed by a (lower case) unit name designation (e.g., Ta was changed to Ota).

Paleozoic Era

Ordovician Period
Os - Schenectady Formation

Hudson Lowland, Melange and Flysch
- Ovfz - Vischer Ferry Zone
- Ohgz - Halfmoon Greywacke Zone
- Ortz - Rocky Tucks Zone
- Ossz - Stillwater Shale Zone
- Omrz - Mohawk River Zone
- Owfz - Waterford Flysch Zone
- Otfz - Troy Frontal Zone

Ordovician and Cambrian Periods
OCta - Taconic Allochthon

Bedrock Map Unit Descriptions

Descriptions of all bedrock map units, generally listed from youngest to oldest, are presented below. In the case of many Hudson Lowland units the difference in units is more changes in unit lithology components than it is in the age of units as many of these units are considered contemporaneous (i.e., deposited at or near the same time). Before each unit description the source map unit symbol, name and age is listed (e.g., Ta - Taconic Allochthon (Late Cambrian to Lower Ordovician)). This was done to denote source map unit symbols and names so that units could be better identified in bedrock source map references. Unit symbols in unit descriptions were not edited (e.g., Ta, a unit symbol on the source map, is used within unit descriptions, and not changed to the GRI unit symbol of Ota for this unit).

Os - Schenectady Formation (Middle Ordovician)

Ss - Schenectady Formation (Middle Ordovician)
The rock in the northwest portion of the map is shale and siltstone that was not deformed by the Taconic Orogeny. Thus, it is neither flysch nor melange. Rather, it is ordinary sedimentary rock that was never mangled by the mountain building event. The shale formed atop the limestone shelf rock as the shelf was deepened by the ongoing Taconic Orogeny. The rock is not very resistant to erosion but is not as

weak as the VFZ and SSZ zones. (*GRI Source Map ID 76030)* (Saratoga NHP Bedrock Map).

The Hudson Lowland, Melange and Flysch

The onslaught of the Taconic Orogeny closed up the western portion of the Iapetus Ocean, eventually resulting in the collision of the Taconia volcanic island arc with the edge of the Laurentian shelf. This slow process was accompanied by the depression of the shallow shelf as Taconia approached. The deeper water and influx of eroded sediments prevented limestone from accumulating on the shelf as time went on. Instead, shale and greywacke formed in the now deeper waters where the shallow shelf once stood.

The crunch of the collision with the thrusting of the Taconic Allochthon compressed and folded and tortured the rocks in what would become the Hudson Lowland. All of this was happening under deep water. Slumps and slides from the rising Taconic Mountains of the overthrust belt brought sediments and rocks to the west of Emmons Line. Indeed, some of these slabs and slumped pieces of crust came from Taconia. The rocks that resulted from this severe torturing can be generically called melange & flysch. Structural geologists have distinguished the rocks of the Hudson Lowland based upon the predominant rock types present & mapped structural details. Melange is rock that resulted from the gravity slumping, sliding and shearing in the zone in front of the thrusted Taconic Mountains. It's a mixed rock and the name is derived from the French for mixed. Flysch is rock that was deposited from eroded sediments into the deep waters of the submerged shelf and crust between Laurentia and Taconia. It typically consists of layers of shale alternating with layers of greywacke. The word flysch is derived from the German for flow. On the bedrock map, these zones are marked according to how shale-rich or greywacke-rich they are. These distinctions help determine the erosional resistance of the rock zones. The zones form distinct bands oriented generally North-South.

Shale - a rock that was formerly mud on an ancient sea floor. It forms off the shore on a shelf and in very deep water.
Greywacke - a very specific type of sandstone that forms from submarine avalanches - scubalanches - of sand and mud into very deep water. Technically, we refer to these underwater avalanches as turbidity currents.
Melange - rock that resulted from the gravity slumping, sliding and shearing in a mountain building zone where the water was a deep basin between the colliding crustal plates. Rock layers may be so broken up that they cannot be traced very far.
Flysch - rock that was deposited from eroded sediments into the deep waters of the submerged shelf and crust between two colliding plates. It typically consists of layers of shale alternating with layers of greywacke.

Ovfz - Vischer Ferry Zone (Middle to Upper Ordovician)

VFZ - Vischer Ferry Zone (Middle to Upper Ordovician)
The rock is a very shale-rich flysch with only minor greywacke. It is quite similar to the SSZ and is just as easily eroded. A major pre-glacial bedrock valley largely follows this weak zone of rock and is called the Colonie Channel. Both Saratoga Lake and Round Lake are found in this channel. The Fish Creek Branch of the Colonie Channel extends Northeast from Saratoga Lake. Another pre-glacial branch, the Lake George Branch, joins the Colonie Channel at the North end of Saratoga Lake. The Colonie Channel and Battenkill-Hudson Channel represent 2 parallel pre-glacial bedrock channels in this part of the Hudson Lowland. (*GRI Source Map ID 76030)* (Saratoga NHP Bedrock Map).

Ohgz - Halfmoon Greywacke Zone (Middle to Upper Ordovician)

HGZ - Halfmoon Greywacke Zone (Middle to Upper Ordovician)
These are two elongate narrow oval bands of greywacke-rich flysch with much less shale than the adjacent MRZ & SSZ. Thus, the rocks of these greywacke-rich zones are much more resistant to erosion than the surrounding rocks. Most of the HGZ is off the map to the South. The RTZ is named for the small hilltop Northwest of the Park's Visitor's Center. The contact between the RTZ and the MRZ largely follows Rte 32 just West of most of the Park and just West of the Visitor's Center. The RTZ and HGZ form prominent uplands on the Hudson Lowland floor. They mostly have a thin cover of glacial deposits and have much exposed bedrock. Ridges very plainly trend to the North-Northeast following the prevailing structural grain in the rock from the Taconic Orogeny. (*GRI Source Map ID 76030)* (Saratoga NHP Bedrock Map).

***Note: Unit has the same unit description as unit Ortz (above).*

Ortz - Rocky Tucks Zone (Middle to Upper Ordovician)

RTZ - Rocky Tucks Zone (Middle to Upper Ordovician)
These are two elongate narrow oval bands of greywacke-rich flysch with much less shale than the adjacent MRZ & SSZ. Thus, the rocks of these greywacke-rich zones are much more resistant to erosion than the surrounding rocks. Most of the HGZ is off the map to the South. The RTZ is named for the small hilltop Northwest of the Park's Visitor's Center. The contact between the RTZ and the MRZ largely follows Rte 32 just West of most of the Park and just West of the Visitor's Center. The RTZ and HGZ form prominent uplands on the Hudson Lowland floor. They mostly have a thin cover of glacial deposits and have much exposed bedrock. Ridges very plainly trend to the North-Northeast following the prevailing structural grain in the rock from the Taconic Orogeny. (*GRI Source Map ID 76030)* (Saratoga NHP Bedrock Map).

***Note: Unit has the same unit description as unit Ohgz (below).*

Ossz - Stillwater Shale Zone (Middle to Upper Ordovician)

SSZ - Stillwater Shale Zone (Middle to Upper Ordovician)
The rock is a very shale-rich flysch that only has very minor greywacke. It forms a fairly narrow band that starts North of Mechanicville. It is the rock that is easiest to erode of all the flysch and melange on the floor of the Hudson Lowland. Thus, the deeper part of the Hudson River pre-glacial valley follows the trend of this zone. We call this pre-glacial valley the Battenkill-Hudson Channel as the pre-glacial Batten Kill exits the Taconic Mountains and follows this zone. North of the Batten Kill, a branch of the pre-glacial valley extends to the North through Fort Ann and is called the Fort Ann Branch. The SSZ extends East from Rte 4 below the bluffs of the Park. (*GRI Source Map ID 76030)* (Saratoga NHP Bedrock Map).

Omrz - Mohawk River Zone (Middle to Upper Ordovician)

MRZ - Mohawk River Zone (Middle to Upper Ordovician)
The rock is melange that is mostly shale with some greywacke. It's of intermediate resistance to erosion and forms several bands on the Hudson Lowland floor. But, it does not form the deeper parts of any pre-glacial bedrock valleys. Some greywacke-rich ridges stand up above the glacial deposits. The MRZ is also notable because an isolated block of pillow basalt, a volcanic rock that formed under the ocean, was incorporated into the melange. This pillow basalt is much more resistant to erosion than the surrounding rocks and stands as a prominent hill, Stark's Knob. Stark's Knob played a significant role as an observation point because it is near the Hudson River and overlooks the river with excellent views to the North and South. See Stark's Knob marked on the map in Schuylerville. Visit the site and you can

see the pillow structure of the basalt that formed when lava oozed onto the ocean floor and cooled into rock. The MRZ underlies most of the Saratoga Battlefield and the low hills that stand about the flat lands in between are cored with somewhat more resistant rock than surrounding areas. The hills were less worn down by glacial erosion. (*GRI Source Map ID 76030)* (Saratoga NHP Bedrock Map).

Owfz - Waterford Flysch Zone (Middle to Upper Ordovician)

WFZ - Waterford Flysch Zone (Middle to Upper Ordovician)
The rock is flysch that is very shale-rich with less greywacke and limestone than the TFZ to the East. Thus, the rock is very non-resistant to erosion and forms the deeper floor of the Hudson River pre-glacial valley South from Waterford. From the best we can tell, the Hoosic River pre-glacial bedrock valley follows this rock zone when it exits the Taconics and turns to the South. The WFZ pinches out just North of the Hoosic Valley. The type section for this rock is in the lower part of the Mohawk River's Cohoes Gorge. (*GRI Source Map ID 76030)* (Saratoga NHP Bedrock Map).

Otfz - Troy Frontal Zone (Middle to Upper Ordovician)

TFZ - Troy Frontal Zone (Middle to Upper Ordovician)
The rock is a melange that is very shale-rich but with some greywacke. This narrow band of rock is immediately adjacent to the Taconic Allochthon. Thus, it contains numerous slivers and pieces of both Laurentian limestone shelf rock and Taconian deep water rock. Among the latter, there may be Mt. Merino shale that contains green chert, a Native American source material for tools. The limestone slivers and pieces may contain grey or black chert. The TFZ rock is of intermediate resistance to erosion and forms the eastern edge of the Hudson Lowland up against the lower flank of the Taconic Mountains. More resistant areas may stand up as low ridges or small hills above the fill of glacial deposits. (*GRI Source Map ID 76030)* (Saratoga NHP Bedrock Map).

OCta - Taconic Allochthon (Late Cambrian to Lower Ordovician)

Ta - Taconic Allochthon (Late Cambrian to Lower Ordovician)
The rocks consist of phyllite, slate and shale with some interbeds of greywacke. They are stacked up with numerous thrust faults, not unlike thin sheets of rock or a deck of cards. The metamorphosed rocks, having been altered by heat and pressure, are the strongest rocks of the region. They are most resistant to erosion and stand tall as the eroded remnants of the ancient Taconic Mountains.

> Phyllite - a metamorphic rock from moderate heating of shale.
> Slate - a metamorphic rock from slight heating of shale.
> Limestone - a sedimentary rock that forms from the remains of tropical and subtropical life that accumulates on the ocean floor of the shelf.

(*GRI Source Map ID 76030)* (Saratoga NHP Bedrock Map).

GRI Source Map Ancillary Information

Saratoga National Historical Park Surficial Map

Produced using the following source map,

De Simone, David, 2015, Surficial Geologic Map of Saratoga National Historical Park and Vicinity, New York: De Simone Geological Investigations, 1:24,000 scale surficial map. (*GRI Source Map ID 76029)*

Surficial Map Data Sources and References for Further Explanation

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Saratoga National Historical Park Bedrock Map

Produced using the following source map,

De Simone, David, 2015, Bedrock Geologic Map of Saratoga National Historical Park and Vicinity, New York: De Simone Geological Investigations, 1:62,500 scale bedrock map. (*GRI Source Map ID 76030)*

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