Background Geologic Information for Dimmock Hollow

Prepared by Les Hasbargen (Assistant Professor of Geology, SUNY Oneonta)

July 12, 2009

Key Talking Points

1. 2006 Flood effects: look for debris draped around trees, tilted plate-like boulders, and road repair (riprap embankment). Morris Brook downstream from the dam has been scoured by the flood.
2. Large recent cobble delta in Morris Pond, much of it brought in during the 2006 event
3. Bedrock gorge with a pothole at base of St. Mary's Falls. The age of formation of the gorge is not easy to decipher. It could have been here before the glaciers arrived; it could have formed from sub-glacial meltwater when glaciers covered this area; or it could be a post-glacial gorge. There are signs of ongoing erosion in the gorge and bedrock section of the channel upstream. These include block removal of platy chunks of sandstone, and smoothing of the bedrock at a small scale, which implies abrasion by particle impacts.
4. Bedrock is sandstone and siltstone layers, with ripples. The ripples formed in a shallow water environment under the influence of waves. Some brachiopod fossils might be visible. Age of these rocks is in the range of 359-385 million years old (Mid to Upper Devonian). They are part of the Unadilla formation. Not visible, but traceable on the ridges above the Hollow is the Oneonta formation, with sedimentary layers formed on land (they have land plant fossils). Thus, the rocks indicate that the local environment changed over time from shallow marine to terrestrial.
5. All Saints Chapel is built on a kame terrace. This consists of river-born sand and gravel deposited in contact with a glacier. Presumably, during glacial retreat, Dimmock Hollow was ice free and Morris Brook carried a lot of debris down to the Butternut Valley, which still had some ice in it.

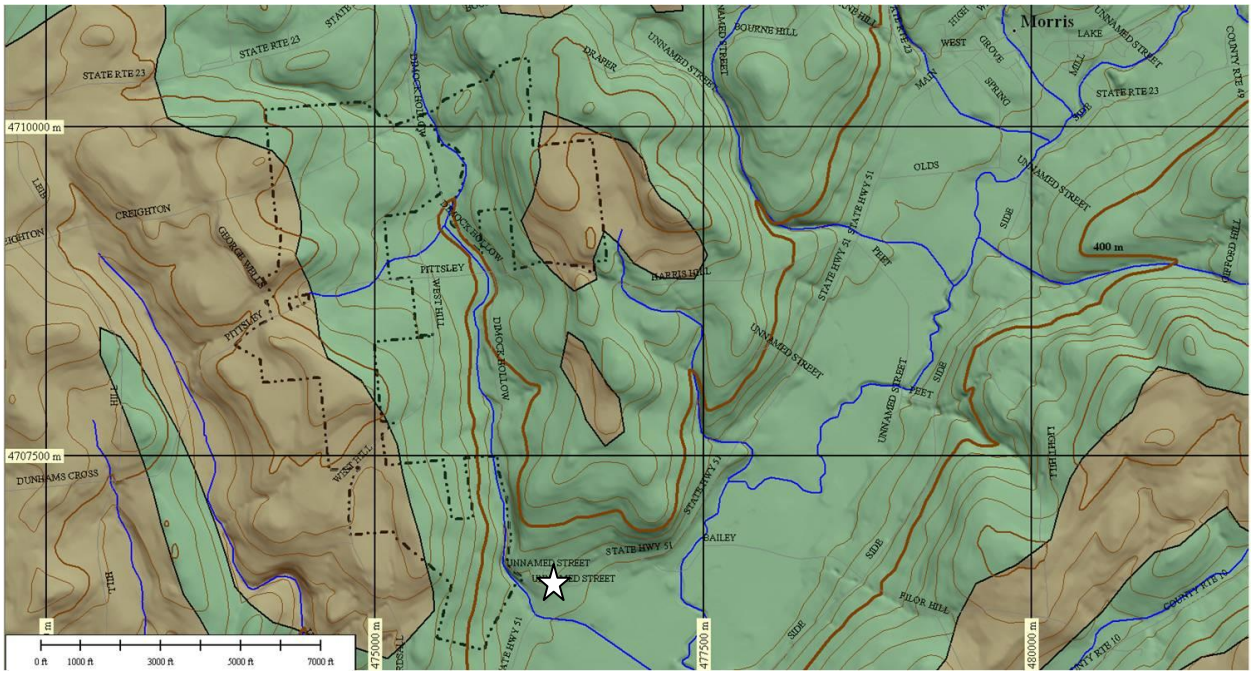
Geologic Overview

Dimmock Hollow rests on sedimentary rocks deposited during the mid-to-upper Devonian, roughly 359-385 Ma (million years). The sedimentary layers exposed in the Hollow extend both east and west, and are part of a large basin that received sediments from a high mountain range (the Acadian Mountains) that extended along the northeastern US coast into the Gaspe peninsula. The basin comprised both an onland (i.e., a terrestrial) and marine portion, with large rivers dropping sediments in floodplains in the east, and a marine basin in the west. The boundary between the two settings of course is a shoreline. This boundary moved back and forth in time across the basin, but was on average located east of Dimmock Hollow. The rocks underlying Morris Brook were deposited in a shallow marine environment. It is not hard to find brachiopods (shelled creatures with two valves), and petrified ripples which formed under the action of waves in shallow water. On both ridges above Morris Brook, one can find sedimentary rocks which weather to a reddish soil, and have trace fossils (from burrowing creatures), and root casts from early land plants. Thus, this area was alternately below and above sea level during the Devonian. These layers were buried by other deposits which have since been eroded in this area, but are exposed farther south. The story that unfolds is one of burial and uplift, followed by longer term erosion. Sedimentary layers now gently dip toward the southwest, and do so over a very wide area. The modern land surface achieved its present form after glaciers advanced and retreated

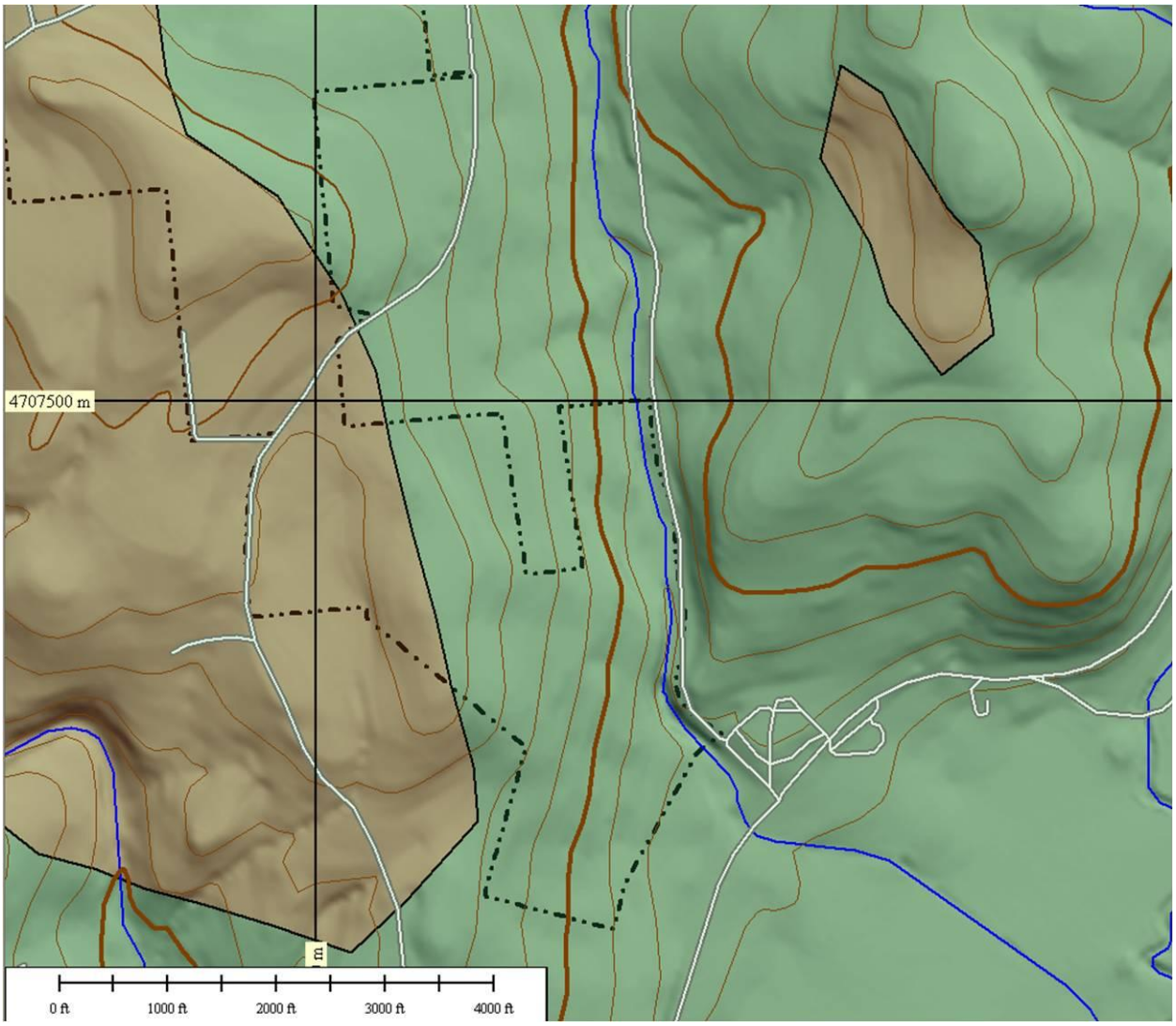
repeatedly in the last few million years. The glaciers did some erosion of the uplands in the area, but the drainage basin networks which are clearly a result of river erosion prior to glaciation are still visible on topographic maps. The last glaciers retreated from this area about 14,000 years ago. Meltwater from the glaciers moved significant amounts of sediment down into the main valley of the Butternut. Several alluvial fans are visible in the main valley at the mouth of most tributaries between Gilbertsville and New Lisbon. In some cases, the fans have irregular surfaces, which could indicate that tributary streams dropped sediment onto stagnant ice. The alluvial fans to this day dictate the location of the Butternut Creek in the valley floor, with the main channel usually pushed to the far side of the valley opposite from the fan.

Morris Brook Drainage Basin statistics

Drainage basin area = 20.9 km^2 (8.2 mi^2)
Height at channel source: 532 m above sea level (1745 ft above sea level)
Height at channel mouth: 323 m above sea level (1060 ft above sea level)
Channel length: 9.28 km (5.8 miles)
Vertical Difference (Start to Finish): 209 m (686 ft)
Average channel bearing: 171°
Average channel gradient = 1.29°



Geologic map of the lower Morris Brook watershed. Star marks St. Mary's Chapel. Colors delineate main geologic formations. Dotted dashed line marks the General Morris State Forest. The Oneonta Fm (brown unit; upper Devonian, 385-359 Ma) comprises mostly sandstone layers with occasional plant fossils. The Oneonta Fm overlies the Unadilla Fm (green area; mid-upper Devonian, 397-385 Ma), which is mostly sandstone with marine fossils and wave-generated ripple marks. Contour interval = 20 m (~60'). UTM projection, grid spacing = 500 m.



Map showing Morris Brook, Dimmock Hollow, geologic units, topography, and General Morris State Forest (outlined with dot-dot-dash line). Roads are white. Brown geologic unit = Oneonta Formation, deposited in the near shore or in floodplains close to sea level. Green area occupied by Unadilla Formation, deposited in a shallow marine environment.

References

Map data: NYS Museum's digitized geologic map of the Finger Lakes region and the Hudson-Mohawk region; USGS spatial data from the online USGS Seamless server (digital elevation, roads, cities); Stream layer from the National Hydrography Data server

Additional geologic background from
Marine transgressions and regressions recorded in Middle Devonian shore-zone deposits of the Catskill clastic wedge, by J. S. Bridge and B. J. Willis, Geological Society of America Bulletin, v. 106, p. 1440-1458, November 1994.

Wikipedia site for the Devonian: http://en.wikipedia.org/wiki/Devonian

Symmetric ripple-marked sandstone slab from the Unadilla Formation, in a nearby tributary. These large overturned slabs were mobilized during the 2006 flood event.

Brachiopod impressions from a clast from the Unadilla formation, which tells us that the depositional environment was clearly marine.

Summary of features to point out for the walk-talk

Stream features:

- Bedrock gorge and waterfalls
- Pothole
- Plucked (fractured and removed blocks) bedrock
- Flood debris and high water marks from June 2006 flood
- River bank stabilization efforts

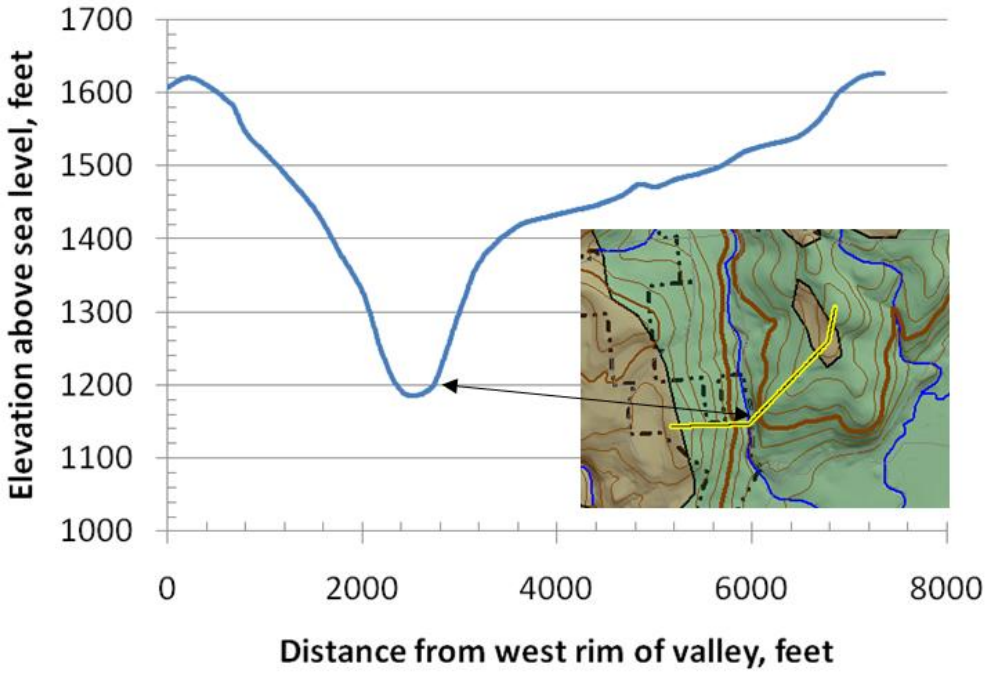
Bedrock features

- Sandstone layers
- Ripples (some are 3 dimensional)
- Marine fossils

Geomorphic features

- Small alluvial fans near Ziner farm
- Larger fans and kame terrace at mouth of Morris Brook (underlies the chapel)
- Irregular kame field? North of the chapel
- Storm channel erosion near the log ice house
- Morris Pond delta (lots of cobbles!)
- Scoured channel of Morris Brook downstream from Morris Pond

Chart below is for general interest about the shape of Dimmock Hollow in the gorge area. I think any argument for a v-shape (stream origin) or a u-shape (glacial origin) of the gorge is equivocal. It does look like there is about 175-200 feet of incision in the inner gorge of the Hollow.



Gorge of Morris Brook near St. Mary's Falls. Inset map shows the location of the profile. Contour interval on the map is 20 m (~60 ft). Topographic data from USGS National Elevation data set.