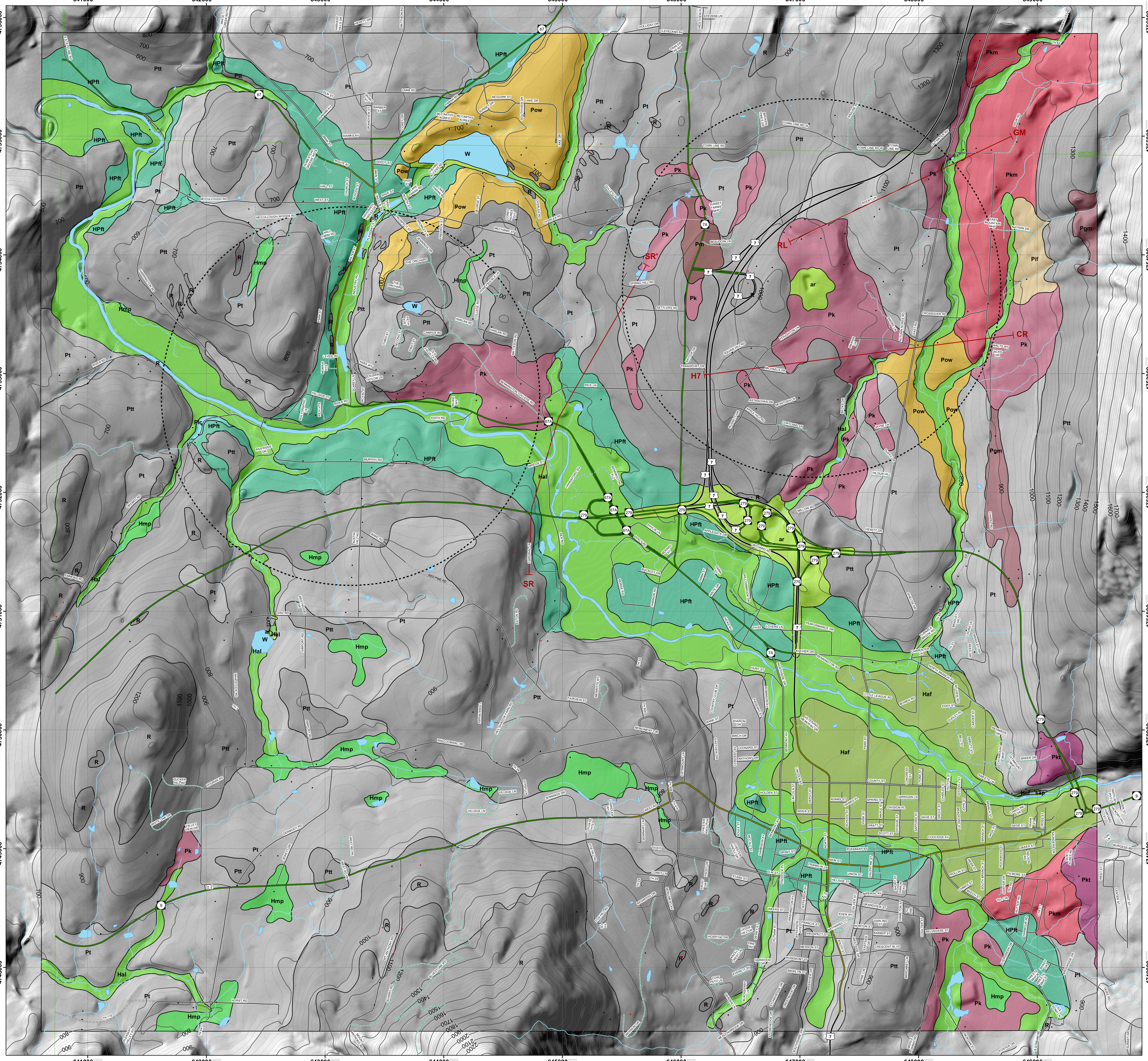


Description of Map Units

Recent

ar Artificial Fill. Variable materials used as artificial fill along rail beds, road beds, embankments and low lying areas. Large areas of fill are commonly shown on the map. Small areas of fill and areas along rail lines are not shown.

Holocene

Hmp Muck-Peat. Organic sediment. Primarily silt and clay in wetlands and swamps. Deposits are located in low lying flat lands that are prone to flooding.

Hal Alluvium. Fine sand, silt and gravel, stream flood plain deposits of river channel, bar, and overbank areas. Deposits usually have intermediate to low permeability but can be a good aquifer if sufficiently thick. Surface sediment may be poorly drained overbank silt or well drained channel and bar sand and gravel.

Haf Alluvial Fan. Gravel, silt and sand, often poorly sorted, includes diamicton. Moderately sloping tributary stream deposits located at the base of steep slopes and at stream junctions. Deposits usually have intermediate to low permeability but can be a fair aquifer if sufficiently thick and permeable.

Holocene/Pleistocene

HPft Fluvial Terrace. Fine sand, silt and gravel generally less than 5 meters thick overlying other material. Flat to gently sloping old flood plain deposits. Deposits have variable permeability but usually intermediate. Usually serve as a fair aquifer. Banks above streams may be prone to failure.

Pleistocene

Plc Lake Clay-Silt. 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 but especially toward the bottom. Deposits are poorly drained and form an aquitard to an aquiclude. Deposits are also are prone to landsliding and gullying.

Pif Inwash Fan. Stratified fluvial sand, sand and gravel, or gravel. Deposited in topographic setting similar to alluvial fans but lower distal position was glacial ice and not solid ground. Deposits are well drained and, if thick, a good unconfined aquifer.

Pow Outwash. Well sorted gravel and sand typically greater than 5 meters thick. Deposits form gently sloping to flat lands which may be pitted due to melted ice blocks. Deposits have intermediate to high permeability and are an excellent aquifer with high gravel-sand resource potential.

Pk Kame. Stratified and unstratified sand, gravel and boulders with variable silt. Deposits form undifferentiated hummocky terrain. Comprised of glacial deposits from streams, slumps, and deposition by ice. Deposits have intermediate to high permeability, high gravel-sand resource potential, and are a fair to good unconfined aquifer, limited by variable thickness and aerial extent, which may be recharge to confined aquifer on valley floor.

Pkt Kame Terrace. Stratified and unstratified gravel, sand, boulders and some silty sand with gravel. Ice contact melt water and sediment flow deposits that typically exceed 10 meters in thickness and form flat to nearly flat lands. Deposits have intermediate to high permeability and serve as an excellent unconfined aquifer that may be recharge to the valley floor confined aquifer. Deposits also have high gravel-sand resource potential, and slopes at edges of these areas may pose a stability problem.

Pkm Kame Moraine. Stratified and unstratified gravel and sand with silt and boulders. Ice contact melt water and sediment flow deposits that form rolling, hilly ridged lands with local flat areas. Deposits have intermediate to high permeability, high gravel-sand resource potential, and local steep slopes pose a slope stability problem.

Pgm Ground Moraine. Hummocky till with sand and gravel ranging from stratified and well-sorted gravel and sand to unstratified and poorly sorted silt, sand, gravel and boulders (diamicton). Ice contact sediment flow, meltwater, and ice deposited sediments of variable texture that may form gently rolling or elongate hills. Deposits have low to high permeability and limited local slope stability problems.

Pm Moraine. Unstratified and stratified silt, sand, gravel and boulders that may form a ridged or smoothly undulating landform. Ice contact, ice deposited, sediment flow, and meltwater deposited materials that form broad ridges and swales with rolling low hills. Deposits have variable permeability and local slopes may pose a stability problem.

Pt Till. Ice-derived, unsorted, and unstratified hardpan silt, boulders, gravel and sand greater than 3 meters in thickness. Material was deposited beneath the glacier and may contain deformed stratified units that may be re-deposited diamictons from subaqueous or subglacial flows. Deposits form smoothed and streamlined hills and drumlins in the valley and gently undulating slopes on the lower mountain flanks, to nearly flat plains dotted with erratics. Deposits have low permeability and retard infiltration to bedrock aquifer. Slopes are often unstable in excavations and prone to significant slope failures along stream banks.

Ptt Thin Till. Ice-derived, unsorted, and unstratified hardpan silt, boulders, gravel and sand less than 3 meters thick with rock outcrops or ledge frequent. Surface boulders or erratics are common. Deposits are located on moderate to steep mountain slopes and summit areas. Deposits have low permeability; however, soil formation typically improves permeability and enables recharge to bedrock aquifer. Steep slopes are unstable and slides are common.

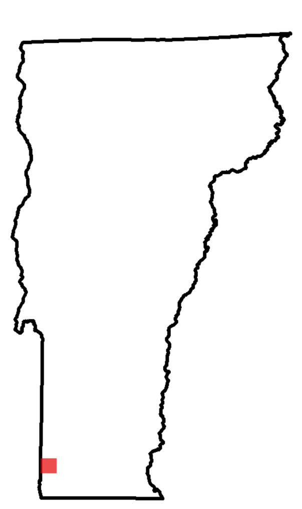
Pre-Pleistocene

sap Saprolite. Deeply, thoroughly weathered bedrock altered under climatic conditions much different than today. Saprolite was observed along the Walloomsac River in several exposures opened up by Hurricane Irene. Slumping has covered some of these preserved weathering profiles.

R Rock Outcrop. Areas of predominantly outcrop with patches of till or slump or slide debris. Outcrop areas serve to recharge bedrock units with groundwater. Slopes are generally stable except steep slopes where rock slides and rock falls may occur.

Surficial Geologic Map of the Bennington Area, Vermont

Vermont Geological Survey Open File Report VG2017-1: Plate 1



Location

Scale 1:12,000

Contour Interval = 20 ft

0 0.25 0.5 1 Miles

0 0.25 0.5 1 1.5 2 Kilometers

David J. DeSimone, PhD

2017

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http://dec.vermont.gov/geological-survey
Digital Cartography by Colin Dowey

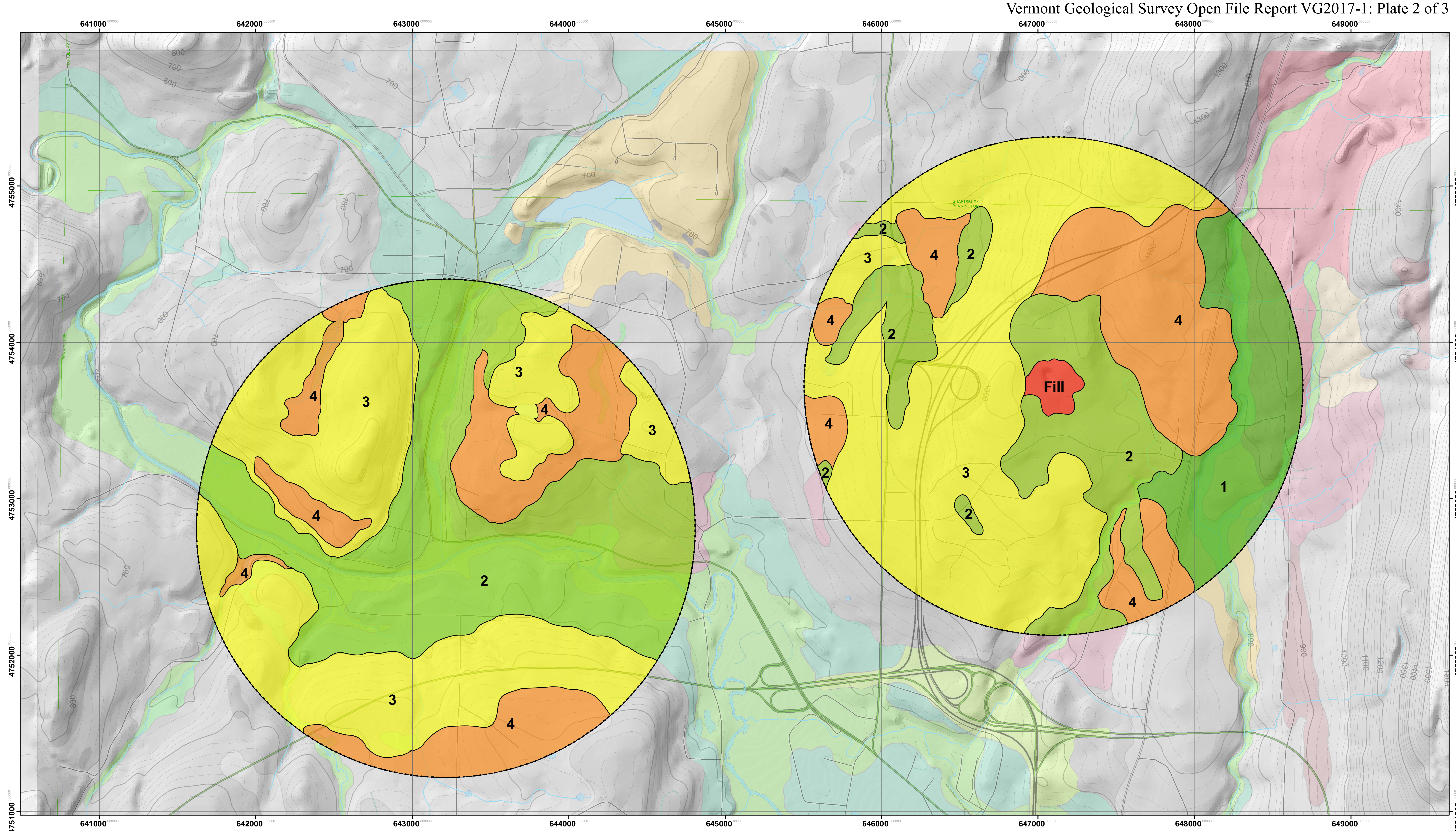
14°
Magnetic North
True North

Description of Map Symbols

Field Locations (Bedrock Outcrops)	Lakes/Ponds
Field Locations	Rivers
Area Analyzed for Recharge Potential	Cross-Sections
Town Boundaries	

Grid Overlay: NAD 1983 UTM Zone 18N
Basemap and Contours derived from USGS 10m National Elevation Dataset.

Suggested Reference: DeSimone, D. J., 2017, Surficial Geology of the Bennington Area, Vermont: Surficial Geologic Map, Vermont Geological Survey Open File Report VG2017-1, Plate 1 of 3, Scale 1:12,000.



Recharge Potential

Highest

1 Areas of highly permeable overburden that are believed to be comparatively thick and persistent based upon well logs and the character of the deposits. The extensive kame moraine and outwash with adjacent kamic areas have the highest potential to recharge the bedrock aquifer. A kame moraine consists of predominantly fluvial sediment that may have lenses and interbeds of low permeability till that are typically not laterally extensive. Outwash is a highly permeable fluvial deposit of gravel and sand with little or no impermeable sediment. Adjacent kamic deposits may have both permeable and impermeable interbedded sediments.

2 Areas of intermediately permeable materials including kamic sediment, outwash, moraine, eroded till, fluvial terraces and alluvium. The kamic areas are likely the most permeable sediment of this category and consist largely of gravel and sand. The area of outwash included in this group has an unknown thickness and may overlie bedrock or till. The small morainal feature is not well expressed and may be more kame moraine in sediment texture. Eroded till punctuated by several bedrock exposures suggests comparatively easy recharge to the bedrock aquifer. Fluvial terraces and alluvium consist of gravel, sand and silt in variable proportions with highly variable surface layer permeability.

3 Areas of thin till overlying bedrock. The upper meter or so of the till is typically weathered to a more permeable texture than the underlying till. Weathered till should allow water infiltration to bedrock more easily than unweathered till. The process of soil formation oxidizes and alters the upper meter or so of the sediment and thinner areas of till may be weathered throughout the sediment profile. In addition, this group includes small rock outcrops within areas of till.

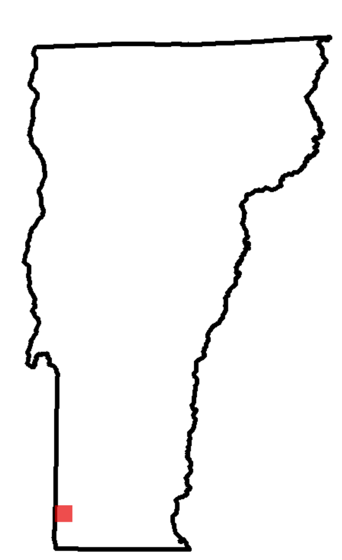
Lowest

4 Areas of thick impermeable till. Thick till has a thicker profile of unweathered till beneath the soil zone than weathered till. Unweathered till has an extremely low permeability and low recharge potential. A small area of exposed glacial lake clay-silt is also assigned to this category as clay-silt has a very low permeability.

Aquifer Recharge Potential as a Function of Surficial Materials in the Bennington Area, Vermont

Vermont Geological Survey Open File Report VG2017-1: Plate 2

David J. DeSimone, PhD
2017



Location

Scale 1:12,000

Contour Interval = 20 ft

0 0.25 0.5 1 Miles

0 0.25 0.5 1 1.5 2 Kilometers

14° Magnetic North True North

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Published by:
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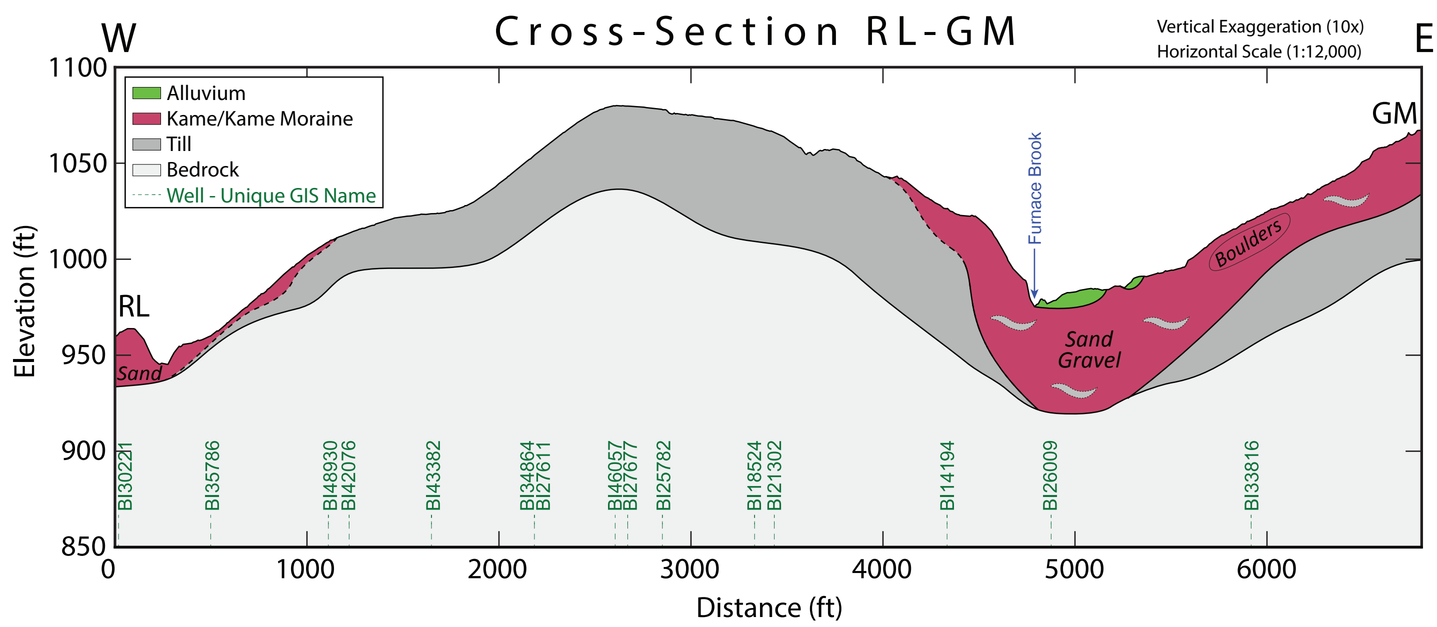
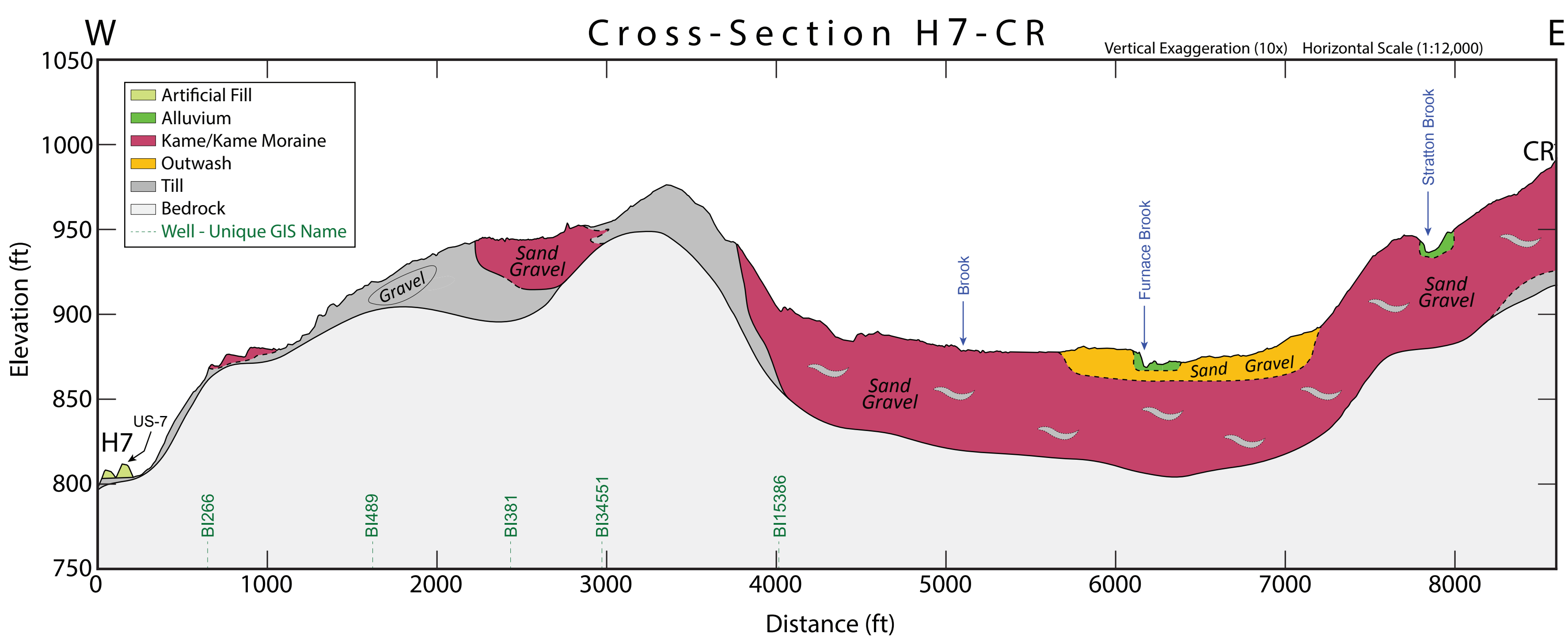
Digital Cartography by Colin Dowey

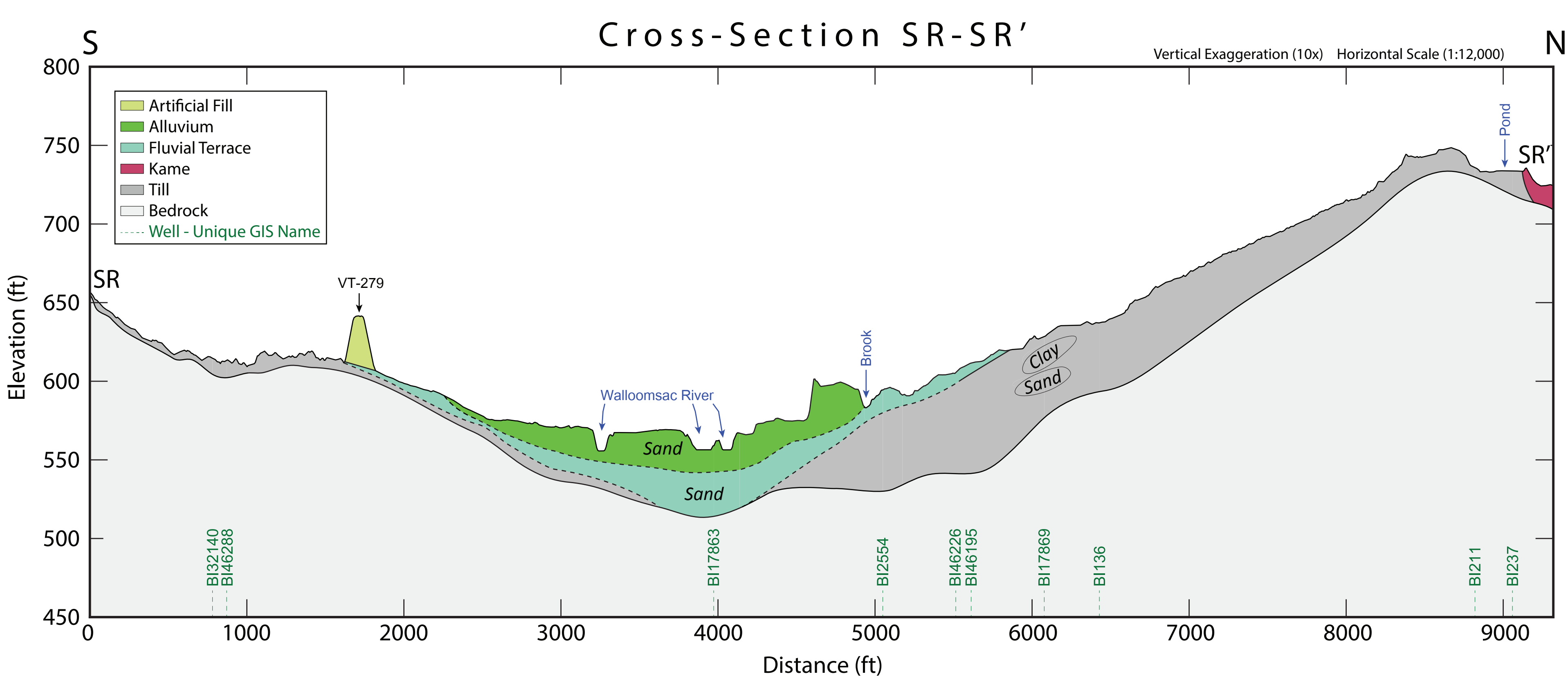
Suggested Reference: DeSimone, D. J., 2017, Surficial Geology of the Bennington Area, Vermont: Aquifer Recharge Potential, Vermont Geological Survey Open File Report VG2017-1, Plate 2 of 3, Scale 1:12,000.

Surficial Geology of the Bennington Area, Vermont: Cross Sections

Authors: David J. DeSimone, PhD and Colin Dowey







Land surface elevation derived from
VT Lidar Hydro-flattened DEM (2 meter) - 2012 - Bennington
from the Vermont Center for Geographic Information.
Bedrock surface elevation derived from Lidar Data,
Outcrop Locations, and Well Completion Reports.

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Suggested Reference: DeSimone, D. J., & Dowey, C., 2017, Surficial Geology of the Bennington Area, Vermont: Cross Sections, Vermont Geological Survey Open File Report VG2017-1: Plate 3 of 3, Scale 1:12,000.

DRAFT Fence Diagram Correlating Surficial Materials Between Cores on the Chemfab Property

Authors:
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Jon Kim (Vermont Geological Survey, Montpelier, VT)
Emmet Norris and Peter Ryan (Middlebury College, Middlebury, VT)

- F — **F** Artificial Fill; 4-10ft thick; Variable composition with coal, ash, brick, concrete & angular rock fragments
- 3 — **Unit 3** Flood plain alluvium; 9-15ft thick but tapers westward to 0-5ft thick in Paran Creek; Fining upwards sequence with well preserved A & B horizons in core 7; basal poorly sorted cobble to pebble gravel & silt fines upward through medium & fine sand to fine sand & silt.
- 2 — **Unit 2** Walloomsac middle alluvium; 5.5ft thick; cobble to pebble gravel fining upwards to coarse & medium sand; well sorted & bedding preserved; confined to Walloomsac bedrock channel.
- 1 — **Unit 1** Walloomsac basal alluvium; basal cobble to pebble gravel with silt & small wood fragment; fines upward through medium sand to fine sand & silt; disseminated organic matter throughout.
- B — **Bedrock** Whitish-weathering, gray crystalline dolomitic limestone of the Shelburne Formation

KEY TO STRATIGRAPHIC SYMBOLS

F fill
BF boulder fill (log description)
ST silt
CL clay
FS fine sand
MS = medium sand
CS = coarse sand
PG = pebble gravel
CG = cobble gravel
R rock

Static Water Level

INTERPRETATION

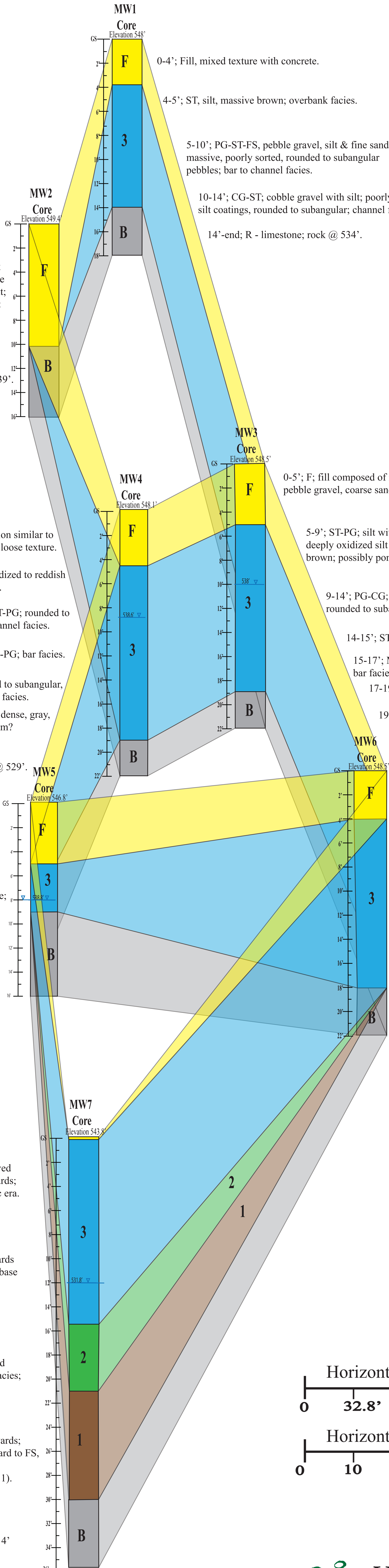
Bedrock surface; The bedrock surface generally slopes eastward and southward beneath the cores. A steep slope in the bedrock profile occurs between Core 5 and Core 7, a drop of 24ft, at the junction of the Paran and Walloomsac channels. It is not known if the slope is stepped or a continuous drop but clearly represents a buried nick point.

Late Pleistocene events; The Paran Creek and Walloomsac valleys experienced fluvial discharges related to glacial lake lowering and one small lake breakout. The stepped and rapid lowering of Glacial Lake Bascom from the 900ft Potter Hill level through brief bedrock controlled steps at 700ft, 665ft, 625ft and finally to ice controlled lower levels each resulted in avulsion of the Walloomsac and Paran Creek channels. Additionally, Paran Creek received the breakout flow from a small glacial lake in Shaftsbury to the north. These drainage events likely resulted in channel avulsion and erosion of any Pleistocene sediment deposited in the bedrock channels.

Holocene events; The Holocene transition was marked by rapid sea level rise from early through middle Holocene, ~11,000-7000 years, based upon comparison of sea level curves in the literature. This was very likely a time of valley aggradation and deposition of fluvial terrace sediments atop bedrock in the area of the cores. **Unit 1 & Unit 2** were likely deposited in the deeper Walloomsac channel during this time frame. The presence of an unidentifiable fragment of wood near the base of Unit 1, the oldest alluvial sequence, suggests a Holocene age. Regionally, as inferred from numerous geoarchaeology projects in the Hudson drainage basin by DeSimone, valley incision resumed likely during late middle to late Holocene time as sea level rise slowed to it's current level. Many of our local valleys have multiple fluvial terrace sequences and associated abandoned terraces that have been dated from archaeological investigations to the last 6000 years. **Unit 3** likely accumulated across the Walloomsac and Paran drainages as aggradation occurred with a nearly stable sea level. Coal near the top of core 7 and a preserved plow zone inferred near the top of core 5 suggests flood plain deposition continued in the study area through historic time. Individual facies of Unit 3 in cores 1-6 may not be laterally continuous, especially any basal facies inferred to possibly represent channel lag or debris flow origins. Overbank deposits may be more laterally traceable in cores 1-6, where present. Hence, no attempt is made to draw correlation lines among facies, only fluvial terrace sediment packages.

Historic disturbances; Only core 7 preserves a complete Unit 3 without fill while cores 1-6 all show varying degrees of disturbance and addition of thick fill. Fill was likely added to the area to elevate the flood plain and minimize flooding of structures. A preserved possible plow zone in core 5 beneath fill suggests elevation of the land was accomplished with fill. In other cores, the flood plain sediments were truncated at the fill contact and soil profiles were disturbed or removed. Thus, topsoil removal may have been done prior to fill addition. The highly oxidized reddish fine-grained sediments inferred to possibly represent pond sediment may indicate these sediments date from sometime after dams were constructed along Paran Creek. Increased acidity from industrial activity, especially coal burning, may be responsible for the highly oxidized condition of these localized sediments.

*Due to poor recovery in top of Core 6, a depth of 4 ft was arbitrarily chosen to represent the base of fill. This is reasonable, based upon visual observation that suggests little fill. Core 2 fill thickness was arbitrarily chosen because the site is bracketed by deeply excavated utility lines and the material all indicated disturbance and/or fill origins to top of rock. Drilling logs in related adjacent areas to Core 2 were excavated to as much as 8ft depth. The 5 ft fill thickness chosen is consistent with fill thickness in other cores.



MW1 Core

0-4'; Fill, mixed texture with concrete.

4-5'; ST, silt, massive brown; overbank facies.

5-10'; PG-ST-FS, pebble gravel, silt & fine sand; massive, poorly sorted, rounded to subangular pebbles; bar to channel facies.

10-14'; CG-ST; cobble gravel with silt; poorly sorted, silt coatings, rounded to subangular; channel facies.

14'-end; R - limestone; rock @ 534'.

MW2 Core

0-10'; F-BF; fill and/or backfill composed of mostly angular rock fragments of pebble to cobble size several coal fragments throughout; likely disturbed ground from past excavations.

10'-end; R - limestone; rock @ 539'.

MW3 Core

0-5'; F; fill composed of rounded to angular pebble gravel, coarse sand, coal, ash & brick.

5-9'; ST-PG; silt with pebble gravel, massive; deeply oxidized silt from yellow brown to reddish brown; possibly pond or overbank silt; dredged?

9-14'; PG-CG; pebble gravel with minor cobbles; rounded to subangular; oxidized brown.

14-15'; ST; laminated gray silt; overbank facies.

15-17'; MS-PG; oxidized; small brick fragment; bar facies.

17-19'; CG-PG; rounded to subangular; channel.

19'-end; R- limestone; rock @ 529'.

MW4 Core

0-4.5'; F; PG-ST-CG composition similar to Core 3; rounded to subangular, loose texture.

4.5-8.5'; ST-CL; laminated, oxidized to reddish brown; overbank to pond facies.

8.5-10'; CG-ST-PG; rounded to subangular, channel facies.

10-14; FS-MS-PG; bar facies.

14-18'; CG-PG-ST; rounded to subangular, gray; poorly sorted; channel facies.

18-19'; CG-ST-PG; dense, gray, debris flow/colluvium?

19'-end; R- limestone; rock @ 529'.

MW5 Core

0-5'; F; PG-ST composition; angular rock fragments; rusty iron near base.

5-6.5'; ST-PG; organics as clasts; overbank facies; plow zone (?).

6.5-9'; ST; minor pebbles, massive; overbank; below plow zone.

9'-end; R - limestone; rock @ 538'.

MW6 Core

0-9'; F-PG-CG; poor recovery; large cobble likely pushed downward.

9-10'; ST-FS; minor pebbles; oxidized yellow brown; overbank facies.

10-18'; PG-CG-ST; clast supported; dense, gray; most clasts angular to subangular but a few rounded, poorly sorted; channel facies or debris flow (?).

18'-end; R - limestone; rock@ 530'.

MW7 Core

0-5'; ST-FS; minor coal at top; preserved thick A horizon; generally fining upwards; overbank facies, top of unit 3 - historic era.

5-15.5'; PG-CG-ST; fining upwards generally; bar to channel facies, base of unit 3.

15.5-21'; MS-CS-PG-CG; well sorted and bedded, fining upwards; bar to channel facies; unit 2.

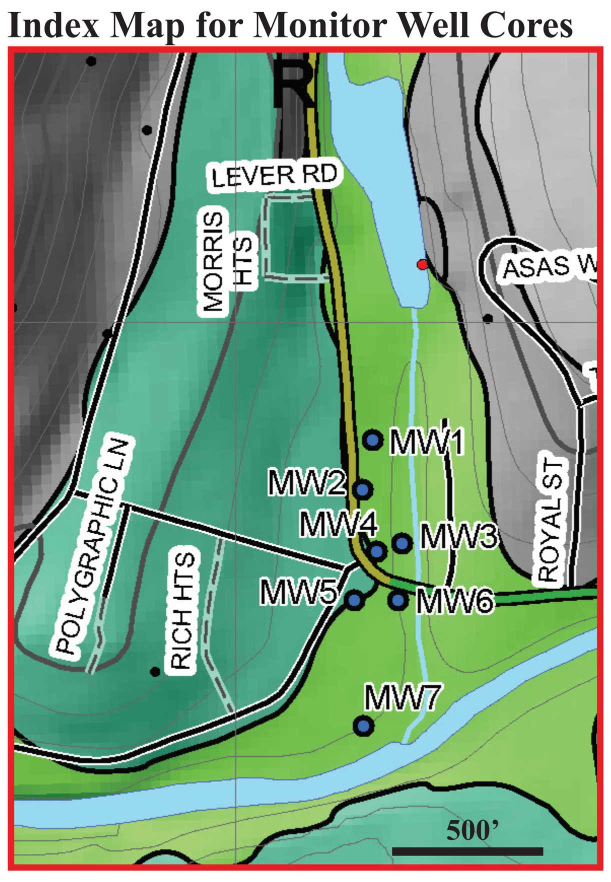
21-30; ST-FS-MS-PG-CG; well sorted; generally fining upwards; basal cobble gravel with silt 1ft thick; 6ft MS that fines upward to FS, organic matter smears and small piece of wood near base; upper 2ft FS & ST; oldest fluvial terrace unit atop rock (unit 1).

30-end; R - limestone; rock @ 514'

Horizontal Scale (ft)
0 32.8' 65.6' 131.2'

Horizontal Scale (m)
0 10 20 40m

Index Map for Monitor Well Cores



See Plate 1 for Index Map location.

Access to the cores was provided by St. Gobain and their consultant C.T. Male during monitor well installation from June 14-16, 2016 at the Chemfab property in North Bennington and on July 6, 2016 at the St. Gobain Warehouse in Hoosick Falls, New York.
Approximate static water levels were obtained in the field from C.T. Male (June 14-16, 2016).

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Suggested Reference:
DeSimone, D.J., Kim, J.J., Norris, E., and Ryan, P., 2017, Surficial Geology of the Bennington Area: DRAFT Fence Diagram Correlating Surficial Materials Between Cores on the Chemfab Property, Vermont Geological Survey Open File Report VG2017-1, Plate 4 of 4.