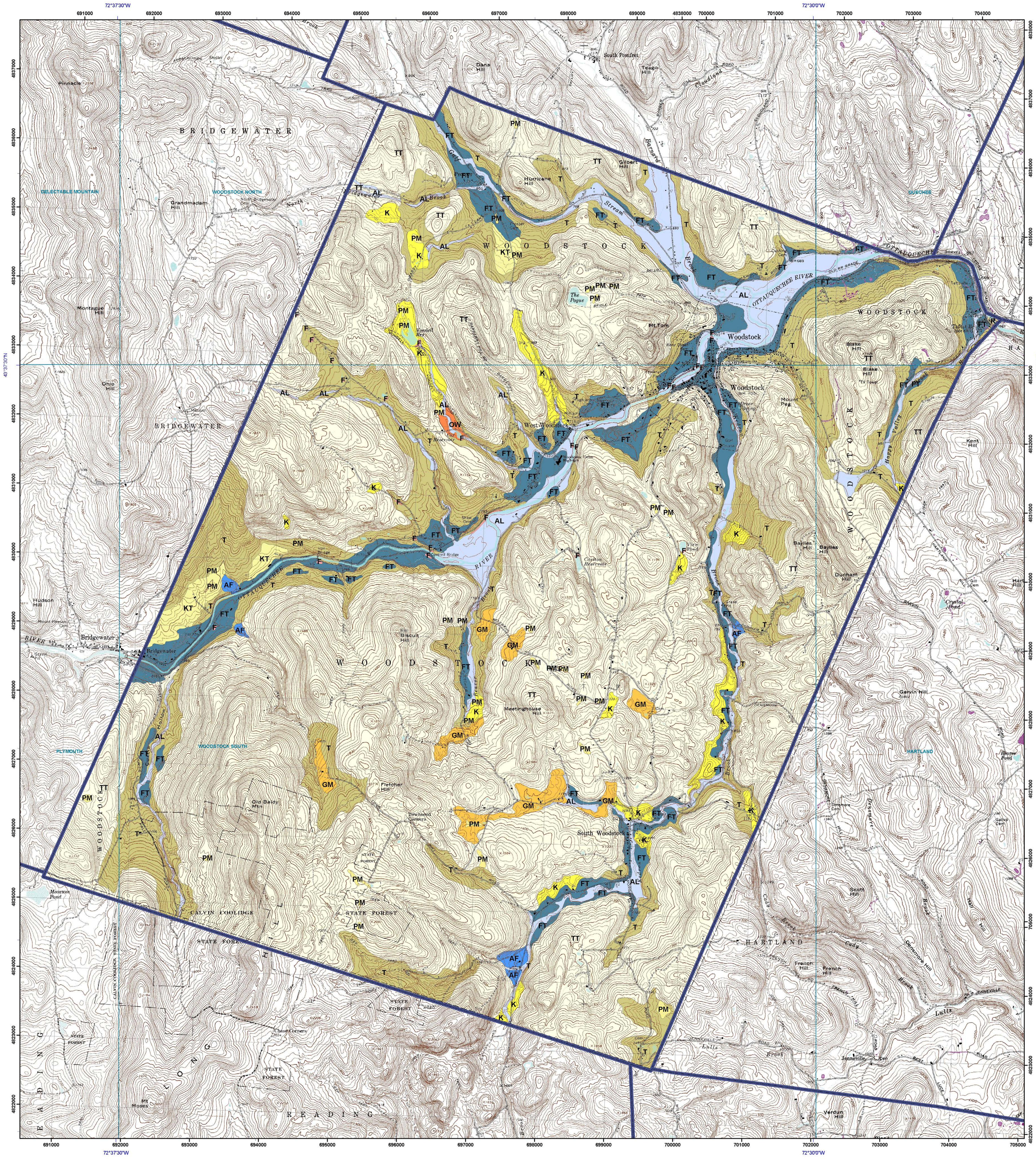


DESCRIPTIONS OF UNITS

RECENT

F — Fill; variable materials used as artificial fill along rail beds, road beds, embankments and low lying areas.

PM — Peat & Muck; organic sediment, mostly silt and clay in wetlands and swamps; low lying flat lands prone to flooding; aquifer discharge areas.

AL — Alluvium; 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; fair to good aquifer if sufficiently thick.

AF — Alluvial Fan; 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.

FT — Fluvial Terrace; old stream terrace deposits above the flood plain; fine sand, silt and gravel to cobble size; generally less than 5 meters thick overlying other material; flat to gently sloping lands; variable permeability but usually intermediate; 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 to good aquifer if sufficiently thick.

PLEISTOCENE

OW — Outwash; glacial melt water deposits of well sorted gravel and sand typically greater than 5 meters thick; gently sloping to flat lands; intermediate to high permeability; high gravel-sand resource potential.

K — Kame, undifferentiated; glacial deposits from streams, slumps and deposition from 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 aquifer limited by variable thickness and aerial extent. Undifferentiated kame areas and ground moraine areas can imperceptibly grade from one to the other in physical appearance and in sediment.

KT — Kame Terrace; ice contact melt water and sediment flow deposits of stratified and unstratified gravel, sand, boulders and some silt; flat to nearly flat lands; intermediate to high permeability; high gravel-sand resource potential; slopes at edges of these areas may pose a stability problem; sediment thickness is variable but typically exceeds 10 meters; percolation rates are generally satisfactory for conventional septic systems; aquifer recharge areas prone to contamination from infiltration; good local aquifer.
Two areas of kame terrace accumulation are recognized. The largest occurs along the north side of the Ottauquechee River and extends from just west of Iron Bridge into Bridgewater Village. The kame terrace is above approximately 860ft elevation. The smaller area of kame terrace occurs along Prosper Road and extends above approximately 900ft elevation.

GM — Ground Moraine; ice contact sediment flow, melt water and ice deposited sediments of variable texture ranging from stratified and well sorted gravel and sand to unstratified and poorly sorted silt, sand, gravel and boulders; thickness is variable and rock outcrops may protrude; low to high permeability; limited local slope stability problems; gently rolling hills and elongate smoothed hills are possible; fair aquifer limited by variable sediment texture and limited thickness.
The ground moraine unit represents areas where glacial ice became isolated during stagnation and melted away without further flow of the small masses of ice. The deposits left are a relatively thin cover of sand and cobble sediment with or without abundant silt in the matrix and boulders are common. The loose and un-compacted ground moraine sediment veneers the underlying compacted till and bedrock.

T — Till; 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; not an aquifer and the material is impermeable and tends to impede recharge of bedrock aquifer below; locally perched water tables are common and soils are generally poorly drained.
Slope or bank failures were seen along the south bank of Gulf Stream east of Prosper Road, minor bank failures along Deer Brook, along Beaver Brook east of Fletcher Hill Road, along Noah Wood Brook below the road, along Curtis Hollow Brook, especially the major bank failure which as cut into Curtis Hollow Road, and along the Ottauquechee River's banks on or near Riverside Park Road, Carleton Hill Road, College Hill road and Ledge Road. These slope failures are shown on another map layer.

TT — Till, thin; 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; not an aquifer but thin veneer with permeability improved by soil formation processes allows recharge of bedrock aquifer below.

Slides may expose the underlying bedrock as failure typically occurs along the plane of contact between the bedrock and the overburden causing all the soil and vegetation to slump down slope.

USGS 24K Quadrangle Boundaries

Scale 1:24,000

0 0.5 1 2 Miles

0 0.5 1 2 3 Kilometers

Contour Interval 20 Feet

Base map from U.S. Geological Survey.
Quadrangle names printed in blue.
Coordinate System: Vermont State Plane, meters, NAD 83.
Geographic coordinates shown at topo corners are in NAD 83.
Grid overlay on map is Universal Transverse Mercator, Zone 18N, NAD 27.
Date: September 2006

MN N

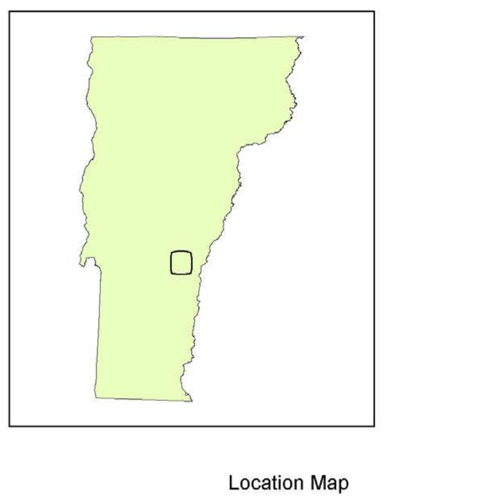
Magnetic declination
15.5 degrees west, 1968

SURFICIAL GEOLOGIC MAP OF WOODSTOCK, VERMONT

by
David DeSimone

Digitization and cartography by Marjorie Gale

2006



Location Map

Research supported by the Vermont Geological Survey, Dept. of Environmental Conservation, VT ANR.
This geologic map was funded in part by the USGS National Cooperative Mapping Program.
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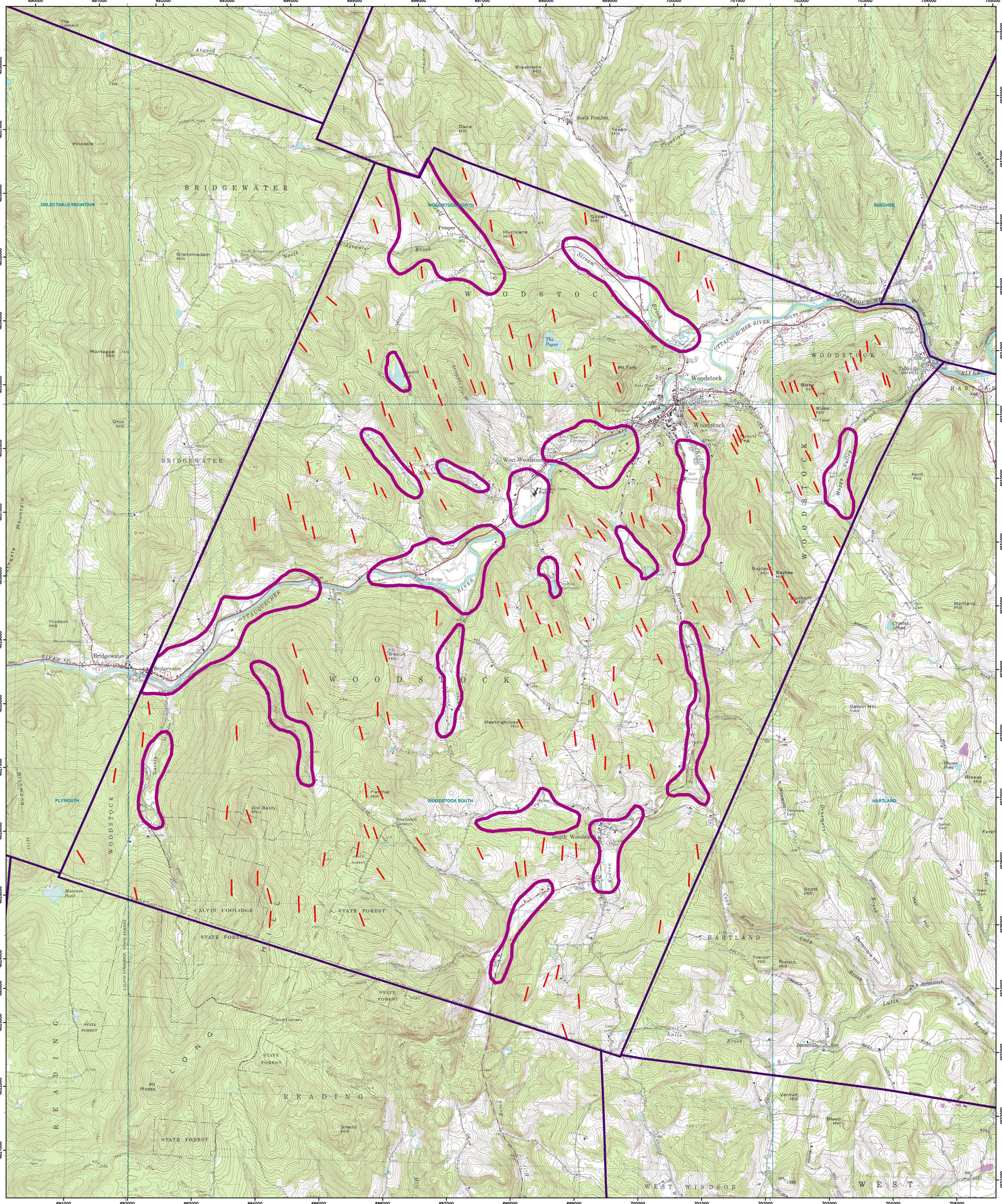

Legend

- Glacial Striation or Groove
- Ice Margin
- Rivers and Streams
- Town Boundaries

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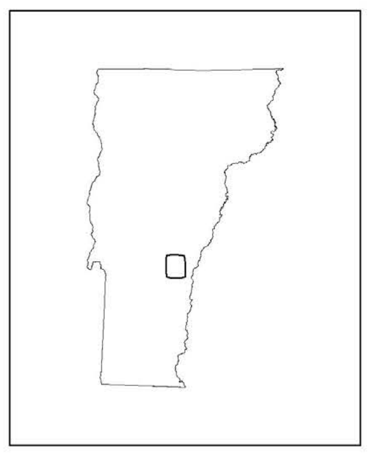

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Digital Cartography by Marjorie Gale
Date: 2006

1:24,000

0 0.5 1 Miles

0 0.5 1 Kilometers

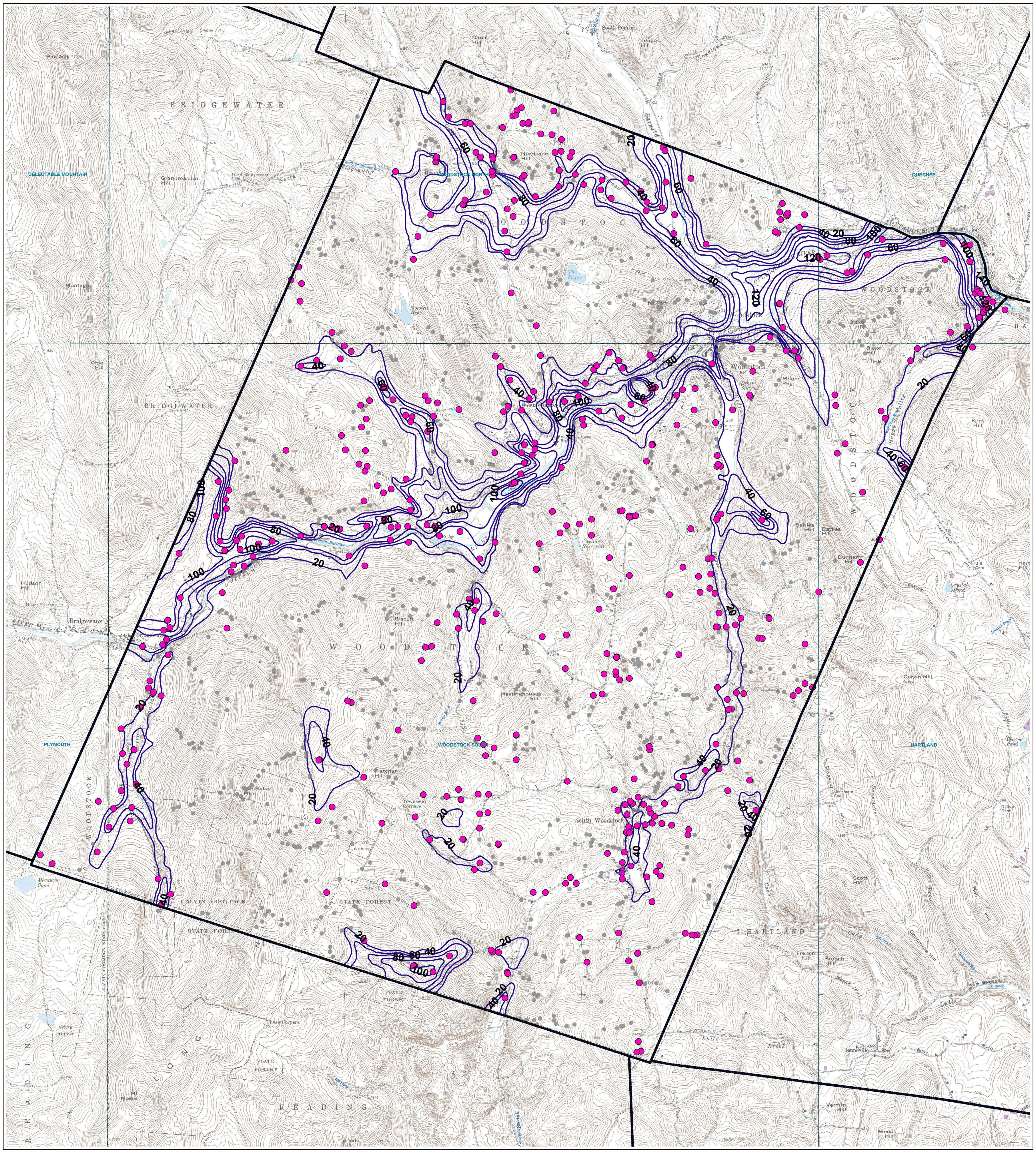
Contour Interval 20 Feet

MN N

Magnetic declination
15.5 degrees west, 1968

ICE MARGINS, ,WOODSTOCK, VERMONT

by
David DeSimone
2006



Legend

- Water Wells Locations
- Bedrock Locations
- Depth to Bedrock
- Lakes, Ponds and Reservoirs
- Rivers and Streams
- Quadrangle Boundaries
- VT Town Boundaries

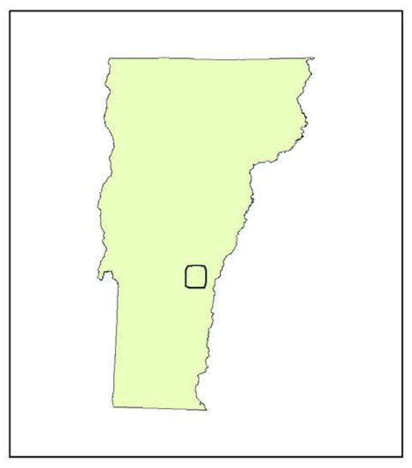
DEPTH TO BEDROCK (OVERBURDEN THICKNESS)

Data contained in well drillers' logs (pink dots) were contoured to generate a depth to bedrock map for Woodstock. These data are plotted and contoured at a 20 foot interval. Zero foot contours are not shown but are reflected by the bedrock outcrop exposures (VGS OFR VG06-4).

Most of the town is covered by less than 20 feet of overburden. This interpretation is based upon available well log data which report depth to rock and/or length of casing. A thin blanket of till atop bedrock predominates in the uplands and many of the tributary valleys.

Major valleys and some tributaries contain greater than 20 feet of overburden. Thick overburden interpreted to be till from drillers' logs and field exposures underlies the flood plain and terraces along the Ottauquechee River, Gulf Stream and Barnard Brook. Tributary valleys with thick till include Happy Valley, Hartland Hill Brook, Kedron Brook, Beaver Brook, Curtis Hollow, Deer Brook, Gabert Brook, and the distal portions of Vondell Brook, Barberry Brook and Prosper Brook.

Well data reveal glacially scoured pockets (Plate 4) filled with the thickest overburden along the Ottauquechee River, Gulf Stream, Barnard Brook and Happy Valley Brook troughs.



Location Map

1:24,000

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0 0.5 1 Kilometers

Contour Interval 20 Feet

MN N

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Date: September 2006

DEPTH TO BEDROCK, WOODSTOCK, VERMONT

By
David DeSimone

Digitization and cartography by M. H. Gale

2006

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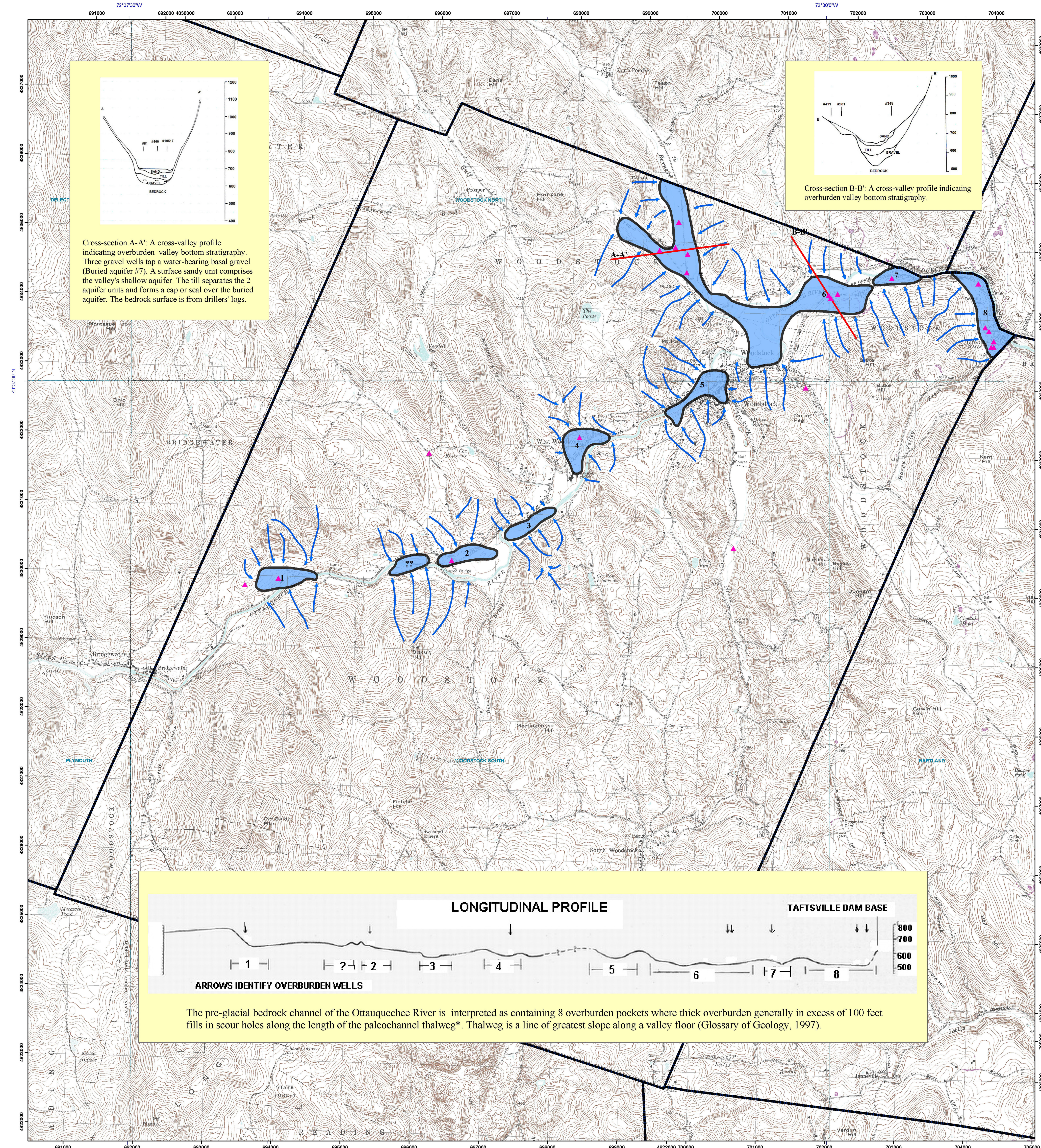

Legend

Recharge flow lines to buried aquifers

Buried Aquifers

Sand and Gravel Wells

Explanation

Buried Aquifer: A buried aquifer (confined aquifer) is a volume of porous and permeable sediment, either sand or gravel or a mixture of sand and gravel, which is buried beneath the ground surface. This permeable valley bottom sediment is isolated from the surface sediment which comprises the shallow aquifers by a variably thick layer of impermeable till. Hydrologists refer to this as a confined aquifer because the aquifer is sealed, capped or confined by an impermeable layer.

Confined aquifers are typically recharged by either or both of 2 pathways. First, ground water flowing in the bedrock may flow upward under pressure and recharge the buried aquifer sediment when there is no barrier between the bedrock and the permeable sediment. Second, buried aquifers may have a physical and hydraulic connection to permeable sediment exposed at the surface along valley flanks. The latter pathway for recharge of the buried aquifers has not been demonstrated by drillers' logs or field mapping evidence. Thus, it is likely that recharge to the buried aquifers comes from the underlying bedrock.

Overburden stratigraphy: The valleys contain surface deposits of variably permeable sediment mapped as kame terrace, ground moraine, fluvial terrace and alluvium. Together, these sediments constitute the shallow aquifers in the town. Elsewhere along the valley flanks and in places along the valley floors, impermeable till is the surface sediment. Drillers' logs report the till is extensive beneath the surface and consistently occurs beneath the permeable shallow aquifers sediments.

There are 22 gravel or sand overburden wells in the town and 18 of these wells occur in a similar setting along the valley floors or valley sides. The drillers' logs for these 18 wells consistently penetrate a variably thick layer of till and bottom in a water-bearing gravel or sand unit. None of these 18 wells fully penetrated the buried gravel unit so its thickness remains unknown. Thus, what lies beneath the buried gravel unit also remains unknown. There may be impermeable till beneath the gravel with bedrock below or the gravel may persist to the bedrock contact. In similar stratigraphic settings examined by the author in other locations, the typical occurrence was for gravel to persist to the bedrock contact without any till layer separating the gravel from the bedrock. Thus, the gravel was basal gravel.

These buried gravel units are the buried aquifers of the town. They occur beneath the thickest sections of overburden in the town along the bottoms of the bedrock paleochannels in most of the 8 overburden pockets identified on the depth to bedrock map. Overburden pockets #1, 2, 4, 6, 7 & 8 all contain one or more water-bearing overburden wells. Thus, these are confirmed buried aquifers in the town.

Overburden pockets #3, 5 and the questionable pocket shown on the depth to bedrock map do not contain an overburden well so they are only possible buried aquifers. Drilling would be necessary to verify the existence of a water-bearing gravel layer in these overburden pockets.

The lateral continuity of the buried aquifers is unknown due to the lack of well data that would demonstrate the persistence of gravel from one overburden pocket to the next adjacent overburden pocket. However, the longitudinal profile on the depth to bedrock map suggests that overburden pockets #1, 2, 3, 4, & 5 may be distinct and isolated from each other. The gravel may not be continuous between these overburden pockets.

In contrast, overburden pockets #6, 7 & 8 appear to be physically linked and the gravel may persist all along the valley floor from up valley of the confluence of Gulf Stream and Barnard Brook to their confluence with the Ottauquechee River and then down valley to the limits of the town. These 3 overburden pockets may be linked because the thresholds separating the 3 scour holes are shallow and the reported thickness of gravel in several of the wells may allow for the gravel to persist as a single layer extending from one scour hole to the next. These 3 overburden pockets contain 15 of the 18 buried gravel overburden wells including the town's water supply well. If linked, then the gravel in these 3 overburden pockets represents one buried aquifer and is clearly the town's most significant ground water resource.

Base map from U.S. Geological Survey.
Quadrangle names printed in blue.
Coordinate System: Vermont State Plane, meters, NAD 83.
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Digital Cartography by M.H. Gale
Date: September 2006

Scale 1:24,000

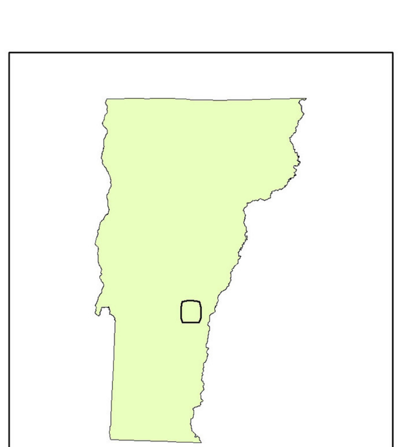
0 0.5 1 2 Miles

0 0.5 1 2 Kilometers

Contour Interval 20 Feet

MN N

Magnetic declination 15.5 degrees west, 1968



Location Map

POTENTIAL BURIED AQUIFERS, WOODSTOCK, VERMONT

By
David DeSimone

Digitization and Cartography by M.H. Gale

2006

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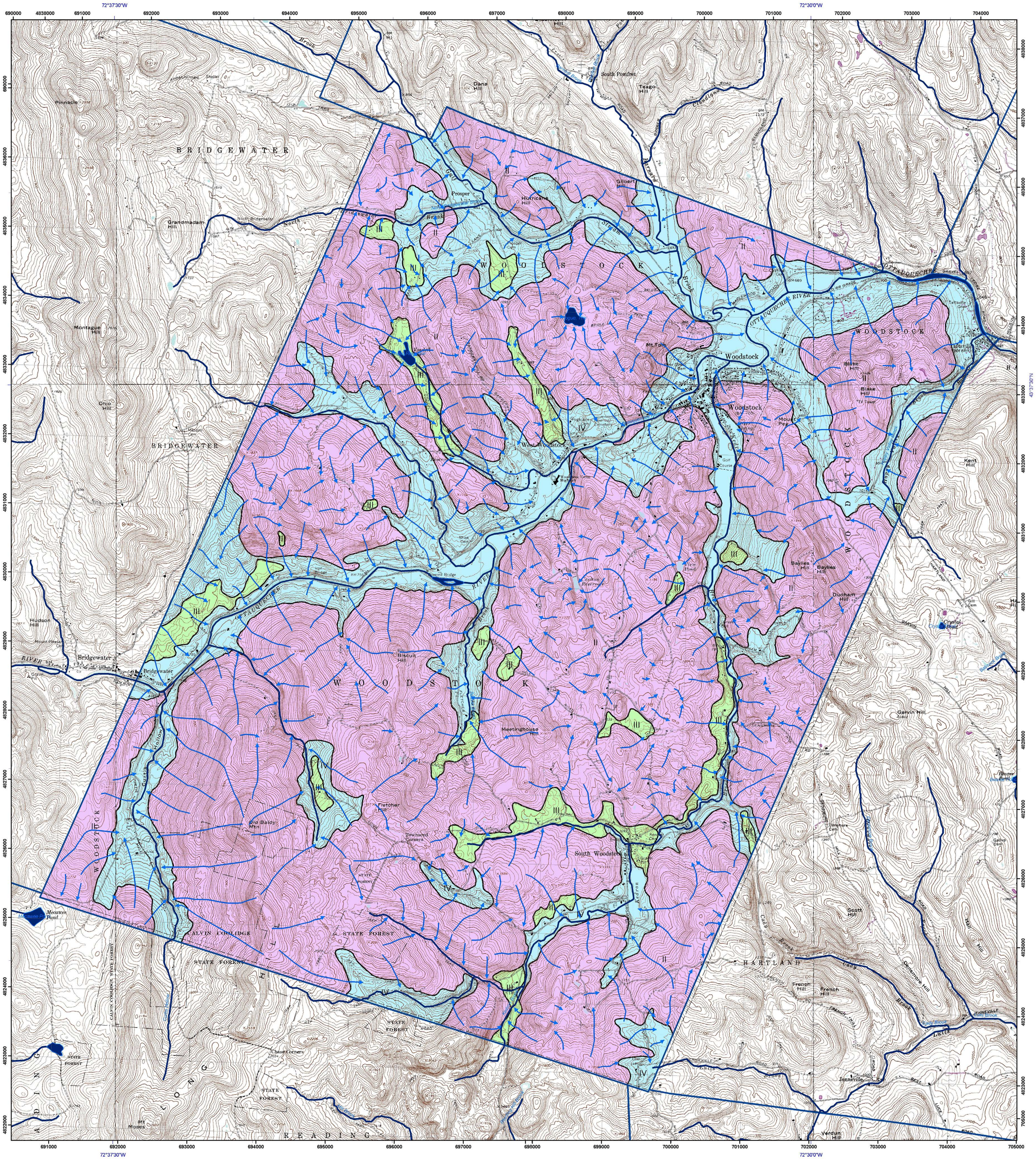


Legend

Recharge Potential to Bedrock Aquifers

II — HIGH; Thin till areas, TT, throughout the the Town which recharges the bedrock aquifer and likely recharge the confined overburden aquifers from below.

III — MODERATE; Areas of ice contact sediment, K, KT, GM, which may be partly or wholly in contact with bedrock, facilitating recharge of the bedrock aquifer.

IV — LOW; Areas of thick till, T, and valley floors where the surface sediment is either fluvial terrace, FT, or alluvium, AL. These latter areas are underlain by a thick and pervasive impermeable diamicton unit as revealed in well logs and in exposures.

I: HIGHEST; Thin till areas where there are many rock outcrops indicating no impedance to downward infiltration of precipitation. No such areas were delineated in the town.

V: LOWEST; Areas of relatively impermeable bedrock and areas of extensive wetlands. No areas were ranked with the lowest recharge potential.

Flow Lines; indicate general flow path from recharge to discharge areas.

VT Town Boundaries

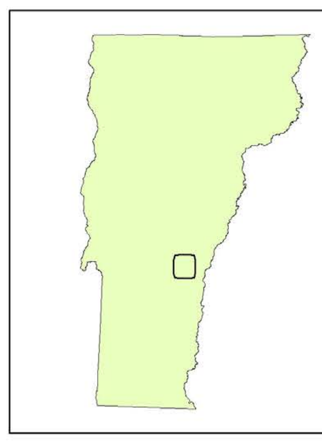
USGS 24K Quadrangle Boundaries

Explanation of Terms

Flow Lines: Flow lines indicate general flow paths from recharge to discharge areas. Flow lines were drawn based on the contoured depth to the peizometric surface in bedrock. The depth was based on static water level data contained in the well reports.

Piezometric Surface: The piezometric surface is the level to which water will rise in a borehole or well. It is a surface analogous to the water table found where wells tap an unconfined aquifer. However, the piezometric surface exists for confined aquifers – bedrock or overburden – and may rise above the top of the aquifer or above the ground surface. The water in a well will rise to a static level which is where the downward pressure of the atmosphere balances the upward pressure of the water.

Recharge Potential: Recharge potential is ranked from I being the highest to V being the lowest. The criteria are based on knowledge of the surficial geology, overburden thickness and the stratigraphy of the overburden as determined from analysis of the well logs and as shown in the cross sections. These recharge potentials are qualitative and no absolute values on rates of recharge through each of the surficial material types can be provided. This is especially true because of the heterogeneous nature of most surficial materials deposited in glacial environments.



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Date Printed: July 2007

1:24,000

0 0.5 1 Miles

0 0.5 1 Kilometers

Contour Interval 20 Feet

MN N

Magnetic declination 15.5 degrees west, 1968

RECHARGE POTENTIAL TO BEDROCK AQUIFERS, WOODSTOCK, VERMONT

By
David DeSimone

Digitization and cartography by Marjorie Gale

2006

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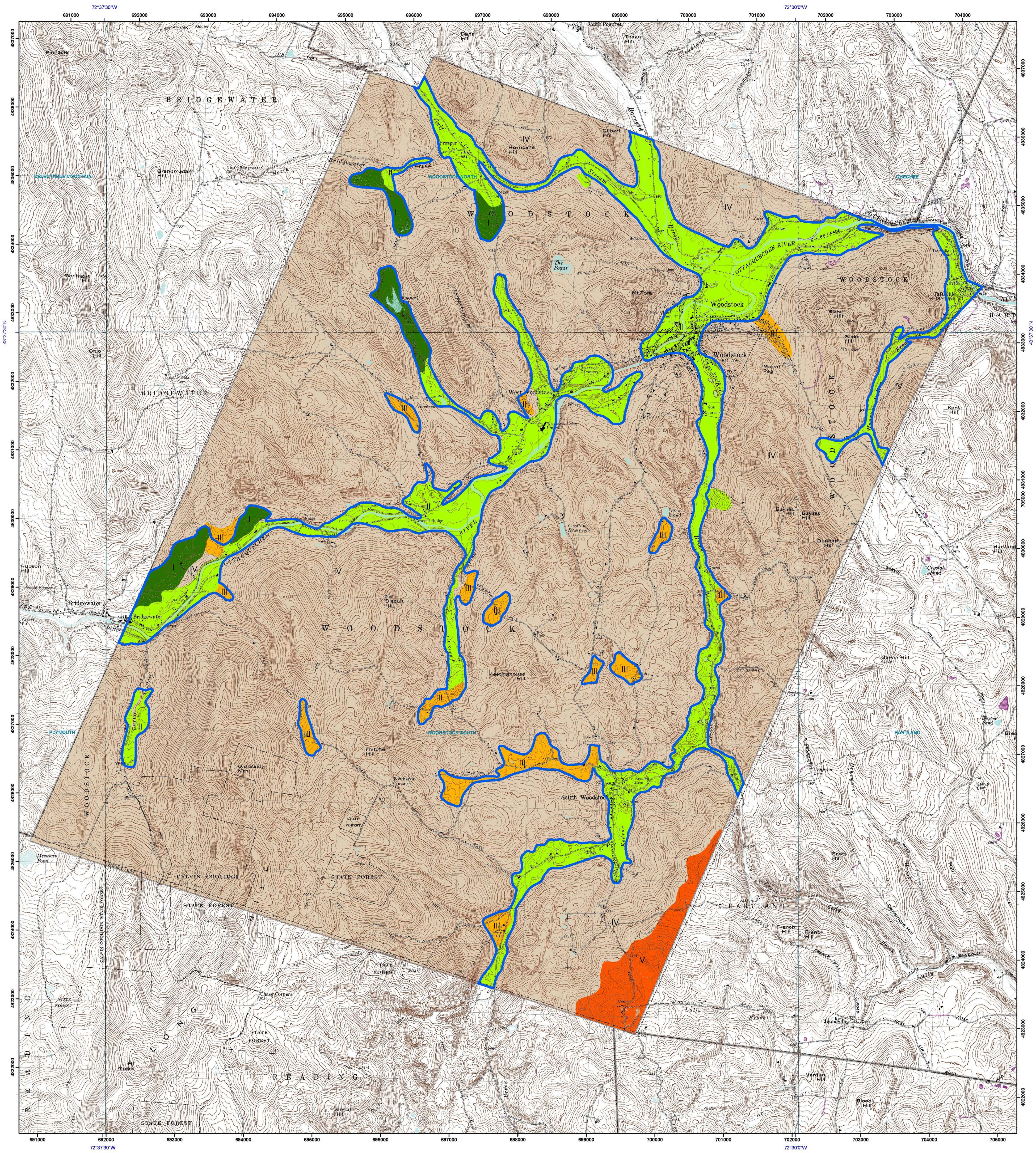

LEGEND

Recharge Potential

- **I** — HIGHEST; Thick areas of ice contact sediment, K and KT.
- **II** — HIGH; Thinner areas of ice contact sediment, K and KT; fluvial terrace sands and gravels, FT, and valley floor alluvium, AL.
- **III** — MODERATE; Areas of ground moraine, GM, isolated areas of ice contact sediment away from the valley floors, K, alluvial fan sediment, AF, and higher fluvial terrace surfaces, FT.
- **IV** — LOW; Thin till areas within aquifer catchment, TT, Thick till areas, T, and areas of muck, presumed to be aquifer discharge zones, PM.
- **V** — LOWEST; Down-gradient areas and areas of thick lacustrine silt and clay, the latter not recognized within the mapped region.

Shallow Aquifer

USGS 24K Quadrangle Boundaries

EXPLANATION

SHALLOW AQUIFER

A shallow aquifer is a volume of porous and permeable sediment, either sand or gravel or a mixture of sand and gravel, which is exposed at the ground surface. Hydrologists refer to this as an unconfined aquifer because the aquifer is not sealed, capped or confined by an impermeable layer. Shallow aquifers are recharged by direct downward infiltration of surface water from precipitation, snow melt and possibly through the bottoms of stream channels.

RECHARGE POTENTIAL

Recharge potential is ranked from I being the highest to V being the lowest. The criteria for the rankings are based on knowledge of the surficial geology, overburden thickness and the stratigraphy of the overburden as determined from analysis of the well logs.

The recharge potentials are qualitative and no absolute values on rates of recharge through each of the surficial material types can be provided, especially because of the heterogeneous nature of most surficial materials deposited in glacial environments. Areas of the thickest and most permeable sediments are assigned the highest recharge potential while thinner permeable deposits are assigned a recharge potential of II. Moderate recharge potential is assigned to the most heterogeneous permeable deposits, specially ground moraine. Low to lowest potential recharge areas are found where the sediment is relatively impermeable such as till or lacustrine clay, to areas down the hydraulic gradient from the extent of the overburden aquifer, and to presumed aquifer discharge areas represented by wetlands.

OVERBURDEN STRATIGRAPHY

Till

The thick overburden which fills the paleochannels of the major valleys is layered in a typical sequence encountered in numerous drillers' logs. Most logs along the flanks of the valleys record a thick layer of till, a mixed deposit from a glacier. Till is a comparatively impermeable sediment; although it holds much water, it is unable to transmit this water readily.

Kame

Several types of permeable sediment with landforms occur in portions of the valley. Down valley from Bridgewater, the north side of the valley has a kame terrace sediment at the surface. This is a permeable sand and gravel material that can be several tens of feet thick. The permeable sediment overlies the till.

Ground Moraine

In some tributary valleys, there is a sediment mapped as ground moraine, a variably permeable mixture of sand, gravel, silt and some bouldery areas. In some places, there may be more till than sand and gravel in the ground moraine. The thickness of the ground moraine may also be up to tens of feet. Till occurs beneath the ground moraine but bedrock may be present also.

Fluvial Terrace

The valley floors have variably permeable sediment mapped as fluvial terraces - terraces that are higher and not frequently flooded - and as alluvium - terraces that may be frequently flooded. These flat surfaces of permeable sediment are usually less than 10-20ft thick. A surface of eroded till underlies these terraces.

Conclusion

All of the permeable materials described above represent shallow aquifers in the town. Although shallow aquifers may be sources of water, they are also easily contaminated by salt, pesticides, herbicides, organic matter, petrochemicals, cleaning solvents and other soluble and insoluble sources of contamination. Fluctuations of the water table may allow these shallow aquifers to become dry during periods of maximum withdrawal and/or minimum recharge. For this reason, most drillers prefer to drill beyond the shallow aquifer to more reliably safe water sources.

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Date Printed: June 2007

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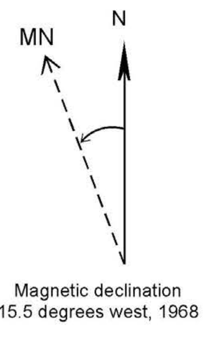

Magnetic declination
15.5 degrees west, 1968

RECHARGE POTENTIAL TO SHALLOW (UNCONFINED OVERBURDEN) AQUIFERS WOODSTOCK, VERMONT

By
David DeSimone
Digitization and Cartography by Marjorie Gale

2006

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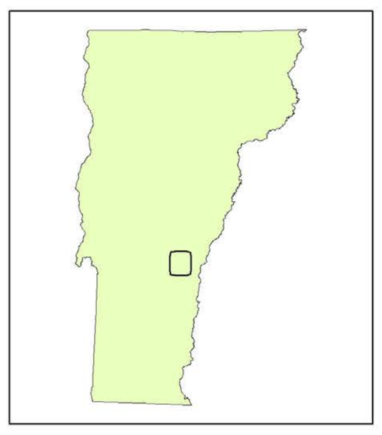

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