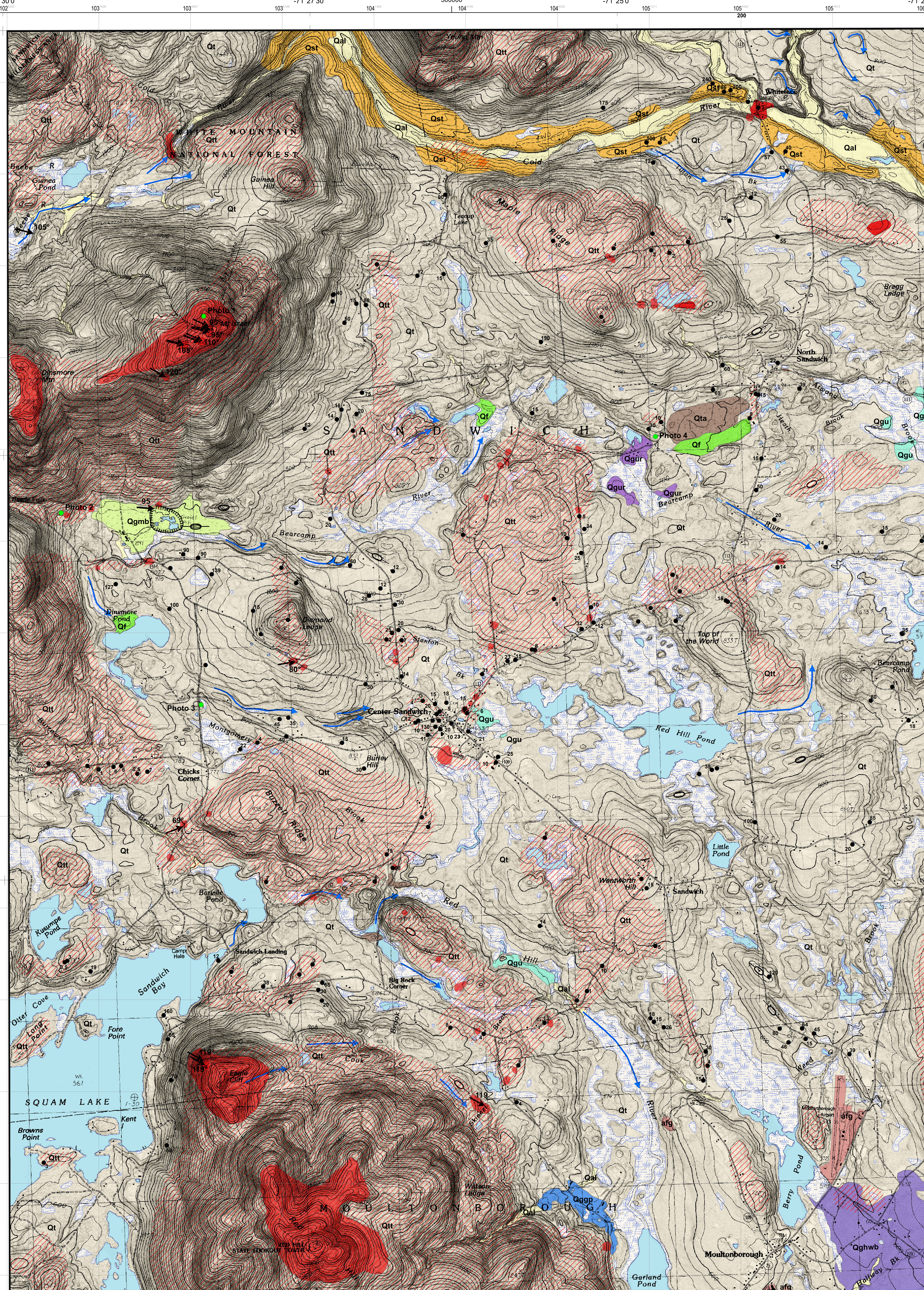
SURFICIAL GEOLOGIC MAP OPEN-FILE SERIES
GEO-086-024000-SMOF_CenterSandwich

Frederick Chormann
State Geologist

SURFICIAL GEOLOGIC MAP OF THE CENTER SANDWICH QUADRANGLE
Carroll County, New Hampshire

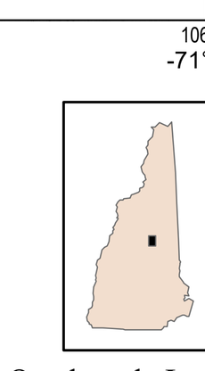


Base map (provisional) by the U.S. Geological Survey, 1987, Center Sandwich, New Hampshire. 10,000-foot grid ticks based on New Hampshire coordinate system. 1000-meter Universal Transverse Mercator grid ticks, Zone 19. Horizontal Datum: 1927

SCALE 1:24,000

Contour Interval 20 Feet

Declination 16 deg.



Quadrangle Location
GRANIT Tile No. 86

DESCRIPTION OF MAP UNITS

af — **Artificial Fill (Holocene)**

afg — **Graded or Re-worked Surfaces or Artificial Fill**

Wetland Deposits (Holocene) - Generally 5 to 10 feet thick. Muck, peat, silt, and sand.

Surface Water

Bedrock Exposure

NON-GLACIAL DEPOSITS (Pleistocene to Holocene)

Qal — **Alluvium (Holocene)** - Sand, pebbles, cobbles, and boulders in active floodplains along rivers and streams. Up to 10 feet thick.

Qst — **Stream Terrace** - Sand, pebbles, cobbles, and boulders forming early-post-glacial terraces above the present Cold River. Many are erosional surfaces in underlying till with localized fluvial deposits. Up to 10 feet thick.

Qf — **Alluvial Fan** - Sand, pebbles, cobbles, and boulders deposited by glacial meltwater and post-glacial precipitation. Up to 40 feet thick.

UNCORRELATED GLACIOFLUVIAL DEPOSITS (Pleistocene)

Qgu — **Undifferentiated Sand and Gravel Deposit** - Glaciofluvial sand and gravel deposits uncorrelated with a specific spillway or lake deposit. Likely formed during short-term glacial meltwater events near or at some distance from the glacier front. Up to 40 feet thick.

GLACIOFLUVIAL/GLACIOLACUSTRINE DEPOSITS (Pleistocene)

Lake Winnipesaukee Deposits

During the continued recession of the glacier through the region, Lake Winnipesaukee remained in contact with the ice margin and a series of glaciofluvial and glaciolacustrine deposits formed around the perimeter of the Lake. The northernmost extent of the paleo-lake surface just entered the southern portions of the quadrangle.

Qghwb — **Halfway Brook Deposit** - Clay to pebble glaciofluvial to glaciolacustrine deposit that developed both in front of the ice margin and from glaciofluvial re-working of upstream deposits. Up to 30 feet thick.

Qgwp — **Wakondah Pond Deposit** - Silty sand to pebble glaciofluvial to glaciolacustrine deposit almost completely in the Center Harbor Quadrangle to the south. Deposit developed along ice margin and stranded ice blocks. Tops of deposits graded to an elevation of approximately 560 to 580 feet. Up to 40 feet thick.

GLACIOFLUVIAL DEPOSITS (Pleistocene)

Qggp — **Garland Pond Deposit** - Silty sand to pebble glaciofluvial deposit. Deposit developed from meltwater and later meteoric water from the east flank of Red Hill. Up to 40 feet thick.

Qgur — **Upper Road Deposit** - Silty sand to pebble glaciofluvial deposit. Deposit resulted from meltwater erosion upstream within the Bearcamp River watershed. Up to 40 feet thick.

Qgmb — **Mead Base Deposit** - Silty sand to pebble/cobble glaciofluvial deposit derived from meltwater erosion upstream of Beede Falls and beyond, on the neighboring Squam Mountains Quadrangle. Meltwater may have been overflow from a temporary glacial lake likely to have formed in the Beebe River drainage. Up to 50 feet thick.

GLACIAL TILL

Qtt — **Thin Till** - Area of bedrock exposures or till deposits interpreted to be less than 10 feet thick.

Qt — **Till** - Non-sorted to poorly sorted mixture of silt, sand, pebbles, and boulders. Basal till is very compact and light to dark gray, and limited to only a few exposures.

Qta — **Ablation Till** - Non-sorted to poorly-sorted mixture of silt, sand, pebbles, and boulders. Deposited in close proximity to receding ice and may contain local ice-contact deposits of water-sorted beds; it is generally less compact and sandier than till deposited beneath the ice mass.

LEGEND FOR SEDIMENT TEXTURES

Mixed sand and gravel

Fine to Coarse Sand, Minor Silt

EXPLANATION OF MAP SYMBOLS

Meltwater channel

Gravel pit extent

Drumlin or Streamlined Hills — *Number posted is orientation of drumlin axis in degrees east of north.*

NHGS Well Data — *Depth to bedrock in feet.*

Photo 1 Location of photograph on map.

Representative Photographs of the Map Area

Photo 1: Looking north from Mt. Israel; ice-flow direction was from the left.

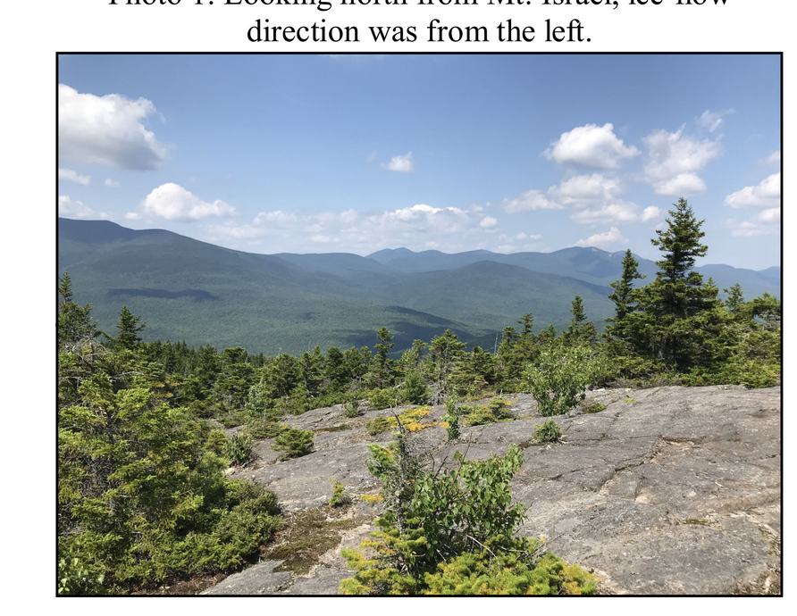
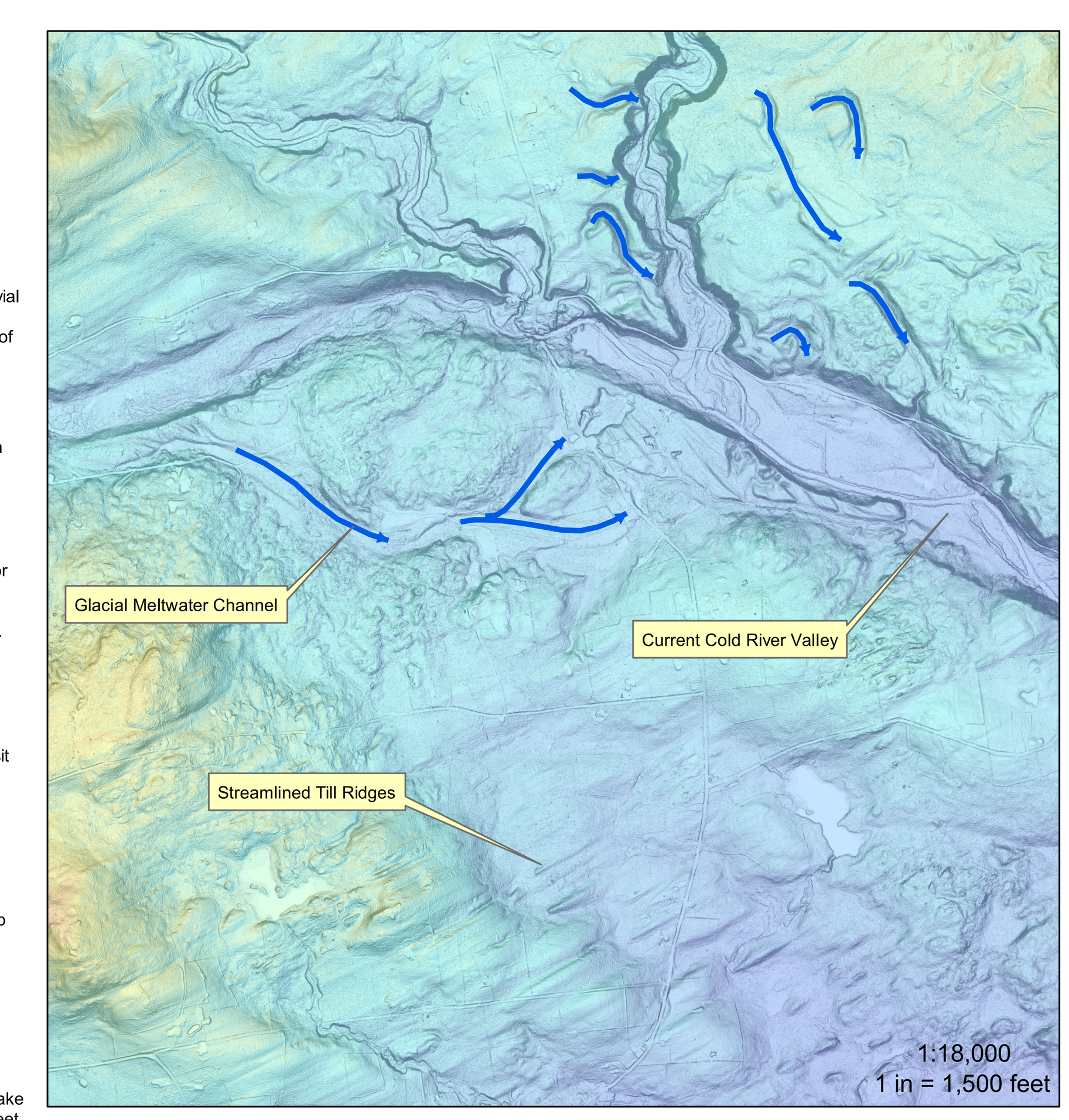


Photo 2: Cow Cave: a remnant of intense scouring within a temporary glacial meltwater channel.

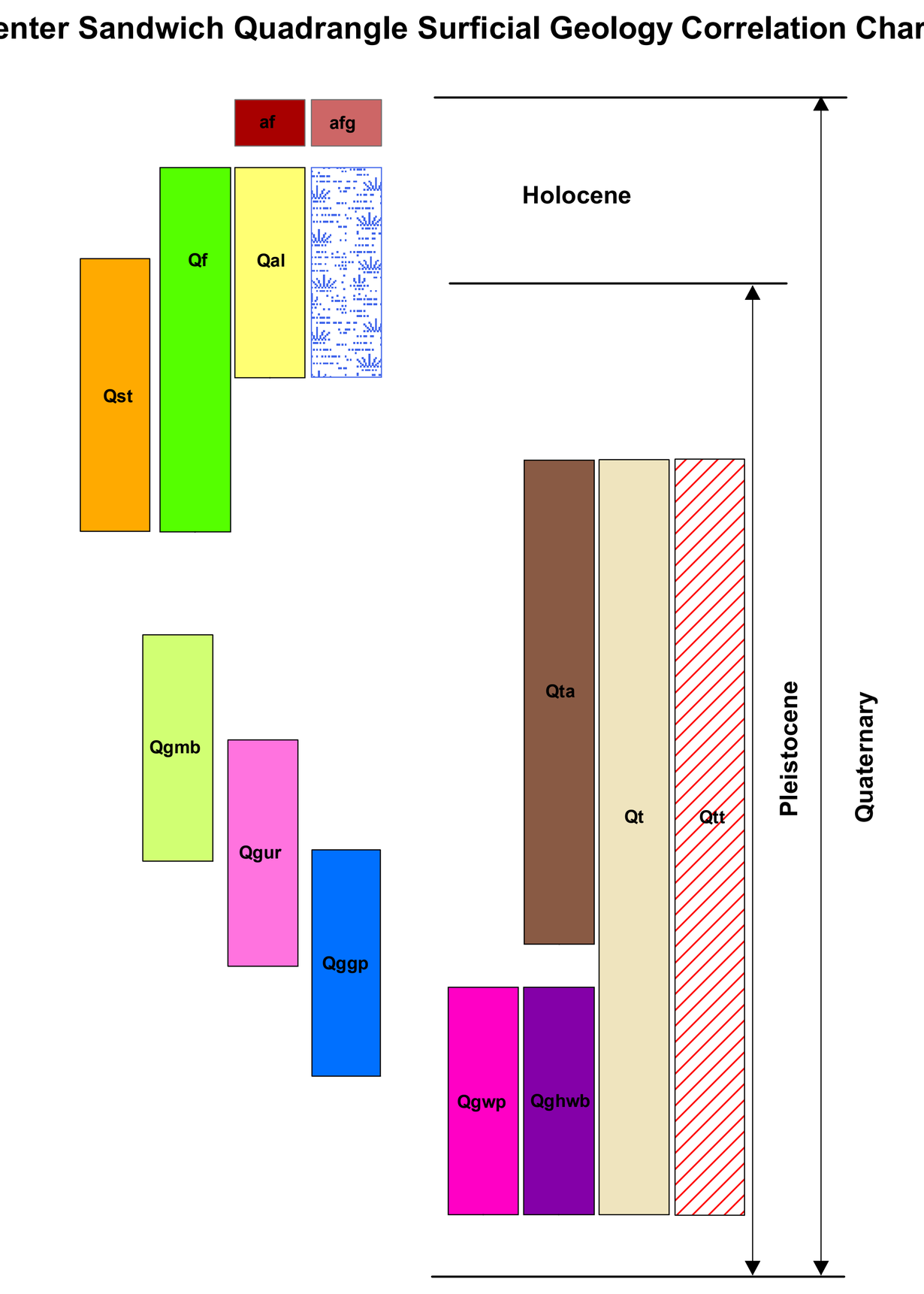
Photo 3: Poorly-sorted, sandy ablation till common in portions of the Center Sandwich Quadrangle.

Photo 4: Remnant boulders stranded following the winnowing of finer deposits by glacial meltwater.



Inset 1: Slope Map constructed using LiDAR (Light Detection and Ranging) data showing the streamlined glacial topographic features indicating ice flow direction of

Center Sandwich Quadrangle Surficial Geology Correlation Chart



Surficial Geology of the Center Sandwich Quadrangle

The surficial geologic map of the Center Sandwich, New Hampshire, 7.5-minute Quadrangle shows the lateral distribution of the unconsolidated surficial materials (e.g. alluvium, glacial till, sand and gravel) and bedrock exposed at the ground surface. The unconsolidated sediments largely reflect deposition related to the most recent period of continental glaciation (which ended approximately 14,000 years ago), post-glacial deposition within fans and along streams and rivers. The advance and retreat of the glacial ice resulted in the deposition of an assortment of surficial deposits and the formation of a variety of landforms.

As the continental glacier advanced through the area, it scoured the paleo-landscape, mobilizing vast quantities of pre-glacial sediment and bedrock fragments. These materials were entrained at the bottom of the glacier, where they were crushed and then re-deposited directly beneath the ice mass as till deposits, which are present as a thin veneer of poorly-sorted sediments over a majority of the Center Sandwich Quadrangle. Some of the till was deposited as streamlined hills/ridges, the orientation of which indicates the direction of glacial advancement through the quadrangle. The LiDAR (Light Ranging and Detection) slope map that provides the backdrop of the map, highlights these streamlined ridges, especially in the northern reaches of the quadrangle where many of the features indicate ice flow direction to the north of east, as opposed to the typical regional ice flow direction towards the southeast.

As the glacial period ended, the ice sheet began to melt and retreat through the Center Sandwich Quadrangle. During this retreat, glacial meltwater and precipitation remobilized much of the sediment that was previously entrained within the advancing glacial ice. Most of the deposits demarcated on the map were deposited by glacial meltwater (glaciofluvial deposits) away from the active ice margin. However, a number of the glacial “ice-contact” deposits appear to have been bounded by active or stagnant ice blocks. These deposits have been classified as ablation till (Qta) and were laid down proximal to or on the melting ice sheet, but with minimal sorting of material. The present day ground surface within the ablation till deposits is typically highly irregular, hilly, and hummocky.

A number of post-glacial fan deposits developed from sediments derived directly from the glaciers or from post-glacial streams which eroded into the glacial till and other deposits. The most significant erosion by glacial meltwater occurred in the Cold River Valley, which despite a relatively small watershed reflects deep erosion (over 100 feet). The meltwater that carved this valley is thought to have been largely contributed by a glacial lake in the Beebe River basin to the west of quadrangle. As the glacier receded, it formed a dam forcing meltwater from that drainage system into the Cold River watershed. Stranded stream terraces far above the present river level provide evidence of protracted erosion as the river carved its current channel.

Post-glacial fluvial processes continue today, eroding and depositing surficial deposits in the Center Sandwich quadrangle. Sediments remobilized during the erosion are deposited as alluvial deposits within numerous streams. In addition, abundant wetlands and ponds now lie in the lowlands that were once scoured by glacial meltwater.

Sources of Data:

Swamp deposits and boundaries of lakes were modified from NH GRANIT GIS database layers for the National Wetland Inventory (NWI) and surface water (NHarea), respectively. Soil distributions from the Soil Survey Geographic (SSURGO) database for New Hampshire were also referenced. Well information was obtained from the NHGS Water Well Inventory.

Thompson, W.B., 2015, Surficial Geologic Map of the Squam Mountains 7.5 Minute Quadrangle: New Hampshire Geological Survey GEO-085-024000-SMOF: Scale 1:24,000.

Brooks, J.A. and Tinkham, D.J., 2012, Surficial Geologic Map of the Center Harbor Quadrangle, Belknap and Carroll Counties, New Hampshire: New Hampshire Geological Survey GEO-098-024000-SMOF, Scale 1:24,000.

MAP PREPARATION

Surficial mapping completed by Daniel J. Tinkham, Steven Lamb, and John A. Brooks (consulting geologists at Emery & Garrett Groundwater Investigatiions, A Division of GZA) during the 2018 field season.

DRAFT

Surficial Geologic Map of the Center Sandwich Quadrangle Carroll County, New Hampshire

By Daniel J. Tinkham, Steven R. Lamb, and John A. Brooks

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Digital Compilation By: Emery & Garrett Groundwater Investigations, A Division of GZA

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