ISSUE PAPER SERIES

Tug Hill Aquifer 101 For Local Communities

August 2018

NEW YORK STATE TUG HILL COMMISSION

DULLES STATE OFFICE BUILDING · 317 WASHINGTON STREET · WATERTOWN, NY 13601 · (315) 785-2380 · WWW.TUGHILL.ORG

This paper was prepared in cooperation with the NYS Department of Environmental Conservation Great Lakes Program.

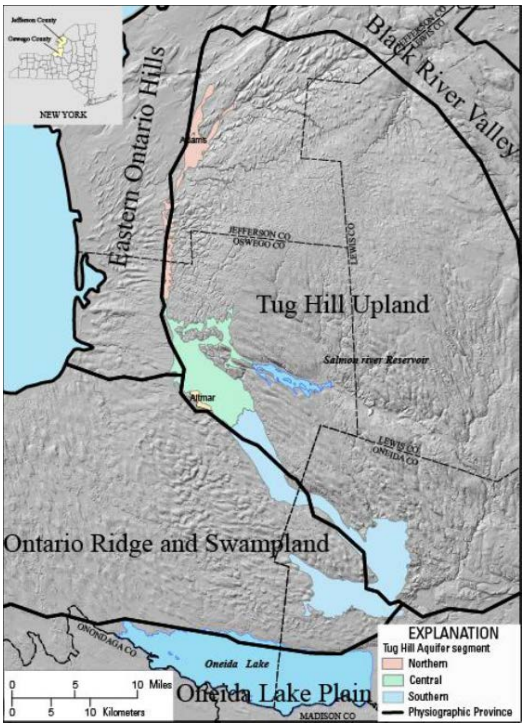
The Tug Hill Commission Technical and Issue Paper Series are designed to help local officials and citizens in the Tug Hill region and other rural parts of New York State. The Technical Paper Series provides guidance on procedures based on questions frequently received by the Commission. The Issue Paper Series provides background on key issues facing the region without taking advocacy positions. Other papers in each series are available from the Tug Hill Commission. Please call us or visit our website for more information.

Tug Hill Aquifer 101 For Local Communities

Table of Contents

What is the Tug Hill Aquifer?

The Tug Hill Aquifer has been identified as an important source of drinking water for communities along the western edge of Tug Hill Plateau since the 1980s, when it was first investigated by the U.S. Geological Survey. Recently, there has been renewed interest by local communities to understand this regional drinking-water supply and how to protect it. This paper provides an update on progress of current studies and gives guidance on how these studies can be used by local planners to manage this important resource. Ongoing research to understand and manage the aquifer resources has been supported by the NYS Tug Hill Commission, NYS Department of Environmental Conservation (NYSDEC), U.S. Geological Survey (USGS), Tug Hill Tomorrow Land Trust, Jefferson and Oswego counties, and the Salmon Rivers Council of Governments.



Historical context

In 1980 and 1981, the USGS investigated the hydrogeological character of the part of the Tug Hill aquifer that lies in Oswego County. This led to further study, and in 1988, a report on the hydrogeology and water quality of the entire Tug Hill Aquifer was published (Miller et al. 1988) which included the first map that depicted the aquifer boundary.

In the early to mid-2000s, there was renewed focus on the aquifer. In 2006, the northern section was designated by the United States Environmental Protection Agency (EPA) as a sole source aquifer, which recognized the value of the aquifer's water resources as a drinking-water supply, and required some additional level of federal review for certain projects (see the Tug Hill Commission's related issue paper http://www.tughill.org/wp-content/uploads/2011/10/DesignationOfNorthernTHAquiferAsSoleSourceAquifer2007.pdf).

Also, during this period, there was expansion of Fort Drum in the Watertown area and a growth in the agricultural industry, which created some additional development pressure in the northern portion of the aquifer. Additional stresses included a water bottling plant that was proposed in the central portion of the aquifer and significant changes which were occurring in water withdrawal at the Felix Schoeller paper company well field near Richland. There was reduced withdrawal for a period and then the company ended up selling their wells to the town of Richland to be used as a municipal well field.

In 2007, the USGS, with multiple stakeholders, entered into a program to collect more detailed data in order to better understand the aquifer resource. The program was designed in two phases:

1. Data collection phase
2. Numerical groundwater flow modeling

Based on the limited sources of funding available for this study, only the data collection phase in the northern and central parts of the aquifer were investigated in detail. Periodic updates of the investigation were presented at stakeholder meetings during the course of the project to keep communities and interested parties informed. Much of that material is available on the Tug Hill Commission website: http://www.tughill.org/projects/tug_hill_aquifer/.

The final report entitled *"Hydrogeology and Water Quality of the Northern and Central Parts of the Tug Hill Glacial Aquifer System"* is in final review stages, and is expected to be released by the end of 2018. The key findings from that report, as well as other prior reports and background information, are incorporated into this paper. Please note that all totals are estimates based on data from a 5-year period.

Who uses water from the Tug Hill Aquifer?

The aquifer supplies drinking water to numerous municipalities (Villages of Adams, Mannsville, Lacona/Sandy Creek, and Pulaski; and hamlets of Richland and Orwell) as well as rural homeowners on private wells. Slightly over 11,400 people are provided drinking water from the aquifer in the northern and central parts of the aquifer. About 3.34 million gallons per day, or about 1.2 billion gallons per year, were withdrawn annually during 2012-2017. Industries and businesses not supplied by municipal water were not accounted for in this estimate due to lack of reported data.

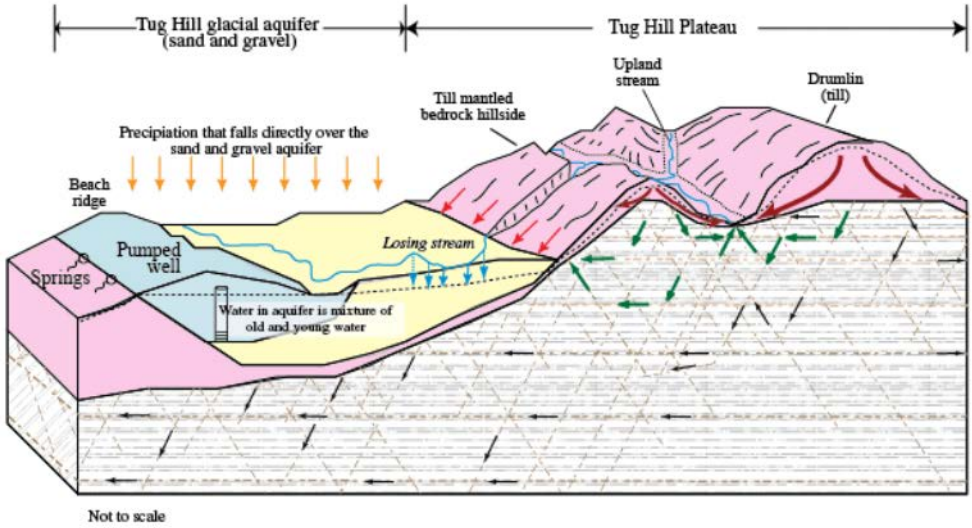
Water from the aquifer is an important source of water for agriculture (primarily dairy) and value-added production at Great Lakes Cheese. The NYSDEC Salmon River Fish Hatchery in the Town of Albion also depends on cold water from the aquifer to support its fishery operations. Groundwater that seeps into streams provides the cool baseflow to streams which is critical in sustaining the ecological environment needed for trout to thrive in the area.

Where does the aquifer water come from?

Both the northern and central parts of the Tug Hill Aquifer gain water from:

(1) Precipitation that falls directly over the aquifer;
(2) Runoff from till and bedrock hills that border the eastern side of the aquifer;

(3) Losses from streams that drain from the Tug Hill Plateau and discharge water to the aquifer generally during spring; and
(4) Ground-water inflow from the till and bedrock on the adjoining Tug Hill Upland.



Where does the aquifer water go?

Groundwater in the northern and central parts of Tug Hill Aquifer discharges to:

(1) Springs, seeps, headwaters of streams, and wetlands along the western boundary of the aquifer;
(2) Pumping wells (municipal and residential, fish hatchery, farms, and local businesses);
(3) Manmade ditches along roads and fields; and
(4) Most stream channels and wetlands over the central part of the aquifer.

Continuous water-level data collected at 6 wells for several years indicate that the water table generally fluctuates less than 15 feet seasonally. Water levels collected in many wells throughout the aquifer indicate that the water table generally slopes from east to west and the general direction of groundwater flow is also from east to west.

Continuous water-level and temperature data was recorded at specific wells. Well B-29 was in the Richland well- field.

What was studied in the most recent data collection phase?

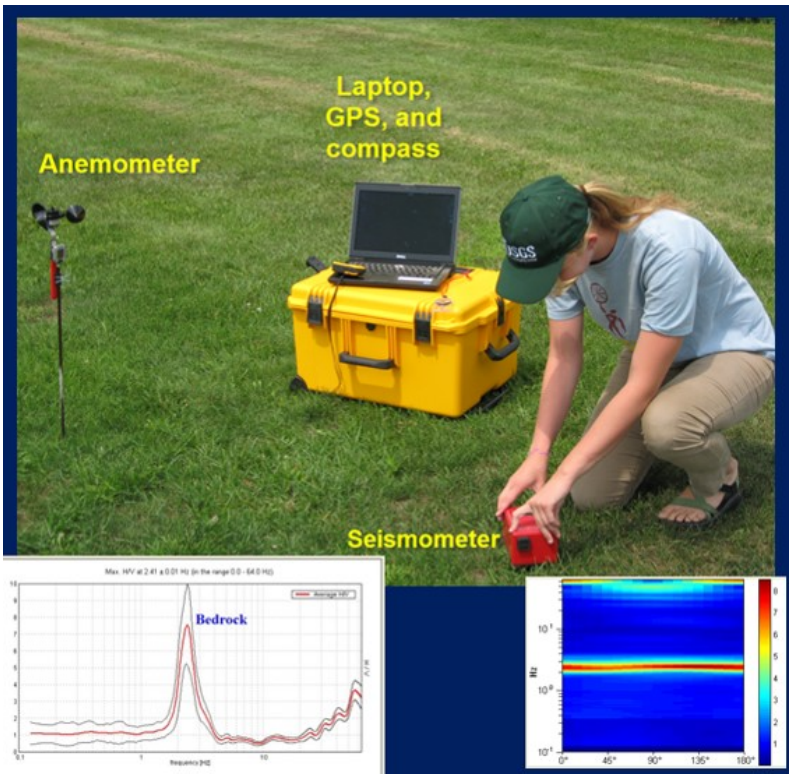
Field work for the recent detailed assessment included:

- Well site inventory of 171 wells (including two test wells drilled for this project);
- Streamflow measurements made during low-flow periods at 31 sites;
- Seismic surveys to determine depth to bedrock, which is typically the bottom of the aquifer;
- Collection and analysis of 23 surface-water samples and 24 groundwater samples; and
- Temperature data loggers installed at 6 surface-water sites

What were the findings of the most recent data collection?

In the northern portion of the aquifer:

- Unconsolidated deposits range in thickness from 4 to 136 feet, with a median thickness of 38 feet;
- The aquifer is comprised of deltaic, beach, outwash, and recent alluvial sand and gravel;
- The aquifer is under unconfined conditions, which makes it vulnerable to contamination from chemicals that are applied to land surface and can readily infiltrate to the water table);
- In the Sandy Creek Valley northeast of the Village of Adams, direction of groundwater flow is predominately to the southwest (downgradient in the valley). Elsewhere in the aquifer, the direction of groundwater flow is predominantly from east to west;
- Groundwater discharges into streams over the central parts of the aquifer and streams typically lose water to the groundwater system along the eastern margin of the aquifer;
- Withdrawals from the northern portion of the aquifer are approximately **217 million gallons per year (594,000 gallons per day)**, not counting industries and businesses that do not use municipal water. Annual withdrawals by the municipalities of Adams, Adams



Seismic surveys were conducted at over 200 sites.

Center and Mannsville is 196 million gallons with the remainder used by individual homeowners and farms; and

- Results of the two test drilled in Sandy Creek Valley indicated that extent of the aquifer in this valley extends further to the north than past studies suggested.

In the central portion of the aquifer:

- Unconsolidated deposits range in thickness from 5 to 122 feet, with a median thickness of 41.5 feet;
- Groundwater flows predominantly from east to west;
- Streams in the central part of the aquifer are recharged by the aquifer, as well as heads of streams and springs along the western boundary of the aquifer. Especially large amounts of groundwater discharges to springs and headwater streams to Spring Brook near Richland, which is the municipal source of water for the Village of Pulaski;
- Withdrawals from the central portion of the aquifer are approximately **1 billion gallons per year (1,000 million gallons per year)**, not counting industries and businesses that do not use municipal water. The municipalities of Sandy Creek, Lacona, Orwell, Pulaski and Richland account for withdrawal of about 261 million gallons per year. Homeowners withdraw approximately 42 million gallons per year. The NYSDEC Salmon River Fish Hatchery withdraws about 700 million gallons per year; and
- The surface-water drainage divide between Fish Creek Valley and Salmon River Valley is the boundary between the central and southern parts of the aquifer.

What is the water quality of the Tug Hill Aquifer?

Water quality samples were collected from surface water and groundwater in 2009 and 2013 and were analyzed by USGS for physiochemical properties, major ions, trace metals, nutrients, and dissolved gasses. Specific analyses include:

- Water temperature, pH, specific conductance
- Dissolved gasses (oxygen, chlorofluorocarbons)
- Nutrients (nitrogen, phosphorus)
- Major ions (magnesium, potassium, sodium, calcium, chloride, carbonate, sulfate, etc.)
- Trace metals (barium, borium, lithium, etc.)
- Radionuclides (tritium)

In the northern portion of the aquifer, both surface water and groundwater quality was good, with no nutrient levels exceeding drinking-water standards. Groundwater age was estimated by determining the concentrations of chlorofluorocarbon in three wells. The age of the groundwater varied from as old as from the early 1950s, to the early to mid-1970s. Tritium sampling confirmed the dating of the well with the oldest water.

In the central portion of the aquifer, both surface water and groundwater quality were found to be good. No nutrient concentrations exceeded drinking-water standards. Aging of the groundwater in this area indicated that the groundwater is from the mid to late 1970's.

In comparing the water quality between the northern and central portions of the aquifer, the median concentrations of chemical constituents in surface water and groundwater were generally greater in the northern part of the aquifer system, as compared to the central part.

Stream temperature data was collected at 8 sites.

Where do we go from here?

As summarized here, Phase I of the study included a reassessment of the aquifer boundary, water quality, geologic framework, water use, groundwater flow directions, and recharge and discharge conditions based on new hydrogeological data that was collected as part of the Phase I work, which was in the northern and central portions of the aquifer. This information will help communities and the public to understand current conditions of the aquifer. If stakeholders in the southern portion of the aquifer are interested in pursuing a similar in-depth investigation, they should reach out to USGS and the Tug Hill Commission to talk about ways to approach funding.

Phase II of the project is to develop several numerical groundwater-flow models of the aquifer system, in order to provide communities and stakeholders with a tool for decision making. Lack of funding is currently precluding work on Phase II.

Some existing statewide or national tools include the NYSERDA Climate Change Science Clearinghouse, which can help communities identify how changes in precipitation will affect the water supply, and the Natural Resource Navigator, which identifies restoration and protection needs to protect water quality. Communities can contact NYSERDA for more information on how these tools can assist them.

In addition, the USEPA Drinking Water mapper has current information on reports for State Pollutant Discharge Elimination Systems.

For More Information

EPA Sole Source Aquifer designation for Tug Hill. 2006. https://yosemite.epa.gov/opa/admpress.nsf/27166bca9a9490ee852570180055e350/d6e890c057b27a48852572270069e551!OpenDocument

Miller, T.S. et al., 1988, Hydrogeology and water quality of the Tug Hill glacial aquifer in northern New York. U.S. Geological Survey Scientific Investigations Report 88-4014. https://pubs.er.usgs.gov/publication/wri884014

Miller,T.S. et al. 2007, Hydrogeology of Two Areas of the Tug Hill Glacial Drift Aquifer in Oswego County, NY. U.S. Geological Survey Scientific Investigations Report 2007-5169. https://pubs.er.usgs.gov/publication/sir20075169

Miller, T.S. and Fisher, B.N., 2018. Hydrogeology and Water Quality of the Northern and Central Parts of the Tug Hill Glacial Aquifer System. U.S. Geological Survey Scientific Investigations Report – *In Review*.

Porter et al. 1990. Tug Hill Aquifer: A Guide for Decision-makers". Cornell Cooperative Extension. https://ecommons.cornell.edu/handle/1813/3405