Summary of Findings for the Woodstock Aquifer and Proposed Water Supply Overlay District

by

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Woodstock Aquifer Geometry

Surficial Deposits

As Figure 1 (next page) indicates, there are two distinct types of surficial deposits that comprise portions of the so-called Woodstock Aquifer. Ice-contact deposits overlie the area to the west and northwest of Bearsville. As their name implies, ice-contact deposits were laid down next to melting ice during deglaciation. Ice-contact deposits display a high degree of lateral variability in sorting, texture, and thickness. These deposits generally range in size from boulders to sand. Boulders are particularly characteristic of the local ice-contact deposits as evidenced by drilling logs. Hydraulically, ice contact deposits are highly heterogeneous. Permeabilities are highly variable due to their complex depositional setting. The saturated thickness also ranges widely. Well logs revealed that the deposits are sometimes unsaturated.

The other deposits comprising the Woodstock Aquifer are fluvial sand and gravel or outwash sand and gravel. These proglacial deposits were laid down by glacial meltwater in advance of the glacial ice margin and are comprised of coarse to fine gravel and sand. The Woodstock Water District's current water supply wells tap proglacial deposits. Laterally continuous layers of silt are sometimes present, indicating a fluctuating depositional environment. These layers of finer-grained material are evident on several of the logs and are characteristic of these proglacial deposits.

Aquifer Stratigraphy

Proglacial deposits have been known to overlie older ice-contact deposits in some settings in New York. However, no detailed subsurface data exists in the area of the Woodstock Aquifer east of Bearsville to adequately resolve the stratigraphic relationship between the ice-contact deposits and proglacial deposits. For example, a domestic well located on Marco Drive indicates an accumulation of sand and gravel to a depth not exceeding 110 feet. Similarly, the log for Well Field 1 does show sand and gravel to a depth in excess of 100 feet. However, this log also indicates a unit interpreted as glacial till at a depth of 37 to 50 feet. If this were indeed glacial till, it would form a confining or semi-confining unit that hydraulically separates the valley fill deposits.

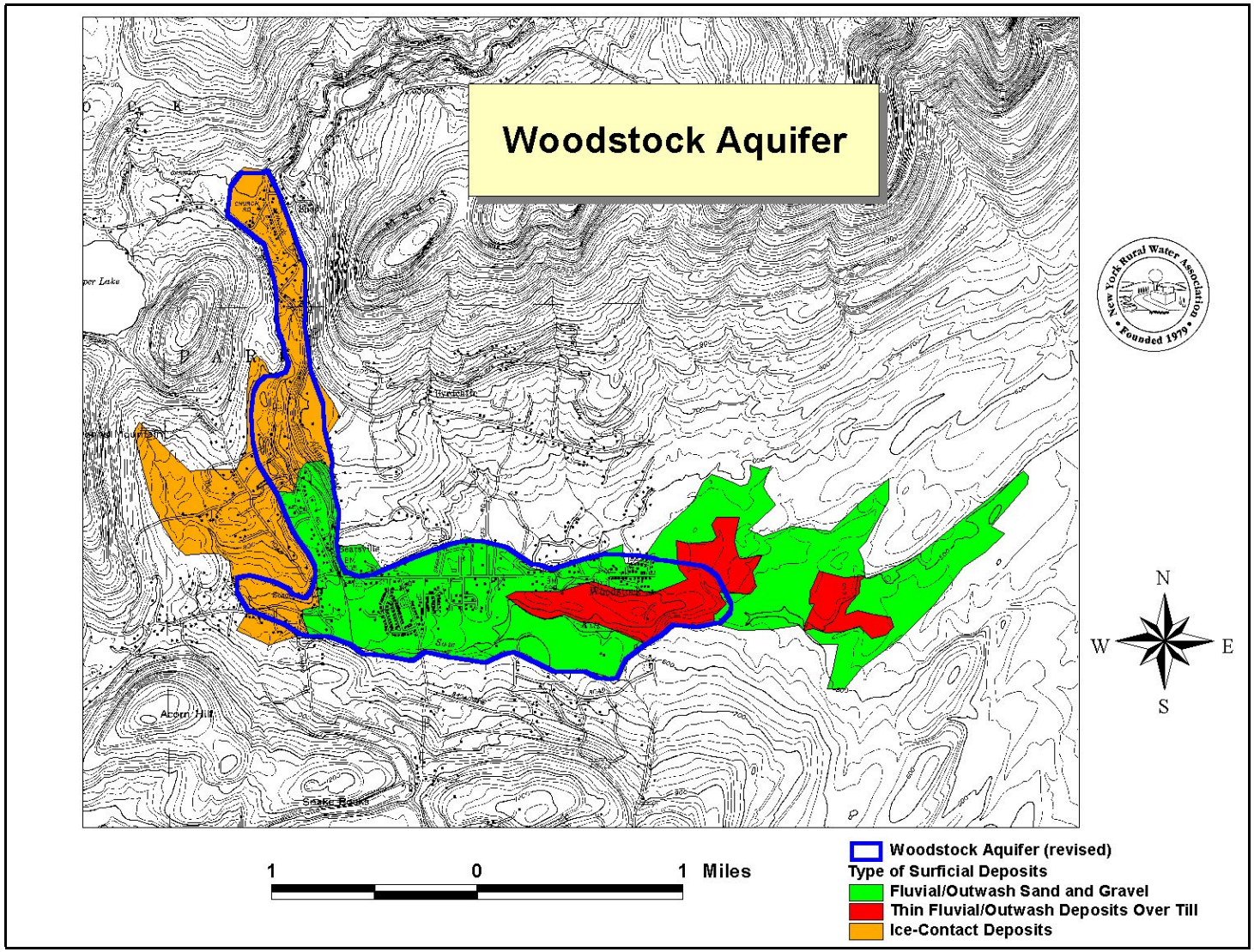

Figure 1. Woodstock Aquifer and Surficial Geology

Aquifer Lateral Boundaries

The United States Geological Survey defines an aquifer as a geologic unit that will yield water in a usable quantity to a well or spring. Obviously, the term *usable quantity* is a term that is open to much interpretation. For example, a yield of 5 gallons per minute is usable for an individual household, but would not be nearly enough for municipal needs. For the purposes of the Woodstock Water District, a usable quantity of water that would be economically significant would be much larger.

The chief factors that control potential well yield are the unconsolidated deposits' saturated thickness, texture, and degree of sorting. With this in mind, I revised the lateral boundaries of the Woodstock Aquifer as indicated in Figure 1 based upon recently available well data. The boundary of the aquifer (see the blue line in Figure 1) was drawn to include those areas where the underlying unconsolidated deposits are believed to have sufficient saturated thickness and texture to potentially produce at least 10 gallons per minute to wells.

Some upland areas of ice-contact deposits were not included in the revised Woodstock Aquifer boundaries. Well logs in these areas revealed that the surficial deposits here were largely unsaturated and/or had insufficient sorting to be a significant water producer. Not surprisingly, domestic wells in these areas rely upon bedrock for water supply purposes.

Water Supply Protection Overlay District

The purpose of the proposed Water Supply Protection Overlay District (WSPOD) (see Figure 2) is two-fold. First, the WSPOD is designed to protect those areas of the Woodstock Aquifer that are known to *directly* supply the present production wells. The second purpose is to protect those portions of the aquifer that could realistically supply a future production well for the Woodstock Water District.

Wellhead Protection Area

In 1994 the hydrogeological consulting firm of Horsley & Whitten delineated the Woodstock Water District's Wellhead Protection Area. This is the area that was thought to *directly* contribute ground water to the District's production wells (see Figure 2). It was delineated using the USEPA's WHPA computer code for wellhead protection area delineation. No other modeling of the contribution area for the Woodstock Water District wells has been subsequently completed. I used the

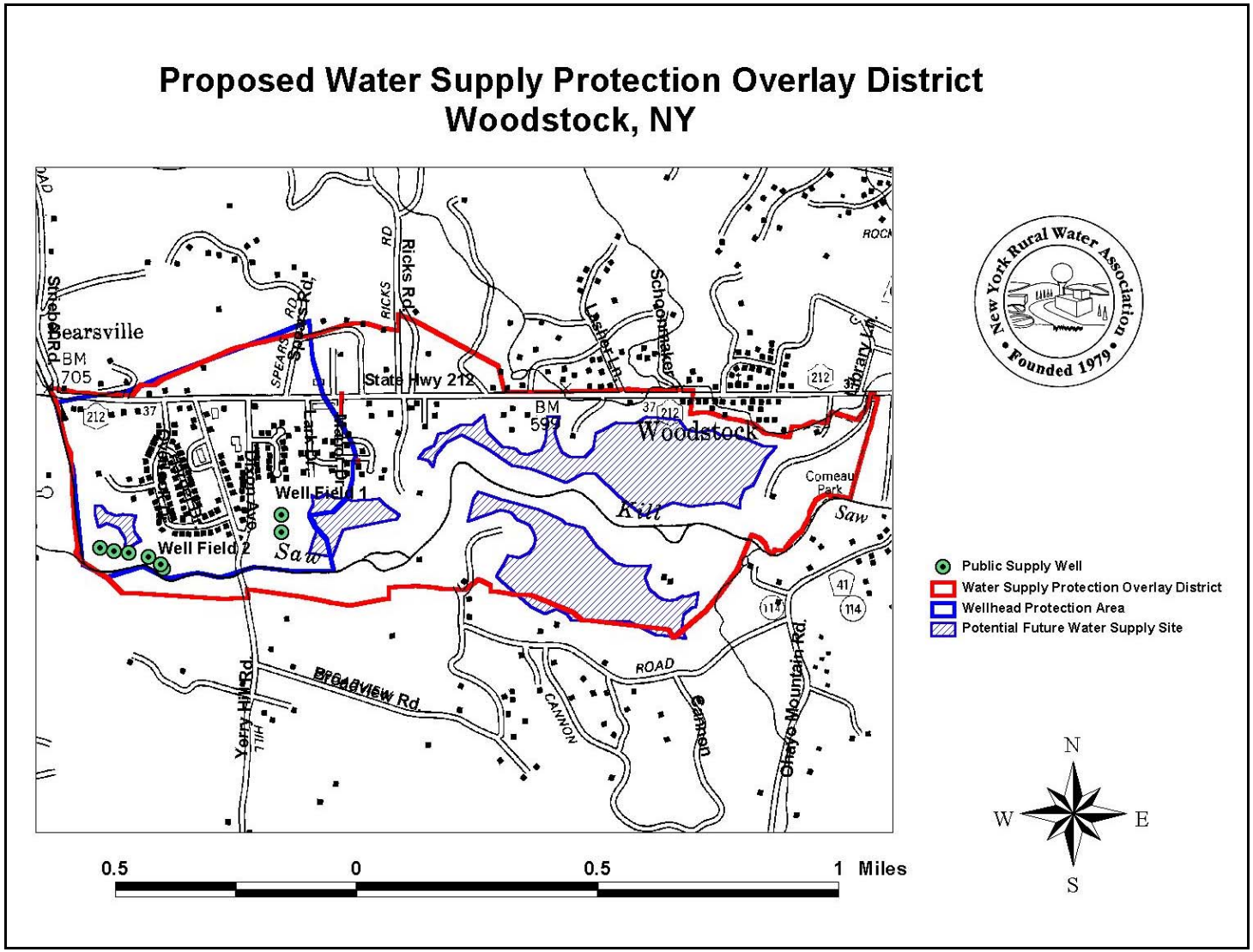

Figure 2. Water Supply Protection Overlay District

Wellhead Protection Area delineated by Horsley & Whitten as a portion of the WSPOD.

Two important assumptions were made by Horsley & Whitten as part of their WHPA model for the area. One assumption was that the saturated thickness of the aquifer was 20 feet. This was based upon the depths of the current supply wells. Should this depth be increased to in light of logs that indicate a depth of sand and gravel in excess of 100 feet? In my opinion, there is insufficient stratigraphic data to extend the saturated thickness of the aquifer beyond that of the current water supply wells. On the contrary, the USGS well log for Water District Well Field 1 indicates that the assumption made by Horsley & Whitten is appropriate.

The other assumption made by Horsley & Whitten in its WHPA model was that the Saw Kill serves as a recharge boundary. Pumping would induce recharge of stream water from the Saw Kill, into the aquifer, and toward the supply wells (particularly to Well Field 2). By establishing this positive boundary condition, Horsley & Whitten excluded ground water flow to the west of the Saw Kill in the aquifer. Does ground water in the area west of the Saw Kill flow eastward under the Saw Kill, eventually reaching Well Field 2 and Well Field 1? This condition, termed underflow, can occur in some settings. One setting where it could take place is where a distinct, deeper ground water flow system is present. Another setting is where the stream is not in hydraulic communication with the aquifer. Do these conditions exist in Woodstock? At this time, I do not feel that there is specific stratigraphic or hydrogeologic data to say yes and contradict the work of Horsley & Whitten. Rather, I believe that based upon the available data, it is reasonable to predict that the bulk of shallow ground water in the aquifer deposits to the west of the Saw Kill discharges to the Saw Kill. This water in the Saw Kill is then available for induced recharge.

The risk to the water supply wells from contaminated ground water discharge into the Saw Kill is *significantly* smaller than that from *direct* ground water flow toward the wells in the aquifer. This is because of dilution effects and relatively rapid surface water travel times. The watershed for the Saw Kill was considered early in the current protection efforts for the water supply wells. Ground water discharge and surface water runoff in this area serves as an *indirect* source of recharge water to the wells. However, local officials decided early in the planning process that the Saw Kill watershed could be adequately protected using the Town's recently enacted Wetlands and Watercourse Law.

Future Ground Water Supply Areas for the Woodstock Water District

As indicated above, the other purpose of the WSPOD was to protect areas that could realistically serve as future ground water supply areas for the Woodstock Water District. I used several variables in order to map areas that may be suitable for future ground water supply development. These included: distance from the existing water system, distance from the Saw Kill and any other streams, distance from potential contaminant sources, distance from roads, distance from houses, floodplains, parcel

size, land use, and finally hydrogeological potential. The area used in this analysis included all areas within 1,500 feet of the existing distribution system of the Woodstock Water District. This distance was thought to represent the realistic extent of new water main that the present Water District could economically afford to construct in order to tap a new source of supply. The areas shaded in blue in Figure 2 are the areas that were judged to have ground water supply potential for the present Woodstock Water District.

The outer boundaries of parcels that are within the Wellhead Protection Area or adjacent to the areas with groundwater supply development potential were used to delineate the WSPOD. The use of parcel boundaries is in order to effectively enforce a Water Supply Protection Overlay District.

Future Work

I have recommended that additional test drilling be conducted in the Woodstock Aquifer area in order to locate a ground water supply that is less dependent on the Saw Kill than Well Field 2 is. I understand that money has or will be appropriated for this purpose. Exploratory test drilling should also shed light on some of the aquifer issues that I previously mentioned.

I do not believe that it necessary or prudent to put the proposed Water Supply Protection Law on hold until more aquifer subsurface data is collected. The delineation for the proposed Water Supply Protection Overlay District is reasonable based upon available existing information. The WSPOD can be adjusted later if additional aquifer data supports it and/or a new water supply production well is installed. Protecting the community's water supply source is certainly within the planning objectives and public health interests of Woodstock and should not be delayed any further.