DRAFT

GROUND WATER PROTECTION PLAN

for the

TOWN OF ROCHESTER
ULSTER COUNTY, NEW YORK

AUGUST 2006

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EXECUTIVE SUMMARY

In order to preserve the groundwater resources of Rochester for today and the future, the New York Rural Water Association (NYRWA) has prepared a Groundwater Protection Plan in cooperation with the Town of Rochester Planning and Zoning Committee and the Town of Rochester Environmental Commission. This plan maps the groundwater resources and aquifers in Rochester, identifies potential sources of contamination, and outlines potential protection strategies.

The physiography and geology of Rochester is quite varied, and four distinct physiographic regions exist: the Shawangunk Mountains, the Rondout Creek Valley, the Hamilton Hills, and the Catskill Mountains. Each of these regions has distinct topographic and geologic controls on groundwater occurrence.

Over ninety percent of residences and businesses utilize bedrock in the Town of Rochester for their source of water supply. These bedrock wells average 294 feet deep with a mean 73 feet of casing. The median yield of bedrock wells is 7 gallons per minute (gpm), sufficient for typical household purposes. However, there are areas where documented well yields are consistently less than 5 gpm (the amount recommended for meeting household needs). These are areas of shale rich rocks such as the Esopus Shale and the Bakoven Shale. In contrast, two of the bedrock hydrostratigraphic units in Rochester, the Helderberg/Tristates Group Carbonates and the Silurian Carbonates, have median yields of 15 gpm. These units have been grouped together into what is termed the Karst Aquifer System. This aquifer underlies much of the Rondout Creek Valley region.

The Rondout Creek Valley also contains two distinct unconsolidated aquifers: a deeper confined sand and gravel aquifer and a much shallower unconfined sand and gravel aquifer. The confined sand and gravel is confined beneath 80 to 400 feet of fine-grained glaciolacustrine sediments. Yields in this confined valley aquifer range from 10 to 400 gpm, with a median yield of 20-25 gpm. Wells have also tapped much shallower unconfined sand and gravel deposits across the Rondout Valley. These deposits vary considerably in thickness, from less than 20 feet thick to as much as 80 feet deep. Yields in the unconfined sand and gravel range from 4 to 30 gpm, with a median yield of 8 gpm. Note that yields in most sand and gravel wells in Rochester have not been optimized due to the well construction methods used. Very thick accumulations of up to 300 feet of sand, gravel, and boulders exist in some locales across the Hamilton Hills and Catskills regions. In areas where these deposits are sufficiently permeable and saturated, relatively high well yields can be produced.

Although the Town of Rochester does not currently own or operate any municipal water system, there are sixteen (16) community public water systems in Town. These privately-owned systems serve year-round residents in mobile home parks, apartments, and individual developments. Some of these systems are regulated by the New York State Public Service Commission. All are regulated by the New York State Department of Health and the Ulster County Health Department. In addition to the community water systems, the Rondout Valley Middle School and the Rondout Valley High School operate public water systems for these campuses. There are also over 25 other smaller public water systems such as restaurants, motels, resorts, summer camps, and convenience stores. It is important to recognize that public water systems do exist in Rochester. The impacts on these water systems should be carefully considered when the Planning Board approves new uses and activities, as well as new subdivisions.

Most of the ground water in Rochester is ultimately replenished through infiltration of rainfall or snow melt. NYRWA has calculated rates of shallow groundwater recharge in Rochester. Rates of annual groundwater recharge range vary from as much as approximately 20 inches per year in some coarse sand and gravel deposits in mountainous regions to as little as 6 inches per year in areas of poorly permeable clayey sediments in the Rondout Creek Valley. Consideration of the rate of groundwater recharge is important to ensure that there are adequate lot areas to supply individual water well supplies as well as to safely dilute the effluent from septic systems. Using groundwater recharge rates, NYRWA calculated recommended minimum lot sizes for undeveloped areas in Rochester that range from 2 to 5 acres. These lot sizes are considerably larger than minimum lot sizes currently specified by the Town's zoning. Changes in the Town zoning for minimum lot size are thus recommended.

NYRWA has suggested several other specific changes to Rochester's current subdivision and zoning laws in order to safeguard groundwater supplies. In the subdivision regulations, NYRWA believes that the location, yield, and quality of wells should be considered by the Planning Board prior to approval of a new subdivision. In addition, relatively large subdivisions as well as other subdivisions in low well yield areas should have a hydrogeological report completed prior to approval. Detailed requirements for such a study are presented. One of the criteria for approval of a larger subdivision should be that the subdivision avoids adverse impacts to existing groundwater users and/or surface waters. Elements related to water use, potential contaminant sources, etc. should be included as part of submittal of a site plan.

Site plan review and a hydrogeological study are recommended for any development project that has relatively large on-site groundwater withdrawals and/or on-site sewage disposal flows. In addition, it is proposed that site plan review should be conducted for any multi-family residential project, as well as many higher-risk commercial or industrial projects within the proposed Aquifer Protection Overlay District. The proposed Aquifer Protection Overlay District is the land area of the Town of Rochester that overlies either the Rondout Valley Unconsolidated Aquifer System or the Karst Aquifer System. A proposed overlay zoning district is presented that prohibits certain high risk land uses, revises lot coverage restrictions based upon impervious surfaces, triggers more site plan review, and specifies approval criteria.

Based upon a Town-wide analysis of current lot size, potential sources of contamination, and groundwater recharge rates, three areas in and around Accord have been identified as possibly in need of community water and/or wastewater systems. These areas have more numerous potential sources of contamination, smaller lot sizes, and limited groundwater recharge rates. Such areas are thought to be more prone to water quality and quantity problems. The highest priority area should be the actual hamlet of Accord, where nearly one-half of all lots are less than one acre in size. It is recommended that the Town survey residents in this area to determine if there are water/wastewater issues. A well testing program and/or sanitary survey of the area may also be in order.

1.0 INTRODUCTION

1.1 Goals and Objectives

Ground water is a valuable resource for the Town of Rochester, with a number of privately-owned public water systems as well as individual households and businesses relying upon wells for their source of supply. In addition, ground water contributes a significant portion of water to local streams, wetlands, and ponds. Unfortunately, groundwater contamination can and does occur as a consequence of a variety of land use activities. In addition, ground water can become depleted if withdrawal rates exceed natural replenishment rates.

The Town of Rochester, like many communities in Ulster County, is concerned about residential and commercial development pressures. In order to preserve the groundwater resources of Rochester for today and the future, the following Groundwater Protection Plan for the Town of Rochester area has been prepared by the New York Rural Water Association (NYRWA). This plan maps the groundwater resources and aquifers in Rochester, identifies potential sources of contamination, and outlines potential protection strategies.

1.2 Scope and Methods

New York Rural Water Association has utilized a variety of published and unpublished data sources for this plan. All data were inputted into a Geographical Information System (GIS). This is a computer system that allows one to visualize, manipulate, analyze, and display geographic (spatial) data.

Well data was collected from the United States Geological Survey (Frimper, 1972), the New York State Department of Environmental Conservation, Coates et al. (1994), and Ulster County Information Services. In all, data for over 500 water wells was collected. Water well data is plotted on the figure entitled “Bedrock Well Yields”. Geologic maps from Frimpter (1970), Coates et al (1994), and the New York Geological Survey were reviewed and digitally scanned. Similarly, paper soils maps from the Ulster County Soil Survey (Tornes, 1979) were utilized. Elevation data were taken from digital elevation models (DEMs). This information was then used to derive hillshading and slopes. Land use information was taken from parcel mapping from Ulster County Information Services. Other digital data including surface waters, roads, regulated facilities, aerial photography, etc. were downloaded from the New York State GIS Clearinghouse and the Cornell University Geospatial Information Repository.

New York Rural Water Association also conducted on-site activities in Rochester to document the location of some geologic features, public water supply wells, potential contaminant sources, etc. A global positioning system (GPS) device was used to capture the geospatial coordinates of such features. New York Rural Water Association also conducted geologic reconnaissance in selected areas to confirm surficial and bedrock mapping.

2.0 HYDROGEOLOGIC SETTING

2.1 Physiography

NYRWA has subdivided the Town of Rochester into four distinct **physiographic regions** (see Figure 1). Each of these regions has distinct topographic and geologic controls on groundwater occurrence.

The Shawangunk Mountains occupy the southeastern portion of the Town of Rochester. The Shawangunks are actually a ridge of mountains extending northeast from New Jersey to nearby Rosendale. They are largely underlain by the resistant Shawangunk Formation that is composed of interbedded **conglomerate** and **sandstone**. Elevations climb southeastward from around 300 feet above sea-level near Rondout Creek to over 2,100 feet above sea-level along the southern Town boundary. Most of the region has slopes in excess of 8 percent. Steep cliffs in excess of 35 percent can be found in many places. The Shawangunk Mountains in Rochester are drained by four northeast flowing streams: the Stony Kill, Sanders Kill, Peters Kill, and the Coxing Kill. Each of these streams flow in a valley that formed in a structural geologic feature known as a **syncline** (Coates et al., 1994).

Northwest of the Shawangunk Mountains lies the Rondout Creek Valley. Elevations in the Rondout Creek Valley range from 200 feet above sea-level along Rondout Creek near the Town of Marbletown line to 500 feet along the boundary with the Hamilton Hills. Slopes in this low-lying area are generally below 3 percent. The Rondout Valley is underlain largely by Devonian **limestone** and **shale** bedrock. The region also contains a considerable thickness of **unconsolidated** sediments deposited largely during the **deglaciation** period.

Bordering the Rondout Valley to the north are the Hamilton Hills. This is an area underlain by sandstones and shales of the Hamilton Group. This region was termed by Dineen (1987). More resistant sandstones of the lower Hamilton Group form a series of low hills with adjacent valleys underlain by weaker shales and siltstones. The local relief between the ridge and valleys in this region is typically on the order of 100 to 300 feet. Overall, elevations in the region increase northward toward from as low as 500 feet above sea-level to as much as 1,200 feet above sea-level. The Hamilton Hills region has variable slopes ranging from less than 3 percent to over 25 percent. Glacial erosion likely caused the characteristic streamlined shapes of the hills and ridges in the region.

North of the Hamilton Hills are the Catskill Mountains. The boundary between the Hamilton Hills and the Catskill Mountains is a steep slope known as the Catskill front. The Catskill front is not as prominent in the Town of Rochester as other areas to the northeast. Elevations in the Catskills in Rochester range from 1,100 feet above sea-level to as much as 2,600 feet above sea-level along the northern Town boundary. The Catskill Mountains are underlain by relatively flat-lying sedimentary rock formations. In Rochester, these bedrock formations include reddish sandstones with interbedded shale beds. Slopes are variable in the Catskills, ranging from less than 3 percent in large intermountain wetland areas to over 35 percent in rugged mountainous terrain.

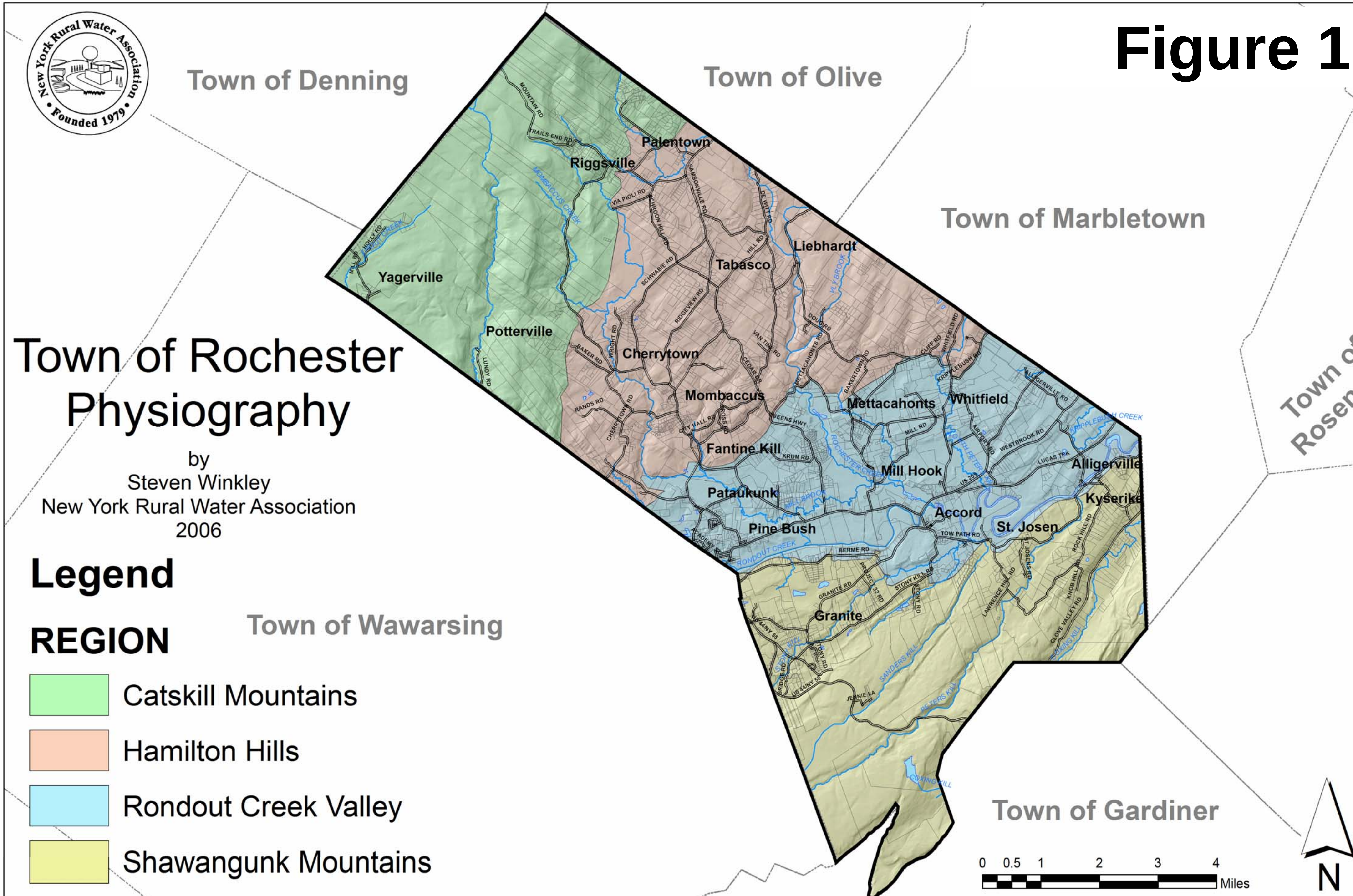


Figure 1
Town of Rochester
Physiography
by
Steven Winkley
New York Rural Water Association
2006
Legend
REGION
Catskill Mountains
Hamilton Hills
Rondout Creek Valley
Shawangunk Mountains
New York Rural Water Association
Founded 1979
Town of Denning
Town of Olive
Town of Marbletown
Town of Wawarsing
Town of Gardiner
Palentown
Riggsville
Liebhardt
Tabasco
Yagerville
Potterville
Cherrytown
Mombaccus
Mettacahonts
Whitfield
Fantine Kill
Mill Hook
Alligerville
Pataukunk
Accord
Kyserike
Pine Bush
St. Josen
Granite
0 0.5 1 2 3 4
Miles
N

2.2 Bedrock Hydrogeology

Approximate ninety percent of residences and businesses utilize bedrock in the Town of Rochester for their source of supply. These bedrock wells average 294 feet deep with 73 feet of casing. The median well yield in Rochester is 7 gallons per minute. Yields are summarized in Table 1. As development has increased recently in the Town, so has the amount of water well drilling.

In bedrock, steel casing is set through the overburden and into the first few feet of sound rock. The remainder of the well is left as an open borehole in the rock. There are three types of well drilling methods used in Town. These are cable tool, rotary, and air hammer. Cable tool, the oldest and least popular drilling method in Town, involves repeatedly lifting and dripping a heavy string of drilling tools into the borehole. The crushed rock or loosened sediment is then removed by a sand pump or bailer. In contrast, the rotary method is much faster. Rotary drilling involves rotating a bit and removing the cuttings by circulation of air and/or a drilling fluid. The air hammer method, the most common method in Town, is a specific type of rotary drilling where a pneumatic drill or "hammer" strikes the rock as the drill pipe is rotated.

The bedrock underlying the study area consists of Silurian to Devonian age rocks. New York Rural Water Association has grouped these various bedrock formations into seven hydrostratigraphic units (see Figure 2 and Table 1). Each of these hydrostratigraphic units is a mappable body of rock that is hydraulically connected or grouped together on the basis of similar hydrologic properties such as hydraulic conductivity, porosity, and well yields. In general, each hydrostratigraphic unit acts as a reasonably distinct hydrologic system. The hydrostratigraphic units have been mapped on Figure 2.

Two of the hydrostratigraphic units have been termed as an aquifer. An **aquifer** is defined in this plan as a body of rock (or unconsolidated deposits) that yields economically significant quantities of water to wells. An economically significant quantity of water is generally viewed as sufficient of water for public water supply purposes and is taken to be a median domestic well yield of 10 gallons per minute (gpm).

The Helderberg/Tristates Group Carbonates and the Silurian Carbonates both are considered to be bedrock aquifers on the basis of existing and potential yields. For example, the median well yield in both units is 15 gpm. Collectively, these formations are included in what is referred to as the **Karst** Aquifer System. The areal extent of the Karst Aquifer System is depicted on the figure entitled "Bedrock Hydrogeology".

Highest rates of groundwater **recharge** to the Karst Aquifer System occur in the areas indicated on the figure entitled "Bedrock Hydrogeology". The Karst Aquifer Recharge Area consists of areas where the carbonate bedrock is at or near the land surface and/or where permeable sand and gravel deposits exist over the aquifer. Both of these conditions preferentially allow infiltration to reach the bedrock.

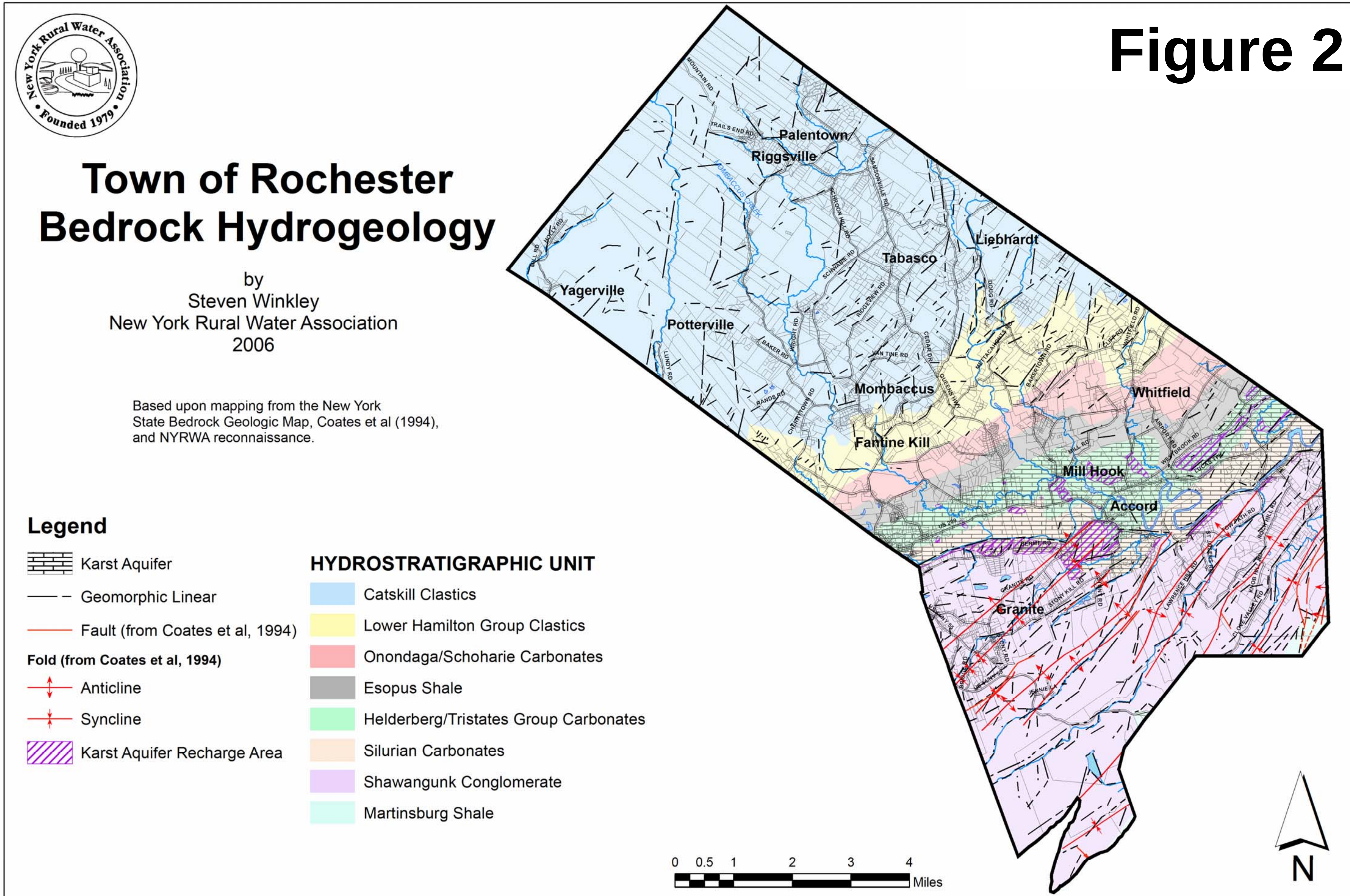


Figure 2
New York Rural Water Association
Founded 1979
Town of Rochester
Bedrock Hydrogeology
by
Steven Winkley
New York Rural Water Association
2006
Based upon mapping from the New York State Bedrock Geologic Map, Coates et al (1994), and NYRWA reconnaissance.
Legend
Karst Aquifer
Geomorphic Linear
Fault (from Coates et al, 1994)
Fold (from Coates et al, 1994)
Anticline
Syncline
Karst Aquifer Recharge Area
HYDROSTRATIGRAPHIC UNIT
Catskill Clastics
Lower Hamilton Group Clastics
Onondaga/Schoharie Carbonates
Esopus Shale
Helderberg/Tristates Group Carbonates
Silurian Carbonates
Shawangunk Conglomerate
Martinsburg Shale
Palentown
Riggsville
Liebhardt
Tabasco
Yagerville
Potterville
Mombaccus
Whitfield
Fantine Kill
Mill Hook
Accord
Granite
0 0.5 1 2 3 4
Miles
N

Hydrostratigraphic Unit	Geologic Formations	Rock Type(s)	Estimated Thickness (feet)	No. of Wells	Average Yield (gpm)	Median Yield (gpm)	Range (gpm)
Catskill Clastics	Lower Walton Formation Oneonta Formation Moscow Formation (Potter Hollow and Manorkill Fm.) Plattekill Formation	Red to gray shale and sandstone Red to gray shale, siltstone, and sandstone Red to gray shale, siltstone, and sandstone Red to gray shale, siltstone, and sandstone	1,000 - 3,000	167	11.3	7	1 - 100
Lower Hamilton Group Clastics	Ashokan Formation Mount Marion Formation Bakoven Shale	Dark gray sandstone Dark gray shale and sandstone Black shale	200 - 1,300	73	8.2	6	1 - 80
Onondaga/Schoharie Carbonates	Onondaga Limestone Schoharie Formation	Limestone Clayey limestone	165 - 400	32	14.8	8.5	2 - 86
Esopus Shale	Esopus Shale	Dark to black siltstone and silty shale	~ 200 - 600 (?)	33	6.0	5	1 - 40
Helderberg/Tristates Group Carbonates	Glenerie Limestone Connelly Formation Port Ewen Limestone Alsen Limestone Becraft Limestone New Scotland Formation Kalkberg Limestone Coeymans Limestone Manlius Limestone	Cherty limestone Conglomeratic sandstone Clayey limestone Clayey limestone Fossiliferous limestone Clayey limestone Cherty limestone Limestone Limestone	~50 - 500	48	16.2	15	2 - 40
Silurian Carbonates	Rondout Formation Binnewater Sandstone High Falls Shale	Limestone Sandstone with dolomitic shale and clayey dolostone Red to green shale with limestone or dolostone	~ 50 - 165	31	21.1	15	3 - 100
Shawangunk Conglomerate	Shawangunk Conglomerate	Quartz pebble conglomerate	up to 300	104	13.8	8	1 - 50

Table 1. Bedrock Hydrostratigraphic Units.

Overlying the Karst Aquifer System is a regional confining unit known as the Esopus Shale. Groundwater flow is much more limited in the relatively poorly-permeable shale. Not surprisingly, well yields in the Esopus Shale are significantly lower than any other unit (Table 1). The median yield from 33 domestic wells in the Esopus Shale is just 5 gpm. There are many wells where just 1 or 2 gpm can be produced from this unit (see Figure 3).

Other bedrock units in Rochester generally produce adequate amounts of water for domestic purposes. Nevertheless, there are areas where documented well yields are consistently less than 5 gpm (see Figure 3). These areas, termed Low Well Yield Areas are chiefly where shale rich rocks such as the Esopus Shale and the Bakoven Shale of the Lower Hamilton Group Clastics exist.

Well yields in excess of 10 gpm can sometimes be found if underlying fracture zones are intersected. Such zones often coincide with topographic linear features (see figure entitled "Bedrock Well Yields"). In an area of high relief, such as in the Shawangunks, wells intersecting such fracture zones often flow in response to steeper topographic gradients.

2.3 Unconsolidated Deposits

2.3.1 Surficial Geology

Surficial deposits are geologic materials that are found at the land surface. Most of these are **unconsolidated deposits** that formed as a result of continental glaciation, **deglaciation**, and post-glacial deposition. A map of surficial deposits has been completed by NYRWA (see Figure 4). This map was derived from examination of Tornes (1979), water well data, site reconnaissance, and the topographic expression of the various deposits.

Glacial **till** is the oldest glacial sediment, and was deposited directly from glacial ice. Till is an unsorted dense mixture of clay, silt, sand, gravel, and boulders. Relatively thin till deposits (less than 5 feet thick) cover much of the upland areas of Rochester. In these areas, bedrock frequently outcrops at the land surface. Glacial till has relatively low permeability and does not typically produce significant water well yields. Some large-diameter dug wells are sometimes constructed in thicker till deposits. However, these wells typically fail during dry periods and are prone to contamination from surface water runoff.

Glaciofluvial deposits typically consist of sorted and stratified sand and gravel that was deposited from glacial meltwater streams during the deglaciation period. Glaciofluvial deposits comprise the highest yielding aquifers in the region. In Rochester, these glaciofluvial deposits take two forms. One is as **ice-contact deposits**. These are deposits of sand, gravel, and boulders that were deposited adjacent to melting ice. Very thick accumulations of ice-contact deposits were laid down in upland valleys such as that of Rochester Creek, Mettacahonts Creek, Vly Brook, Mombaccus Creek, and Sapbush Creek. This occurred as glacial ice apparently stagnated in the area just beyond the Catskill Mountains. A specific type of ice-contact deposit, known as a kame terrace, appears to have formed between the Rondout Valley wall and the ice. This feature has a fairly flat top in

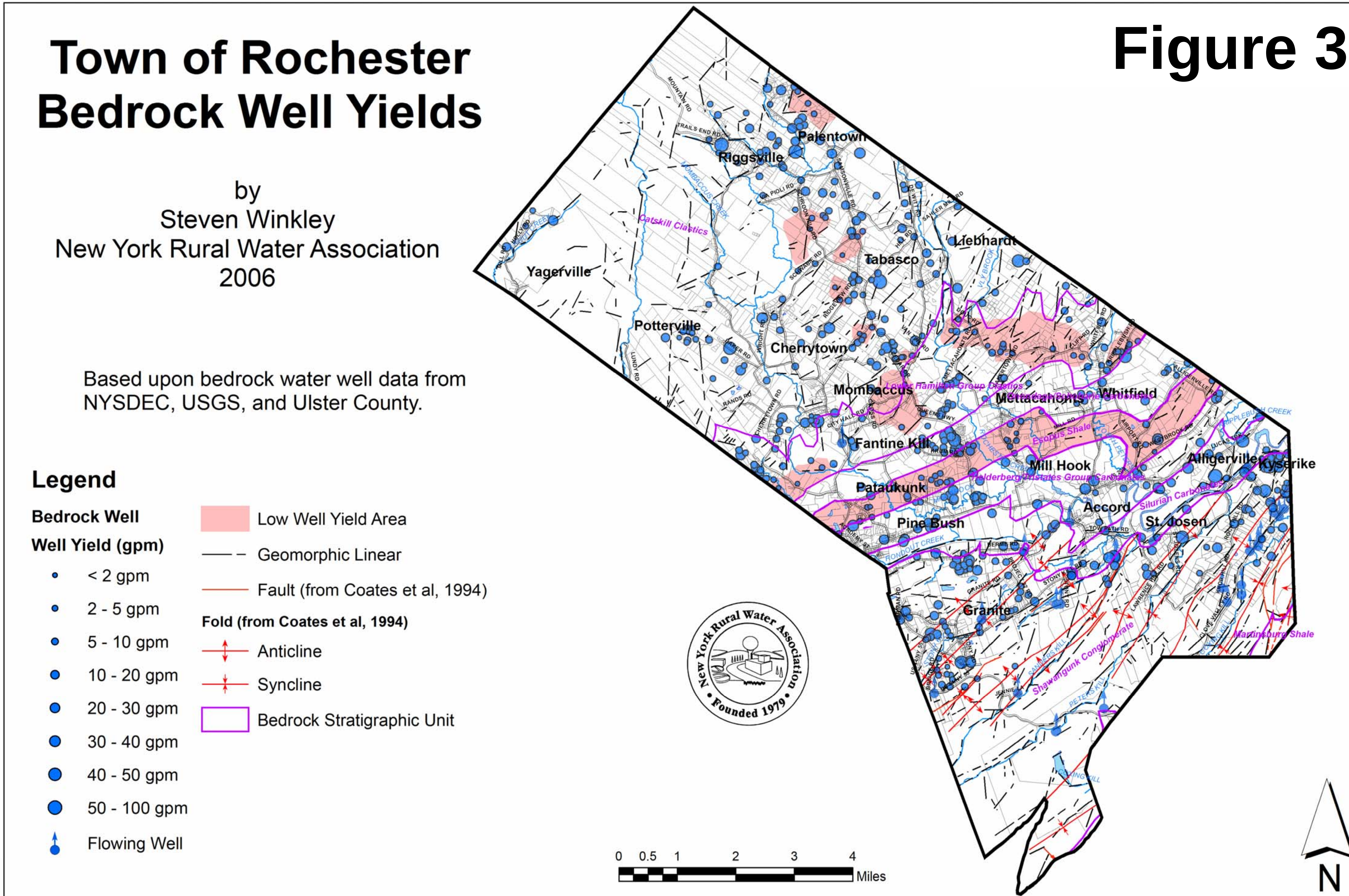


Figure 3
Town of Rochester
Bedrock Well Yields
by
Steven Winkley
New York Rural Water Association
2006
Based upon bedrock water well data from NYSDEC, USGS, and Ulster County.
Legend
Bedrock Well
Well Yield (gpm)
< 2 gpm
2 - 5 gpm
5 - 10 gpm
10 - 20 gpm
20 - 30 gpm
30 - 40 gpm
40 - 50 gpm
50 - 100 gpm
Flowing Well
Low Well Yield Area
Geomorphic Linear
Fault (from Coates et al, 1994)
Fold (from Coates et al, 1994)
Anticline
Syncline
Bedrock Stratigraphic Unit
New York Rural Water Association
Founded 1979
Palentown
Riggsville
Liebhardt
Tabasco
Yagerville
Potterville
Cherrytown
Mombaccus
Mettacahonts
Whitfield
Fantine Kill
Mill Hook
Alligerville
Kyserike
Pataukunk
Accord
Pine Bush
St. Josen
Granite
Catskill Clastics
Esopus Shale
Shawangunk Conglomerate
Martinsburg Shale
0 0.5 1 2 3 4
Miles
N

Town of Rochester Surficial Geology

Figure 4

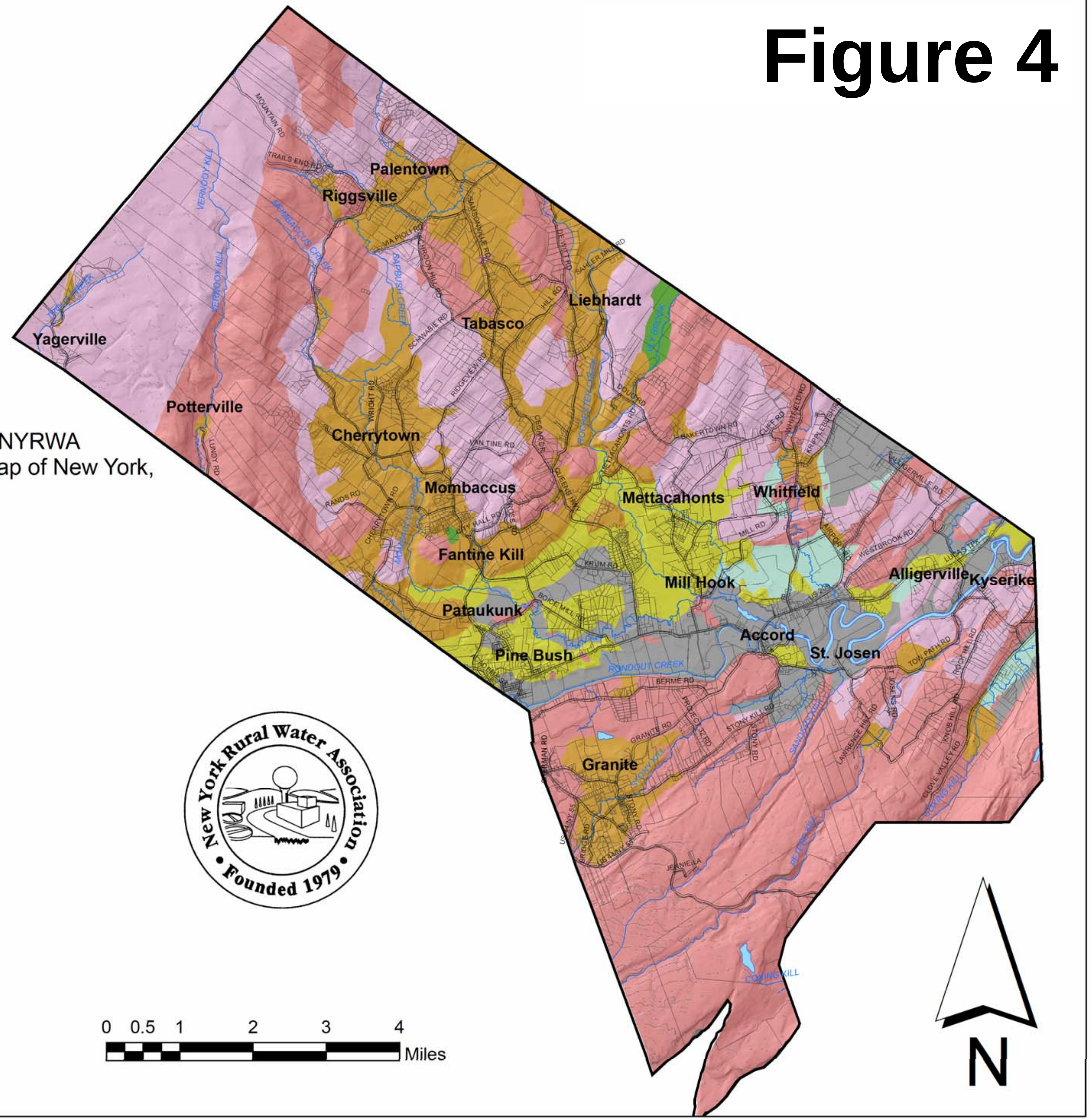
by
Steven Winkley
New York Rural Water Association
2006

This map displays the geologic materials found at or near the land surface. Surficial geologic mapping based upon NYRWA reconnaissance, water well data, the Surficial Geologic Map of New York, and the 1979 Ulster County Soil Survey.

Legend

Surficial Geologic Material

- Swamp Deposits
- Glaciolacustrine Silt and Clay
- Glaciolacustrine Silt and Sand
- Outwash Deposits
- Ice-Contact Deposits
- Glacial Till
- Shallow Rock



many places as well as a steep southern-facing ice-contact slope. It occurs at an elevation of approximately 600 feet against valley wall.

The other type of glaciofluvial deposit are better sorted sand and gravel deposits laid down by glacial meltwater streams that flowed further to the south in advance of the ice. Sometimes these deposits formed deltas where such streams entered a quieter body of water. In this case, the water body was a glacial lake that occupied the Rondout Valley. A large glacial delta is apparent in the area extending from Mettacahonts to Mill Hook. The sand and gravel deposits were overlapped in some places by **glaciolacustrine** silt and clay and/or glaciolacustrine silt and sand. In other places, the coarser sand and gravel is not present at depth and the valley contains a thick sequence of largely fine-grained deposits.

2.3.2 Unconsolidated Aquifers

Rondout Valley Unconsolidated Aquifer System

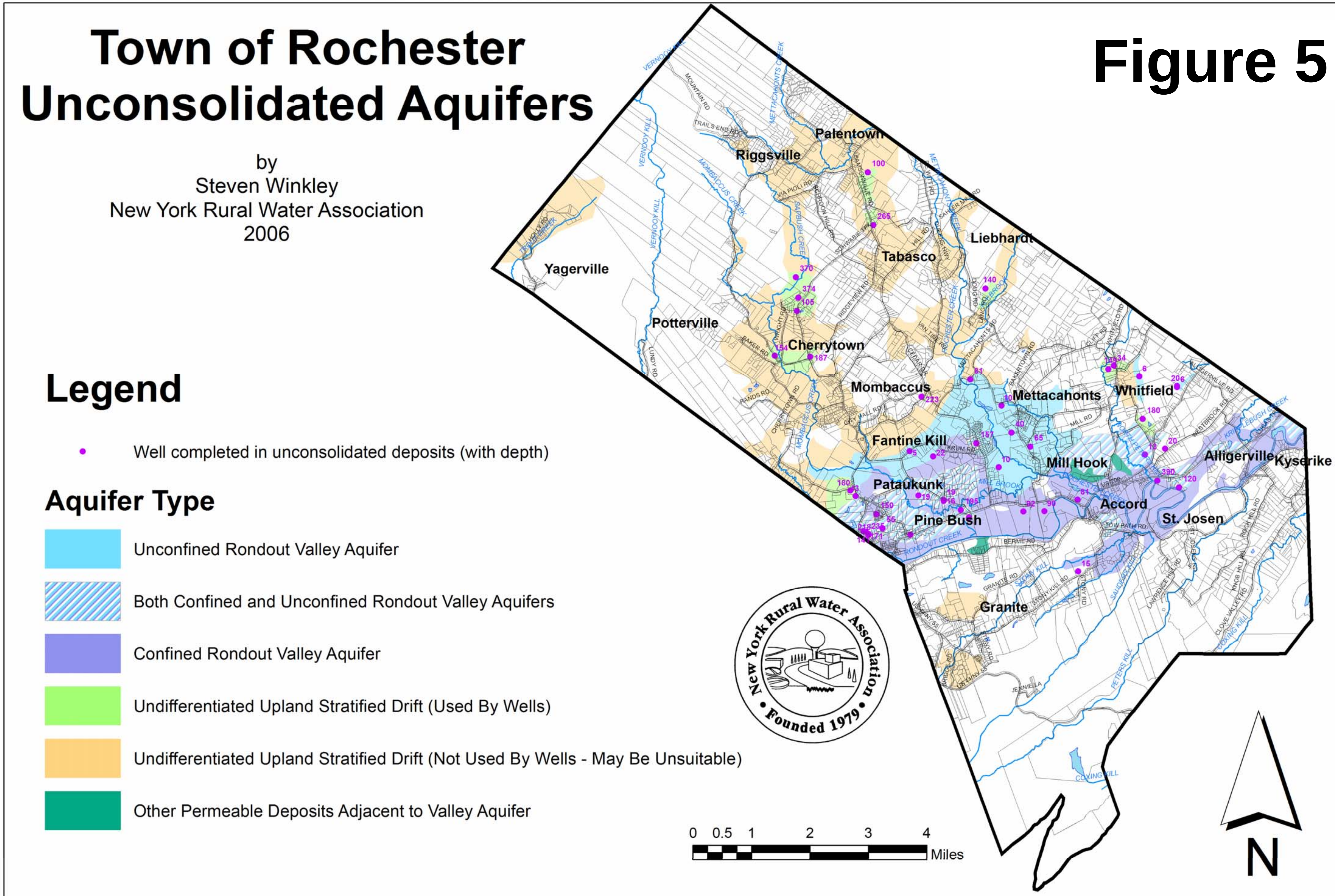
The Rondout Valley contains a complex set of unconsolidated deposits that were laid down during deglaciation of the region. Two distinct aquifers were subsequently deposited: a deeper confined sand and gravel aquifer and a much shallower unconfined sand and gravel aquifer. These different aquifer types are depicted on Figure 5.

In some places, wells have been known to intersect relatively coarse-grained sand and gravel at significant depths in the Rondout Valley ranging from 81 to 390 feet (see the figure "Unconsolidated Aquifers"). Here, the sand and gravel is buried beneath thick accumulations of fine-grained clay and silt and is considered to be a **confined aquifer**. Yields in the confined valley aquifer range from 10 to 400 gpm, with a median yield of 20-25 gpm.

Water wells have also tapped **unconfined** (surficial) sand and gravel deposits across the Rondout Valley. Some of these deposits are quite shallow (5 to 20 feet thick) and often grade downward into finer sediments. In other places, such as nearer the northern wall of the valley, unconfined aquifer deposits are thicker. Here, well depths can extend 40 to 80+ feet deep in sand and gravel. Yields in the unconfined sand and gravel range from 4 to 30 gpm, with a median yield of 8 gpm. Note that most sand and gravel wells completed for household use in Rochester are finished simply with an open-ended casing. To maximize yields, a screen could be placed in the well.

Undifferentiated Upland Stratified Drift

In the Hamilton Hills and Catskills region north of the Rondout Valley, thick accumulations of sand, gravel, and boulders exist in many locales. It is believed that the thickness of these **stratified drift** deposits exceeds 100 to 300 feet in many locations. In areas where these deposits are sufficiently permeable and saturated, relatively high well yields can be accomplished. Areas where such unconsolidated deposits are utilized by wells are depicted on the figure entitled "Unconsolidated Aquifers". Yields from these upland deposits range from 5 to 100 gpm, with a median yield of 50 gpm. Again, these wells are producing such


Town of Rochester
Unconsolidated Aquifers
by
Steven Winkley
New York Rural Water Association
2006
Figure 5
Legend
Well completed in unconsolidated deposits (with depth)
Aquifer Type
Unconfined Rondout Valley Aquifer
Both Confined and Unconfined Rondout Valley Aquifers
Confined Rondout Valley Aquifer
Undifferentiated Upland Stratified Drift (Used By Wells)
Undifferentiated Upland Stratified Drift (Not Used By Wells - May Be Unsuitable)
Other Permeable Deposits Adjacent to Valley Aquifer
Palentown
Riggsville
Yagerville
Liebhardt
Tabasco
Potterville
Cherrytown
Mombaccus
Mettacahonts
Whitfield
Fantine Kill
Mill Hook
Alligerville
Kyserike
Pataukunk
Accord
St. Josen
Pine Bush
Granite
New York Rural Water Association
Founded 1979
0 0.5 1 2 3 4
Miles
N

yields through open-ended casing, not screening. Many areas of the Hamilton Hills and Catskill Mountains physiographic regions are underlain by stratified drift, but local water wells rely upon bedrock as a source of supply (see figure entitled "Unconsolidated Aquifers").

3.0 PUBLIC WATER SUPPLIES

According to data from the New York State Department of Health, there are approximately 500 residents in Rochester that receive their water from public water systems that are privately-owned and supplied by ground water. With the exception of 33 residences located in the Kerhonkson Water District, the remainder of Rochester's citizens rely upon individual residential wells for their supply sources.

3.1 Public Water Supply Wells

A public water system is an entity that provides water to the public for human consumption through pipes or other constructed conveyances. Any system having at least 5 service connections or that regularly serves an average of at least 25 people daily for at least 60 days out of the year is considered a public water system. Public water systems are classified as one of three types: community, non-transient non-community, or transient non-community. A community water system is a public water system that serves the <u>same</u> people year-round. It has the most regulatory requirements of the three system types, including the need for a certified operator and more extensive monitoring. Based upon NYSDOH data, there are 16 community water systems relying upon wells in the Town of Rochester (see Table 2). These include mobile home parks, apartments, water-works corporations that (regulated by the NYS Public Service Commission, and a homeowners association (also regulated by NYS Public Service Commission). The locations of most of these community water systems are depicted on Figure 6.

A non-transient non-community water system water system does not serve year-round residents, but does regularly serve at least 25 of the <u>same</u> people more than six months per year. It now requires a certified operator, but has less monitoring and reporting requirements than a community system. Based upon NYSDOH data, non-transient non-community water systems in the Town of Rochester includes the Rondout Valley Middle School and High School (see Table 2 and Figure 6).

A transient non-community water system does not regularly serve at least 25 of the same people over six months per year. It does not require a certified operator and monitoring is largely limited to bacteria, nitrate, and nitrite. There are some 27 businesses having wells that are regulated as a transient non-community water system in the Town of Rochester. These are listed in Table 3 below.

PUBLIC WATER SYSTEM NAME	LOCATED ON MAP ?	POPULATION	CONNECTIONS	SYSTEM CLASSIFICATION	TOTAL DESIGN CAPACITY (GPD)	DESCRIPTION
FRIENDLY ACRES HOMEOWNERS ASSOCIATION	YES	16	8	C-Community	1,760	HOMEOWNERS ASSOCIATION
GRANITE CREEK MOBILE HOME PARK	YES	20	11	C-Community	1,000	MOBILE HOME PARK
GRANITE ESTATES WATER COMPANY	YES	24	13	C-Community	21,600	SUBDIVISION
HIDDEN FOREST ESTATES MHP	YES	25	5	C-Community		MOBILE HOME PARK
HILLSIDE MOBILE HOME PARK	YES	42	15	C-Community		MOBILE HOME PARK
JOINT VENTURES	YES	8	8	C-Community		WATER-WORKS CORPORATION
LUCAS ESTATES WATER COMPANY	YES	48	17	C-Community	576,000	WATER-WORKS CORPORATION
M & M MOBILE HOME PARK	NO	20	8	C-Community		MOBILE HOME PARK
PARK ESTATES	YES	45	15	C-Community	2,400	MOBILE HOME PARK
PAULAS APARTMENTS	NO	11	14	C-Community	27,360	APARTMENTS
RONDOUT VALLEY HIGH SCHOOL	YES	1050	44	NTNC-Non-transient non-community	21,000	SCHOOL
RONDOUT VALLEY MIDDLE SCHOOL	YES	950	56	NTNC-Non-transient non-community	19,000	SCHOOL
RT 209 TRAILER COURT	YES	20	9	C-Community	1,800	MOBILE HOME PARK
SHADY ACRES APARTMENTS	NO	16	8	C-Community	1,800	APARTMENTS
STREAMSIDE ESTATES	YES	67	21	C-Community		MOBILE HOME PARK
SYLVAN GLADES WATER COMPANY	YES	100	33	C-Community	64,800	WATER-WORKS CORPORATION
VALLEY GARDENS TRAILER PARK	NO	22	8	C-Community	1,000	MOBILE HOME PARK
ZOLOTA OSIN INC	YES	25	26	C-Community	92,000	APARTMENTS/CONDOMINIUMS

Table 2. Community and Non-Transient, Non-Community Public Water Systems in Rochester (from NYSDOH).

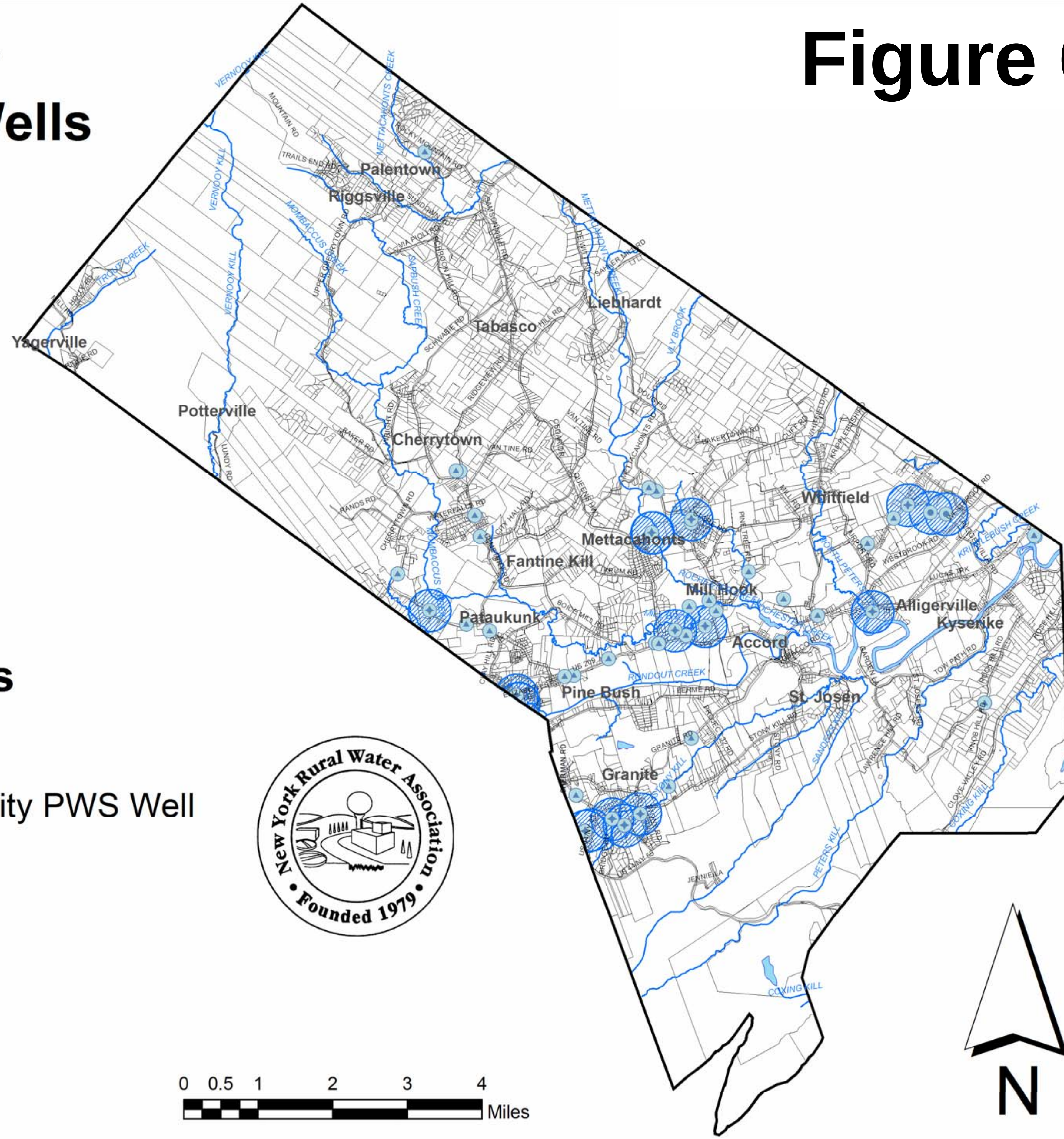
PUBLIC WATER SYSTEM NAME	DESCRIPTION
209 QUICK MART	CONVENIENCE STORE
CAMP RAV TOV-CHERRYTOWN	SUMMER CAMP
CAMP YESHIVA OF STATEN ISLAND	SUMMER CAMP
CHINA PAVILION	RESTAURANT
ELAT CHAYYIM	HOTEL/MOTEL
HUDSON VALLEY RESORT	HOTEL/MOTEL
IVANS AT RONDOUT	RESTAURANT
KALAKA VILLAGE	HOTEL/MOTEL
LOG CABIN	RESTAURANT
MAKOWSKYS COTTAGE COLONY	HOTEL/MOTEL
MAYBROOK LODGE INC.	HOTEL/MOTEL
MOUNTAIN VALLEY RESORT	HOTEL/MOTEL
PINE GROVE RANCH	HOTEL/MOTEL
PIONEER XCHANGE EXPRES	CONVENIENCE STORE
PIONEER XCHANGE KERHONKSON	CONVENIENCE STORE
POOL-FOUR GREEN FIELDS	POOL/BATHING BEACH
POOL-LOS BOMBEROS	POOL/BATHING BEACH
RAINBOW DINER	RESTAURANT
RONDOUT VALLEY CAMPGROUND	CAMPGROUND
RONDOUT VALLEY GROCERY	CONVENIENCE STORE
STAR GROCERIES	CONVENIENCE STORE
STARLITE MOTEL	HOTEL/MOTEL
THE ROUND-UP	RESTAURANT
TRAFICANTIS HILLSIDE REST.	RESTAURANT
TROYS DELI & PIZZA	RESTAURANT
TWIGGYS	RESTAURANT
VERITAS VILLA	HOTEL/MOTEL

Table 3. Transient, Non-Community Public Water Systems in Rochester (from NYSDOH).

Town of Rochester
Public Water Supply Wells

by
Steven Winkley
New York Rural Water Association
2006

Figure 6



Legend

Public Water Supply Wells

- Community PWS Well
- Non-Transient Non-Community PWS Well
- Non-Community PWS Well
- Wellhead Protection Area

3.2 Wellhead Protection Areas

The USEPA (1994) defines a wellhead protection area as the surface and subsurface area surrounding a well through which contaminants are reasonably likely to move toward and reach the water well. This is the area where preventative steps should be focused to reduce the risk of contamination of the public water supply. New York State's Wellhead Protection Program uses a fixed radius of 1,500 feet from the wellhead to delineate wellhead protection areas in bedrock aquifers. This is the approach used by NYRWA and mapped on Figure 6.

4.0 GROUND WATER RECHARGE AND DISCHARGE

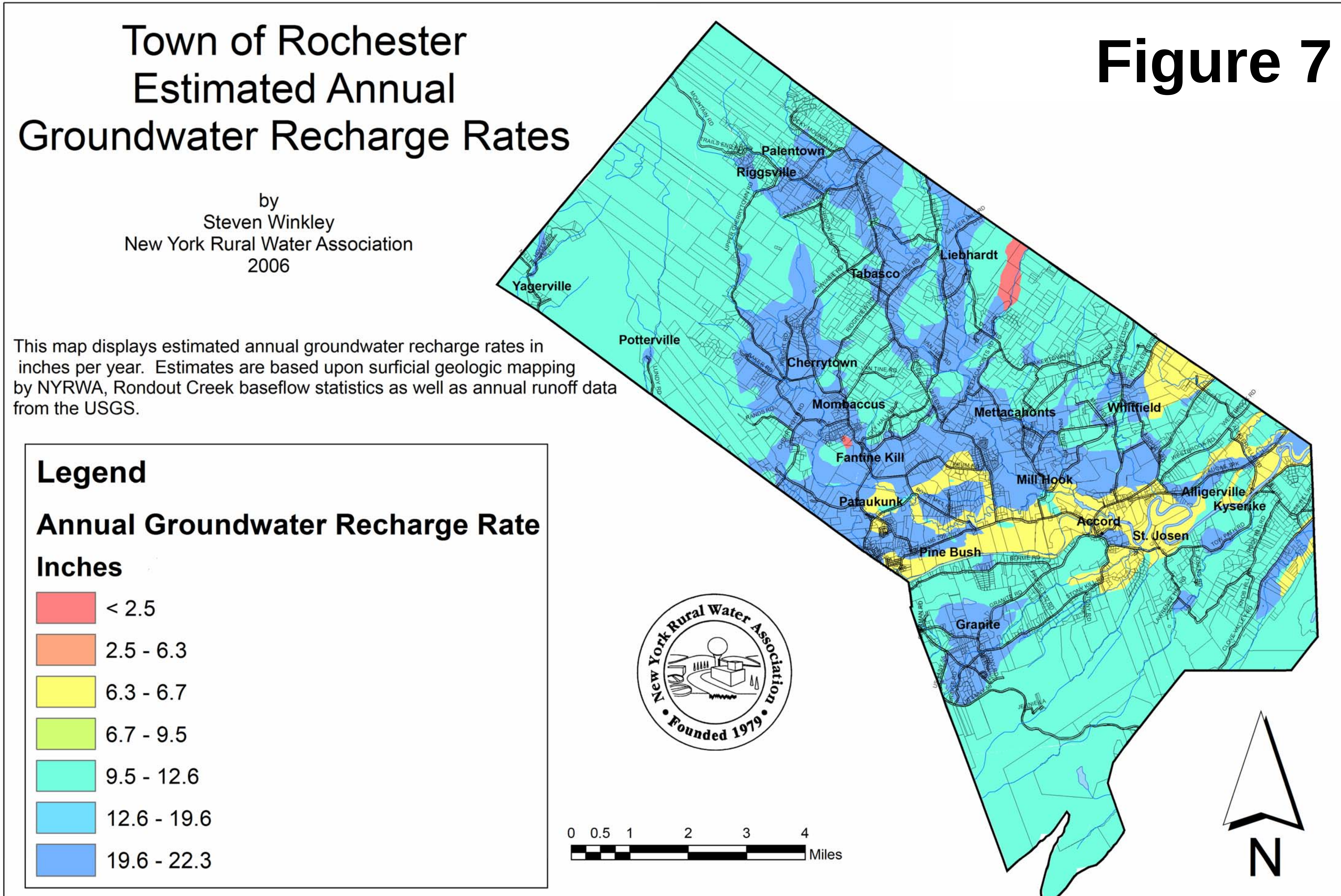
Ground water flows from recharge areas to discharge areas. Recharge areas are where ground water is being replenished and it is flowing downwards and away from the water table. Typically recharge areas represent 70 to 95 percent of a region (Freeze & Cherry, 1979). Conversely, in discharge areas, ground water flows upwards toward the water table and eventually is removed from the subsurface into surface water bodies. In an area of high topographic relief such as in Town of Rochester, much of the ground water moves in local flow systems. In local flow systems, ground water is recharged at a topographic high and discharged at the next local topographic low. Some deeper ground water in Town *may* be involved in regional flow systems.

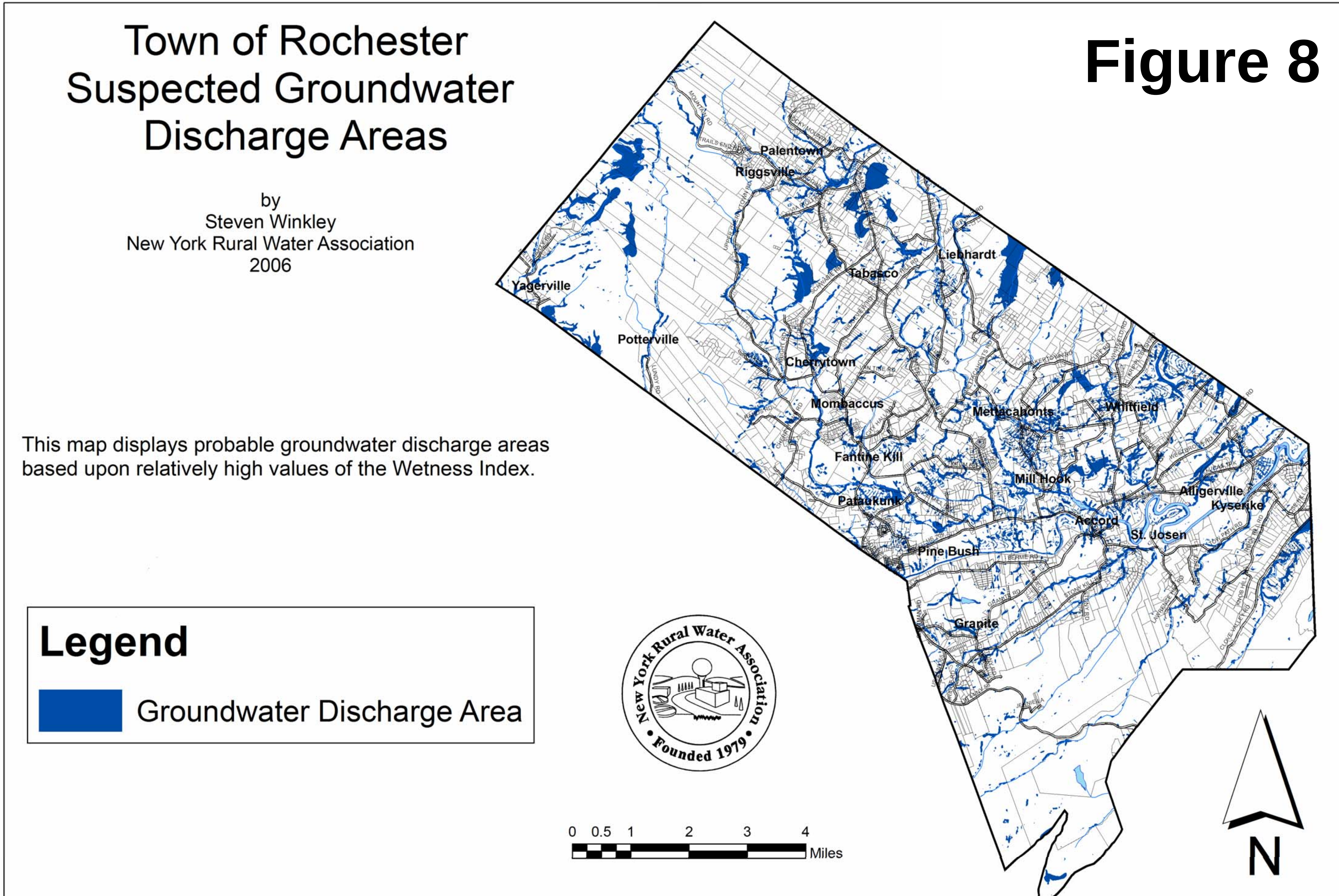
4.1 Recharge

Most of the ground water in Rochester is ultimately recharged (replenished) through infiltration of rainfall or snow melt. Rates of ground water recharge vary widely based upon many factors, but the important variable is believed to be the surficial geologic material. Rates of shallow groundwater recharge in Rochester have been calculated by NYRWA based on base flow estimates and mean annual runoff in the region. These calculations are based upon the widely held assumption that long-term average natural groundwater recharge is equal to long-term average baseflow to streams. Recharge rate calculations are contained in Appendix A. Rates of annual groundwater recharge range from as much as approximately 20 inches per year in some glaciofluvial sand and gravel deposits to as little as 6 inches per year in areas of poorly permeable glaciolacustrine silt & clay sediments. Figure 7 is a map of estimated annual groundwater recharge rates.

4.2 Discharge

Ground water discharge areas are relatively low-lying areas where ground water is removed from the subsurface through evapotranspiration at the land surface or movement into surface water bodies. The water table is at or relatively near the land surface in discharge areas. One indicator of these wet conditions is what is commonly referred to as the Wetness Index. This parameter is a function of the topography and the slope of the landscape. A high wetness index indicates probable wet conditions and a likely discharge area. Figure 8 is a map of suspected ground water discharge areas based upon high wetness index values


Town of Rochester
Estimated Annual
Groundwater Recharge Rates
Figure 7
by
Steven Winkley
New York Rural Water Association
2006
This map displays estimated annual groundwater recharge rates in inches per year. Estimates are based upon surficial geologic mapping by NYRWA, Rondout Creek baseflow statistics as well as annual runoff data from the USGS.
Legend
Annual Groundwater Recharge Rate
Inches
< 2.5
2.5 - 6.3
6.3 - 6.7
6.7 - 9.5
9.5 - 12.6
12.6 - 19.6
19.6 - 22.3
Palentown
Riggsville
Liebhardt
Tabasco
Yagerville
Potterville
Cherrytown
Mombaccus
Mettacahonts
Whitfield
Fantine Kill
Mill Hook
Pataukunk
Alligerville
Kyserike
Accord
St. Josen
Pine Bush
Granite
New York Rural Water Association
Founded 1979
0 0.5 1 2 3 4
Miles
N


Town of Rochester
Suspected Groundwater
Discharge Areas
by
Steven Winkley
New York Rural Water Association
2006
Figure 8
This map displays probable groundwater discharge areas based upon relatively high values of the Wetness Index.
Legend
Groundwater Discharge Area
Palentown
Riggsville
Liebhardt
Tabasco
Yagerville
Potterville
Cherrytown
Mombaccus
Mettacahonts
Whitfield
Fantine Kill
Mill Hook
Alligerville
Kyserike
Pataukunk
Accord
St. Josen
Pine Bush
Granite
New York Rural Water Association
Founded 1979
0 0.5 1 2 3 4
Miles
N

5.0 GROUND WATER CONTAMINATION

Ground water resources are susceptible to contamination from a variety of manmade sources. These include various industrial, commercial, residential, and agricultural uses and activities. Several of these potential sources of contamination are regulated by state agencies such as the New York State Department of Environmental Conservation (NYSDEC). Some others are not. Once contaminated, ground water is very difficult and costly to cleanup

5.1 Existing Contamination

Fortunately, there are no identified groundwater contamination sites in Town under the state or federal Superfund sites. Unfortunately, there have been a number of petroleum and other chemical spills that have been investigated by the NYSDEC Spill Response Unit. These have been mapped by NYRWA on Figure 9. The majority of these spills were found to not be of serious concern and their cases were closed. Approximately 20 of these spills have not yet been closed in the Town of Rochester. Such spills have not been closed because typically they are either still being investigated or cleaned up or they have not met cleanup standards.

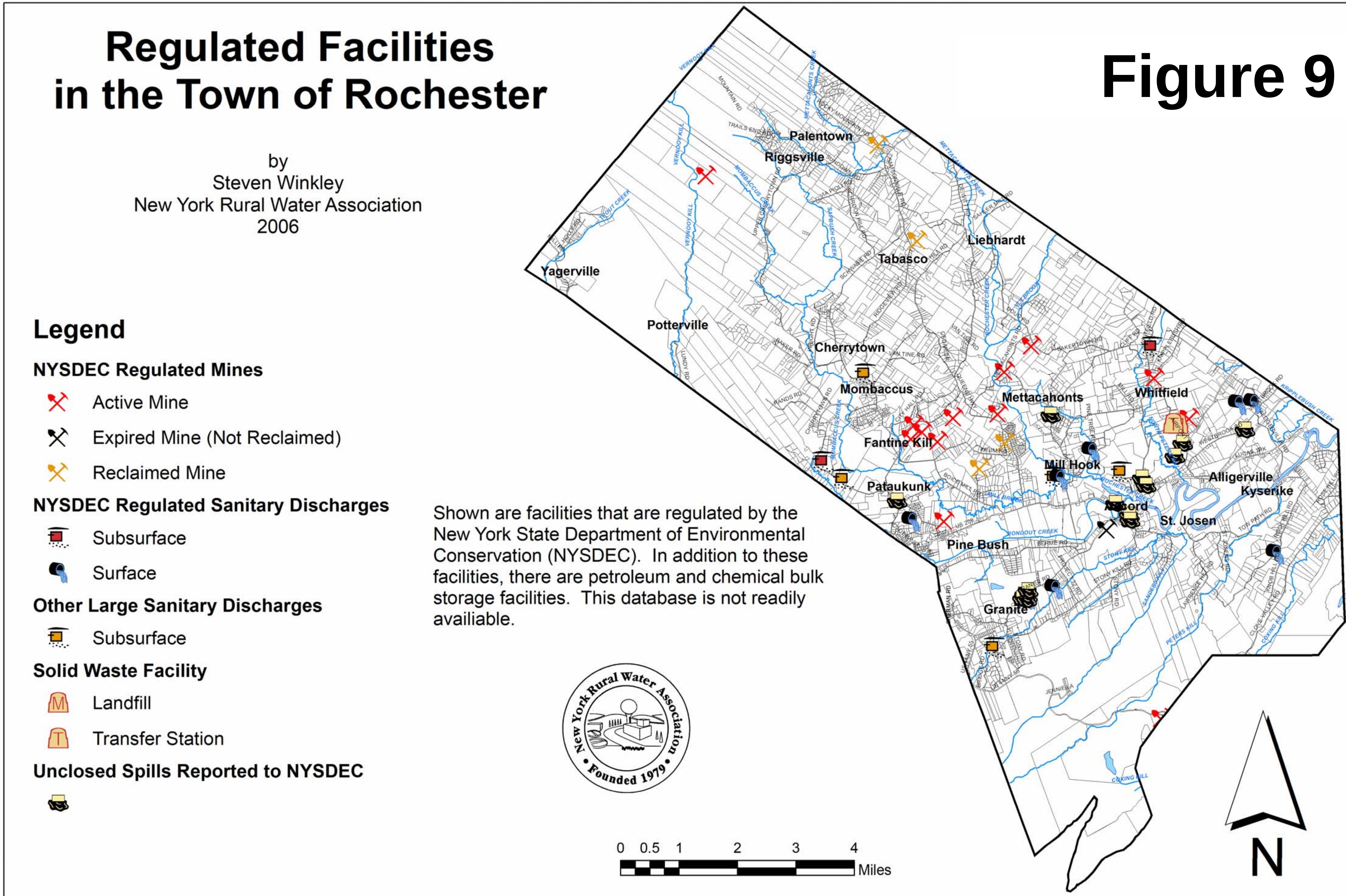
Spills arise from a number of different circumstances. The most common cause of chemical spills is the failure of a tank. Several of these tanks have been home heating oil tanks.

5.2 Potential Sources of Contamination

As indicated previously, there are a number of different uses and activities that have the potential to contaminate ground water. These practices typically involve the handling, use, storage, and/or disposal of petroleum and other hazardous substances that are capable of contaminating ground water. The threat of ground water contamination can be reduced to some extent through the use of environmentally-sound best management practices and/or structural methods.

Figure 9 is a map displaying potential ground water contamination sources that are currently regulated by the NYSDEC in Rochester. These include solid waste management facilities, mines, and SPDES discharges (wastewater discharges). Data was not digitally available from NYSDEC for petroleum and chemical bulk storage sites.

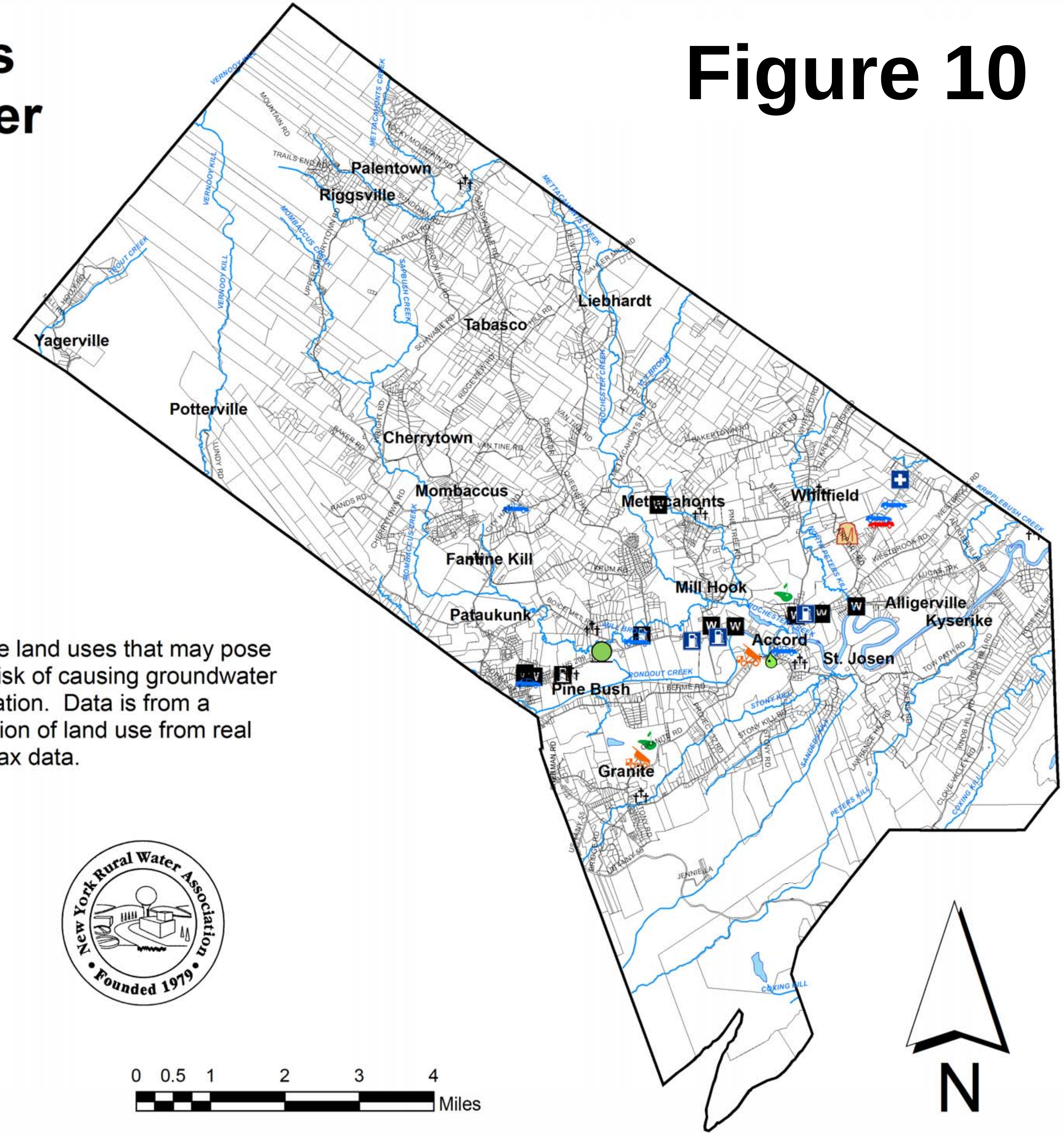
NYRWA used property classification codes from Ulster County real property data to identify largely non-regulated uses that *could* be considered as potential contamination sources. The centroids of these parcels are plotted on Figure 10 according to the property classification.


Regulated Facilities
in the Town of Rochester
by
Steven Winkley
New York Rural Water Association
2006
Legend
NYSDEC Regulated Mines
Active Mine
Expired Mine (Not Reclaimed)
Reclaimed Mine
NYSDEC Regulated Sanitary Discharges
Subsurface
Surface
Other Large Sanitary Discharges
Subsurface
Solid Waste Facility
Landfill
Transfer Station
Unclosed Spills Reported to NYSDEC
Shown are facilities that are regulated by the New York State Department of Environmental Conservation (NYSDEC). In addition to these facilities, there are petroleum and chemical bulk storage facilities. This database is not readily availiable.
New York Rural Water Association
Founded 1979
Palentown
Riggsville
Yagerville
Tabasco
Liebhardt
Potterville
Cherrytown
Mombaccus
Mettacahonts
Whitfield
Fantine Kill
Mill Hook
Alligerville
Kyserike
Pataukunk
St. Josen
Pine Bush
Granite
0
0.5
1
2
3
4
Miles
N
Figure 9

Higher Risk Land Uses in the Town of Rochester

Figure 10

by
Steven Winkley
New York Rural Water Association
2006



Legend

Higher Risk Land Uses

- Cemetery
- Chemical sales and storage
- Equipment sales and service
- Gasoline service station
- Gasoline station
- Golf course
- Highway garage
- Landfill and/or transfer station
- Medical services (including dental/vet)
- Motor vehicle repair and/or body shop
- Motor vehicle sales and service
- Petroleum storage and distribution
- Warehouse and/or storage facility

Shown are land uses that may pose a higher risk of causing groundwater contamination. Data is from a classification of land use from real property tax data.

New York Rural Water Association • Founded 1979 •

5.3 Future Growth

According to the U.S. Census, between 1990 and 2000, Rochester had the highest percentage growth of any town in Ulster County. Recently, the trend in the region appears to be towards larger proposed residential developments, ranging in size from 200 to 650 dwelling units.

Residential development does have the potential to affect the quantity and quality of available ground water resources. If improperly planned, development in sensitive hydrogeologic areas could conceivably lead to a diminishment of ground water supplies or an increased risk of contamination.

5.3.1 Predicting Growth Areas

In order to protect ground water resources from aspects of growth, it is necessary to try to predict where development may occur. First, an assumption is made that development will occur on land that is not now developed and is not protected from development. A second assumption is made that development is not likely in some areas due to physical constraints. Open space are lands that are not intensively developed for residential, commercial, industrial or institutional use. Protected open space consists of land that is publicly-owned or owned by private land conservation trusts.

NYRWA used a GIS to identify non-protected open space. First the assumption was made that private open space includes: (1) parcels that are greater than 10 acres in size that are vacant, agricultural, rural residential with acreage, or private forest lands; and (2) are not owned by government or land conservation trusts. A resulting map showing various types open space lands is presented as Figure 11.

Some areas are either not developable or are less likely to be developed due to certain site characteristics that are referred to as physical site development constraints. These constraints include: (1) proximity to wetlands, streams, ponds, lakes, and other surface waters; flood plain areas; and (3) steep slopes.

Residential or commercial development would not likely occur within close proximity to wetlands and surface water bodies due to state or local regulations. For example, a setback of 50 feet is required from surface water bodies for certain components of onsite wastewater treatment systems. A wetlands permit is required for most development activities within 100 feet of a mapped wetland.

Areas located within flood hazard areas are not recommended and are often prohibited. Steep slopes are problematic for new construction for a variety of reasons including surface erosion, creep and sudden slope failure, as well as septic system failure. Septic systems are generally not permitted on slopes greater than 15 percent.

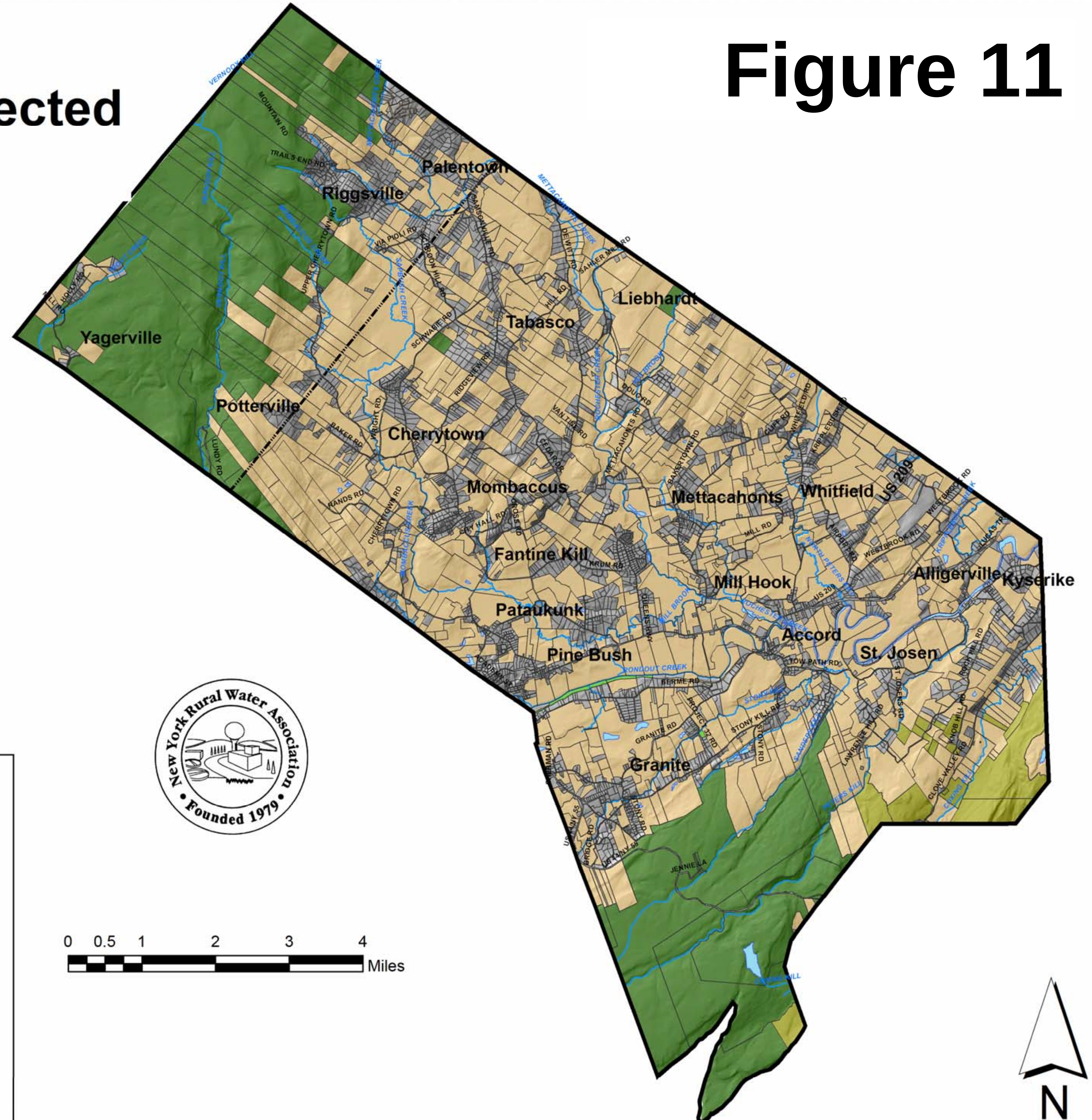
Figure 12 is a map of physical site development constraints in Rochester that was produced by NYRWA using a GIS.

Town of Rochester Protected and Non-Protected Open Space

Figure 11

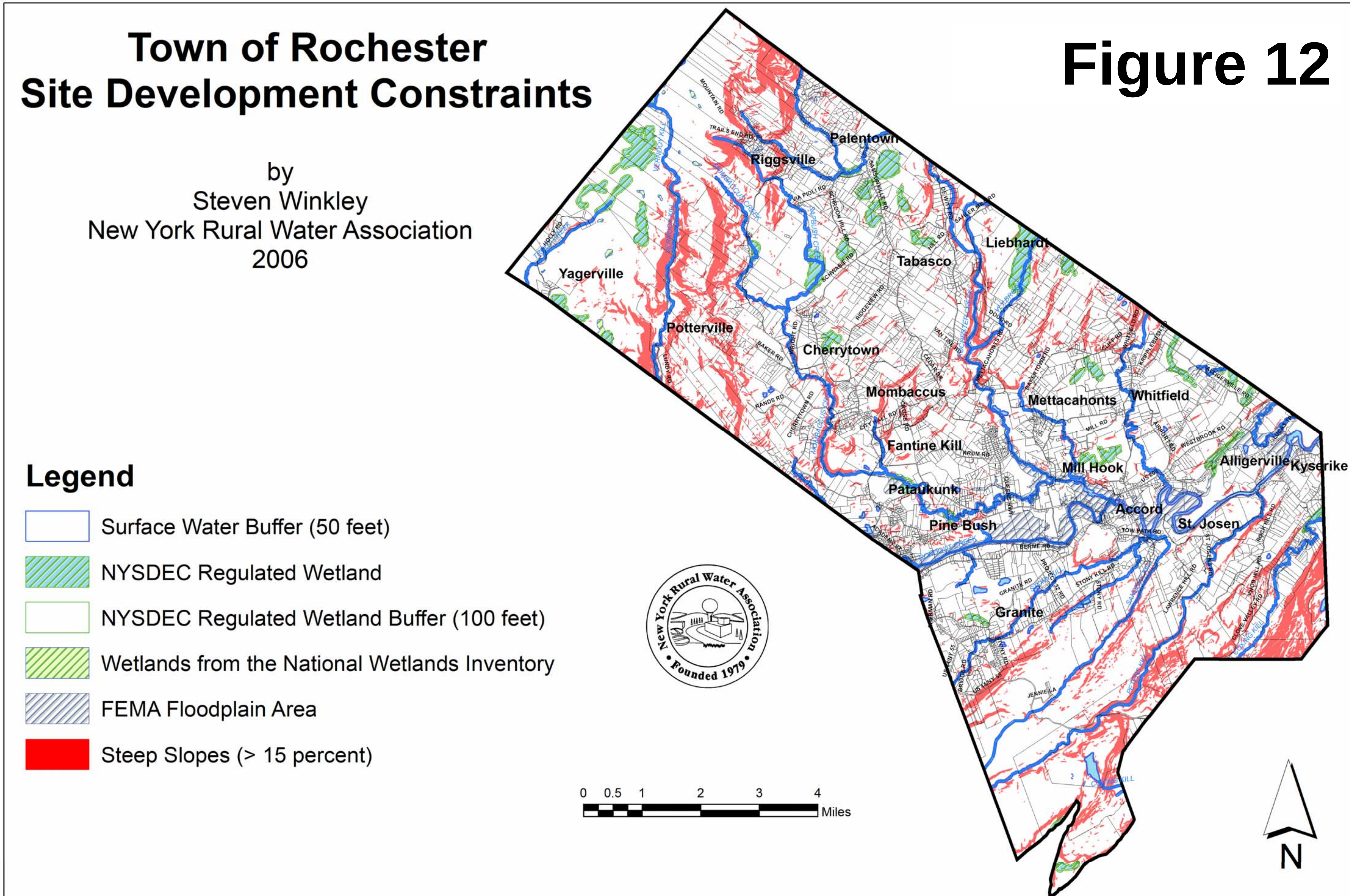
by
Steven Winkley
New York Rural Water Association
2006

Land ownership type is from real property data provided by Ulster County Information Services. Open space are lands that are not intensively developed for residential, commercial, industrial or institutional use. Protected open space consists of land that is publicly-owned or owned by private land conservation trusts. Non-protected open space generally consists of privately-owned land parcels that are greater than 10 acres in size. Most are classified as either vacant, agricultural, rural residential with acreage, or private forest lands.



Legend

- Catskill Park Boundary
- Conservation land owned by land trusts
- Conservation land owned by Town
- Conservation land owned by State
- Non-protected open space


Town of Rochester
Site Development Constraints
by
Steven Winkley
New York Rural Water Association
2006
Figure 12
Legend
Surface Water Buffer (50 feet)
NYSDEC Regulated Wetland
NYSDEC Regulated Wetland Buffer (100 feet)
Wetlands from the National Wetlands Inventory
FEMA Floodplain Area
Steep Slopes (> 15 percent)
Palentown
Riggsville
Liebhardt
Tabasco
Yagerville
Potterville
Cherrytown
Mombaccus
Mettacahonts
Whitfield
Fantine Kill
Mill Hook
Alligerville
Kyserike
Pataukunk
Accord
St. Josen
Pine Bush
Granite
New York Rural Water Association
Founded 1979
0 0.5 1 2 3 4
Miles
N

Subtracting Figure 12 from Figure 11 yields a map of developable open space areas. These areas are depicted on Figure 13.

5.3.2 Ground Water Related Development Issues

Development involves a number of potential ground water resource issues. These issues involve: (1) water supply; 2) wastewater treatment; 3) impervious surfaces and storm water systems; and (4) improper waste disposal and spills.

Water Supply

Development in non-urbanized areas typically involves the use of onsite ground water for water supply. Sometimes a community water system is formed to serve a residential development. These systems may be privately or publicly owned. In this instance, one or two wells typically serve the needs of many homes. Community water systems are closely regulated by local county health departments and are managed by licensed water system operators. New community water systems are carefully planned and designed to minimize contamination potential. However, community water systems are expensive to install and operate.

Recent development in the Town of Rochester has chiefly involved the use of individual private wells. Compared to central water systems, individual wells are less expensive to install and their operation is not regulated. The location, construction, and testing of private water wells has recently been regulated by the New York State Department of Health in Appendix 5-B of 10 NYCRR Part 5. Table 2 lists the required minimum separation distances from potential contamination sources contained in the NYSDOH regulations for private wells.

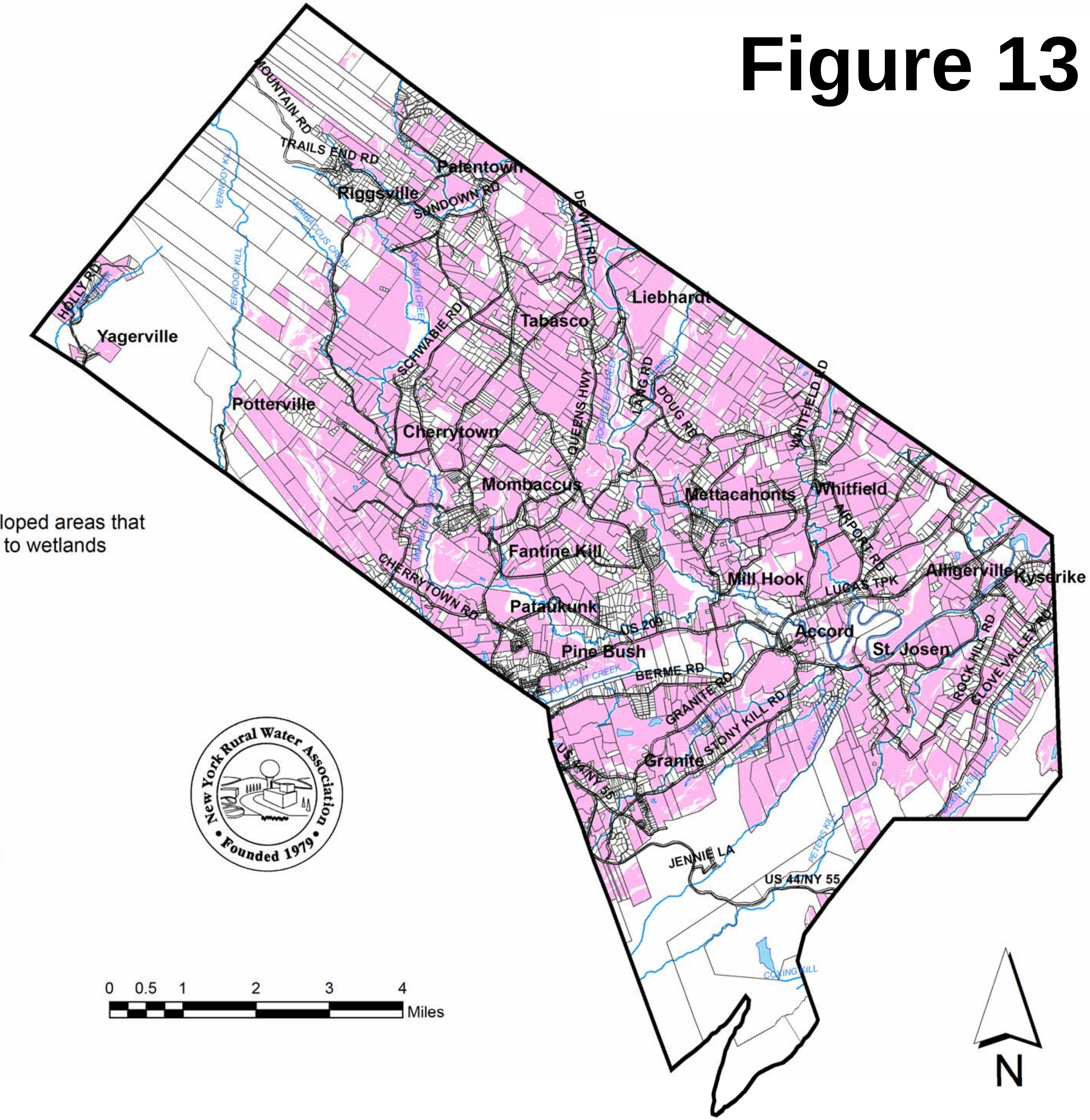
The density and placement of individual water wells with respect to the ground water flow direction is also important. Adequate well spacing is necessary to sustain well yields. Due to the limited water-bearing characteristics of the bedrock in some areas of Rochester (see below), the density and spacing of water wells can be very important. Too many wells in such areas could lead to ground water depletion or deterioration of ground water quality. NYRWA has calculated estimated recharge areas that are necessary to safely supply a typical household in Rochester (see Appendix B) for various recharge rates. Calculated recharge areas range from 0.2 to 0.6 acres. Wells should be placed such that their recharge area does not overlap with that portion of the lot where effluent from the wastewater disposal system is diluted. Ideally, wells should not be placed directly downgradient of disposal systems on adjacent lots as well

Town of Rochester Developable Open Space

by
Steven Winkley
New York Rural Water Association
2006

Figure 13

Developable open space are privately-owned, relatively undeveloped areas that do not contain development constraints such as close proximity to wetlands or surface water, floodplain areas, or steep slopes.



Legend

Developable Open Space

Table 4: Required Minimum Separation Distances to Protect Water Wells From Contamination From Appendix 5-B of 10 NYCRR Part 5

Contaminant Source	Distance (Feet)[1]
Chemical storage sites not protected from the elements (e.g., salt and sand/salt storage)[2]	300
Landfill waste disposal area, or hazardous or radiological waste disposal area[2]	300
Land surface application or subsurface injection of effluent or digested sludge from a Municipal or public wastewater treatment facility	200
Land surface application or subsurface injection of septage waste	200
Land surface spreading or subsurface injection of liquid or solid manure [3]	200
Storage Areas for Manure piles [4]	200
Barnyard, silo, barn gutters and animal pens [5, 6]	100
Cesspools (i.e. pits with no septic tank pretreatment)	200
Wastewater treatment absorption systems located in coarse gravel or in the Direct path of drainage to a well	200
Fertilizer and/or pesticide mixing and/or clean up areas	150
Seepage pit (following septic tank) [5]	150
Underground single walled chemical or petroleum storage vessels	150
Absorption field or bed [5]	100
Contained chemical storage sites protected from the elements (e.g. salt and sand/salt storage within covered structures) [7]	100
Septic system components (non-watertight) [5]	100
Intermittent sand filter without a watertight liner [5]	100
Sanitary Privy pit [5]	100
Surface wastewater recharge absorption system constructed to discharge storm water from parking lots, roadways or driveways [5]	100
Cemeteries	100
Sanitary privy with a watertight vault	50
Septic tank, aerobic unit, watertight effluent line to distribution box	50
Sanitary sewer or combined sewer	50
Surface water recharge absorption system with no automotive-related Wastes (e.g., clear-water basin, clear-water dry well)	50
Stream, lake, watercourse, drainage ditch, or wetland	25
All known sources of contamination otherwise not shown above	100

Notes for Table:

1. The listed water well separation distances from contaminant sources shall be increased by 50% whenever aquifer water enters the water well at less than 50 feet below grade. If a 50% increase in separation distances can not be achieved, then the greatest possible increase in separation distance shall be provided with such additional measures as needed to prevent contamination.
2. Water wells shall not be located in a direct line of flow from these items, nor in any contaminant plume created by these items, except with such additional measures (e.g., sentinel groundwater monitoring, hydraulic containment, source water treatment) as needed to prevent contamination.
3. Based upon on-site evaluations of agricultural properties done per agricultural environmental management (AEM) or comprehensive nutrient management plan (CNMP) programs by a certified nutrient management planner or soil and water conservation district (SWCD) official, water wells may be located a minimum of 100 feet from areas subject to land spreading of manure.
4. Water wells may be located 100 feet from temporary (30 days or less) manure piles/staging areas that are controlled to preclude contamination of surface or groundwater or 100 feet from otherwise managed manure piles that are controlled pursuant to regulation in a manner that prevents contamination of surface or groundwater.
5. When these contamination sources are located in coarse gravel or are located upgrade and in the direct path of drainage to a water well, the water well shall be located at least 200 feet away from the closest part of these sources.
6. Animal pen does not include small pet shelters or kennels housing 3 or fewer adult pets.
7. Chemical storage sites as used in this entry do not include properly maintained storage areas of chemicals used for water treatment or areas of household quantities of commonly used domestic chemicals.

For new residential construction, mortgage lending agencies often like the well system to sustain a flow rate of 5 gpm. In some areas of the Town of Rochester, it is difficult, if not impossible, to obtain an instantaneous well yield of 5 gpm. These relatively water-poor areas are chiefly underlain by the Esopus Shale (see Figure 14). Some other shale rich rocks such as the Bakoven Shale of the Lower Hamilton Group Clastics unit also produce relatively poor yields. Where yields of less than 5 gpm exist, larger diameter wells are sometimes drilled in order to increase available storage. Alternatively, a larger storage tank along with re-pumping at 5 gpm may need to be provided. Wells with yields of less than 2 gpm are generally not recommended for supply purposes.

Wastewater Treatment

Excessive nitrate loading of ground water can occur if there is too high a density of septic systems in a given area. Thus, it is vital to locate septic systems on large enough lots to minimize excess loading. A critical area, referred to as the effluent dilution area, is the minimum area of recharge to dilute resultant nitrate-nitrogen concentration to 5 mg/l (ppm), one-half of the maximum contaminant level (MCL) for drinking water. NYRWA has calculated required effluent dilution areas based upon recharge rates in Rochester (see Appendix B). Effluent dilution areas should be 1.4 acres to 4.5 acres in size depending upon the groundwater recharge rate in the area. Note that the sum of the necessary effluent dilution area and the lot well's recharge area is the recommended minimum lot size.

Impervious Surfaces and Storm Sewer Systems

Development inevitably increases the amount of impervious surfaces in an area. These are roofs, roads, driveways, parking lots, pools, and other surfaces that do not allow precipitation to infiltrate into the soil and reach the water table. Impervious surfaces result in water running off the land surface, directly into wetlands, lakes, and streams. As overland flow and stormwater runoff increases, so does the magnitude and frequency of flooding. Imperviousness can significantly decrease ground water recharge. This in turn reduces the amount of ground water available to local wells, and reduces stream baseflow.

Also, as the volume of stormwater increases, pollutants picked up by the water have less time to settle out. These include nutrients such as phosphorus and nitrogen, hazardous substances and chemicals from automobiles and other sources, sediment from construction activities, and pesticides, herbicides and fertilizers. The result is that these pollutants are more likely to contaminant surface waters and ground water.

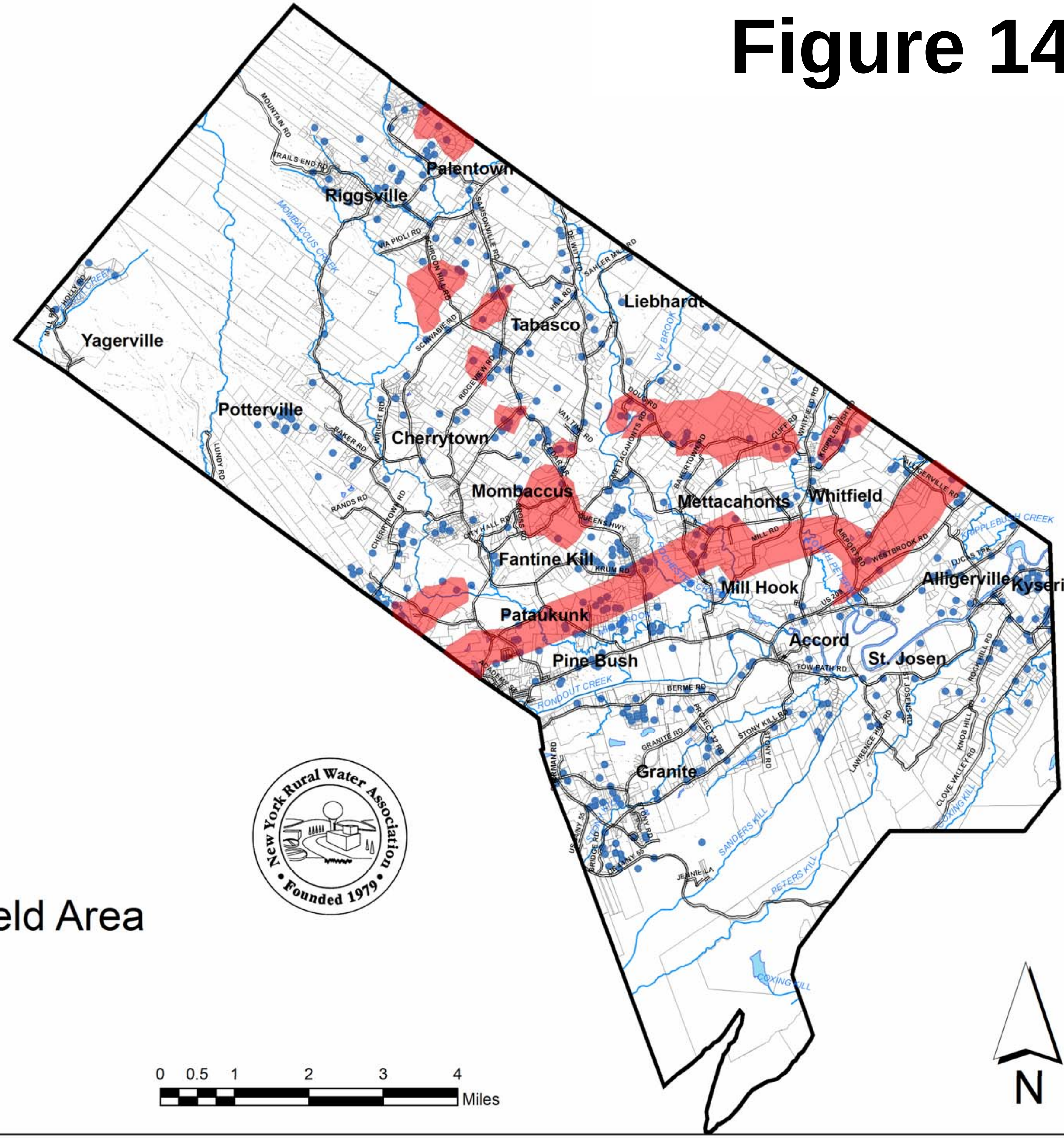
Recent research indicates that ground water resources and streams can be considered stressed once the impervious coverage in an area exceeds a threshold of 10 to 15 percent. Table 3 below includes typical values of impervious coverage for residential development on various lot sizes as estimated by the U.S. Dept. of Agriculture (1986).

Figure 14

Town of Rochester Low Well Yield Areas

by
Steven Winkley
New York Rural Water Association
2006

This map indicates areas where bedrock well yields are consistently less than 5 gpm based upon bedrock water well data from NYSDEC, USGS, and Ulster County.



Legend

Bedrock Well

• Bedrock Well

Low Bedrock Well Yield Area

Parcel Size (acres)	Estimated Impervious Cover (percent)
1/8	65%
1/4	38%
1/2	25%
1	20%
2	12%
3	10%
4	8%

Table 5. Lot size and Impervious Cover Relationship (From U.S. Dept. of Agriculture, 1986)

Historically, most storm water sewer systems discharged water to surface waters. This diversion of water reduces ground water recharge rates. Today, infiltration of storm water to ground water is often encouraged through a number of storm water management practices.

Improper Waste Disposal and Spills

As an area becomes developed, there is an increased likelihood that contamination could result from either improper waste disposals or accidental spills. Dumping of waste oil, paint wastes, antifreeze, and other substances on the ground or down the drain can harm ground water quality. It does not take very much of a substance to contaminate a large volume of ground water. It is not surprising therefore that the source of contaminants found in ground water often cannot be identified. Spills of fuel oil and other substances can sometimes be the result of equipment failure such as a tank failure. Other times the cause is human error such as overfilling a tank, etc.

6.0 GROUND WATER PROTECTION STRATEGIES

It is important to develop and implement effective ground water protection measures in order to protect water resources and encourage future development where it is best suited. There are number of ground water protection measures that can be chosen. Some of these are regulatory in nature. Others are non-regulatory. The Town of Rochester must determine which measures are acceptable given local socioeconomic and political conditions. These measures could include: promulgation of land use regulations, environmental review, direct land purchase or purchase of conservation easements, education, and local infrastructure planning.

6.1 Land Use Regulations

There are three types of land use regulations that can be used to protect ground water and other water resources. These include subdivision regulations, site plan review, and zoning.

6.1.1 Subdivision Regulations

Subdivision regulations relate to how land is to be divided into lots and what improvements such as streets, lighting, fire protection, utilities, drainage, and parks are made to service the lots. In Rochester, the Town has Land Subdivision Regulations (Chapter 125). The Planning Board of the Town of Rochester has the power and authority to approve, modify and disapprove the plan of subdivision. This involves review of the proposed layout of lots, roads, water supply, drainage, sewerage and other needed improvements and utilities, open space for parks and playgrounds, etc.

NYRWA recommends that subdivision regulations in Rochester should be amended to optimize protection of ground water resources. In § 125-13 Plats and documents for conditional approval, the following elements should be included:

- Location of any existing wells onsite and other proposed lot wells in relation to: local topography, lot lines, roads, on-site sewage system components or sewer lines, petroleum storage tanks, surface water and other drainage features, stormwater conveyance systems, and other applicable features.
- Copies of New York State Department of Environmental Conservation Well Completion Reports for completed well(s) (including the well log and pump test data).
- Any and all water quality testing results.
- Proposed individual water supply system details such as pumps, storage, treatment, controls, etc.
- A completed hydrogeological study, if required.

Such details should be in the plats and documents for final approval as well.

A hydrogeological study should be required for any new subdivision involving ten (10) or more lots that relies upon either on-site ground water withdrawals and/or on-site sewage disposal. A hydrogeological study should also be performed for any new subdivision involving five (5) or more lots that relies upon on-site ground water withdrawals and overlies a Low Well Yield Area identified in this document. Proposed requirements for a hydrogeological study are indicated in Appendix C.

Finally, a new section entitled Wells should be added to ARTICLE V, Subdivision Design Standards. This section should specify the following:

A. Well locations. Existing and proposed wells are located at minimum separation distances from on-site and off-site potential sources of contamination as specified in Appendix 5-B of 10 NYCRR Part 5.

B. Supply suitability. A representative number of well(s) indicate that the available quantity and quality of on-site groundwater resources are suitable for household purposes.

C. Adverse impacts. For proposed subdivisions requiring a hydrogeological study, the determination has made that the subdivision avoids adverse impacts to existing or future groundwater users and/or surface waters within 1,500 feet of the subdivision. If adverse impacts cannot be avoided, the applicant must provide adequate mitigation of such impacts.

Within § 125-4 Definitions, adverse impacts should be defined. An adverse impact to ground water can be defined as any reductions in ground water levels or changes in ground water quality that limit the ability of a ground water user to withdraw ground water. An adverse impact to surface water would be any reductions in the level of flow or water quality needed for beneficial uses such as protection of fish and wildlife habitat, maintenance of waste assimilation, recreation, navigation, cultural and aesthetic values, drinking water supply, agriculture, electric power generation, commercial, and industrial uses.

Rochester's subdivision regulations can also be written to encourage the use of so-called conservation subdivisions. The neighboring Town of Marbletown has produced local laws dealing with conservation subdivisions. A conservation subdivision is essentially a cluster-type development that is planned around the open space protection of conservation areas. These conservation areas can include areas that are regulated such as wetlands and floodplains as well as other elements such as steep slopes, mature woodlands, prime farmland, meadows, wildlife habitats, stream corridors, historic and archeological sites, scenic views, and of course groundwater recharge areas. Conservation subdivisions also use the similar principles of low-impact development and better site design. In the case of the ground water, the guiding design standard is to maintain or replicate the predevelopment hydrologic functions of storage, infiltration, and ground water recharge. This can be done by using stormwater retention and detention areas, reducing impervious surfaces, lengthening flow paths and runoff time, and preserving environmentally sensitive site features.

Low-impact development and better site design are primarily stormwater management concepts. Wastewater management is also a very important consideration. On-site septic systems recharge ground water. Properly located, installed, and operated on-site septic systems should be encouraged in order to return water to the subsurface. Sewers not only export wastewater away that can be recharged, they also export ground water and storm water as well since most sewers are prone to inflow from these sources.

Conservation subdivisions do pose a concern with respect to onsite wastewater disposal. By clustering homes on smaller lots, there is the possibility that the density of individual disposal systems will lead to excess nitrate loading. If individual disposal systems are planned, lot sizes must be appropriately sized to prevent loading. Alternatively, a small on-site centralized wastewater disposal facility could be constructed for the subdivision as long as it is carefully located with respect to ground water and surface water.

6.1.2 Site Plan Review

Site plan review is a local regulatory process that involves municipal review and approval of how development is to occur on a single parcel of land. In this way, site plan review differs substantially from subdivision regulations. Site plan review does not prohibit certain land uses. However, it does regulate how development will take place by specifying the arrangement, layout and design of the proposed use.

Local site plan review and approval requirements are currently part of the Town of Rochester Zoning Law (Chapter 140). Site plan approval by the Planning Board is required for certain uses as indicated in Article IX and the Schedule of Zoning Uses. In addition, any use that requires securing a special use permit must also submit a site plan for approval as indicated in Article VII, Conditional Uses Allowed by Special Use Permit. The required elements of a site plan currently include locations of all buildings, parking areas, traffic access and circulation drives, open spaces, and landscaping.

NYRWA recommends that the following site plan elements are also included:

- The proposed means of storage, distribution, use, treatment, and/or disposal of wastewater, other wastes, chemicals, etc.
- The proposed means of water supply, including if applicable an estimate of the total daily groundwater withdrawal rate;
- The location(s) of all public water systems and other groundwater users within 1,500 feet of the proposed development boundaries;
- A list of all petroleum, chemicals, pesticides, fuels and other hazardous substances/wastes to be used, generated, stored, or disposed of on the premises;
- A description of the pollution control measures proposed to prevent ground water or surface water contamination; and
- A statement as to the degree of threat to water quality and quantity that could result if the control measures failed.

NYRWA believes that submittal of a site plan *and* a hydrogeological study should be required for *any* proposed project in Rochester that has projected on-site groundwater withdrawals and/or on-site sewage disposal flows potentially equal to or exceeding an average of two thousand (2,000) gallons per day (gpd). This amount of flow would be during any single thirty (30)-day period. These types of projects could include, but are not limited to, recreational developments (golf courses, water theme parks, etc.), multi-family housing (apartments, condominiums, townhouses, etc.), industrial, or commercial developments. Proposed requirements for a hydrogeological study are indicated in Appendix C.

It is also proposed that site plan review be extended to certain proposed uses and activities within the Aquifer Protection Overlay District (see Appendix D).

The basis and standards for approval of a site plan (§ 140-35 and § 140-49) should include the following additional criteria:

- ❑ The proposed use has an adequate water supply in terms of quantity and quality to meet specified needs.

- The proposed use does not adversely impact existing or future groundwater users as well as surface waters within 1,500 feet of the site development boundary. If adverse impacts cannot be avoided, the applicant must provide adequate mitigation of such impacts.

An adverse impact to ground water would be defined similar that proposed for the Land Subdivision Regulations (see above).

6.1.3 Zoning

Zoning regulates land uses, the density of land uses, and the siting of development. For those communities with zoning, like Rochester, it can prove to be an effective means of water resource protection. There are a number of zoning techniques that are applicable to groundwater protection. One of these techniques is minimum lot size. As discussed before, an individual lot must be sufficiently large to supply on-site groundwater needs and adequately dilute effluent introduced from the site's septic system. NYRWA has calculated minimum lot sizes based upon groundwater recharge rates in Rochester. These calculations are found in Appendix B. NYRWA recommends that minimum lot size for on-site sewer and wells range from 2 to 5 acres (see Figure 15). Currently, the minimum lot size in Rochester's zoning is only ½-acre to 1-acre.

Perhaps the most widely accepted zoning technique for water resource protection involves overlay zoning. Overlay zoning creates a set of regulations for a given area that are in addition to the regulations in the standard "underlying" zoning districts. The area that is covered by overlay zoning depends upon the particular resource to be protected. Examples of overlay zoning are for waterfront areas, flood plains, historic areas, steep slopes, and sensitive environmental areas such as wellhead protection areas, watersheds, and groundwater recharge areas. Overlay zoning regulations frequently define what additional uses are prohibited, what the bulk and area regulations exist in the overlay zone, and what design standards apply.

NYRWA has mapped a proposed Aquifer Protection (AP) Overlay District for the Town of Rochester (see Figure 16). The criteria used to delineate the AP overlay included those areas overlying either the Rondout Valley Unconsolidated Aquifer System or the Karst Aquifer System. Median well yields in this area exceed 10 gpm. Proposed regulations for the Aquifer Protection Overlay District are contained in Appendix D. These include prohibitions on certain high risk land uses, revised lot coverage restrictions, and additional site plan submittal, review, and approval requirements.

6.2 Environmental Review

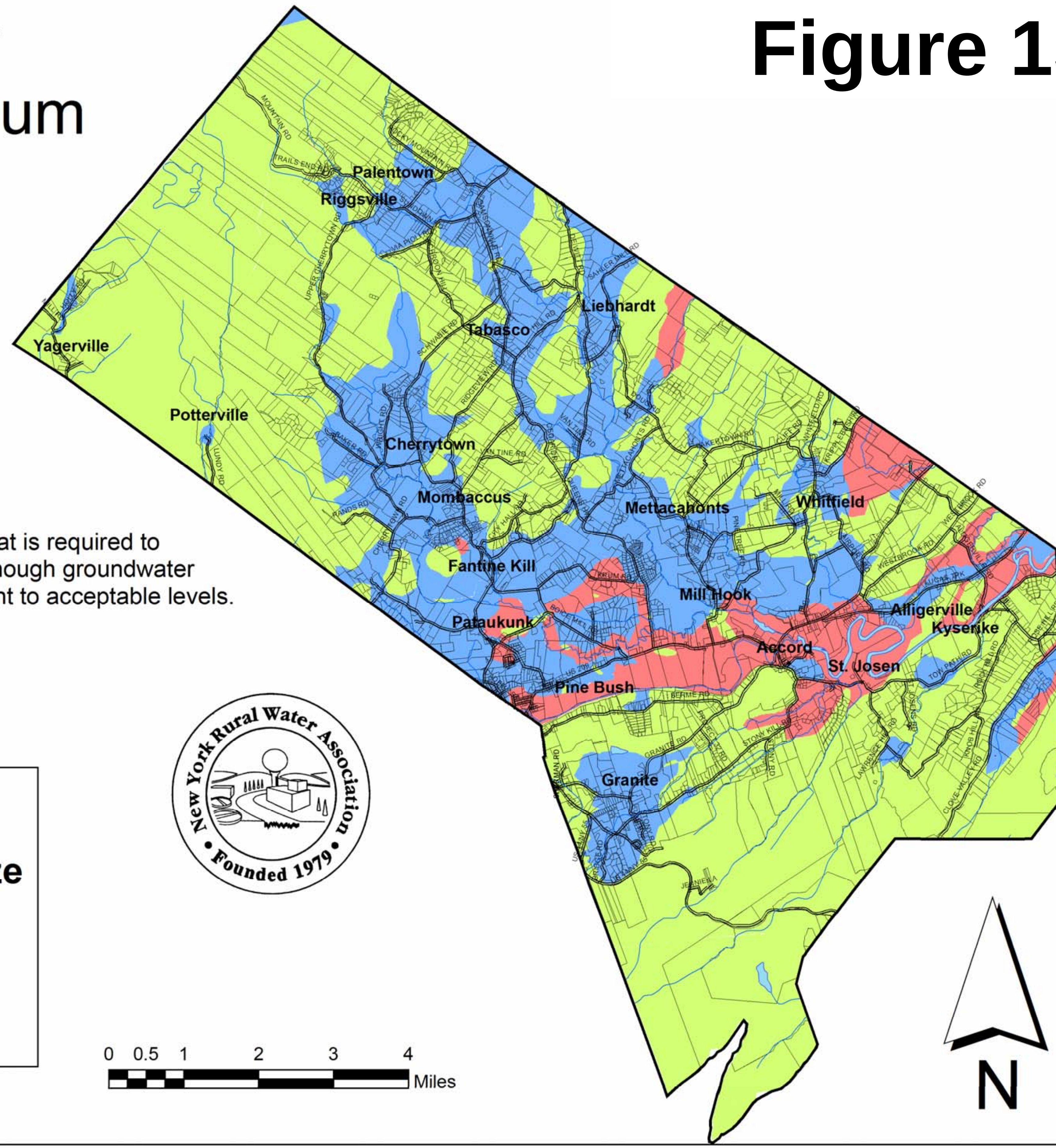
In New York, all state and local government agencies are required by the State Environmental Quality Review Act (SEQR) to consider environmental impacts prior to making decisions to approve, fund, or directly undertake an action. Types of decisions or actions that are subject to SEQR include approval or direct development of physical projects, planning activities that require a decision, and adoption of rules, regulations, procedures and

Figure 15

Town of Rochester Recommended Minimum Lot Sizes

by
Steven Winkley
New York Rural Water Association
2006

This map displays the recommended minimum lot size that is required to adequately supply a domestic water well and generate enough groundwater recharge to safely dilute onsite wastewater system effluent to acceptable levels.



Legend

Recommended Minimum Lot Size

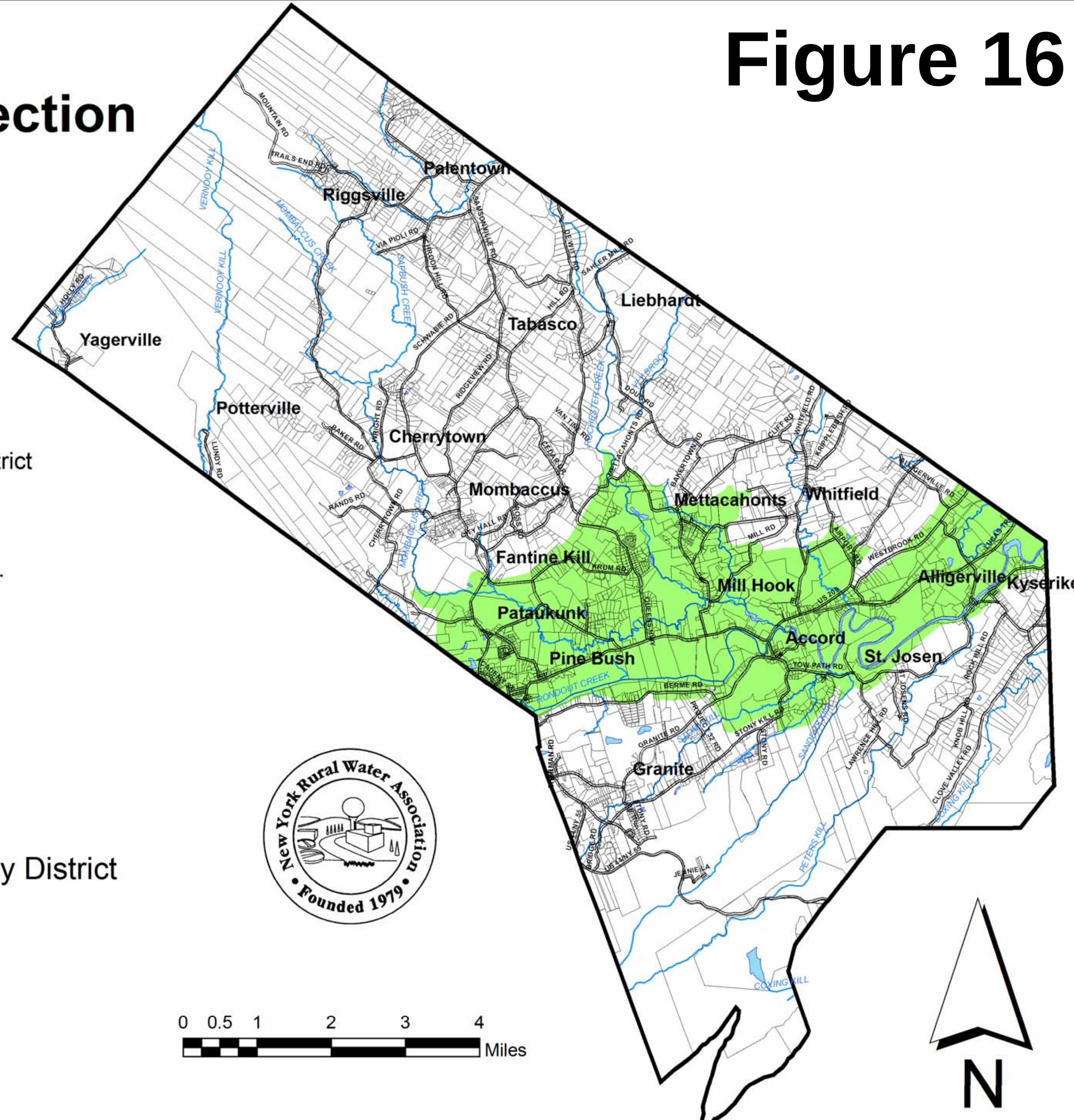
- 5 acres
- 3 acres
- 2 acres

Town of Rochester Proposed Aquifer Protection Overlay District

Figure 16

by
Steven Winkley
New York Rural Water Association
2006

This map represents the Aquifer Protection Overlay District as proposed by NYRWA. This area was delineated to consist of areas overlying the Rondout Valley Unconsolidated Aquifer System or the Karst Aquifer System. Median well yields in this area exceed 10 gpm.



Legend

Aquifer Protection (AP) Overlay District policies. Note that so-called Type II actions do not require environmental review because they either do not significantly impact the environment or are specifically precluded from environmental review under SEQR. However, all other so-called Type I or Unlisted Actions do require a determination of significance. If an action is determined to have potentially significant adverse environmental impacts, an Environmental Impact Statement (EIS) is required.

One way to insure that agencies take an area of critical environmental importance into account when making discretionary decisions is for a local municipality to designate a specific geographic area within its boundaries as a critical environmental area (CEA) under SEQR. Aquifer, watersheds, wetlands, etc. would meet the SEQR criteria for a CEA. The consequence of designating a CEA is that all government agencies (local or state) must consider the potential impact of any Type I or Unlisted Action on the environmental characteristics of the CEA when determining the significance of a project.

The Town of Rochester may wish to consider naming the Aquifer Protection (AP) Overlay District as critical environmental areas.

6.3 Direct Purchase or Purchase of Conservation Easements

In some instances, a community may wish to purchase the full interest in a particular parcel(s) in order to conserve its natural or scenic resources. A more common method of land preservation is the purchase of an interest in the land, called a conservation easement. The easement places deed restrictions on property uses to assure that the property is not developed in an inappropriate manner. Typical easements permit agriculture, forestry, recreation, etc. but restrict or prohibit industrial, commercial, and residential development.

Communities may purchase conservation easements or individuals can donate the easements and thus qualify for possible tax advantages. Alternatively, non-profit land trusts may purchase conservation easements or work with local governments to facilitate conservation easements.

6.4 Education

Public education can be an excellent non-regulatory tool to minimize potential contamination. There are several instances where education may be effective. These include:

- Educating homeowners on proper operation and maintenance of onsite wastewater treatment systems and wells;
- Encouraging the use of water saving devices within homes;
- Promoting natural landscaping and other lower demand vegetation;
- Educating homeowners on proper fertilizer/pesticide application rates and practices; and
- Supporting proper waste disposal (i.e. recycling).

6.5 Future Infrastructure Planning Areas

As communities such as Rochester experience growth, the issue of forming water and sewer districts sometimes becomes evident. One way to moderates the fears of excessive growth is to carefully plan new water or sewer districts to include only those areas where there are legitimate water quality or water quantity concerns. Such areas could include locales that have experienced contamination and/or are most susceptible to ground water contamination in the future. Such areas in Rochester include areas with more numerous potential sources of contamination, small lot size, and limited groundwater recharge rates. Such areas are thought to be more prone to water quality and quantity problems. There are three such areas in and around the hamlet of Accord that meet these criteria (see Figure 17).

The first area (Area 1) is in the actual hamlet of Accord along Stony Kill Road, Tow Path Road, and Granite Road to U.S. Route 209. Here, there are some 65 parcels with on-site septic systems and wells. Lot sizes range in size from 0.06 acres to 4.7 acres, averaging just 1.2 acres. This area should be considered the highest priority area given the lot size and intensity of use.

The second area (Area 2) is located around the intersection of U.S. Route 209 and Whitfield Road (see Figure 17). There are 53 lots here, averaging 2.4 acres in size. The third area (Area 3) is chiefly along the north side of U.S. Route 209 from Boice Mill Road to east of the intersection with the Mettacahonts Road (Figure 17). Here, there are over 40 parcels, averaging approximately 6 acres in size. Over ¼ of the lots here are commercial.

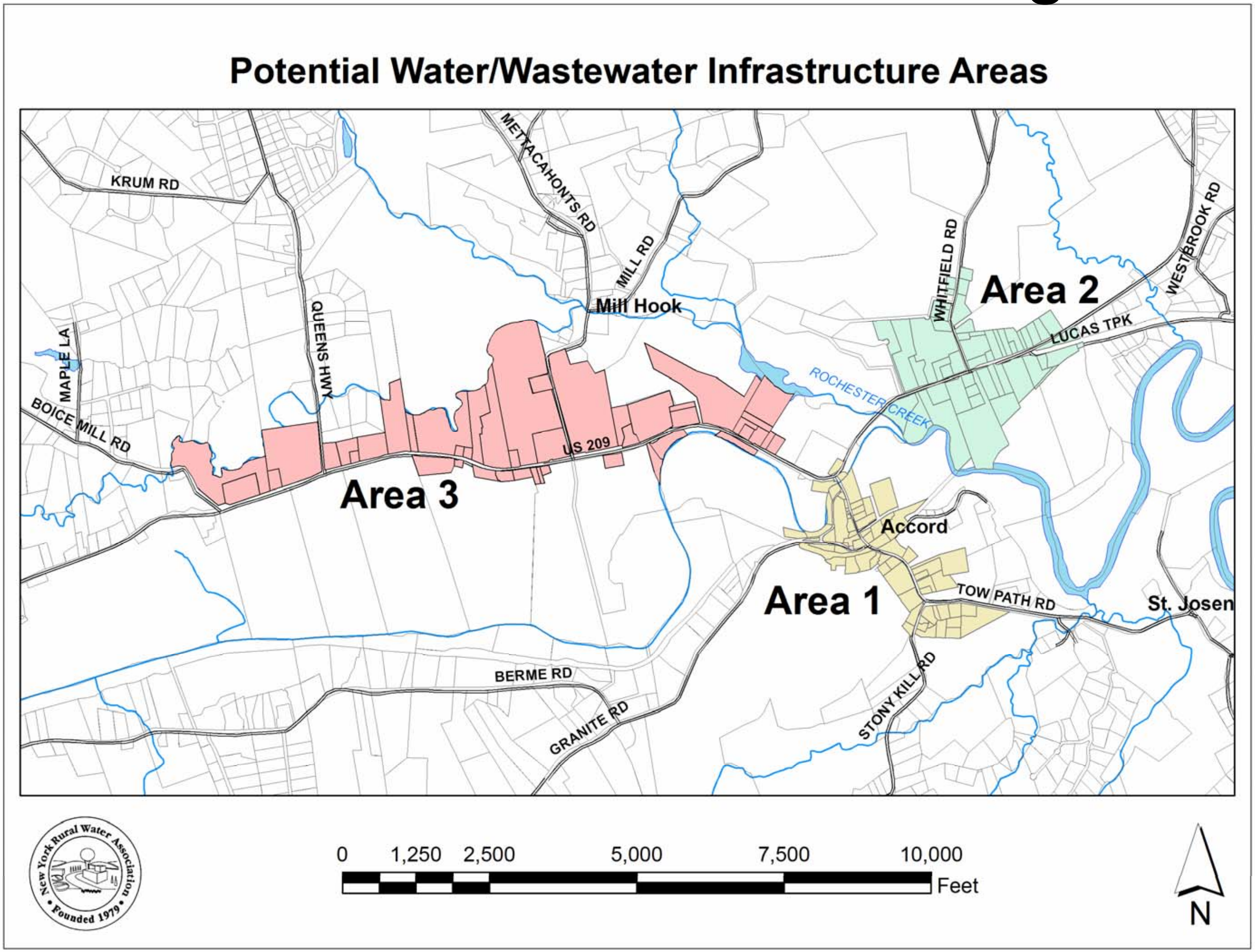
The Town may wish to survey residents in Accord hamlet to determine if there are water/wastewater issues. If so, a well testing program and/or sanitary survey of the area may be in order.

The water source(s) for any future water supply system(s) in the Accord area could conceivably be the Rondout Valley Unconsolidated Aquifer System, the Karst Aquifer System, or perhaps even flowing wells that are known to exist in the fractured Shawangunk Conglomerate south of the area (see Figure 3). The discharge location for any possibly wastewater system could conceivably be the Rondout Creek or its tributaries.

7.0 EMERGENCY PLANNING

Unfortunately, emergency situations affecting ground water do sometimes occur. One conceivable scenario involves petroleum/hazardous material spills and/or the discovery of contamination. As indicated before in this plan, numerous spills have occurred in the Town of Rochester. With the Route 209 corridor throughout the Town, the potential exists for accidents exists.

Figure 17


Potential Water/Wastewater Infrastructure Areas
KRUM RD
METTACAHONTS RD
MILL RD
WHITFIELD RD
WESTBROOK RD
Area 2
LUCAS TPK
Mill Hook
QUEENS HWY
MAPLE LA
BOICE MILL RD
ROCHESTER CREEK
US 209
Area 3
Accord
Area 1
TOW PATH RD
St. Josen
STONY KILL RD
BERME RD
GRANITE RD
0
1,250
2,500
5,000
7,500
10,000
Feet
N
New York Rural Water Association
Founded 1979

Under state law, all petroleum and most hazardous material spills must be reported to the DEC Hotline (1-800-457-7362. NYSDEC then informs other response agencies such as the local fire department if the spill poses a potential explosion and/or fire hazard and the health department if a drinking water supply is threatened as result of a spill. However, in most instances, the local municipality is not required to be notified. Nevertheless, it is important that the Town be notified if a spill is discovered within a sensitive drinking water resource area such as the proposed Aquifer Protection Overlay District.

Another emergency situation involving ground water is drought. Here in New York State we on average have ample precipitation. However, there are variations in weather patterns that result in periods of drier weather. Based upon data from the National Climatic Data Center, New York State regularly experiences moderate drought conditions every 2 to 5 years. These moderate droughts typically last for a few months. Of much more concern is the fact that we also experience severe to extreme droughts every 10 to 20 years. These can last nearly a year to over two years. During these periods of severe to extreme drought, many private wells with marginal yields may fail. The Town of Rochester may wish to have a plan in place in order to assist households or water systems in such difficulty. For example, the Town could help arrange that water tankers be brought in.

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APPENDIX A. RECHARGE RATE CALCULATIONS

Groundwater Recharge Estimates
Town of Rochester, NY

Rates of shallow groundwater recharge in Rochester have been estimated by NYRWA based on base flow estimates and mean annual runoff in the region. Base flow is the component of stream flow that can be attributed to groundwater discharge into streams. The commonly-held assumption is that water that discharges to a stream as base flow originated as local shallow groundwater recharge. The United States Geological Survey (USGS) has calculated a variable known as the base flow index (BFI) for the watersheds of each of its stream gages. BFI is the ratio of base flow to total flow, and values were computed using an automated hydrograph separation computer program called the BFI program. BFI values for current and historical USGS stream gages in the conterminous U.S. are available from Wolock (2003a).

Working in the Great Lakes Basin, Neff et al. (2005) developed an empirical relation between measured base flow characteristics at gaging stations and the surficial geologic materials in the surrounding drainage area. In this study, a value of BFI was assigned to each surficial geologic material. The BFI for the gage watershed was calculated by the following equation taken from Neff et al. (2005):

$$y_{g,i} = \sum_j A_{g,i,j} \, x_{g,j} \,,$$

where:

$y_{g,i}$ is the value of BFI for watershed i that results because of geological factors,
$A_{g,i,j}$ is proportion of geology class j within watershed i, expressed as a decimal between 0 and 1, and
$x_{g,j}$ represents ground-water discharge to the stream and is the value of BFI assigned to geology class j.

The value of BFI for each different surficial geologic material, x_{gj}, is indicated below from Neff et al. (2005):

Table 1. Values of $x_{g,j}$, the value of BFI assigned to geologic class j, used in equations 1 and 2 to calculate base-flow index used in this study.

Surficial-Geologic Material	$x_{g,j}$
Bedrock	0.78
Coarse-textured sediments	.89
Fine-textured sediments	.25
Till	.52
Organic sediments	.09

The surficial geologic materials for the Neff et al. (2005) study were taken from a 1:1,000,000-scale map of Quaternary deposits developed by Soller (1993) and digitized as Soller and Packard (1998). To test the BFI method, NYRWA initially used the values of x_{gj} from Neff et al. (2005) for the Soller and Packard (1998) mapping for the Rondout Creek watershed. Through iterative methods for the Rondout Creek watershed and surrounding region, the following mean values of x_{gj} for found:

Surficial Material	Geometric Mean x_{gj}
Bedrock & Till	0.41
Coarse-textured sediments	.78
Fine-textured sediments	.25

Note that due to the observed variability of the surficial mapping unit for shallow bedrock, areas underlain by till and shallow bedrock were combined. The values of x_{gj} closely corresponded to those of Neff et al. (2005). The smaller value of x_{gj} for bedrock & till compared with the findings of Neff et al. (2005) is likely due to the lower permeability of local till and bedrock, as compared with that found in the Great Lakes Basin.

Mean annual groundwater recharge can be calculated by multiplying a grid of local base flow index (BFI) values by a grid of mean annual runoff values. This approach is consistent with that of Wolock (2003b) to estimate mean annual natural groundwater recharge. The approach assumes that: (1) long-term average natural groundwater recharge is equal to long-term average natural ground-water discharge to streams, and (2) the BFI reasonably represents, over the long term, the percentage of natural groundwater discharge in stream flow. NYRWA constructed a grid of BFI values in Rochester using the detailed surficial geology dataset that was derived by NYRWA for the Town. A grid spacing of 10 meters was utilized. Note that in Rochester, coarse-grained stratified sediments were assumed to include alluvium, glaciolacustrine sand, ice-contact, and outwash deposits. Fine-grained stratified sediments were taken to include the glaciolacustrine silt & clay surficial unit. Mean annual runoff is long-term average stream flow expressed on a per-unit-area basis. A USGS GIS dataset by Cohen and Randall (1998) was used to define a grid of mean annual runoff across the Town. Note that annual runoff ranges from 30 inch/year in the Catskills of the northern portion of Town to 24 inch/year at the southern Town boundary.

The resulting grid of estimated mean annual groundwater recharge is depicted on Figure 7. The highest rates of groundwater recharge in Rochester (approximately 20 inches per year) can be found in glaciofluvial sand and gravel deposits. The lowest rates of groundwater recharge (approximately 6 inches per year) are found across the low-lying glaciolacustrine silt & clay sediments in Town.

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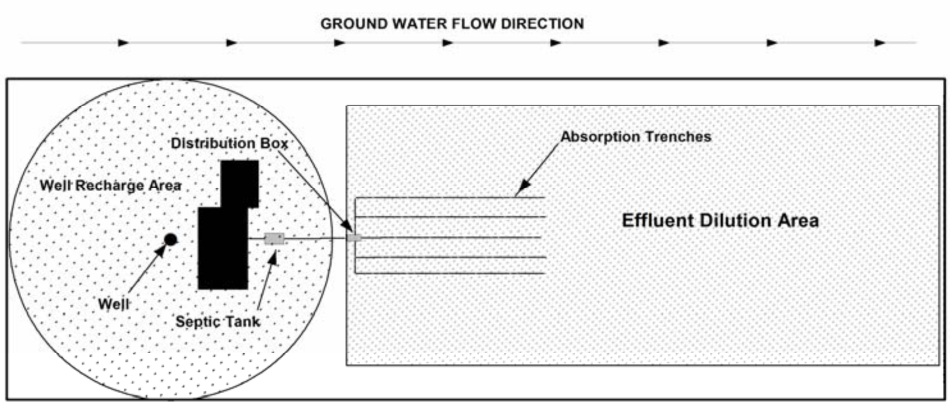
APPENDIX B. RECOMMENDED MINIMUM LOT SIZE CALCULATIONS

Calculations for Recommended Minimum Lot Size

The basis of the recommended minimum lot size is that the area of the lot must be sufficiently large to supply enough groundwater recharge to: (1) dilute the effluent from the lot's septic system effluent to acceptable levels; and (2) replenish the lot's water well without interference with other adjacent wells or the lot's septic system. This is illustrated in the figure below. Ideally, the lot enough so that the well's recharge area does not reach out and intersect the area needed to dilute the septic system's effluent.



The effluent dilution area can be calculated from an equation known as the modified Trela-Douglas nitrate dilution equation (Hoffman and Canace, 2001). This equation is:

$$R = 4.4186HM /(C_q A(1\text{-}0.179A^{-0.5708}))$$

Where: H equals persons per home;
M equals pounds per person per year
Cq is the target concentration in mg/L of nitrate-nitrogen;
A is the effluent dilution area in acres per home; and
R equals the groundwater recharge rate in inches per year.

Since A is difficult to directly solve for, various values of A are chosen in order to match the recharge rate, R, in the area. Note that the following constants are used:

H = 3 persons per home
M = 10 pounds per person per year
C_q = 5 mg/L (½ of the nitrate MCL).

The modified Trela-Douglas equation was solved using a Microsoft Excel spreadsheet program.

The approximate recharge area for an onsite well was determined by dividing the estimated annual pumpage (in ft^3/yr) by the groundwater recharge rate (ft/yr) in the area. A water consumption rate of 75 gallons per person per day was assumed, together with an average household of three individuals. As with the Trela-Douglas equation, the effects of impervious cover were taken into account using a relationship between estimated impervious cover and lot size that was developed by the Soil Conservation Service. The resulting necessary recharge area was calculated using a Microsoft Excel spreadsheet program.

The total minimum lot area is the sum of the necessary dilution area and the well recharge area. This is a conservative approach designed to minimize water quality and quantity effects arising from a housing development.

A summary of the calculated results for minimum necessary lot size for Rochester follow:

Recharge Rate (in./yr.)	Effluent Dilution Area (acres)	Well Recharge Area (acres)	Total Lot Area (acres)
6.32	4.54	0.63	5.17
6.45	4.45	0.61	5.06
6.50	4.41	0.61	5.02
6.57	4.37	0.60	4.97
6.63	4.33	0.60	4.93
9.64	3.04	0.44	3.48
10.05	2.92	0.43	3.35
10.37	2.84	0.41	3.25
10.58	2.78	0.41	3.19
10.66	2.76	0.41	3.17
10.78	2.74	0.40	3.14
10.86	2.72	0.40	3.12
11.27	2.62	0.39	3.01
11.68	2.54	0.38	2.92
12.10	2.45	0.37	2.82
12.51	2.38	0.36	2.74
19.73	1.56	0.25	1.81
20.12	1.54	0.25	1.79
20.28	1.52	0.25	1.77
20.51	1.50	0.25	1.75
20.67	1.49	0.24	1.73
21.45	1.44	0.24	1.68
22.23	1.40	0.23	1.63

The calculated minimum lot sizes fall into three main groups: Group 1 (1.63 to 1.81 acres); Group 2 (2.74 to 3.48 acres); and Group 3 (4.93 to 5.17 acres). For mapping and possible zoning purposes, the average Group 1 lot size was rounded to 2 acres, the average Group 2 lot size was rounded to 3 acres, and the average Group 3 lot size was rounded to 5 acres (see Figure 15).

APPENDIX C. PROPOSED REQUIREMENTS FOR A HYDROGEOLOGICAL STUDY

TOWN OF ROCHESTER
HYDROGEOLOGICAL STUDY REQUIREMENTS

SECTION 1.0 INTRODUCTION

Hydrogeological studies are required for certain development activities as specified below. The purposes of such hydrogeological studies are to: (1) assess the adequacy of the available groundwater supply to support the proposed development; and (2) evaluate the potential impacts for adverse impacts upon any nearby groundwater users and surface waters. Hydrogeological studies as set forth in this document are based on both on-site testing, and existing and readily available information.

Hydrogeological testing and evaluation shall be performed by a qualified consultant approved by the Town of Rochester Planning Board. Work shall be performed or directly supervised by a licensed or certified professional geologist who has related project experience in Ulster County. Alternatively, work may be performed or directly supervised by a licensed professional engineer who is experienced in performing groundwater studies and has related project experience in Ulster County. Where not specifically defined in this document, the methodology used for testing and evaluation shall follow generally accepted professional hydrologic and hydrogeologic practices and standards.

SECTION 2.0 APPLICABILITY

Hydrogeological studies are required for two general types of land development projects: (1) certain residential subdivisions utilizing on-site ground water and/or on-site sewage disposal; and (2) other types of development that utilize relatively large amounts of on-site ground water and/or dispose of a high volume of sewage on-site (see specific thresholds below).

A hydrogeological study must be performed for any new subdivision involving ten (10) or more lots that relies upon either on-site ground water withdrawals and/or on-site sewage disposal. A hydrogeological study must also be performed for any new subdivision involving five (5) or more lots that relies upon on-site ground water withdrawals and overlies a Low Well Yield Area identified in the Town of Rochester Groundwater Protection Plan prepared by New York Rural Water Association. Eight (8) copies of a hydrogeological study for such a subdivision must be submitted to the Town of Rochester Planning Board in conjunction with submission of the preliminary plat. The hydrogeologic study must be formally approved prior to approval of the preliminary plat.

A hydrogeological study is also required for any type of proposed development project with on-site groundwater withdrawals and/or on-site sewage disposal flows potentially equal to or exceeding an average of two thousand (2,000) gallons per day (gpd) during any single thirty (30)-day period. These types of projects could include, but are not limited to, recreational developments (golf courses, water theme parks, etc.), multi-family housing (apartments, condominiums, townhouses, etc.), industrial, or commercial developments. Ten (10) copies of a hydrogeological study for such a development project is required to be submitted to the Town of Rochester Planning Board as part of the site plan review process indicated in the Town’s zoning regulations.

SECTION 3.0 BACKGROUND EVALUATION

A background evaluation and analysis of the regional and site specific hydrogeologic conditions should be conducted using readily available existing resources such as publications and/or data from the U.S. Geological Survey, U.S. Environmental Protection Agency, U.S. Department of Agriculture's Natural Resources Conservation Service (formerly the Soil Conservation Service), New York State Geological Survey, New York State Department of Environmental Conservation, New York State Department of Transportation, New York State Department of Health, Ulster County Health Department, etc. At a minimum, the evaluation shall include the area within approximately one (1) mile beyond the project boundary.

The evaluation and analysis shall include the following:

- Topographic information from USGS mapping and other sources.

- Property maps, aerial photographs, and land use data (for example from real property classifications).

- Geologic maps and data reports (well logs, water quality analyses, geologic information, soils data, etc).

- Existing well data and descriptive statistical summary of the same (e.g. minimum, maximum and mean of well data, etc.)

- Existing research reports, hydrogeologic reports, etc.

- Locations and identifications of all wells within a minimum of 1,500 feet of the proposed development boundaries, including public water supplies.

- Existing and potential contaminant sources of record or those observed on site and within a minimum of 1,500 feet of the project site boundary. An attempt shall be made to verify sources of record by field reconnaissance.

- Preliminary field verification of existing geologic information including rock outcrops, bedrock fractures, karst features, linear features, photo linears, etc.

- At sites with bedrock outcrops, fracture orientations (strike and dip measurements) shall be measured and documented in the report. The number and orientations of linear features or photo lineaments shall be analyzed and correlated with documented bedrock fractures.

- Evaluation of the site hydrogeology and the occurrence, quality, and quantity of ground water.

SECTION 4.0 TESTING REQUIREMENTS

Section 4.1 Water Supply Testing for Applicable Subdivisions

A. Wells

1. The applicant must submit a plan to the Town of Rochester Planning Board showing the locations and construction details of proposed test wells. The Town of Rochester may approve, approve with conditions, reject, or request more information within 45 days of receipt of such a well plan.

2. Well construction and testing shall be performed by a certified water well contractor (NYS Environmental Conservation Law 15-1525) in accordance with Appendix 5-B of 10 NYCRR Part 5 (Standards for Water Wells).

3. Pumping tests should be conducted during a period of time of average or below average seasonal stream flow conditions (typically not during the months of March, April, and May).

4. Where individual wells are proposed for each lot, test wells shall be installed and tested on at least twenty percent (20%) of the proposed lots and on at least forty percent (40%) of the lots having a portion of the lot situated in a Low Well Yield Area identified in the Town of Rochester Groundwater Protection Plan prepared by New York Rural Water Association. The purpose of these wells is to provide evidence that the hydrogeologic system is capable of furnishing and sustaining the potable water needs of the proposed development.

5. Test wells may be used as designated lot wells if they meet all requirements of Appendix 5-B of 10 NYCRR Part 5 (Standards for Water Wells).

6. For wells that will be used for public water systems, all test wells shall also be located, constructed, and protected in accordance with Appendix 5-D of 10 NYCRR Part 5 (Special Requirements for Wells Serving Public Water Systems) as well as other applicable portions of Subpart 5-1 of 10 NYCRR.

7. Where individual wells are proposed for each lot, test well locations should provide a representative geographic distribution across the proposed subdivision.

8. Where individual wells are proposed for each lot, test well sites shall include wells in each bedrock and/or unconsolidated geologic unit in which wells are proposed.

9. Where individual wells are proposed for each lot, test wells shall be situated in each topographic setting that wells are proposed on the subdivision (i.e. high areas, low areas, sloping areas, etc.).

10. Where individual wells are proposed for each lot, an adequate number of test wells should be installed on adjacent lots in the proposed subdivision in order to evaluate potential adverse impacts to adjacent wells.

11. If there are existing, off-site wells within 1,000 feet of the subdivision, test well(s) should be located in order to evaluate the potential for adverse impacts to these existing wells.

12. If any portion of the subdivision is located within 100 feet of a surface water body or wetland, and individual wells are proposed for each lot, at least one well should be located between 25 and 100 feet of such surface waters in order to determine potential adverse impacts and groundwater quality issues.

13. A well log must be submitted to the Town for each well drilled, along with a copy of the New York State Department of Environmental Conservation Well Completion Report.

14. Where individual wells are proposed for each lot, physical or chemical alteration of geologic materials or structures (e.g., hydraulic fracturing, use of explosives, or addition of chemicals) to increase yield of test wells will not be permitted prior to the pumping test.

B. Formation Sampling

1. During all drilling, representative samples shall be collected for each unconsolidated and consolidated geologic formation encountered. The applicant shall retain these samples and provide them to the Town if requested.

2. A well driller certified in accordance with NYS Environmental Conservation Law (ECL) 15-1525 or a certified/professional geologist shall complete and submit to the Town a well log for each test well constructed for the investigation. The log shall describe materials encountered during drilling (unconsolidated and consolidated materials), and indicate the depth below ground surface of each material change. The log should be indicated on the New York State Department of Environmental Conservation Well Completion Report.

C. Pumping Tests

1. The applicant must submit a plan to the Town of Rochester Planning Board showing the wells that are to be pump tested, along with water level monitoring locations, surface water bodies and wetlands, possible pumping rates, discharge locations, schedules, and laboratory water quality testing details. The Town of Rochester may approve, approve with conditions, reject, or request more information within 45 days of receipt of such a testing plan.

2. No pumping should be conducted at or near the test well site for at least 24 hours

prior to the test.

3. A pumping rate shall be used that reasonably stresses the aquifer but does not result in excessive drawdown in the well. The minimum acceptable pumping rate for the test shall be two (2) gallons per minute. However, a water well that yields a pumping rate of at least 5 gallons per minute is usually necessary to safely meet peak and daily needs of most residences.

4. A test pump capable of providing a minimum of 2 to 5 gallons per minute at the required head must be used to perform the test. Any pump failure must have no significant effect on the data or a similar termination and restart is necessary.

5. The pumping rate shall be measured using a flow meter installed in the discharge line along with a control valve. The flow meter shall be calibrated at the beginning of the pumping period (all calibration measurements shall be recorded). The discharge flow rate shall be monitored and recorded at least once every 15 minutes during the first hour of the test and every 60 minutes thereafter.

   For relatively low flow rates, (< 5 gallons per minute), the flow rate may be obtained by determining the time required to fill a container of known volume (e.g., a 5-gallon bucket). The number of seconds/minutes to fill the container and the exact time of day shall be recorded.

6. The pumping test should include a minimum four-hour period of stabilized drawdown while pumping occurs at a constant flow rate. During the period of stabilized drawdown the stabilized water level shall not fluctuate more than plus or minus 0.5 foot (i.e., within a vertical tolerance of one foot) for each 100 feet of water in the well (i.e., initial water level to bottom of well) over the duration of constant flow rate of pumping. During the duration of constant flow rate pumping, the pumping rate shall not vary by more than 10 percent.

7. Water level measurements must be made to the nearest 0.01 foot. Preferred measurement methods include electronic sensors and pressure transducers.

8. Water level measurements in the pumping well and in at least two (2) of the closest available test wells are required immediately before the start of the test and during the pumping test at the following intervals:

Time After Pumping Started	**Time Intervals**
0 to 15 minutes	5 minutes
15 to 120 minutes	15 minutes
120 to 360 minutes	30 minutes

Note that <u>all</u> wells within a minimum distance of 500 feet of the pumping well shall be monitored, including any off-site wells (if practicable).

9. The water height of any bodies of water within 500 feet of the pumping well shall be monitored prior to the test, hourly during the pumping test, and at the end of the recovery period (see item 11).

10. Water discharged from the pumping well must be discharged a sufficient distance from the pumping well and other measured wells to avoid possible impacts from re-circulating the water. The water should be discharged to a drainage ditch or swale that will direct the water away from the well(s) if possible. If necessary, a temporary water storage tank can be used.

11. Upon completion of the pumping portion of the test, water level measurements should be recorded at the pumped well until the water level recovers back to at least 90 percent of the initial water level or for a period of 24 hours, whichever occurs first. If the water level does not recover to 90 percent of the initial water level after 24 hours, the tested flow rate may not be sustainable for an extended period of time.

12. A check valve must be installed at the base of the pump column pipe in the pumping well to eliminate backflow of water into the well during the recovery period.

13. For public water systems, all test wells shall be tested in accordance with Appendix 5-D of 10 NYCRR Part 5 (Special Requirements for Wells Serving Public Water Systems) as well other applicable portions of Subpart 5-1 of 10 NYCRR. In addition for community water systems, pump tests will follow NYSDEC Appendix 10, TOGS 3.2.1 (Recommended Pump Test Procedures for Water Supply Applications).

D. Laboratory Testing for Water Quality.

1. Water quality samples should be collected at the conclusion of the pumping test.

2. Water quality samples should be analyzed for the following: coliform bacteria, lead, nitrate, nitrite, iron, manganese, sodium, chloride, pH, hardness, sulfate, alkalinity and turbidity.

3. Additional tests for petroleum products or solvents may be necessary if the pumping well is located in the vicinity of a spill, petroleum storage facility, or other similar land use.

4. Tests for hazardous substance list metals, PCBs, and pesticides may be necessary if the pumping well is located adjacent to a landfill, junkyard, etc.

5. Analyses for specific chemicals may be necessary if the pumping well is located near an industry that stores and/or uses particular chemicals.

6. For public water systems, all test wells shall be tested for water quality in accordance with Subpart 5-1 of 10 NYCRR including Appendix 5-D of 10 NYCRR Part 5.

Section 4.2 Water Supply Testing For Other Developments with Groundwater Withdrawals and/or On-Site Sewage Disposal Flows ≥ 2,000 GPD

A. Geology

1. During all drilling, representative samples shall be collected for each unconsolidated and consolidated geologic formation encountered. The applicant shall retain these samples and provide them to the Town if requested.

2. A well driller certified in accordance with NYS Environmental Conservation Law (ECL) 15-1525 or a certified/professional geologist shall complete a well log for each test well constructed for the investigation. The log shall describe materials encountered during drilling (including unconsolidated materials), and indicate the depth below ground surface of each material change. The log should be indicated on the New York State Department of Environmental Conservation Well Completion Report.

B. Wells

1. The applicant must submit a plan to the Town of Rochester Planning Board showing the locations and construction details of proposed test wells. The Town of Rochester may approve, approve with conditions, reject, or request more information within 45 days of receipt of such a well plan.

2. Well construction and testing shall be performed by a certified water well contractor (NYS Environmental Conservation Law 15-1525) in accordance with Appendix 5-B of 10 NYCRR Part 5 (Standards for Water Wells).

3. For water wells that will serve a public water system, the location, protection, construction, yield, etc. of such wells shall be in accordance with Appendices 5-D and other applicable portions of Subpart 5-1 of NYCRR Title 10.

4. A well log must be submitted to the Town for each well drilled, along with a copy of the New York State Department of Environmental Conservation Well Completion Report.

C. Pumping Tests

1. The applicant must submit a plan to the Town of Rochester Planning Board showing the wells that are to be pump tested, along with water level monitoring locations, surface water bodies and wetlands, possible pumping rates, discharge locations, schedules, and laboratory water quality testing details. The Town of

Rochester may approve, approve with conditions, reject, or request more information within 45 days of receipt of such a testing plan.

2. A pumping test shall be performed on each well that is to be utilized by the proposed development in order to determine that the water supply adequately meet the needs of the applicant without adversely affecting others who may rely on the same aquifer.

3. For public water systems, all pumping tests shall be conducted in accordance with Appendix 5-D of 10 NYCRR Part 5 (Special Requirements for Wells Serving Public Water Systems) as well other applicable portions of Subpart 5-1 of 10 NYCRR. In addition for community water systems, pump tests will follow NYSDEC Appendix 10, TOGS 3.2.1 (Recommended Pump Test Procedures for Water Supply Applications).

3. Pumping tests should be conducted during a period of time of average or below average seasonal stream flow conditions (typically not during the months of March, April, and May).

4. No pumping should be conducted at or near the test well site for at least 24 hours prior to the test.

5. Pumping tests should be done when nearby wells normally in operation are running. Pumping of such other wells in the test area should be monitored.

6. A test pump capable of providing the design flow rate at the required head must be used to perform the test. Any pump failure must have no significant effect on the data or a similar termination and restart is necessary.

7. The pumping rate shall be measured using a flow meter or circular orifice weir installed in the discharge line along with a control valve. The flow meter or weir shall be calibrated at the beginning of the pumping period (all calibration measurements shall be recorded). The discharge flow rate shall be monitored and recorded manually at least once ever 15 minutes during the first hour of the test and every 1 to 4 hours thereafter.

   For relatively low flow rates, (< 5 gallons per minute), the flow rate may be obtained by determining the time required to fill a container of known volume (e.g., a 5-gallon bucket). The number of seconds/minutes to fill the container and the exact time of day shall be recorded.

8. The pumping test(s) shall be conducted at a pumping rate at least equal to the design pumping rate. If multiple wells are to be pumped simultaneously to achieve the necessary yield, the test should incorporate such a pumping plan.

9. Water discharged from the pumping well must be discharged a sufficient distance from the pumping well and other measured wells (minimum 200 feet) to avoid

possible impacts from re-circulating the water. The water should be discharged to a drainage ditch or swale that will direct the water away from the well(s) if possible.

10. Water from the pumping well cannot be discharged into any water body or wetland if such discharge results in turbidity or erosion leading to turbidity or down stream flooding. If it is anticipated that discharged water will create flooding, erosion and/or turbidity, water must be directed to a holding area and released in a controlled manner to prevent such problems.

11. The selected pumping rate shall not vary by more than ten (10) percent during the test. Pumping rates should be frequently measured and recorded, following the schedule of the water level measurements (see below).

12. Pumping tests shall be conducted for a minimum of 72 hours at a constant pumping rate. A minimum of six hours of stabilized drawdown must be displayed at the end of the test. Stabilized drawdown is defined as a water level that has not fluctuated by more than plus or minus 0.5 foot for each 100 feet of water in the well. If stabilized drawdown is not achievable, the test period may be extended or semi-log extrapolation of drawdown versus time (or other similar methods) may be employed to demonstrate the ability of the aquifer to supply a pumping rate equal to the desired yield.

13. Water level measurements must be made to the nearest 0.01 foot. Preferred measurement methods include electronic sensors and pressure transducers.

14. Periodic water level measurements in the pumping well and in the observation wells are required immediately before the start of the test and during the pumping test at the following intervals:

Time After Pumping Started	**Time Intervals**
0 to 15 minutes	1 minute
15 to 50 minutes	5 minutes
50 to 100 minutes	10 minutes
100 to 500 minutes	30 minutes
500 to 1000 minutes	1 hour
1000 to 5000 minutes	4 hours

15. At least three (3) observation wells should be monitored on-site during the pumping test. Note that all site wells shall be monitored, as well as any off-site wells within 1,000 feet (if practicable). Observation wells should be located at varying distances from the pumping well in order to characterize the well's zone of pumping influence. Observation wells should be large enough to allow

accurate and rapid measurement of the water levels. Observation wells should be screened in, or open to, the same formation as the pumping well.

16. The water height of any bodies of water within 1,000 feet of the pumping well shall be monitored before the pumping test, every four hours during the test, and at the end of the recovery period (see item 17).

17. Water level measurements should be collected during the recovery period for all wells using the same procedure and time pattern followed at the beginning of the pump test (see item 14). Measurements at the pumping well should continue for at least 24 hours or until the well recovers to 90 percent of the original water level.

18. A check valve must be installed at the base of the pump column pipe in the pumping well to eliminate backflow of water into the well during the recovery period.

19. Rainfall should be measured to the nearest 0.01 inch and recorded for one day preceding the pump test, during the test, and during the recovery period.

D. Laboratory Testing for Water Quality.

1. Water quality samples should be collected at the conclusion of the pumping test.

2. Water quality samples should be analyzed for the following: coliform bacteria, lead, nitrate, nitrite, iron, manganese, sodium, chloride, pH, hardness, sulfate, alkalinity and turbidity.

3. Additional tests for petroleum products or solvents may be necessary if the pumping well is located in the vicinity of a spill, petroleum storage facility, or other similar land use.

4. Tests for hazardous substance list metals, PCBs, and pesticides may be necessary if the pumping well is located adjacent to a landfill, junkyard, etc.

5. Analyses for specific chemicals may be necessary if the pumping well is located near an industry that stores and/or uses particular chemicals.

6. For public water systems, all test wells shall be tested for water quality in accordance with Subpart 5-1 of 10 NYCRR including Appendix 5-D of 10 NYCRR Part 5.

SECTION 5.0 REPORTING REQUIREMENTS

The detailed hydrogeologic report shall include, at a minimum, the items described below. Note that the all data shall be organized by either "type" (well completion reports, pumping test data and analyses, water quality reports, etc.) or by well, in tabbed appendices clearly marked showing the content of the tabbed section.

A. Description of the Proposed Development

The proposed development project must be summarized including information on property acreage; projected water demand; means of wastewater disposal; stormwater runoff control; parking areas and other impervious surfaces; fuel storage; and the number, size and distribution of proposed residential lots (if applicable).

B. Discussion of Site and Regional Hydrogeology

A written discussion of the site and regional hydrogeology shall be included. Items to be included in this discussion include:

1. Geologic setting;
2. Local drainage and watershed(s);
3. Lateral and vertical distribution of local unconsolidated and consolidated hydrogeologic units as well as their hydraulic properties;
4. Land surface elevation and relief;
5. Occurrence and flow characteristics of surface water and ground water;
6. The relationship between local ground water and surface water;
7. Well yield and depth data;
8. Local groundwater use and quality; and
9. Known or potential contamination sources.

Appropriately-scaled maps and cross-sections should be used to depict the hydrogeologic setting (see below).

C. Maps

A set of maps at appropriate scales covering the proposed development should be enclosed. The maps shall contain all existing planimetric features, topography, all proposed roads, proposed lot lines, proposed lot sites, proposed house sites, proposed septic systems, surface water features, proposed and existing wells, bedrock outcrops, karst features, linear features, springs, hydrogeologic units, etc. In addition, map(s) of static groundwater elevations shall be illustrated, along with maps showing drawdown contours and pumping groundwater elevations.

D. Cross-Sections

The report shall contain one or more cross-sections, at true horizontal scale and vertical scale (exaggerated as appropriate). The location of each cross-section shall be shown on the plan view map(s) and the cross-section shall contain the following information:

1. Geologic data including bedrock contacts and structural features if present.
2. Well site locations showing well casings, total depths, and specific capacities.
3. Elevations of ground surface, bedrock depths, and static water surfaces.
4. Final water level in each pumped well and observation well(s) at the end of the pumping tests with the corresponding pumping rate of the well.

E. Well Completion Reports

For each well drilled for the investigation, a New York State Department of Environmental Conservation Well Completion Report will be completed and enclosed. This will include a log of materials encountered that is completed by a certified well driller or a licensed/certified professional geologist. Well construction details will also be noted on each Well Completion Report, including the well number, date of construction, well location coordinates (lat/long, UTM, or State Plane), land surface elevation, total depth, well casing depth, grout depth, bentonite seal thickness, top and bottom of well screen, height of casing above land surface, static water level and date, etc.

F. Well Construction Summary

For all wells constructed for the investigation, a summary table will be provided that includes, at a minimum, the well number, completion date, land surface elevation, well diameter, total well depth, well casing depth, screened interval (if applicable), depth to bedrock, static water level (all on the same date), well yield, and aquifer.

G. Well Testing Summary

In a separate table(s), well testing results shall be summarized, including at a minimum: the well number (and pumping well number if different); date tested; duration of pumping; pumping rate; pre-pumping (static) water level; maximum observed water level drawdown; distance to pumped well; percent of available drawdown used (assume maximum available drawdown is 40 feet above well bottom or use more stringent criteria if appropriate); specific capacity; transmissivity; storativity (if available); and time to achieve 90 percent recovery (or the percent recovery after 24 hours) in the pumped well. Note that the analytical method used to calculate the aquifer transmissivity and storativity should be noted. All pumping test data will be included in the appendices.

H. Groundwater Quality

For all wells tested for the investigation, provide a table summarizing the groundwater quality and include the maximum contaminant levels (MCLs) for each tested parameter. Copies of the laboratory reports shall be included in the appendices.

I. Water Balance

The report shall contain groundwater mass balance and recharge estimates for the area. Applicable calculations and references shall be included as well as assumptions and limitations of the methods used. The report shall include a discussion of the following information, including appropriate supporting calculations and diagrams, which shall include, at a minimum:

1. Identification of the source or sources of recharge, using recharge from rainfall for normal conditions and for drought conditions (assume 60% of average annual precipitation), and the average outflow from the development area.

2. Comparison of calculated recharge to projected withdrawals associated with the development.

J. Potential Impacts to Water Quality

The report shall contain an analysis of potential impacts to groundwater and/or surface water quality that may result from the development. For example, this could include a discussion of impacts from fuel storage, stormwater runoff, nitrate loading associated with septic system effluent, etc.

Calculations should be developed and discussed in the report to estimate the overall loading of inorganic nitrogen to ground water from the development's subsurface wastewater disposal systems (if applicable). In general, the nitrate entering the ground water can be computed for a given area by dividing the annual nitrate load from the area by the annual amount of groundwater recharge (see above). Both normal and drought conditions should be assumed. In order to prevent cumulative degradation of groundwater quality in the region, the resultant projected nitrate level in ground water at the project boundary should not exceed ½ of the MCL (5 mg/L).

K. Potential Impacts of Pumping

The report will present an analysis of the magnitude and extent of water level drawdown that will result from groundwater withdrawals at the project as well as an evaluation of potential impacts of drawdown on groundwater and surface waters within a minimum of 1,500 feet from the development boundary. This analysis will be developed using standard methods and will include an analysis of potential conditions during normal and drought periods. The possibility of other adverse affects of pumping such as altering the flow direction of groundwater from potential pollution sources, introducing zones of poor water quality, etc. must be discussed as well. For community water system wells, the zone contributing ground water (zone of contribution) for such wells must be delineated.

L. Suitability of Groundwater Resources

The consultant must prepare a preliminary written conclusion regarding the suitability of groundwater resources to support the proposed development. A comparison of projected water demands to available source capacity should be included. If applicable, mean and median yields of lot wells must be presented and compared to the 5 gallons per minute usually necessary to safely meet peak and daily needs of a typical residence. In addition, the possibility of wells on the remaining (non-tested) individual lots having inadequate yield must be discussed. Plans on how to overcome potential inadequacies must be addressed.

The adequacy of the development's drinking water quality should be evaluated. The possibility of contamination from on-site and off-site sources must be assessed. Any necessary treatment options should be identified.

M. Investigation and Mitigation Plan

The report must include a plan for investigating and mitigating existing water supply wells or surface waters in the event that either experience reductions in water level or water quality during and/or after construction of the development.

APPENDIX D. PROPOSED TEXT OF AQUIFER PROTECTION OVERLAY DISTRICT

AQUIFER PROTECTION OVERLAY DISTRICT

I. PURPOSE

The Aquifer Protection Overlay District is established to preserve the quality and quantity of the Town's groundwater resources in order to ensure a safe and adequate water supply for present and future generations; and to preserve groundwater resources currently in use and those aquifers having potential for a future use as a public water supply.

II. APPLICABILITY

The provisions of this section shall apply to all properties that lie within the area that is designated as an Aquifer Protection Overlay District, as defined herein, and delineated on the Official Zoning Map and a map entitled "Aquifer Protection Overlay District Map", and filed with the Town Clerk.

III. DEFINITIONS

For the purpose of this section, certain words and terms shall have the meanings as listed below:

Agronomic rate - The rate of nitrogen addition designed to provide the amount of nitrogen needed by the crop or vegetation grown on the land, and to minimize the amount of nitrogen that passes below the root zone of the crop or vegetation grown on the land to ground water.

Animal feeding operation - A lot or facility (other than an aquatic animal production facility) where animals have been, are, or will be stabled or confined and fed or maintained for a total of 45 days or more in any 12-month period, and the animal confinement areas do not sustain crops, vegetation, forage growth, or post-harvest residues in the normal growing season.

Aquifer - A geologic formation or deposit composed of bed rock or unconsolidated sediments that is capable of yielding significant amounts of ground water.

Aquifer Protection Overlay District - The areas identified as such on the Zoning Map and on the map entitled "Aquifer Protection Overlay District Map" based on the document by New York Rural Water Association entitled *"Groundwater Protection Plan for the Town of Rochester"*.

Bottled water - Any product, including natural spring or well water taken from municipal or private utility systems or other water, distilled water, de-ionized water or any of the foregoing to which chemicals may be added, which are put into sealed bottles, packages or other containers, to be sold for domestic consumption or culinary use, involving a likelihood of such water being ingested by human beings.

Bulk water - Water intended for potable uses, which is transported by tank trucks.

Concentrated animal feeding operation (CAFO) - An animal feeding operation that would be required to obtain a State Pollution Discharge Elimination System (SPDES) General Permit based upon the numbers and types of animals and/or method of animal waste discharge.

Contamination - The degradation of natural water quality as a result of human activities to the extent that its usefulness is impaired.

Disposal - The abandonment, discharge, deposit, injection, dumping, spilling, leaking, or placing by any other means of any solid waste, petroleum, radioactive material, hazardous substance, hazardous waste, or wastewater into or onto land or a surface water body.

Ground water - Water in the subsurface zone beneath the water table in which all pore spaces are completely saturated.

Hazardous substance- Any substance listed as a hazardous substance in 6 NYCRR Part 597, Hazardous Substance List, or a mixture thereof. In general, a hazardous substance means any substance which: (1) because of its quantity, concentration, or physical, chemical, or infectious characteristics poses a significant hazard to human health or safety if improperly treated, stored, transported, disposed of, or otherwise managed; (2) poses a present or potential hazard to the environment when improperly treated, stored, transported, disposed of, or otherwise managed; (3) because of it toxicity or concentration within biological chains, presents a demonstrated threat to biological life cycles when released into the environment.

Hazardous waste - A waste, or combination of wastes, which are identified or listed as hazardous pursuant to 6 NYCRR Part 371, Identification and Listing of Hazardous Wastes. Hazardous wastes include but are not limited to petroleum products, organic chemical solvents, heavy metal sludges, acids with a pH less than or equal to 2.0, alkalies with a pH greater than or equal to 12.5, radioactive substances, pathological or infectious wastes, or any material exhibiting the characteristics of ignitability, corrosivity, reactivity, or fails the Toxicity Characteristic Leaching Procedure (TCLP).

Impervious Surface - Any surface resistant to penetration by water, including but not limited to paving, concrete, asphalt, roofs, buildings, loading/unloading areas, decks, patios, and swimming pools, but not including dirt, crushed stone or gravel.

Petroleum - Any petroleum-based oil of any kind which is liquid at 20 degrees Celsius under atmospheric pressure and has been refined, re-refined, or otherwise processed for the purpose of: 1) being burned to produce heat or energy; 2) as a motor fuel or lubricant; or 3) in the operation of hydraulic equipment.

Process waste - Any waste generated by industrial, commercial, or mining operations that by virtue of some use, process, or procedure no longer meets the manufacturer's original product specifications.

Radioactive Material - Any material in any form that emits radiation spontaneously, excluding those radioactive materials or devices containing radioactive materials which are exempt from licensing and regulatory control pursuant to regulations of the New York State Department of Labor or the United States Nuclear Regulatory Commission.

Septage - The contents of a septic tank, cesspool, or other individual wastewater treatment work which receives domestic sewage wastes.

Sewage - The combination of human and household waste with water, which is discharged to the home plumbing system.

Sludge - The solid, semi-solid, or liquid waste generated from a waste processing facility, but does not include the liquid stream of effluent.

Solid Wastes - Any garbage, refuse, sludge from a wastewater treatment plant, water supply treatment plant, or air pollution control facility and other discarded materials including solid, liquid, semi-solid, or contained gaseous material, resulting from industrial, commercial, mining and agricultural operations, and from community activities.

Wastewater - Aqueous carried waste including, but not limited to, dredge spoil, solid waste, hazardous waste, incinerator ash and residue, septage, garbage, refuse, sludge, chemical waste, infectious waste, biological material, radioactive materials, heat, and commercial, industrial, municipal, and agricultural waste.

IV. GENERAL PROVISIONS

A. The provisions of this section are not intended to repeal, abrogate, or annul any portion of these regulations, existing state and federal regulations, or existing easements, covenants, or deed restriction. In any case where there is a conflict, whichever imposes the more stringent restrictions apply.

B. All uses that are permitted in the underlying zones shall be permitted in the Aquifer Protection Overlay District with the exceptions, restrictions, and requirements below.

V. LOT COVERAGE

A. In the Aquifer Protection Overlay District, the maximum amount of impervious surface area for proposed uses and activities shall not exceed fifteen (15) percent of the total area of the lot except for any impervious surface associated with an already approved one-family residential dwelling lot.

VI. PROHIBITED USES

A. The following uses and activities are specifically prohibited in the Aquifer Protection Overlay District in order to safeguard groundwater resources which serve as present or future drinking water supplies:

i. Asphalt, concrete, or coal tar plants.

ii. Chemical, biological testing, or research laboratories.

iii. Concentrated animal feeding operation(s) in an area outside of local agricultural district(s) created pursuant to New York State Agriculture and Markets Law.

iv. Drilling of wells used for oil, gas, gas storage, solution mining, or brine disposal.

v. Hazardous waste treatment, handling, storage, or disposal facilities.

vi. Junkyards, salvage yards, or impoundment yards.

vii. Landfills, dumps, and/or other solid waste management facilities.

viii. Manufacturing use(s) (including but not limited to food processing, animal or vegetable products, textile products, furniture, paper, chemicals, plastics, leather, machine shops, metal industries and shops, electrical/electronic equipment, wood preserving and treating, wood stripping and refinishing, and petroleum refining and manufacturing).

ix. Military installations.

x. Radioactive materials treatment, handling, storage, or disposal facilities.

xi. Regulated medical waste storage, treatment, disposal, and/or destruction facilities.

VII. SITE PLAN REVIEW AND APPROVAL IN AQUIFER PROTECTION OVERLAY DISTRICT

A. Requirements

i. Any of the following proposed uses or activities wholly or partially within the Aquifer Protection Overlay District shall be required to have site plan review and approval by the Planning Board prior to issuance of a building permit or certificate of occupancy:

a. Airports and/or airport maintenance areas.
b. Appliance or small engine repair shops.
c. Automobile repair and/or body shops.
d. Boat service, repair and washing establishments.
e. Bottled water or bulk water facilities (including supply sources).
f. Car washes.
g. Cemetery or crematoriums.
h. Cleaning services (dry cleaning, laundromat, or commercial laundry).
i. Fuel distributors.
j. Gasoline filling stations.
k. Golf courses.
l. Landscaping nurseries.
m. Mining operations.
n. Medical services (including dental/vet).
o. Mobile home parks.
p. Motels, hotel, bungalow colonies, camps, campgrounds, camping resorts, resort hotels, resort ranches, resort lodges, or travel trailer camps.
q. Multifamily residential dwellings including apartments, condominiums, row houses, town homes, continuing care facilities, etc.
r. Municipal sewage treatment facilities with onsite disposal of primary or secondary effluent.
s. Pest control services or pesticide/herbicide stores.
t. Photo processor/printing establishments.
u. Pipeline(s) that carry petroleum (other than natural gas) or hazardous substance/waste.
v. Surface land application facilities for septage, sewage, sludge, or human excreta except where permitted by NYSDEC for agricultural use.
w. Trucking or bus terminals.
x. Any use or activity not otherwise specifically mentioned with projected on-site groundwater withdrawals and/or on-site sewage disposal flows averaging two thousand (2,000) gallons per day (gpd) or more during any single thirty (30)-day period.
y. Any use or activity not otherwise specifically mentioned above that involves the on-site disposal of solid waste, petroleum, radioactive material, hazardous substances, process wastes, hazardous waste, or aqueous-carried waste (except sewage, animal manure and associated bedding material, and agricultural use of

food processing wastes where the waste is applied at or below agronomic rates).

ii. The Planning Board may require changes or additions to the site plan as a condition of approval to safeguard groundwater resources. No building permit and no certificate of occupancy shall be issued unless and until such conditions have been fully met or performed. All improvements to the site shall be completed in strict conformance with the site plan as approved.

iii. In addition to other information that may be required for a site plan submittal, the following information shall be provided for a proposed use or activity located partially or wholly within the Aquifer Protection Overlay District:

a. A location map of the proposed use or activity in relation to the Aquifer Protection Overlay District boundaries.

b. A map and report detailing the proposed conveyance, storage, distribution, generation, use, and/or treatment of any process wastes, aqueous-carried wastes (except sewage), petroleum, hazardous substances, hazardous wastes, solid waste, radiological substances, and/or incidental wastes.

c. A map and report detailing the proposed conveyance, storage, distribution, generation, use, treatment, and/or disposal of any stormwater and sewage including if applicable an estimate of the total daily flows. An application for any proposed use with projected on-site sewage disposal flows potentially equal to or exceeding an average of 2,000 gallons per day (gpd) during any single thirty (30)-day period .shall include a hydrogeological report prepared by a qualified hydrogeologist or engineer. This report shall be prepared in accordance with requirements for a hydrogeological study that are available for review at the Town of Rochester offices.

d. A list of all process wastes, aqueous-carried wastes (except sewage), petroleum, hazardous substances, hazardous wastes, solid waste, and radiological substances to be used, generated, and/or stored on the premises.

e. A description of all pollution control measures and activities proposed to prevent on-site disposal and potential contamination of groundwater or surface water, including spill response activities.

f. A statement as to the degree of threat to groundwater and surface water quality that could result if the control measures failed.

g. A description of the provisions for the off-site disposal of solid waste, petroleum, radioactive material, hazardous substances, hazardous waste, process wastes, and/or aqueous-carried waste (except sewage).

h. A description of the proposed means of water supply, including if applicable an estimate of the total daily groundwater withdrawal rate. An application for any proposed use or activity with projected on-site groundwater withdrawals potentially equal to or exceeding an average of 2,000 gallons per day (gpd) during any single 30 day period shall include a hydrogeological report prepared by a qualified hydrogeologist or engineer. This report shall be prepared in accordance with requirements for a hydrogeological study that are available for review at the Town of Rochester offices.

i. Copies of any permits and applications made to any other governmental agencies;

j. A completed short form SEQR Environmental Assessment Form (EAF);

k. Additional information or material that may be requested by the Planning Board in order to evaluate the site plan.

B. Approval Criteria

The following criteria shall be used by the Planning Board in reviewing applications for site plan review in the Aquifer Protection Overlay District and shall serve as minimum requirements for approval of the application pursuant to this section. The application shall not be approved unless the Planning Board determines that the applicant has met all of these standards. In all instances, the burden of proof shall be on the applicant who must produce evidence sufficient to warrant a finding that all applicable criteria have been met.

i. The proposed use or activity must comply with the regulations and requirements of the Aquifer Protection Overlay District.

ii. Adequate provisions must be made for the collection and disposal of all stormwater that runs off proposed roads, parking areas, roofs, and other surfaces such that it will not have an adverse impact on abutting or downstream properties.

iii. Filling, excavation and earth moving activity must be kept to a minimum. Natural vegetation must be preserved and protected wherever possible. Soil erosion and sedimentation of watercourses and water bodies must be minimized.

iv. The proposed use or activity must be located or designed in such a manner that it will not adversely impact the quantity of ground water available to existing or future wells within 1,500 feet of the proposed use or activity, including well water levels, aquifer water levels, and the levels of adjacent lakes, ponds, wetlands, or watercourses.

v. The proposed use or activity must be located or designed in such a manner that it will not adversely impact the quality of ground water available to existing or future wells within 1,500 feet of the proposed use or activity, including the quality of water that may be induced from adjacent lakes, ponds, wetlands, or watercourses.

vi. If adverse water quantity or quality impacts cannot be avoided, the applicant will provide adequate mitigation of such impacts.

vii. The proposed use has an adequate water supply in terms of quantity and quality to meet specified needs.

viii. The proposed use or activity must be designed with adequate control measures to prevent the on-site disposal of solid waste, pathological or medical waste, petroleum, radioactive material, hazardous substances, hazardous waste, or process waste, including aqueous-carried waste (except sewage). The adequacy of the proposed control measures must be evaluated in terms of their simplicity, reliability, and feasibility, as well as the degree of threat to public water supply wells and other wells in the event that the control measures failed.

ix. All handling and storage of solid waste, pathological or medical waste, petroleum, radioactive material, hazardous substances, hazardous waste, or process wastes must meet the standards of the New York Department of Environmental Conservation, and/or all applicable state or federal agencies.

x. The proposed use or activity must provide adequate provisions for the safe off-site disposal of solid waste, hazardous waste, process waste, and other wastes generated. All waste must be disposed of at a licensed disposal facility having adequate capacity to accept the use’s wastes.

xi. In the event of an on-site disposal (i.e. spill) of potential contaminants, the proposed use or activity must have adequate spill response and containment plans in place to minimize groundwater or surface water contamination.

APPENDIX E. GLOSSARY OF GEOLOGIC TERMS

GLOSSARY OF GEOLOGIC TERMS

Note: most terms are modified from Bates and Jackson (1984).

ALLUVIUM. Deposits of recent origin laid down by streams on river beds and flood plains.

AQUIFER. A body of rock or sediment that is sufficiently permeable and saturated to conduct ground water and to yield economically significant quantities of water to wells.

AQUIFER SYSTEM. Two or more aquifers that are separated at most locations by one or more confining units.

BASEFLOW. That part of stream flow attributed to groundwater discharge into the stream.

CONFINED AQUIFER. An aquifer bounded above and below by impermeable beds or by beds of distinctly lower permeability.

CONFINING UNIT. A body of impermeable or less permeable rock or sediment that restricts water flow from one aquifer to another.

CONGLOMERATE. A coarse-grained sedimentary rock composed of granules, pebbles, cobbles, boulders) set in a fine-grained matrix of and or silt and cemented together.

DEGLACIATION. The uncovering of an area from beneath glacier ice as a result of melting.

DELTA. The nearly flat area at the mouth of a river resulting from the accumulation of sediment supplied by the river.

FAULT. A fracture or fracture zone in rock along which there has been movement of the sides relative to one another.

FRACTURE. A crack, joint, fault, or other break in rocks.

GLACIOFLUVIAL DEPOSITS. Sediments laid down by meltwater streams flowing from glaciers.

GLACIOLACUSTRINE. Pertaining to, derived from, or deposited in glacial lakes.

GROUND WATER. Subsurface water that is in the zone of saturation.

HYDROSTRATIGRAPHIC UNIT. A mappable body of rock or sediment that is hydraulically connected or grouped together on the basis of similar hydrologic properties such as hydraulic conductivity and porosity. In general, each hydrostratigraphic unit acts as a reasonably distinct hydrologic system.

KARST. A type of topography that is formed by the dissolving of limestone, dolomite, or gypsum that is characterized by sinkholes, caves, and underground drainage.

LIMESTONE. A sedimentary rock containing chiefly of the mineral calcite.

PERMEABILITY. A measure of the rate at which water can move through rock or sediment.

PHYSIOGRAPHIC REGION. An area in which all parts are similar in geologic structure and climate and which has had a unified history related to surface features.

POROSITY. The ratio of the volume of the void spaces in rock or sediment to the total volume of the rock or sediment.

RECHARGE. The processes involved in the addition of water to the zone of saturation.

SHALE. A fine-grained sedimentary rock formed by the compaction of clay, silt, or mud.

STRATIFIED DRIFT. Sorted and stratified material deposited by a meltwater stream or settled from suspension in a body of water near a glacier.

SURFICIAL DEPOSITS. Geologic materials that are found at or near the land surface.

TERRACE. A relatively level surface breaking the continuity of a slope.

TILL. Unstratified, often dense material deposited directly from a glacier without reworking by meltwater, generally consisting of a mixture of clay, silt, sand, gravel, and boulders.

UNCONSOLIDATED DEPOSITS. A sediment that is loosely arranged or whose particles are not cemented together.

UNCONFINED AQUIFER. An aquifer that has a free water table and is not confined under pressure beneath relatively impermeable beds.

WELLHEAD PROTECTION AREA. The surface and subsurface area surrounding a well through which contaminants are reasonably likely to move toward and reach the water well.