Town of Minden Groundwater Resources Study

By

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New York Rural Water Association

(NYRWA)

Groundwater Resources Study Goals and Objectives

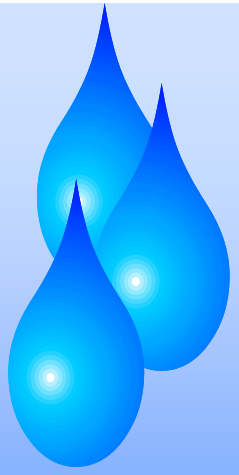
- Map groundwater resources at a scale that is useful for local planning purposes.
- Determine recommended lot sizes to minimize impacts upon groundwater resources.
- Identify sensitive hydrogeologic areas.
- Outline planning recommendations to protect water resources and encourage future development where it is best suited.

Groundwater Resources Study Scope and Methods

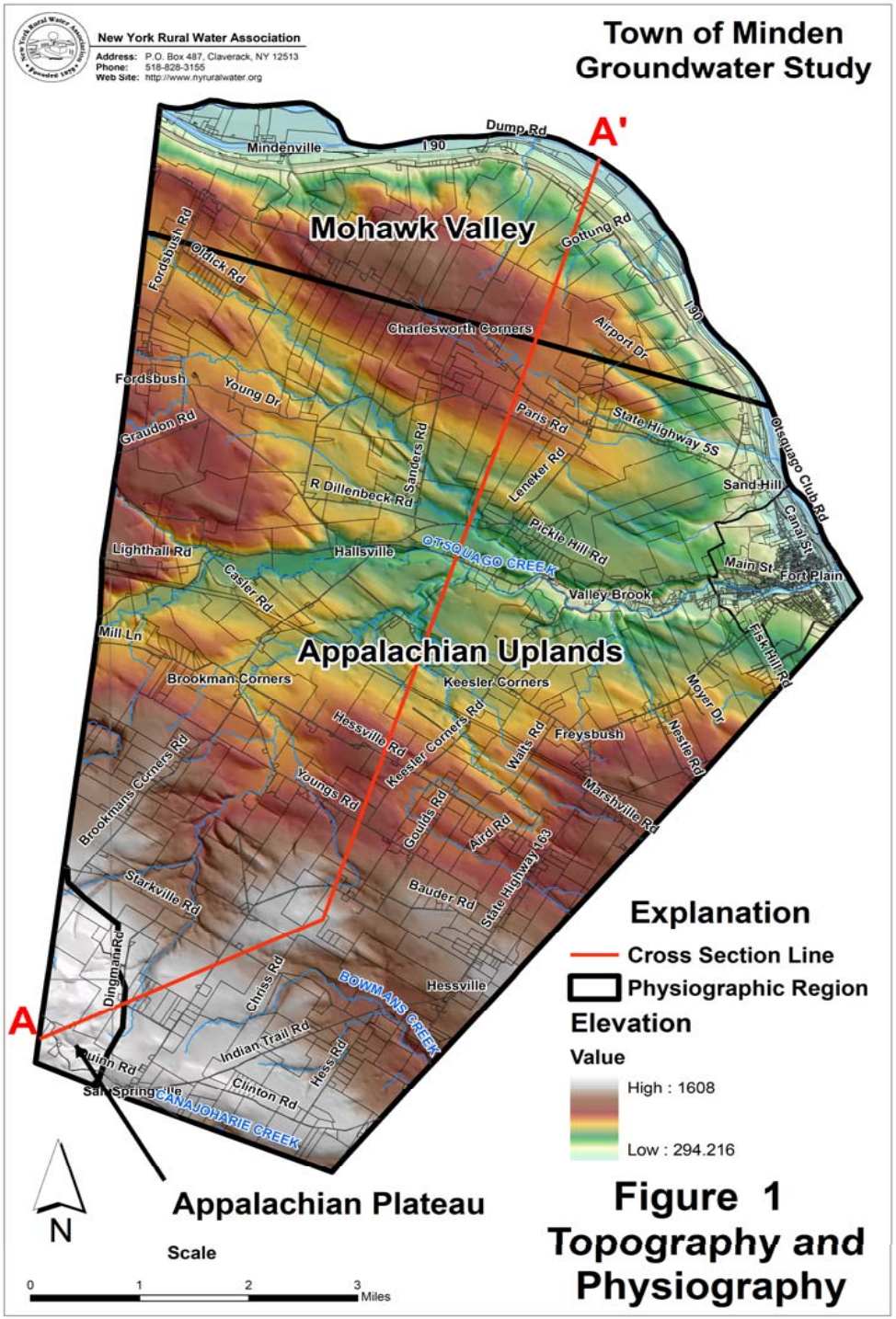
- Study conducted from September 2011 to February 2012.
- Study relied upon compilation and interpretation of existing information:
  - Well data from USGS and NYSDEC Water Well Program.
  - Interviews with local water well drillers.
  - Test borings from the NYSDOT.
  - Digital Montgomery County Soil Survey.
  - USGS WRI Report 88-4091.
  - Data from the NYS GIS Clearinghouse.
  - Other sources.
- On-site mapping activities by NYRWA.

Groundwater Resources Study

- Work products include:
  - 24 x 36-inch plates of compiled subsurface data, surficial geology, and unconsolidated aquifers (1 inch equals 2,000 feet scale).
  - 13 other 11x17-inch maps.
  - Written report.
  - Presentation.

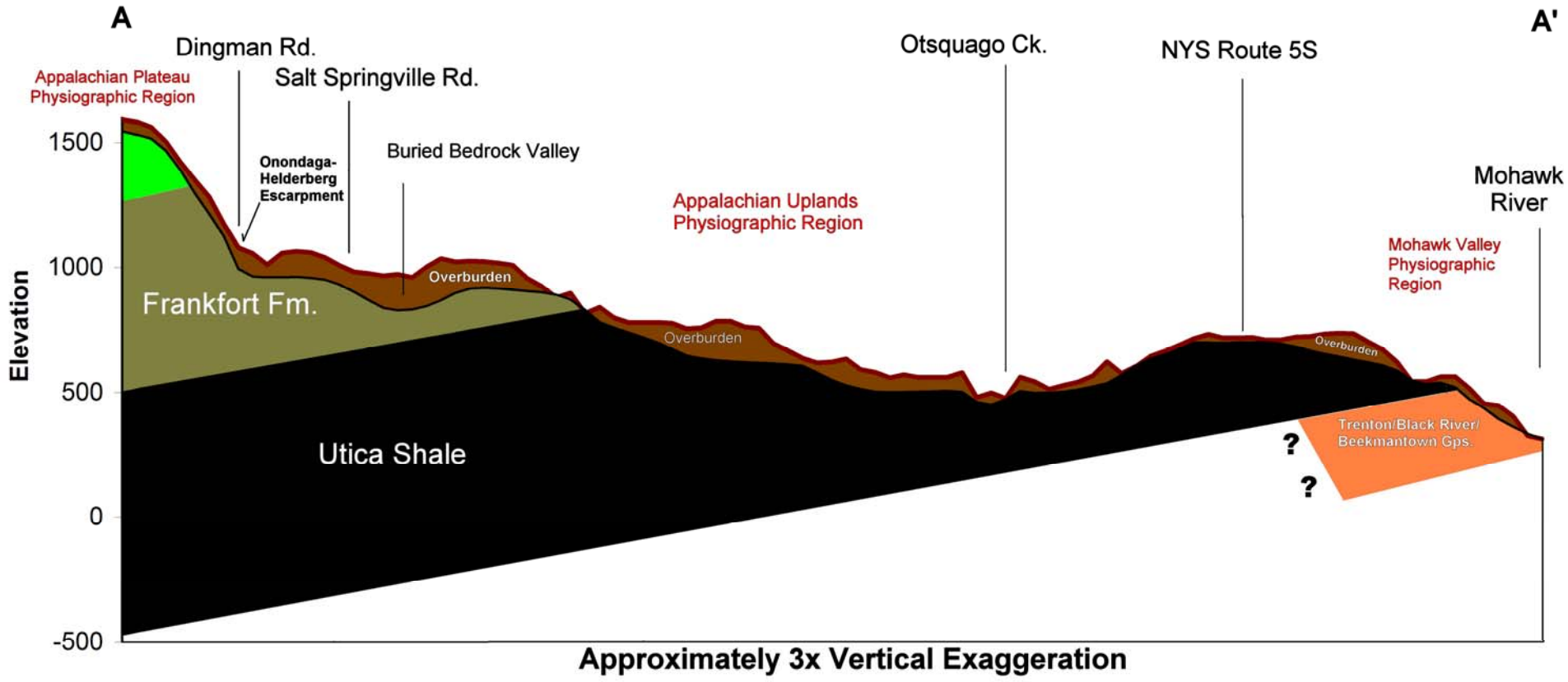


Setting

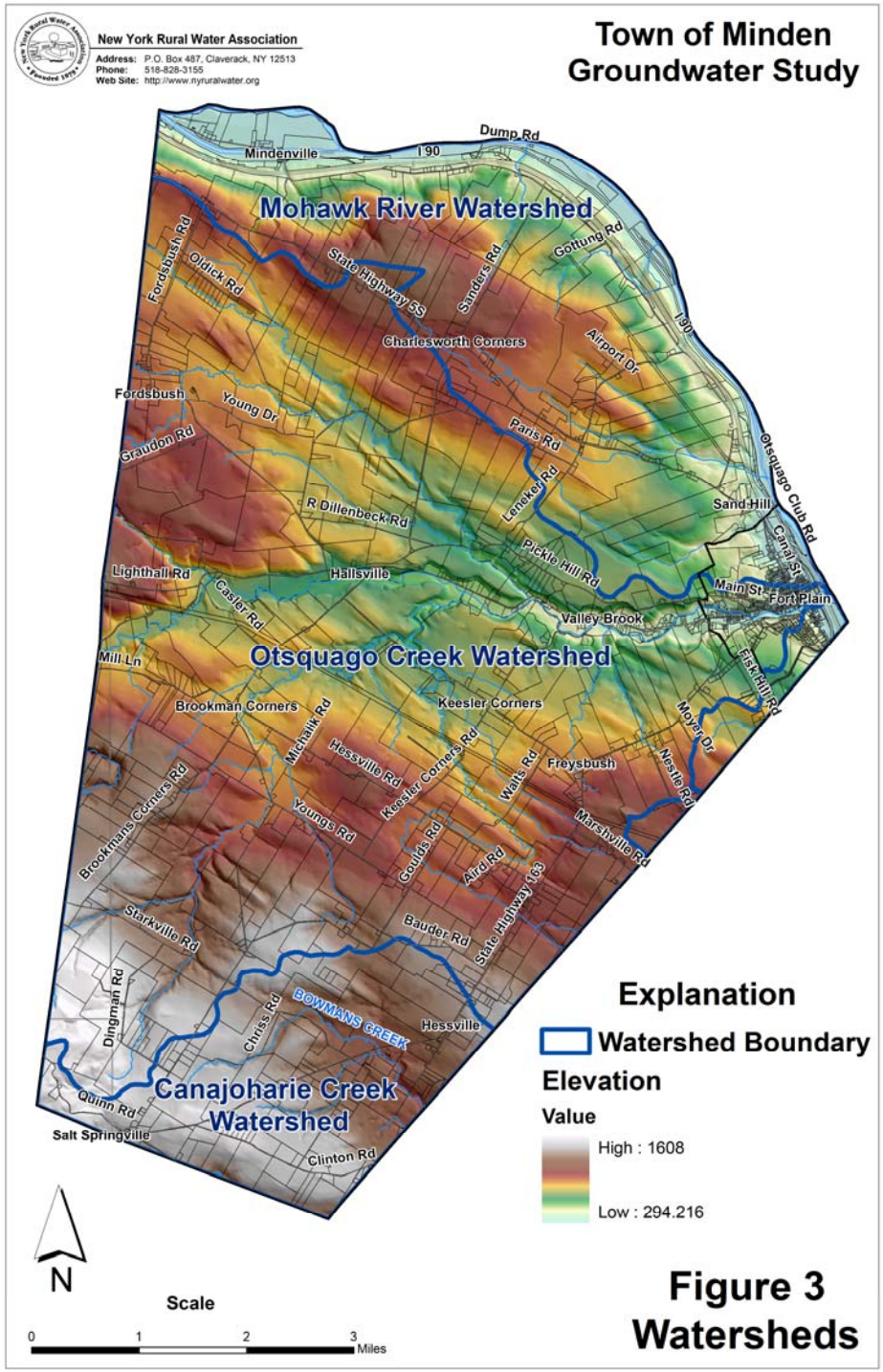


Topography and Physiography

- Minden spans three different physiographic regions: the Appalachian Plateau, the Appalachian Uplands, and the Mohawk Valley.
- Each of these physiographic regions has distinctive topographic relief, landforms, and geology.



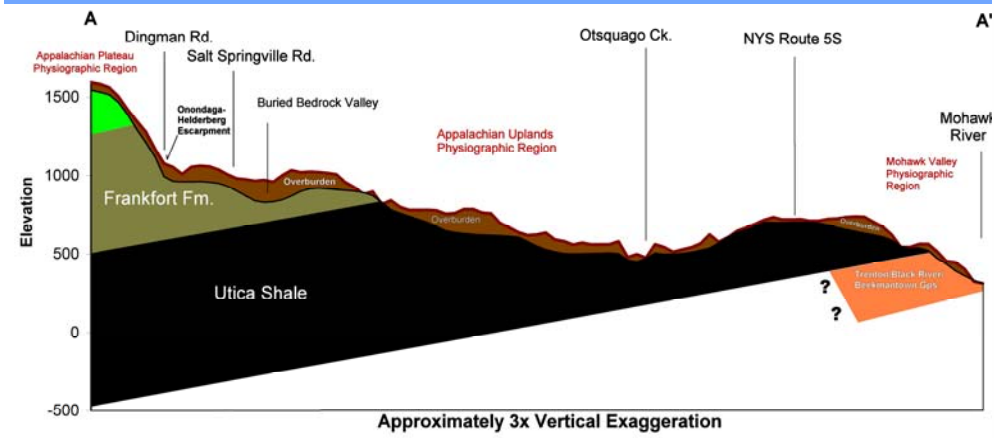
Cross-Section Across Minden by NYRWA



Drainage

- Approximately 63 percent of the Town's land area drains into the Otsquago Creek.
- About 25 percent of Minden eventually drains into Canajoharie Creek.
- The remaining 12 percent of Minden either drains directly into the Mohawk River or through small tributaries that reach the Mohawk River.

Bedrock Geology



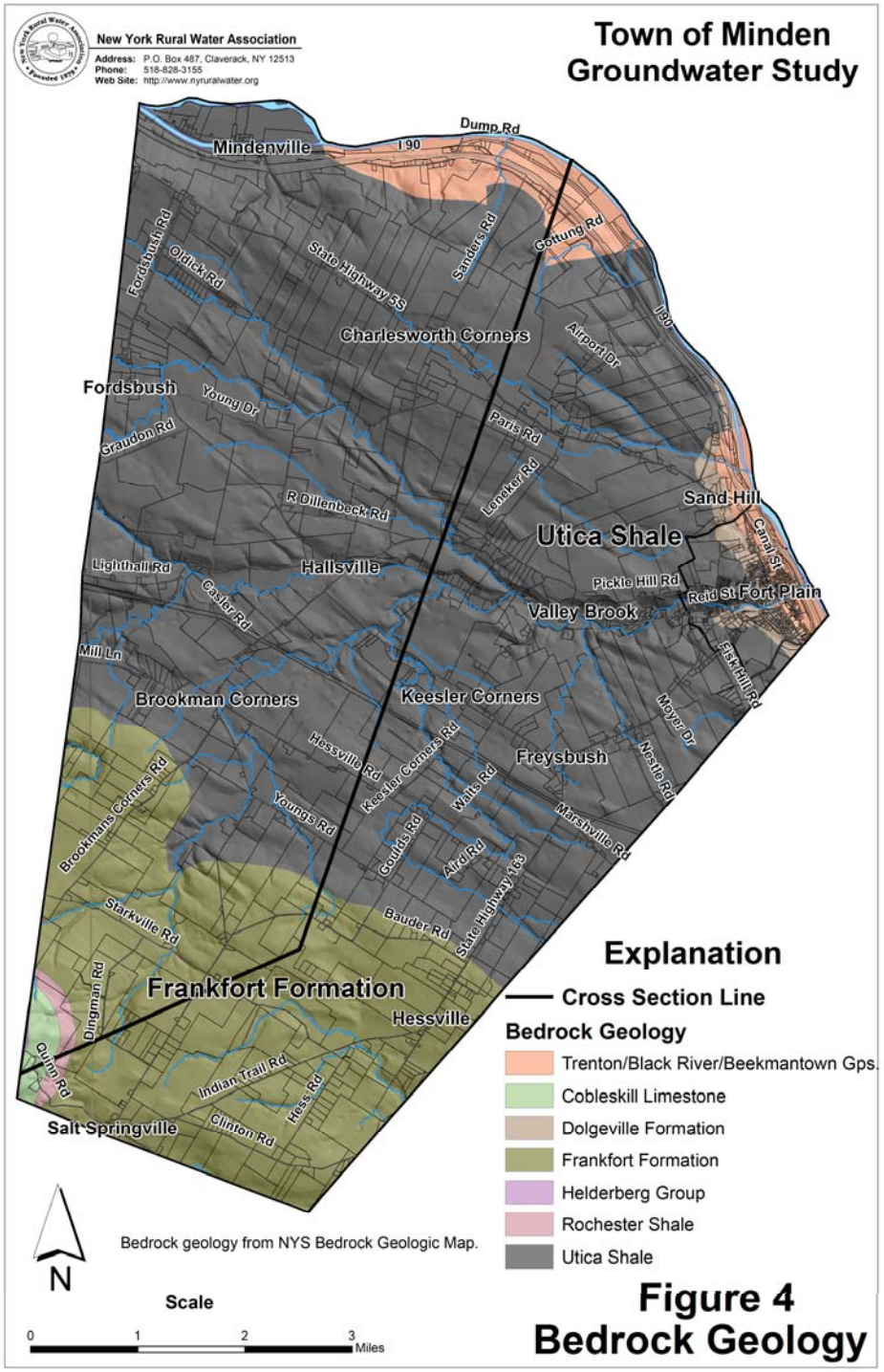


Figure 4
Bedrock Geology

Frankfort Formation

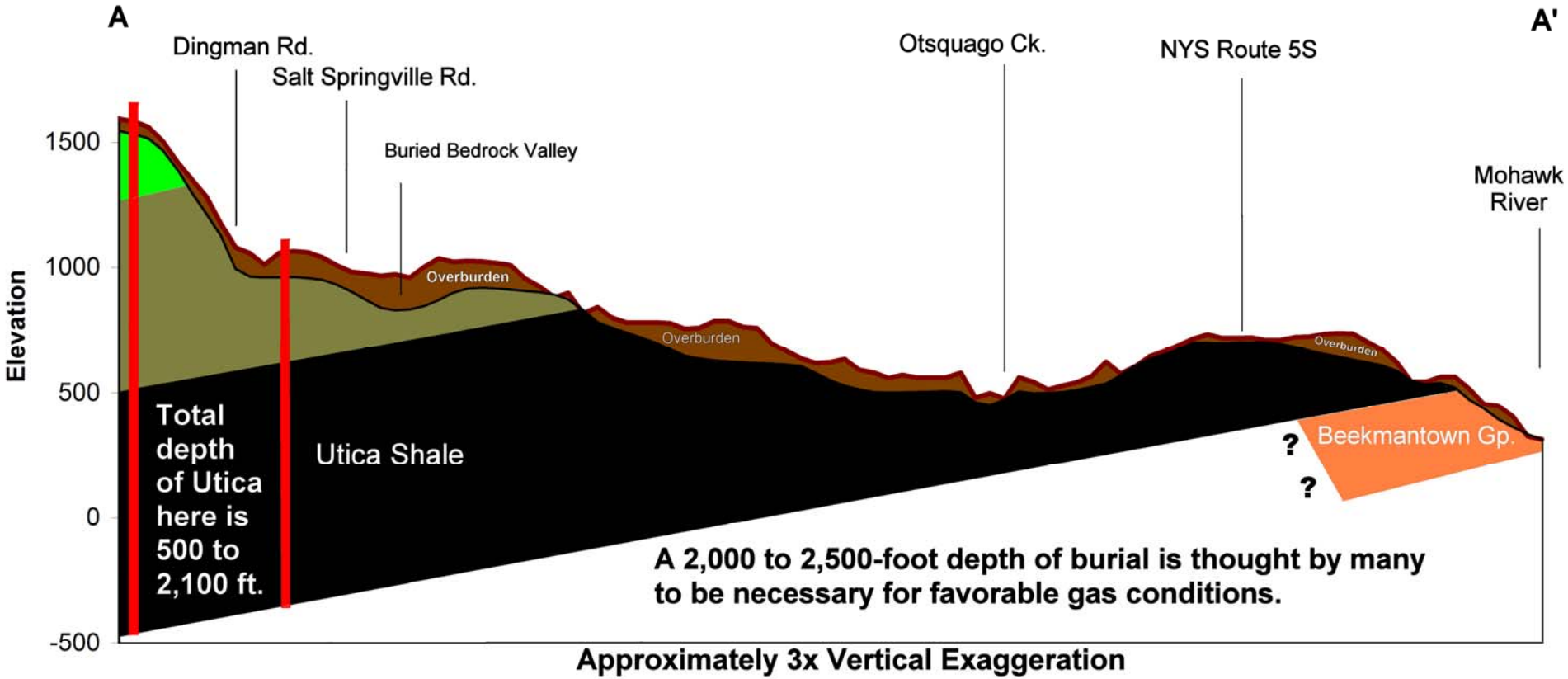
From Selleck (2010)

- Interbedded shale, siltstone, and fine sandstone.
- Locally up to 600 feet thick.

Utica Shale

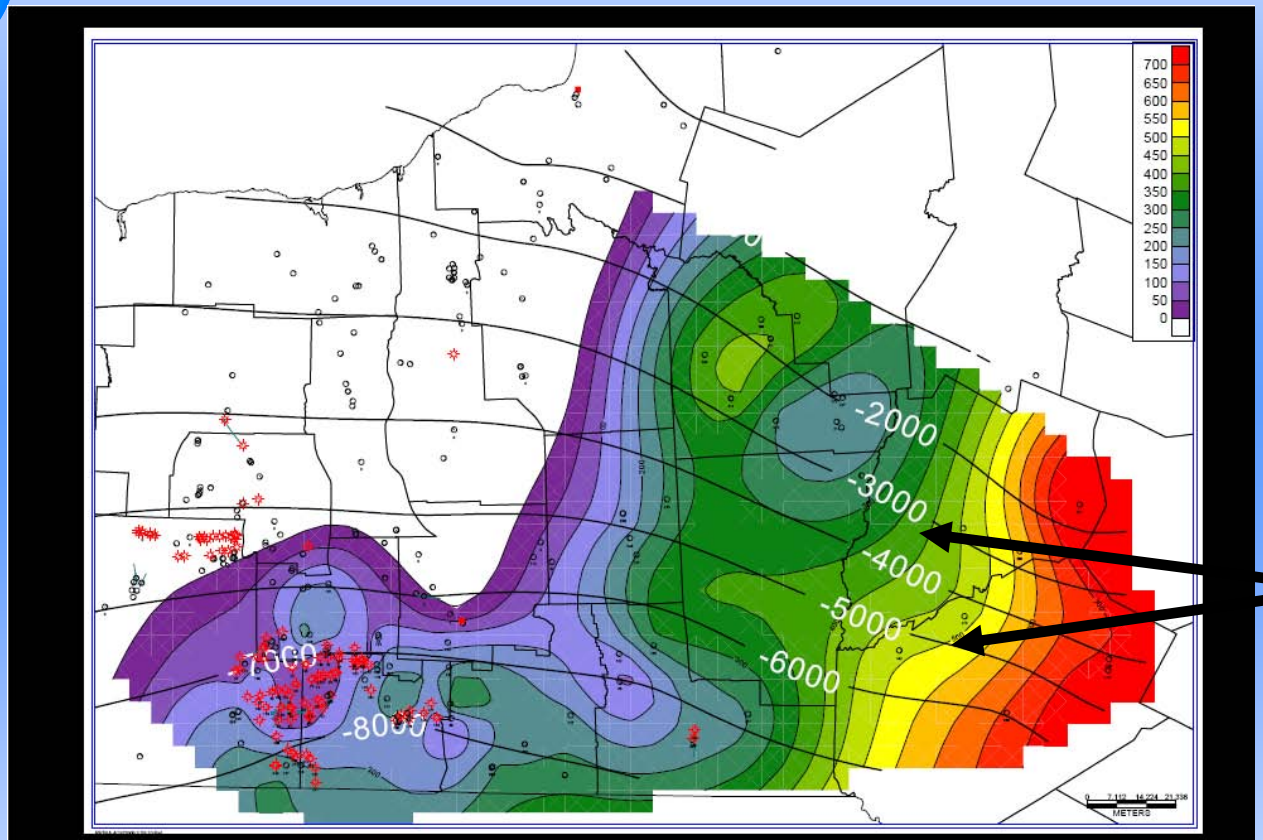
- Varies from dark shale to interbedded limestone and dark shale.
- Locally, measures approximately 700 to 800 feet thick.

Local Availability of Natural Gas in the Utica Shale



Given the Utica Shale's relatively shallow depth and use of a local water source in Minden, natural gas development would likely proceed in other places in New York State first.

Utica Shale Structure Contour Map



Total thickness of Ordovician organic-rich with burial depth contours – a significant portion of the total is buried below 3000-4000 feet

More favorable areas are thought to lie to the southwest (deeper burial).

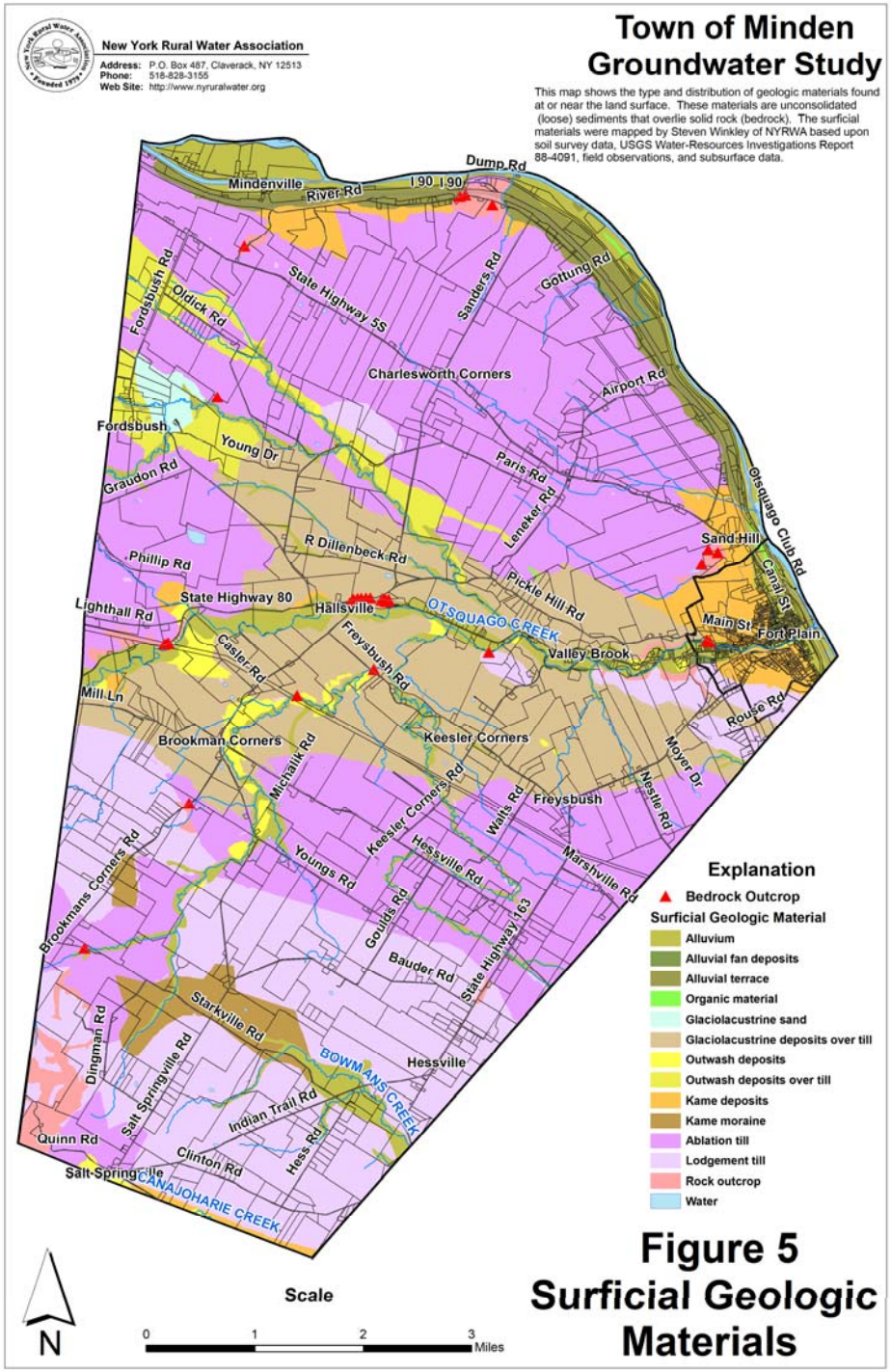
From Smith and Leone (2009)

Beekmantown, Trenton, and Black River Groups

- Limestone and dolostone
- Faulted.
- Outcrops near Thruway.

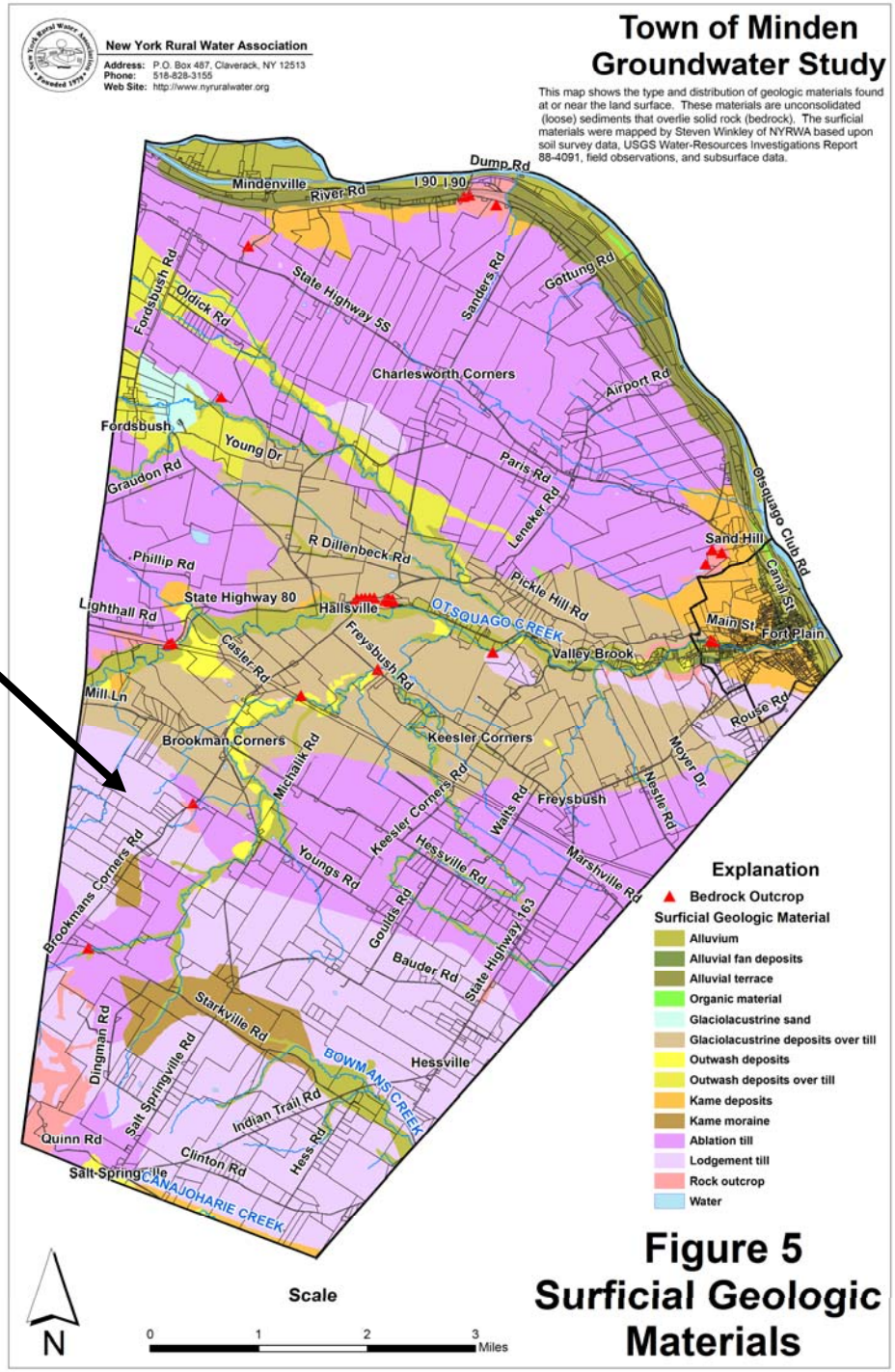
Surficial Geology

- Geologic materials that are found at or near the land surface.
- Mapped by NYRWA in detail based upon soils, USGS mapping, subsurface data, and site reconnaissance.



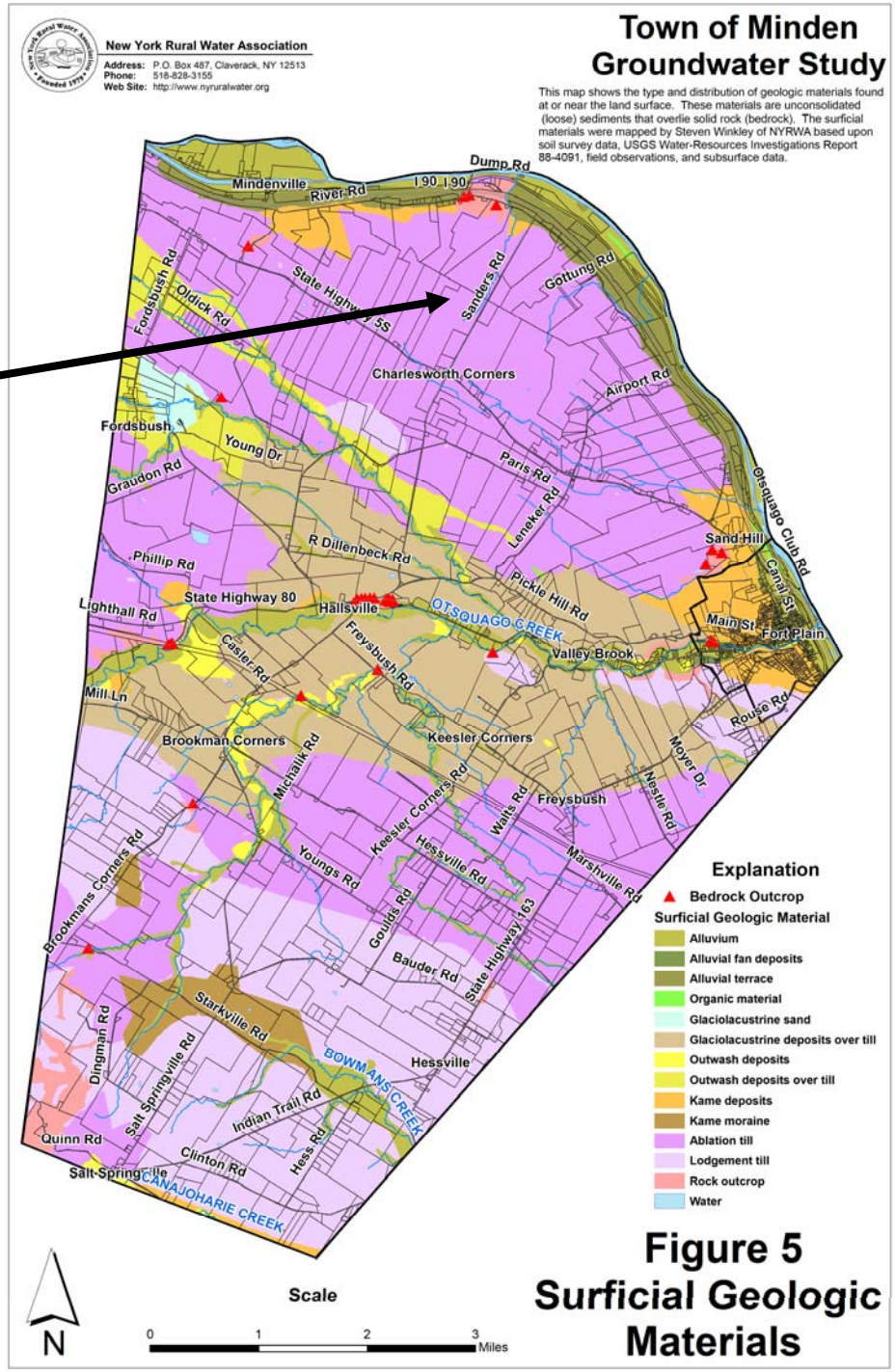
Surficial Geology

- Lodgement till
  - Deposited beneath moving glacial ice.
  - Dense, compact mixture of clay, silt, sand, cobbles, and boulders.
  - Poor permeable and well yields.



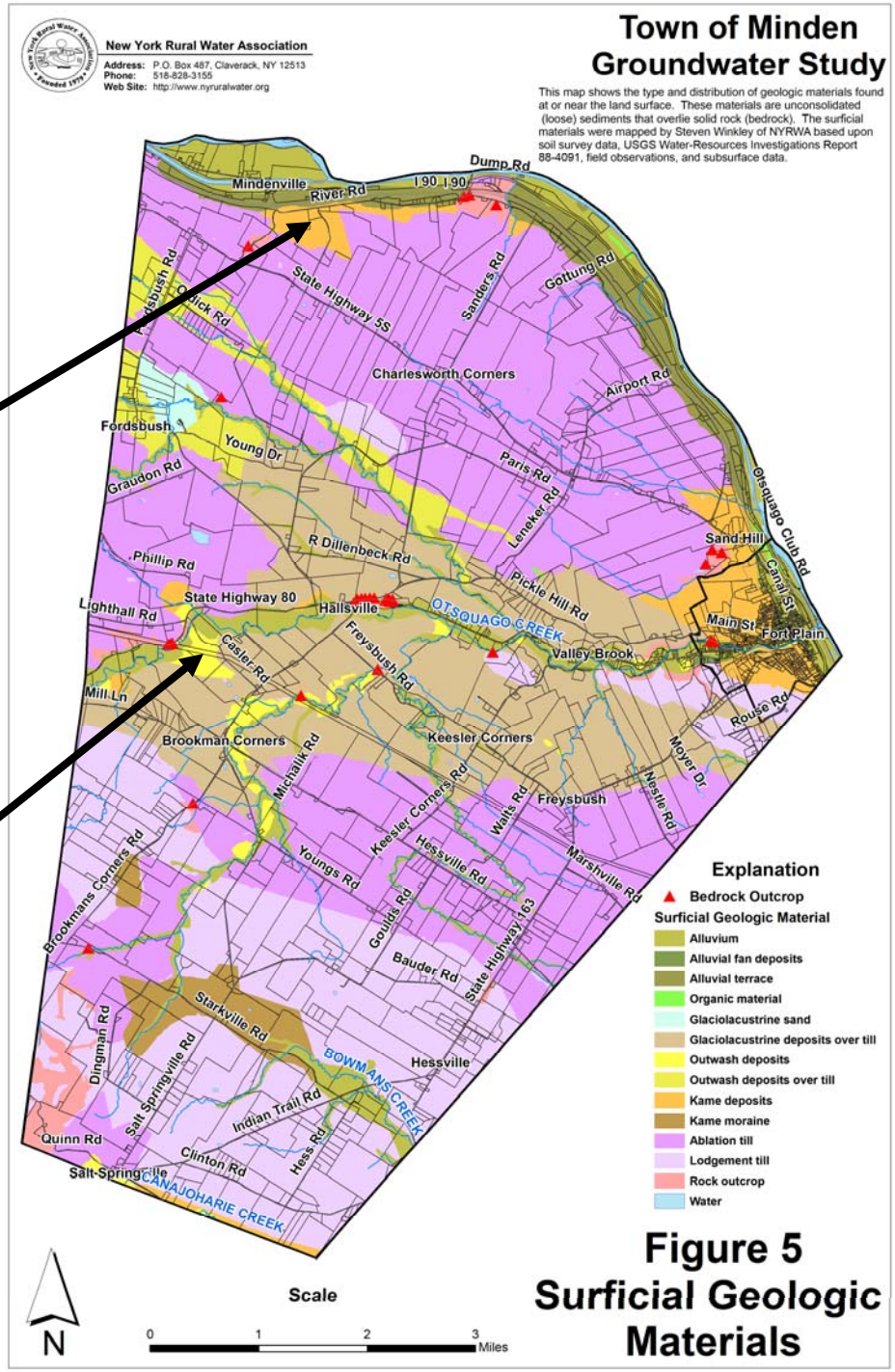
Surficial Geology

- Ablation till
  - Looser and less compact than lodgement till.
  - Formed as the ice melted out.
  - Generally contains less clay and silt than lodgement till.
  - Can produce limited yields to large diameter dug wells.



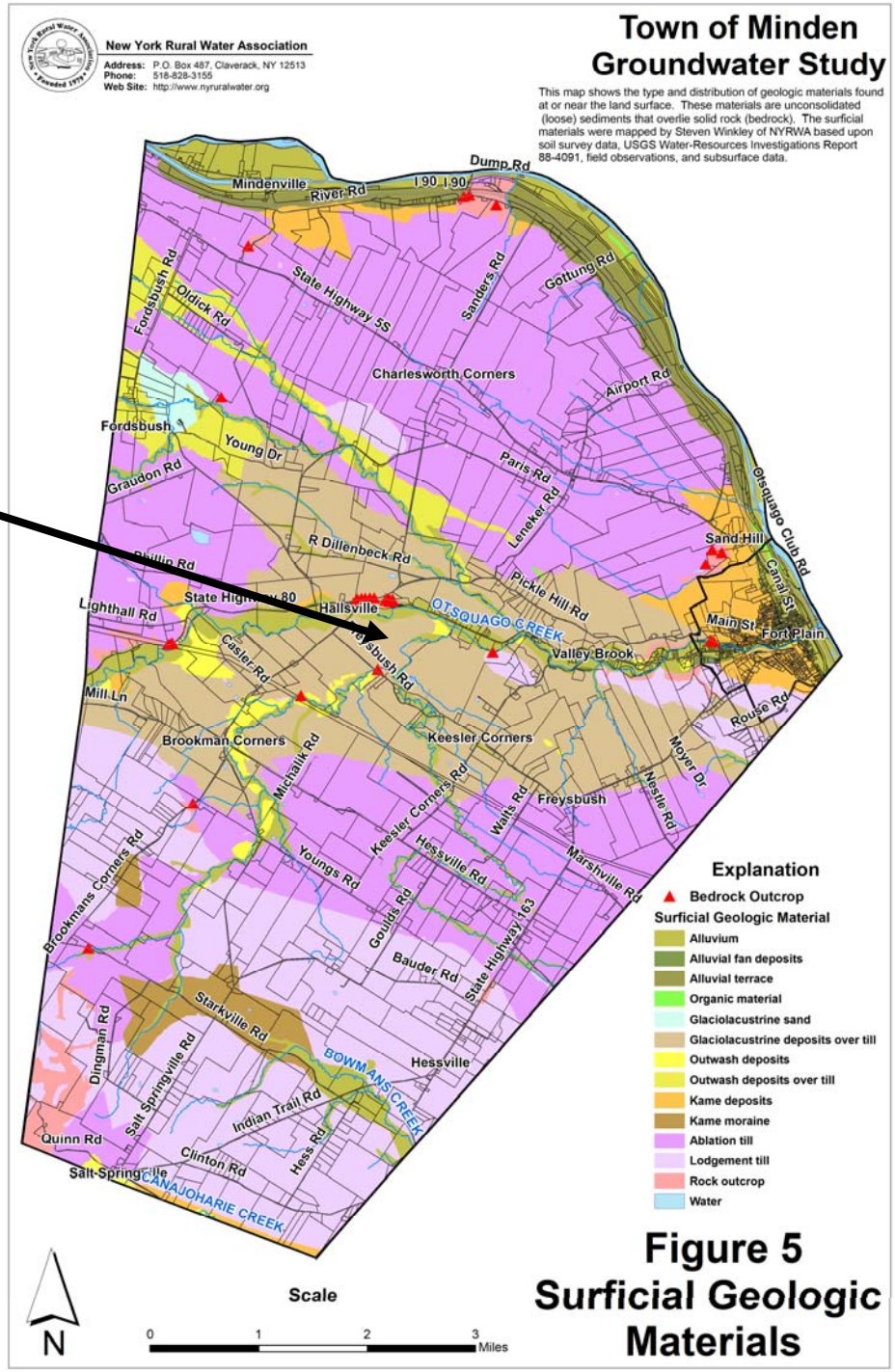
Surficial Geology

- Glaciofluvial Deposits
  - Kame deposits
    - Sand and gravel deposited by glacial meltwater in contact with glacial ice.
  - Outwash deposits
    - Sand and gravel deposited by meltwater streams.
- Form Unconsolidated Aquifers



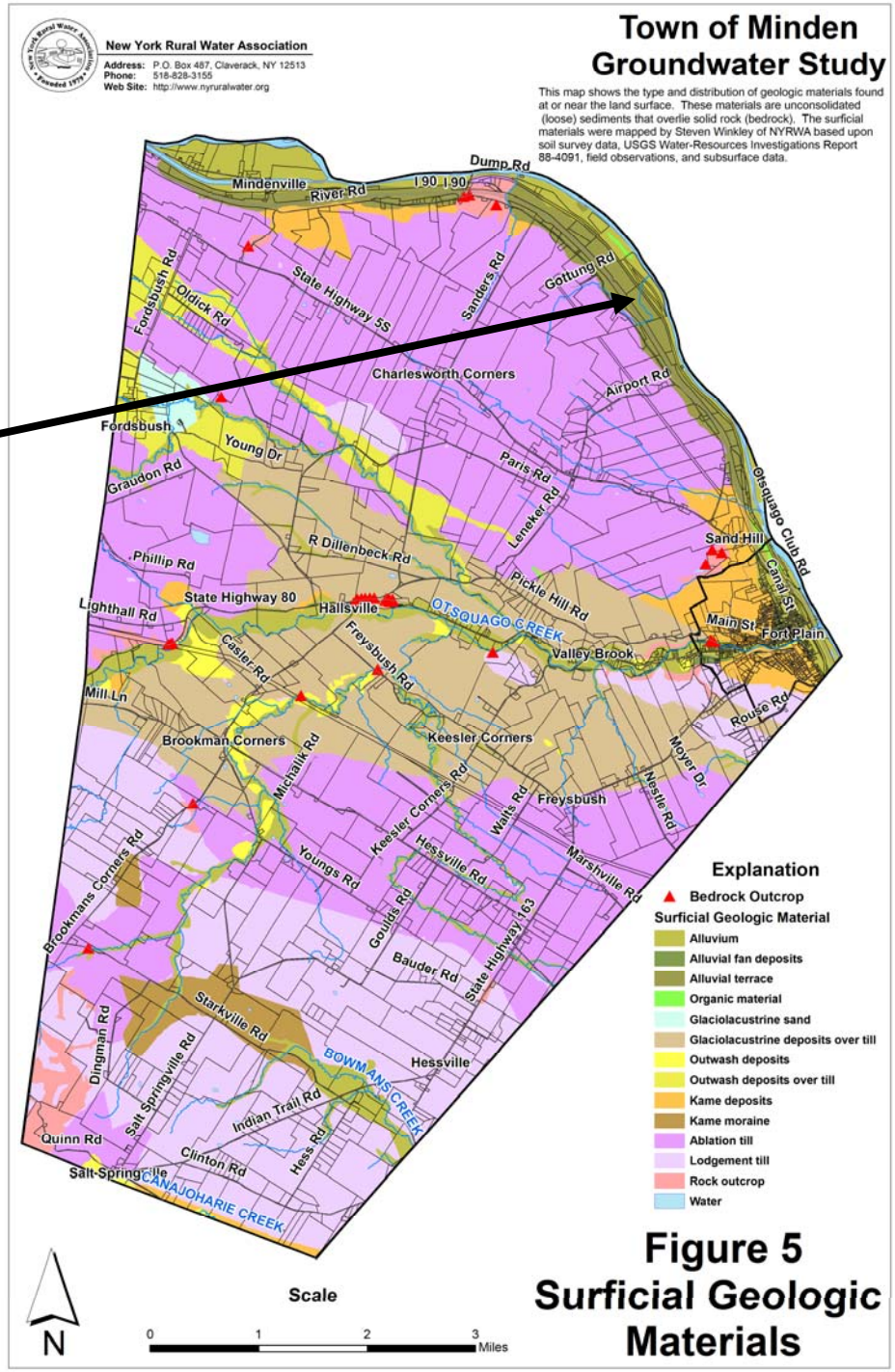
Surficial Geology

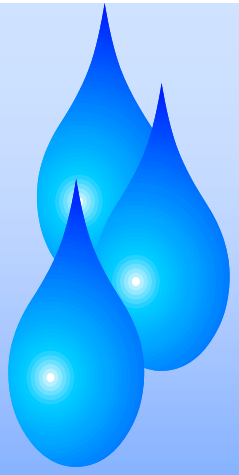
- Glaciolacustrine deposits
  - Silt and clay sediments deposited into a lake that extended up the Mohawk and Otsquago valleys (Glacial Lake Amsterdam).
  - Covers till deposits to depths of up to 20 feet.



Surficial Geology

- Alluvium
  - Sand, gravel, and silt formed along floodplains.
  - Some of these floodplains were above present-day levels.
  - Water-bearing but prone to surface water contamination.

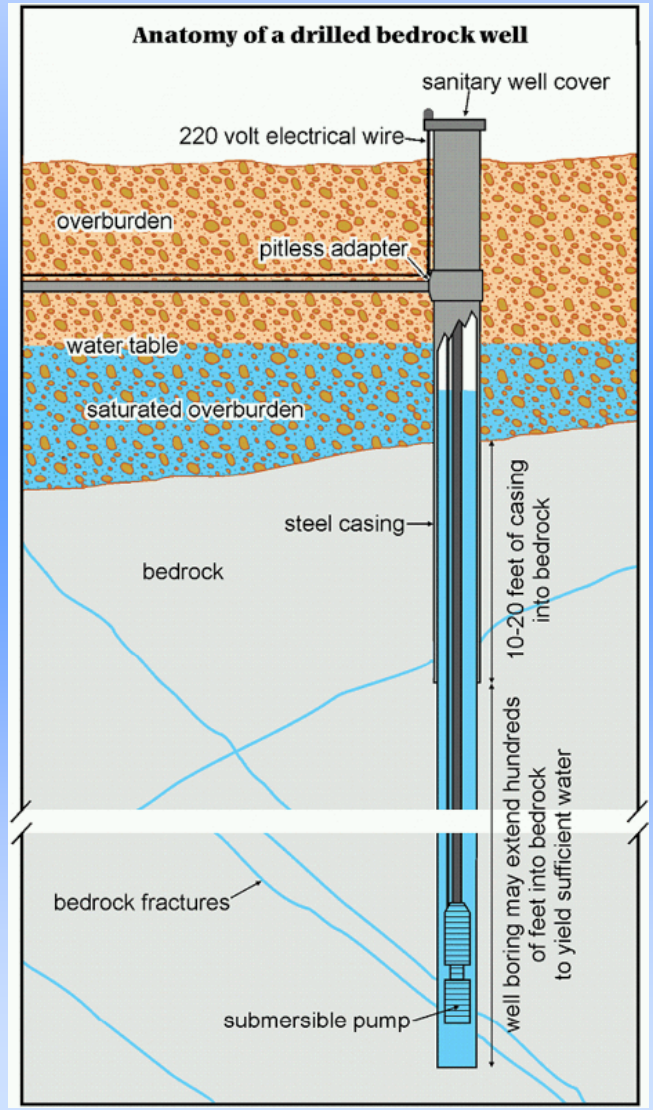




Groundwater Occurrence

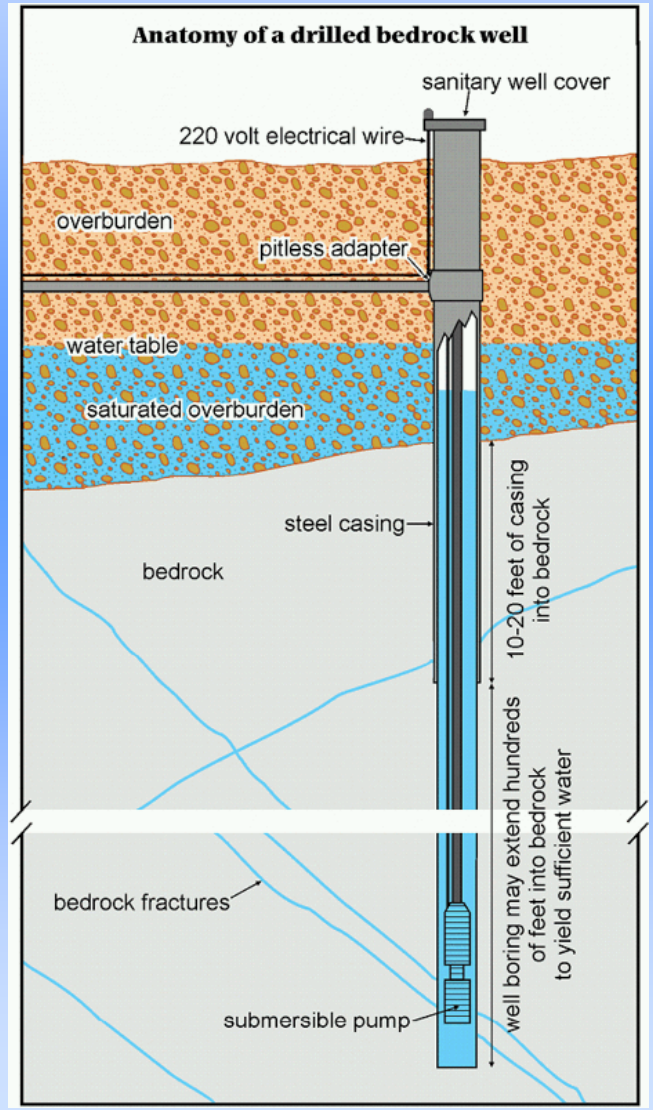
Bedrock Groundwater

- Bedrock supplies approximately 83 percent of wells in Minden.
- In bedrock, steel casing is set through the overburden (unconsolidated deposits) and into the first few feet of sound rock.

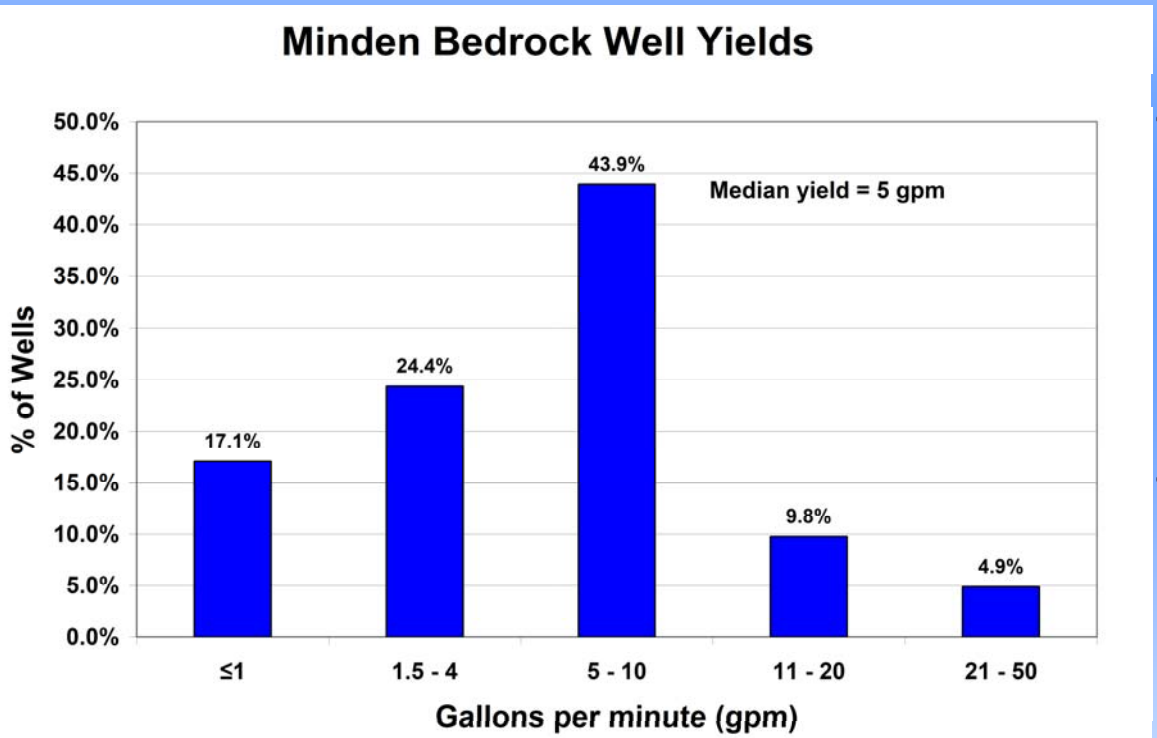


Bedrock Groundwater

- The remainder of the well is left as an open borehole in the rock.
- Local yields are dependent upon the the degree of fracturing.
- Quantity and quality of groundwater vary widely.



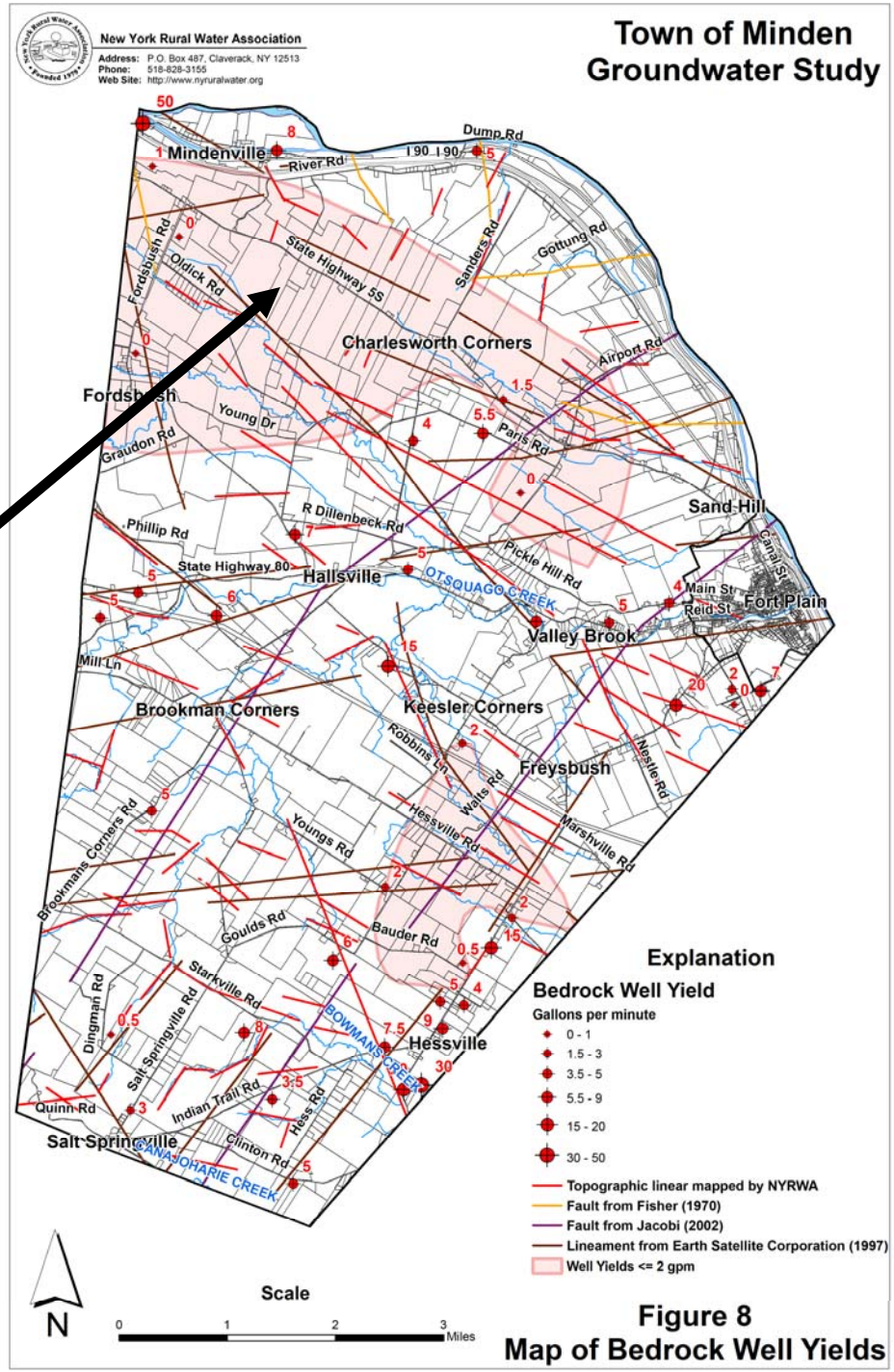
Bedrock Well Yields



- The median yield of bedrock wells in Minden is 5 gpm.
- 17% of wells yield 1 gpm or less (not recommended for use by NYSDOH for 4-bedroom houses).
- 42% of wells yield less than the 5 gpm required by FHA for new home loans.

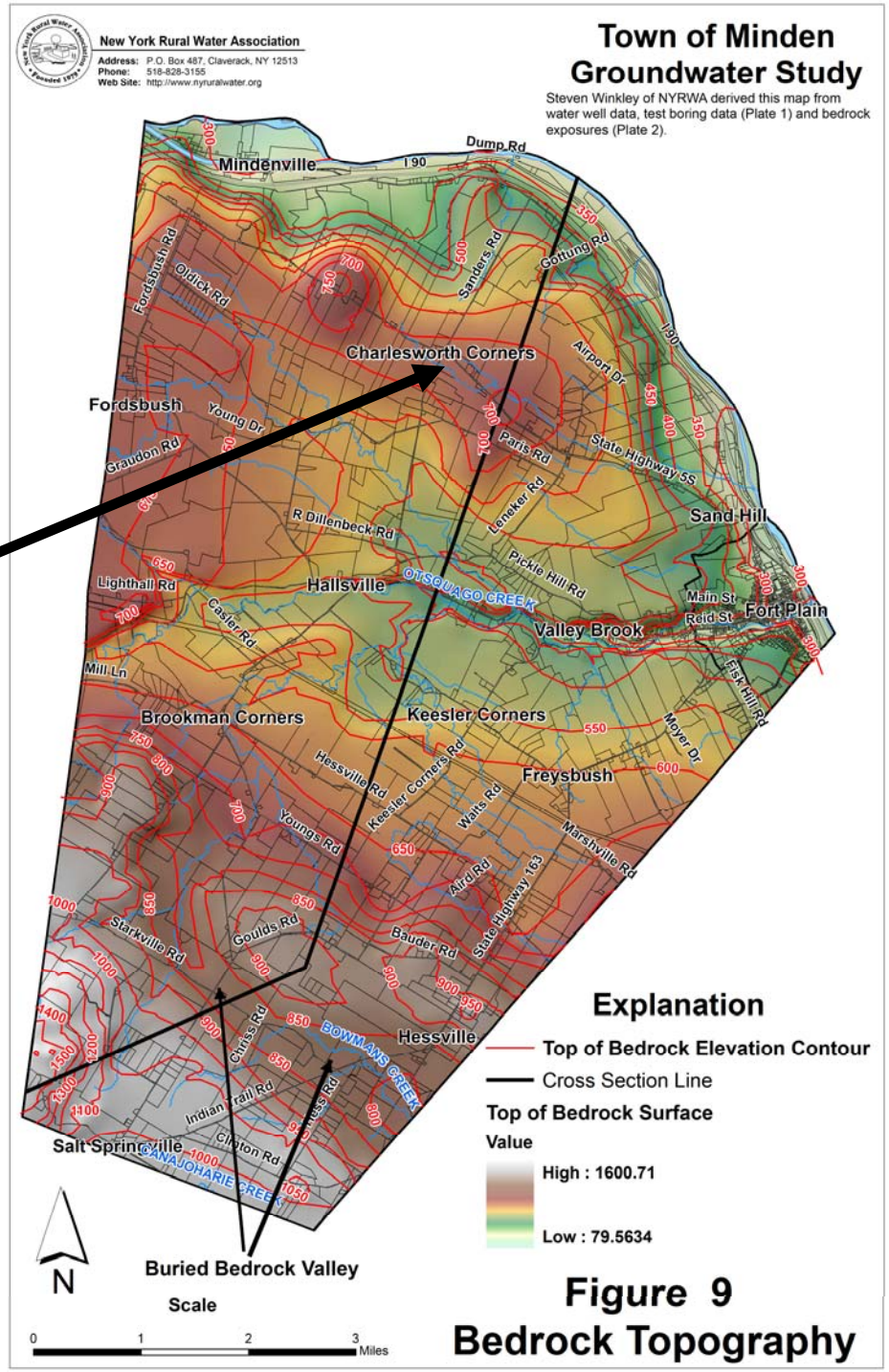
Bedrock Well Yields

- Two areas of lower than average well yields have been documented.
- The largest of these lower-yield areas is situated along NYS Route 5S between Otsquago Creek and the Mohawk River.
- The chief factor to explain well yield variation is likely the localized degree of fracturing of the bedrock.



Bedrock Well Yields and Bedrock Topography

- Poorer yields seem to coincide with “highs” in the local topography of the top of the bedrock surface.
- Higher yields often correspond to bedrock “lows” (bedrock valleys).



Bedrock Water Quality

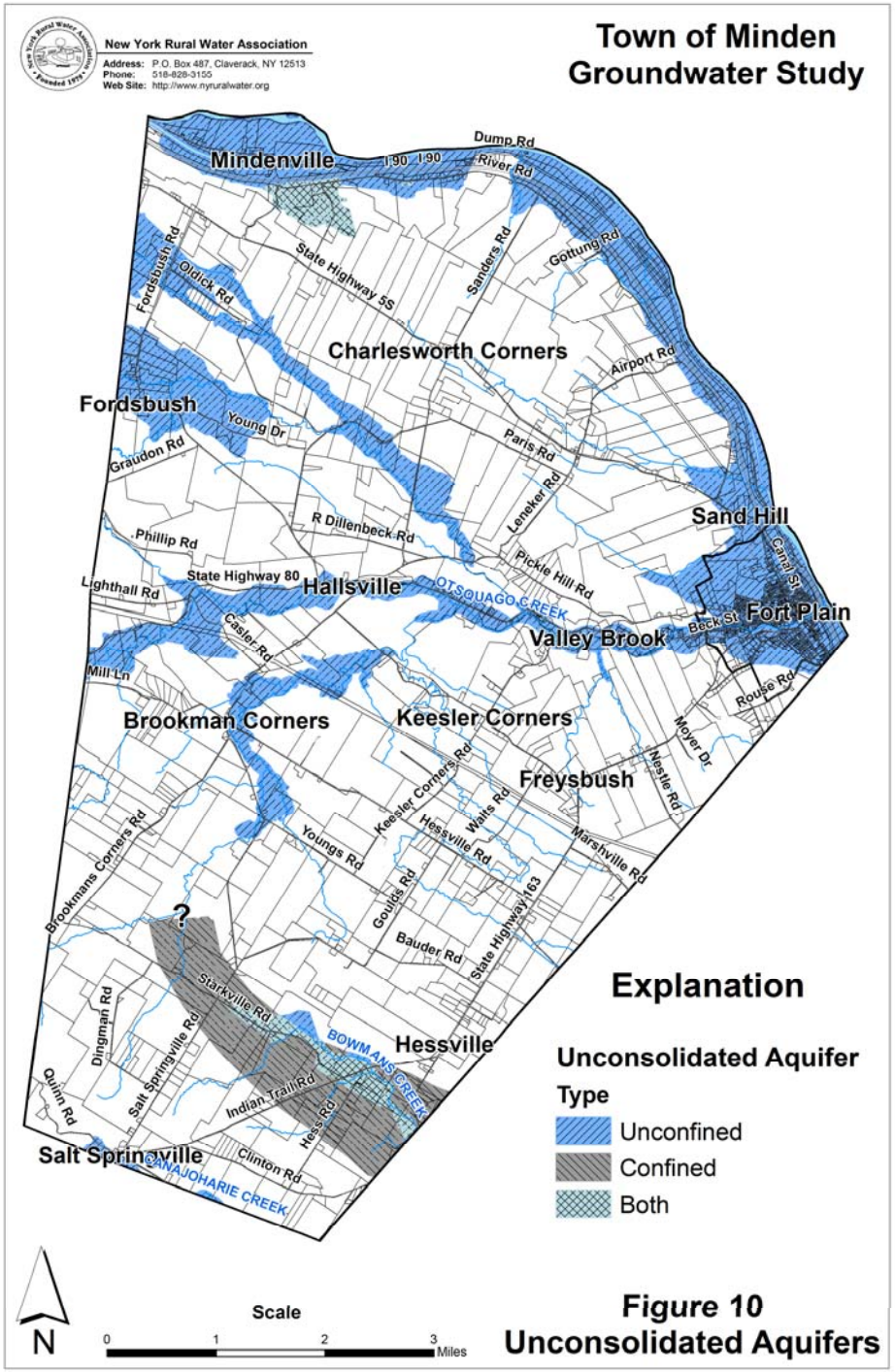
- Little quantitative data exists on water well quality since analyses are not required for residential wells.
- Local drillers indicate about one-half of wells drilled locally have issues with “sulfur” (hydrogen sulfide).
- Most problematic is the localized presence of salt and methane in some wells (near Salt Springville and the Dingman Road areas).

Unconsolidated (Sand and Gravel) Aquifers

- 17 percent of Minden water wells are completed in unconsolidated aquifers.
- The median yield of wells completed in sand and gravel in Minden is 15 gallons per minute (gpm).
- Local wells are typically left as open ended casing. Higher yields can be developed if wells are finished with a properly sized and developed screen.

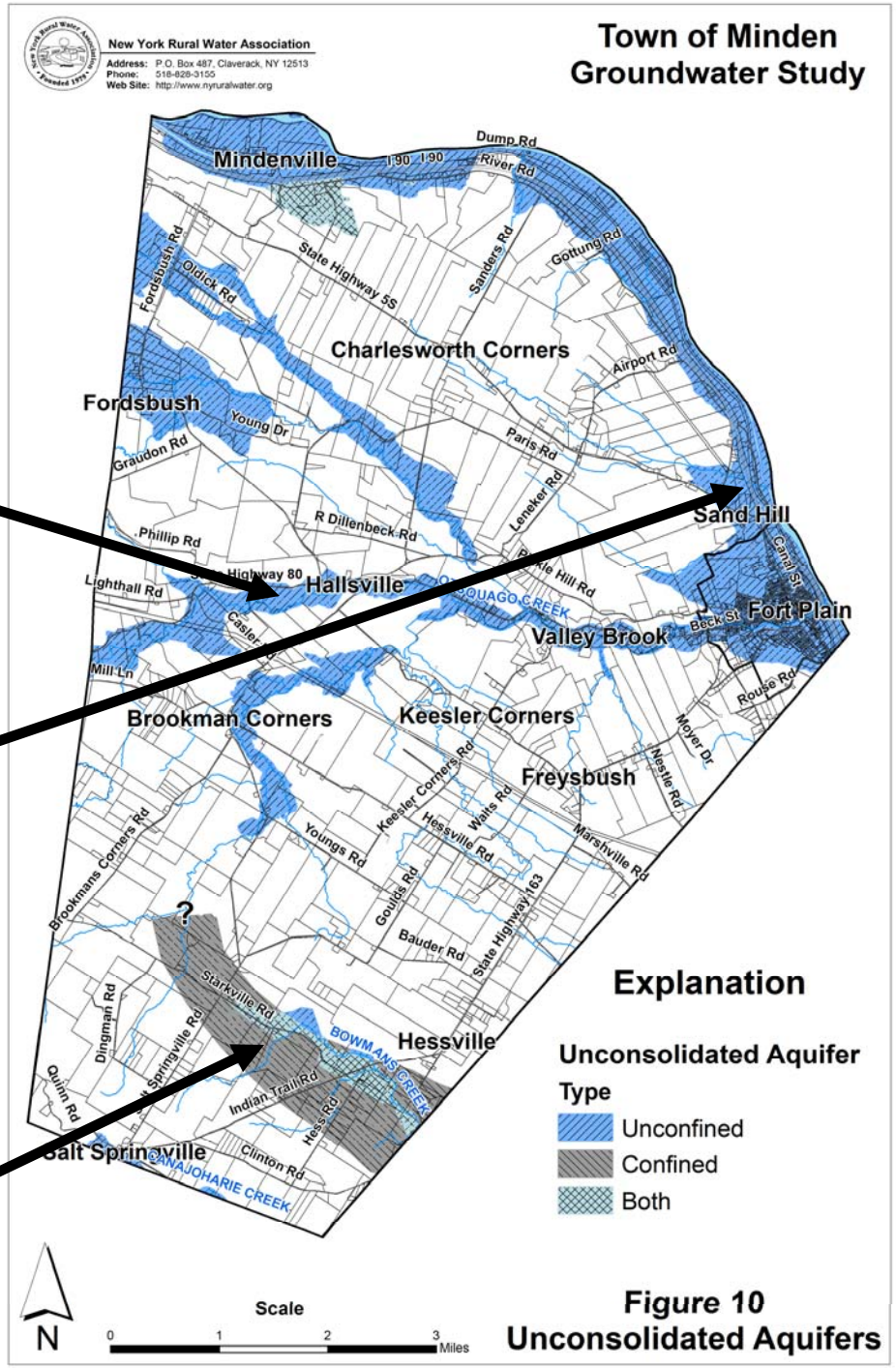
Unconsolidated Aquifers

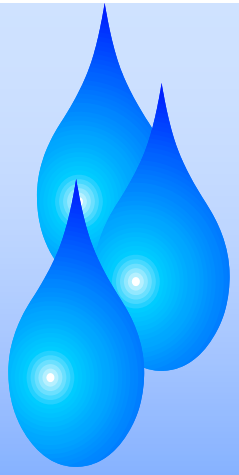
- NYRWA mapped unconsolidated aquifers using a combination of surficial geology and subsurface data.
- Unconsolidated aquifers include both unconfined and confined aquifers.
- Unconfined aquifers are bodies of sand and gravel that do not have an extensive clayey layer.
- Confined aquifers are composed of sand and gravel situated beneath clay, silt, and till.



Unconsolidated Aquifers

- Relatively thin outwash deposits in Otsquago Creek watershed are mostly unconfined.
- Kame deposits and alluvial terraces along the Mohawk River are generally unconfined but can be locally confined.
- Sand and gravel deposits in buried bedrock channels are confined.





Hydrogeologic Analyses

Hydrogeologic Analyses

- Uses detailed mapping and Geographic Information System (GIS) to answer planning questions relating to groundwater.

Hydrogeologic Analyses

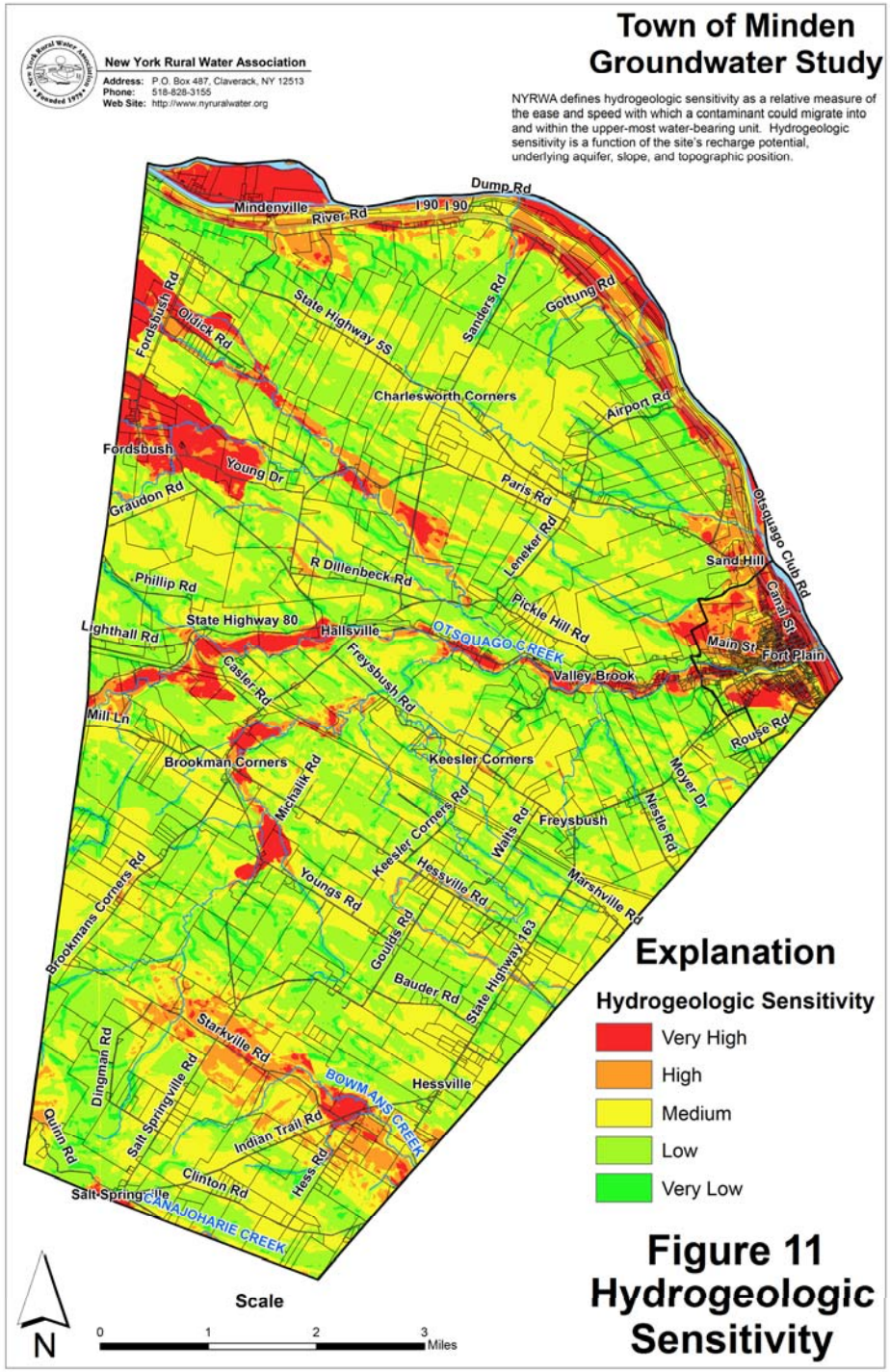
1. Where in Minden could activities at the land surface most readily impact groundwater?
   - Areas of high hydrogeologic sensitivity.

Hydrogeologic Sensitivity

- A relative measure of the ease and speed with which a contaminant could migrate into and within the upper-most water bearing unit.
- If possible, higher-risk land uses should be *steered away* from areas of high to very high hydrogeologic sensitivity.

Hydrogeologic Sensitivity

- Very high sensitivity is found chiefly in relatively flat areas underlain by unconfined sand and gravel aquifers or carbonate bedrock.
- Lowest hydrogeologic sensitivities are found in steeply sloping or low-lying areas underlain by glacial till or fine-grained glaciolacustrine sediments.



Hydrogeologic Analyses

2. How large do lots have to be in order to avoid excess nitrate loading from septic systems in a given area?
   - Calculate the recommended minimum lot sizes across portions of Minden most likely to be developed in the future.

Modified Trela-Douglas nitrate dilution equation

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

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.

Annual Groundwater Recharge Rate

- Depends upon:
  - Surficial geologic materials
  - Runoff rate (the amount of water available to be recharged).

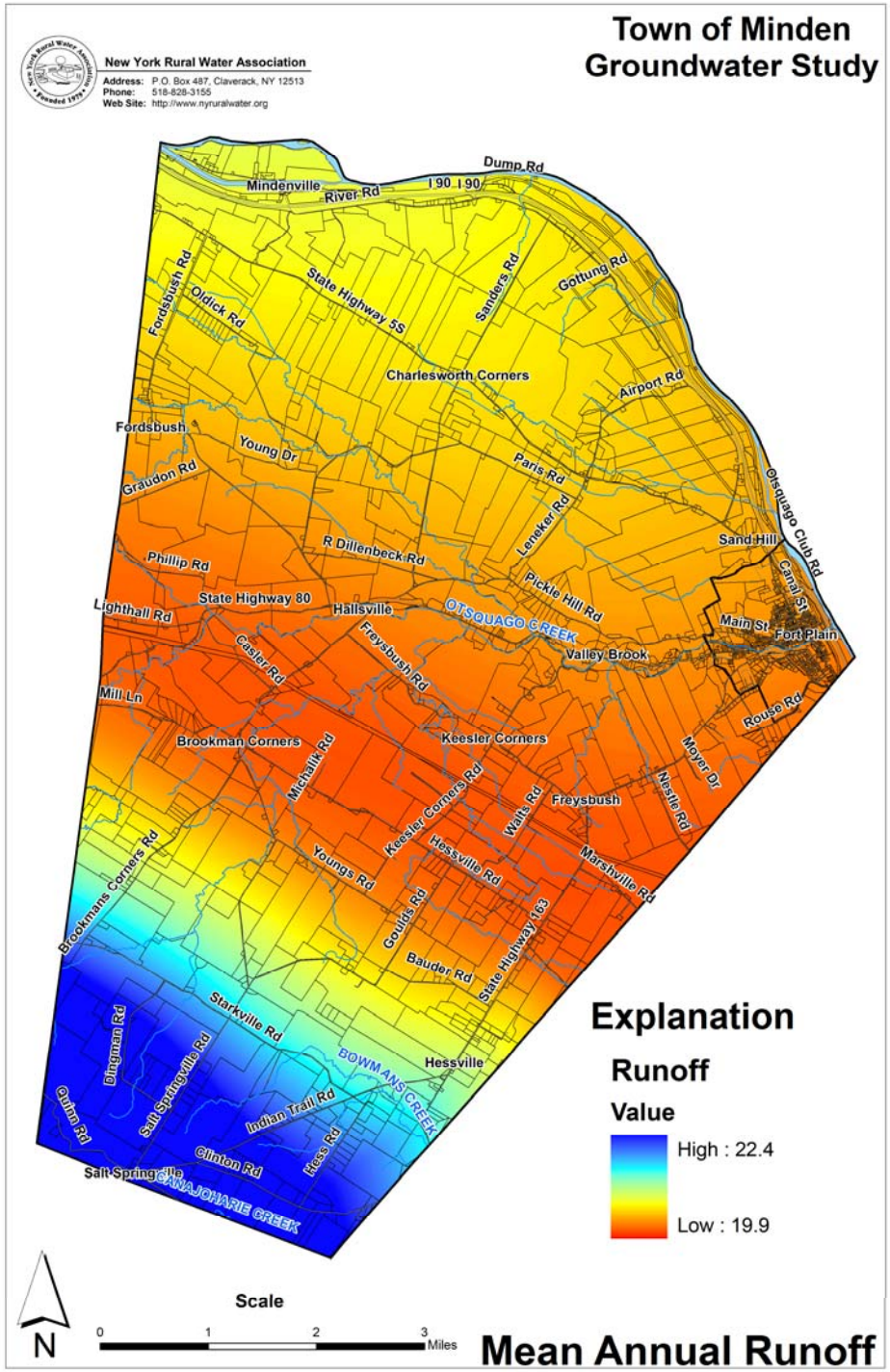
Groundwater Recharge Rates and Surficial Geologic Materials

Material	Recharge Rate (% of annual runoff)
Coarse-grained (kame, outwash, alluvium, etc.)	0.750
Kame moraine (local value)	0.499
Glaciolacustrine silt/clay	0.250
Till (locally derived value)	0.247
Organic deposits	0.090

Annual Runoff Rates

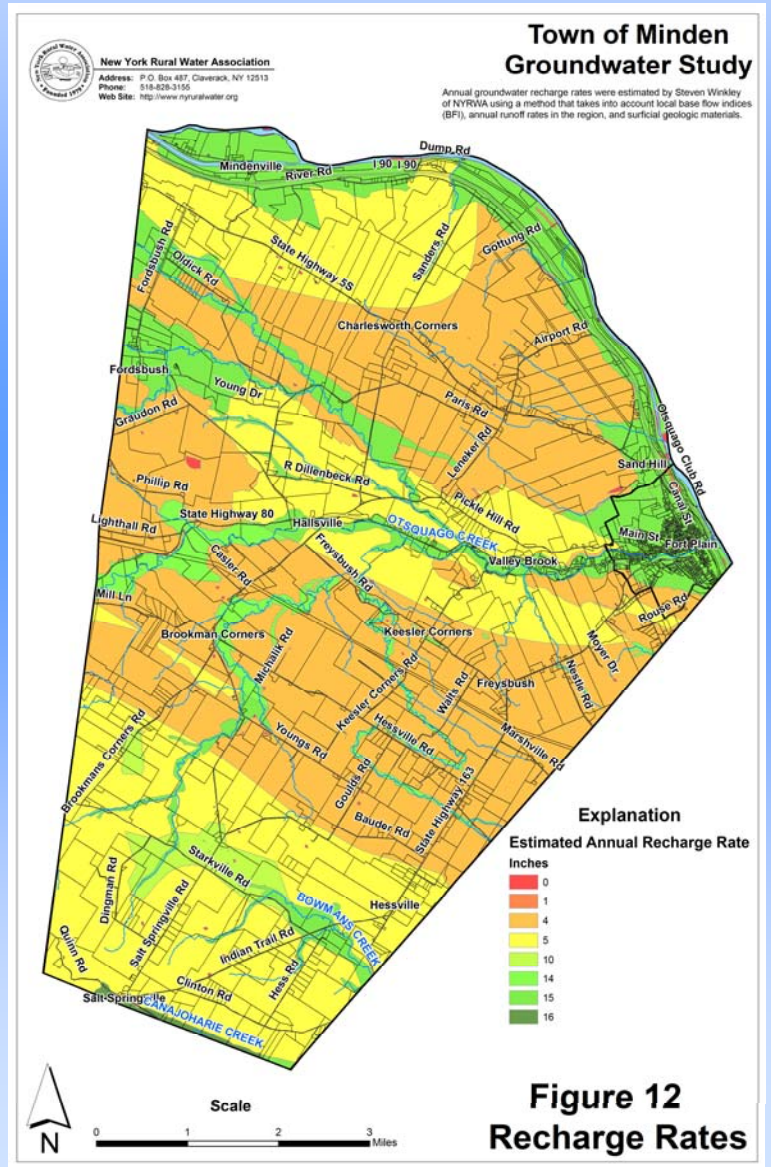
- Ranges from 19.9 to 22.4 inches.
- Highest in Appalachian Plateau region.
- Decreases with elevation.

From Cohen and Randall (1998)



Calculated Annual Groundwater Recharge Rates

- Annual groundwater recharge ranges from 0 to 16 inches.



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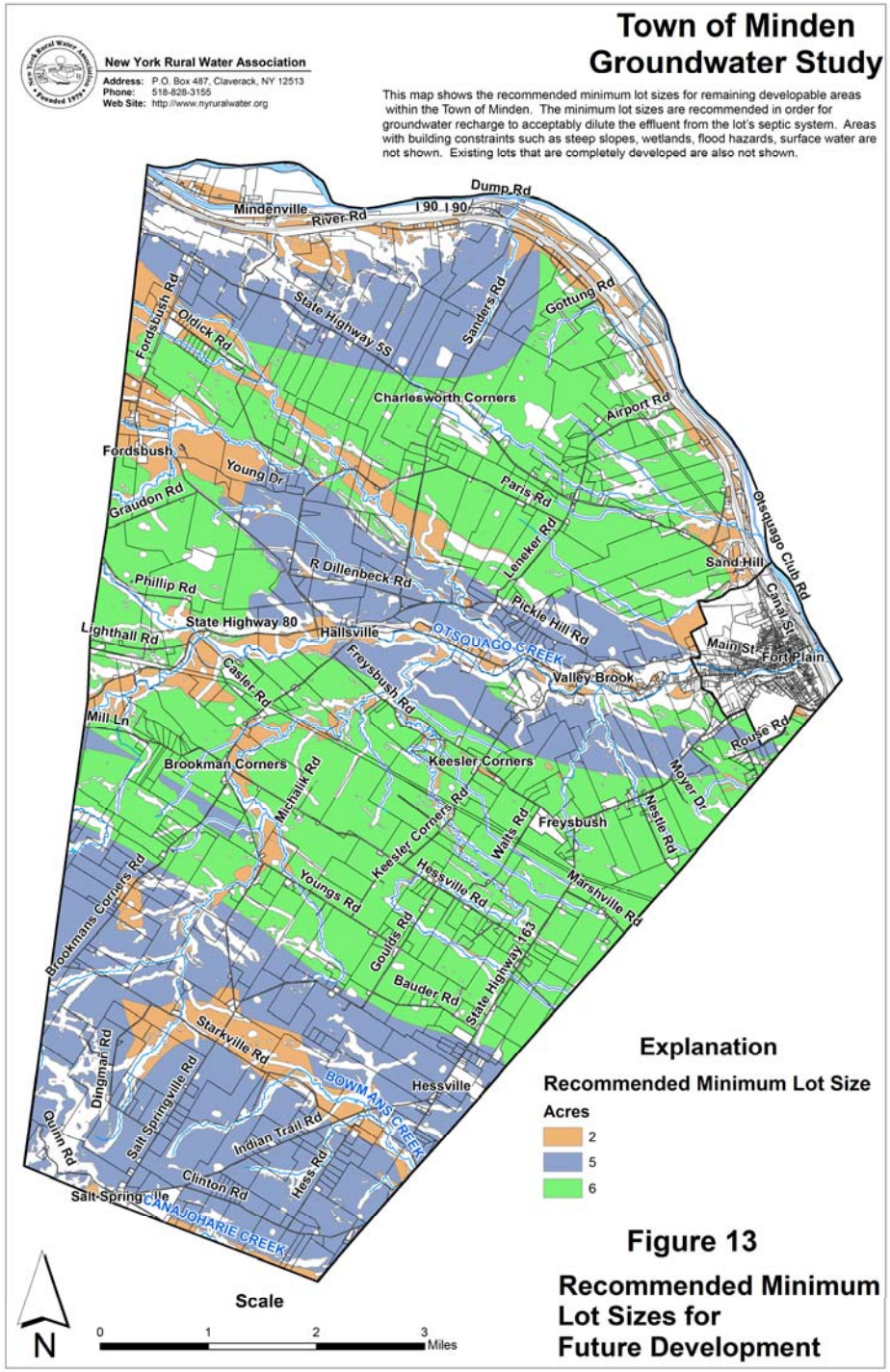
Cq is the target concentration in mg/L of nitrate-nitrogen;

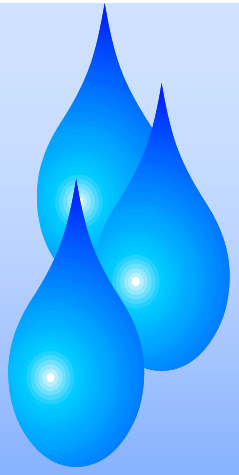
A is the effluent dilution area in acres per home; and

R equals the groundwater recharge rate in inches per year.

Calculated Recommended Minimum Lot Sizes

- Recommended minimum lot size for most of Minden is either 5 or 6 acres, depending upon the local recharge rate.
- Recommended minimum lot size of 2 acres (same as present zoning) occurs in areas of sand and gravel surficial geologic materials.





Proposed Protection Strategies

Proposed Protection Strategies

1. Amending Subdivision Law
2. Revising Zoning Law
3. Environmental Review
4. Education

Proposed Protection Strategies

1. Amending Minden's Subdivision Regulations

A. Additional documentation:

- The location of any existing wells and proposed water supply wells.
- Well Completion Reports for completed wells.
- Any and all water quality testing results.
- Proposed individual water supply system details such as pumps, storage, treatment, controls, etc.
- A completed hydrogeological study (could be required for subdivisions of a certain size or that overlie the lower well yield areas detailed in this report.).

Proposed Protection Strategies

1. Amending Minden's Subdivision Regulations

B. Additional requirements and standards:

- Existing and proposed wells are located at minimum separation distances specified in NYSDOH regulations.
- A representative number of wells indicate that the available quantity and quality of on-site groundwater resources are suitable for household purposes.
- If necessary, a determination has been made that the subdivision avoids adverse impacts to existing or future groundwater users and/or surface waters within 1,500 feet of the subdivision.

Proposed Hydrogeological Study Requirements

Example available from NYRWA upon request

TOWN OF STUYVESANT
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 Stuyvesant Planning Board. Work shall be performed or directly supervised by a professional geologist who has related project experience in Columbia 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 Columbia 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 groundwater and/or on-site sewage disposal; and (2) other types of development that utilize relatively large amounts of on-site groundwater 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 five or more lots that relies upon either on-site groundwater withdrawals and/or on-site sewage disposal. Eight (8) copies of a hydrogeological study for such a subdivision must be submitted to the Town of Stuyvesant 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 1,000 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 Stuyvesant Planning Board as part of the site plan review process indicated in the Town's zoning regulations.

Proposed Protection Strategies

2. Revising Minden's Zoning Law

A. Additional documentation for site plans:

- Copies of Well Completion Reports for completed wells.
- Water quality testing results.
- Public water systems and other supply wells within 1,500 feet.
- The means of storage, distribution, use, treatment, and/or disposal of wastewater, other wastes, chemicals, etc.
- The means of water supply, including if applicable an estimate of the total daily groundwater withdrawal rate.
- Lists of all petroleum, chemicals, fuels, and other hazardous substances/wastes to be used, generated, stored, or disposed of.
- A description of the pollution control measures.
- The degree of threat to water quality and quantity that could result if the control measures failed.
- A hydrogeological study for any proposed project that has projected on-site groundwater withdrawals and/or on-site sewage disposal flows equal to or exceeding a certain amount.

Proposed Protection Strategies

2. Revising Minden's Zoning Law

B. Basis and standards for approval of site plans:

- Adequacy of control measures to prevent groundwater or surface water contamination.
- Proposed use will not result in reductions in groundwater levels or changes in groundwater quality that limit the ability of a groundwater user to withdraw groundwater.

Proposed Protection Strategies

2. Revising Minden's Zoning Law
   C. Consider increasing the minimum lot size to those recommended in this study.
   D. Use overlay zoning to steer-away higher risk land uses from sensitive hydrogeologic areas and/or unconsolidated aquifer areas.

Proposed Protection Strategies

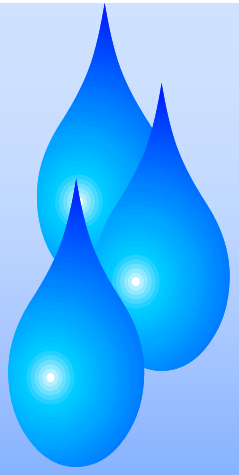
3. Environmental Review

A. Designate unconsolidated aquifer areas, sensitive hydrogeologic areas, etc. as critical environmental areas (CEAs) under SEQR.

B. 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.

Proposed Protection Strategies

4. Education
   A. Notify officials, residents, contractors, and developers about the results of this study.



Questions ? ?