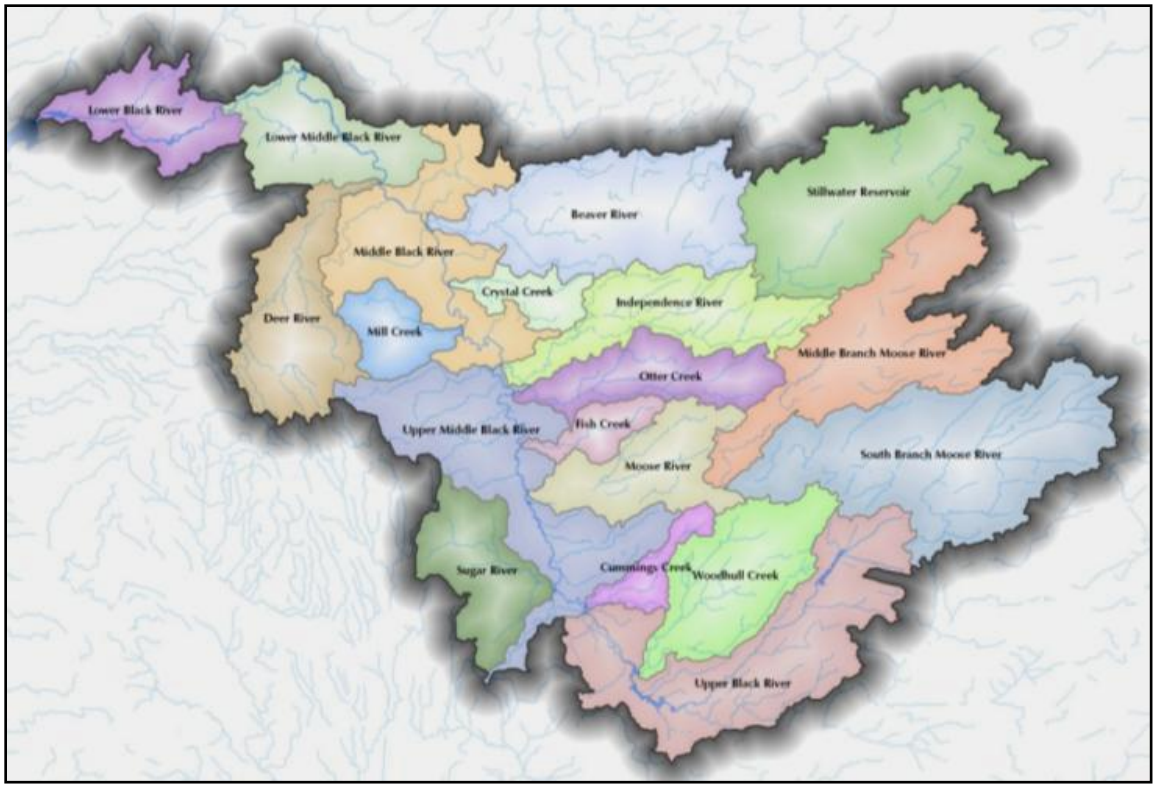
GROUNDWATER ASSESSMENT AND RECOMMENDATIONS REPORT for the Black River Watershed, New York



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1.0 Introduction

1.1 Project Description

This report provides a summary of identified aquifers, utilization of groundwater resources, and an evaluation of future expansion and protection for groundwater resources within the Black River Watershed. This report was prepared by Bergmann Associates for the Town of Greig and other parties as part of a resource evaluation of the Black River Watershed.

1.2 Black River Watershed Description

The Black River Watershed is located in upstate New York and encompasses approximately 1.2 million acres of coverage. The watershed is located in two Physiographic Provinces: The western portion of the Adirondack Mountains Uplift Physiographic Province and also in the eastern portion of the Tug Hill Plateau Province. The Black River divides the watershed into a western and eastern portion. The Black River is located along the western foothills of the Adirondack Uplift and splits the watershed into the western and eastern portions. Figure 1 shows the location of the watershed area. The watershed comprises 19 subwatersheds, shown in Figure 2, with no single subwatershed greater than 11.1 percent of the total watershed area. The watershed comprises a mix of land uses, the majority of which is forested. Approximately 56 percent of the watershed is located in the Adirondack Park. The subwatersheds are summarized in Table 1.

Table 1 - Black River Subwatershed Segments

Subwatershed	Acres	Percent of Total
Beaver River	98,761	8.1%
Crystal Creek	17,085	1.4%
Cummings Creek	14,212	1.2%
Deer River	62,270	5.1%
Fish Creek	14,966	1.2%
Independence River	61,074	5.0%
Lower Black River	39,532	3.2%
Lower Middle Black River	51,985	4.3%
Middle Black River	8,153	6.7%
Middle Branch Moose River	94,880	7.8%
Mill Creek	22,512	1.8%
Moose River	46,711	3.8%
Otter Creek	42,181	3.5%
South Branch Moose River	135,713	11.1%
Stillwater Reservoir	109,992	9.0%
Sugar River	44,732	3.7%
Upper Middle Black River	102,016	8.4%
Upper Black River	115,439	9.5%
Woodhull Creek	62,661	5.1%
Black River Watershed	**1,218,075**	**100%**

2.0 Black River Watershed Groundwater Evaluation

Existing literature, published maps, and reports were obtained that provided data on identified aquifers and utilization of groundwater in the Counties and municipalities within the Black River Watershed. Unconsolidated and bedrock aquifers that serve as viable aquifers were identified. These aquifers comprise approximately 585,460 acres, or 40 percent of the total watershed area. Specific resources are summarized in Section 9 of this Report. Reviewed literature, maps and reports included the following:

- *Water Resources of the Black River Basin, New York, Basin Planning Report BRB-1*, 1975, prepared by the New York State Department of Environmental Conservation. This report contained data on water use as of 1964. This report was used as part of the initial screening to determine municipal water supply systems and surface water and aquifer sources. The information updated with recent data (2006 to 2008) provided by various New York State Department of Health (NYSDOH) Regional Offices and directly by personnel at municipal water system facilities and was supplemented with later reports prepared by the UGGS (including Groundwater Availability in the Black River Basin, Report 86-4040).

- *Groundwater Availability in the Black River Watershed, New York, USGS Water Resources Investigations Report 86-4040, prepared in 1984*. This report consists of three maps showing wells, springs, overburden aquifers and bedrock aquifers in the Black River Basin.

- *Favorable Zone Delineation for Development of New Groundwater Sources, Lewis County, New York, prepared for Lewis County by HydroSource Associates, May 2008*. This report summarized groundwater resources, existing utilization and potential areas for development for Lewis County. This report was the most recent at the time this evaluation was prepared.

- *Potential Yields of Wells In Unconsolidated Aquifers In Upstate, New York: Adirondack Sheet, Finger Lakes Sheet and Hudson Mohawk Sheet*. These sheets were prepared in 1987 provide mapping on unconsolidated aquifers in the project area.

- *Identification of Sole Source-Principal Aquifers, from the New York State Department of Environmental Conservation website*.

- *St. Lawrence County Comprehensive Water Supply Study*, dated 1968, prepared by Atkins-Tisdel Associates and Sterns and Wheler for the New State Department of Health. This report provided regional information on hydrology and dated on adjacent water supply systems in St. Lawrence County and did not directly address the Black River Basin area.

- *Ground-Water Availability from the Unconsolidated deposits of the St. Lawrence River Basin*, USGS Water Resources Investigation Report 87-4119, prepared in 1987. This report of mapping of the St. Lawrence River Basin did not include the Black River Watershed.

- *Hydrogeology of the Fort Drum Area, Jefferson, Lewis and St. Lawrence Counties, New York*, USGS Water-Resources Investigations Repot 85-4119 prepared in 1986. This report consisted of mapping that included the northwestern portion of the Black River Watershed.

3.0 Black River Watershed Municipal Systems

The Black River Watershed encompasses portions of five Upstate New York State Counties: Hamilton, Herkimer, Jefferson, Lewis, and Oneida. These communities provide a variety of municipal services including municipal water systems and sanitary sewage treatment and discharge. Aquifers serve as water supply systems for several municipalities within the Black River Watershed. Several reservoirs, bodies of water, and local supply wells also serve municipal water systems. Municipalities within the Black River Watershed utilize a mix of surface water and groundwater sources as potable water supplies. Communities with municipal water supply systems are shown on Figure 3.

3.1 Black River Watershed Municipal Water Supply Plants

Municipalities within the Black River Watershed utilize a mix of surface water and groundwater sources as potable water supplies. Municipal water supply systems have been identified in portions of Jefferson County; Lewis County; Oneida County; and Herkimer County. The locations, water source and approximate daily production rates were obtained from the New York State Department of Health using data from 2008. No municipal water supply systems were identified in the portion of Hamilton County at the eastern extent of the Black River Watershed (Town of Inlet). The Identified municipal water supply systems are listed in Table 2.

Information as to actual production yields from municipal water supply systems was obtained from various sources. Readily available data consisted of daily production rates but was not available for the entire Watershed. Information on groundwater characteristics was not readily available.

Use of private water supply wells abounds in the Black River Watershed. Private utilization of surface water sources or springs also abounds. Such systems may supply small residences, campgrounds, resorts and commercial operations. Information on private water supply wells was not readily available, and is of questionable reliability concerning screened interval, production zones or daily rates. This type of data was not included in this evaluation.

3.2 Black River Watershed Municipal Sewage Treatment Plants

Sewage treatment plant outfalls can impact surface water quality and the recharge to aquifer systems. Future development of water supply systems that utilize unconsolidated aquifers that are recharged by direct surface waters may be adversely impacted by point discharges of treated effluent from sewage plants. The major municipal sewage treatment plants, water discharge point and coordinates have been determined. No municipal sewage treatment plants were identified in the portion of Hamilton County at the eastern extent of the Black River Watershed. Identified public sewage treatments plants within the project are listed in Table 3.

Information on registered discharge points from nom-municipal sources such as trailer parks, campgrounds and industrial sources is also available. This data set was not readily plottable (not in a GIS-type format) and based on the volume uncertain discharge locations this information was not included in this evaluation.

Table 2 - Black River Watershed Municipal Water Supply Systems

Municipality	Groundwater Utilization	Surface Water Utilization	Dual Utilization	Approximate Daily Rate	Remarks
Hamilton County (Inlet Area)					
Inlet and Arietta: No municipal sources[1,6]	**No**	**No**			**No municipal services**
Village of Speculator-Lake Pleasant[6]	**Yes**	**No**		**180,000 GPD**	**Undetermined source**
Long Lake Water District[6]	**No**	**Yes**		**260,000 GPD**	**Surface Water**
Herkimer County					
Town of Webb, serves Old Forge/Thendara[6]	**Yes**	**Backup**		**118,000 GPD to 400,000 GPD**	**Sand and gravel wells Seasonal increase in use**
Jefferson County[2]					
Village of Black River	**Yes**	**No**		**150,000 GPD**	**Undetermined aquifers**
Brownville	**Yes**	**No**		**150,000 GPD**	**Wells & Purchase**
Village of Dexter	**Yes**	**No**		**80,000 GPD**	**Undetermined aquifers**
Champion	**Yes**	**No**		**26,000 GPD**	**Undetermined aquifers**
Hounsfield	**No**	**No**		**N/A**	**No source-purchase water**
Leray[6]	**Yes**	**Yes**	**Yes**	**310,000 GPD**	**Wells & Purchase water**
Pamelia	**No**	**No**		**N/A**	**No source-purchase water**
Rutland	**No**	**No**		**N/A**	**No source-purchase water**
City of Watertown	**No**	**Yes**		**5.8 million GPD**	**Surface water**
Town of Watertown	**No**	**No**		**N/A**	**No source-purchase water**
Wilna	**Yes**	**No**		**12,000 GPD**	**Wells**
Lewis County[2]					
Castorland[3]	**Yes**	**No**		**43,000 GPD[3]**	**2 drilled wells**
Constableville[3]	**Yes**	**Yes**	**Yes**	**50,000 GPD[3]**	**springs**
Copenhagen[3]	**Yes**	**Deer River Backup**		***8*0,000 GPD[3]**	**2 drilled wells**
Croghan-Beaver Falls[3]	**Yes**	**No**		**200,000 GPD[3]**	**2 gravel wells**
Martinsburg	**Yes**	**No**		**54,00 GPD[6]**	**Undetermined aquifers**
Glenfield Water District-Town of Martinsburg [3]	**Yes**	**No**		**30,000 GPD[3,6]**	**2 drilled wells**
Hillside Water Users/Osceola[3]	**Yes**	**Yes**		**2,000 GPD[3]**	**Spring**
Village of Harrisville[3]	**Yes**	**No**		**100,000 GPD[3]**	**3 drilled wells**
Village of Lowville	**No**	**Yes**		**1,100,000 GPD[3]**	**Young's Pond & 2 streams**
Village of Lyons Falls	**Yes**	**No**		**140,000 GPD[3]**	**Gravel packed wells**
Town of Martinsburg	**Yes**	**No**		**60,000 GPD[2]**	**5 Drilled wells**
Village of Port Leyden	**Yes**	**Yes**	**Yes**	**200,000 GPD[3]**	**Two infiltration gallery**
Village of Turin[2]	**Yes**	**No**		**65,000 GPD[3]**	**Two drilled wells**
Oneida County					
Boonville[4]	**Yes**	**No**		**275,000 GPD**	**Sand & Gravel Wells**
Forestport[5]	**Yes**	**No**		**25,000 GPD**	**Drilled wells, combined gravel & bedrock aquifers**

1: Verbal information provided by the NYSDEC Region 5
2: Information on Jefferson County and Lewis County provided by the NYSDOH Watertown District Office
3: Data from 2006 Lewis County Comprehensive Economic Development Strategy (CEDS) Report
4: Verbal information provided by Municipal Commission of Boonville
5: Verbal information provided by the Town of Forestport Water Department
6. Information provided by the NYSDOH Central Office

Table 3 - Identified Black River Watershed Municipal Waste Water Treatment Plants

Sewage Plant Name	County	Receiving Waters	Daily Discharge	Latitude	Longitude
Jefferson County					
City of Watertown	Jefferson	Black River	16.0 Million GPD	43° 59' 24"	75° 55' 38"
Carthage/West Carthage	Jefferson	Black River	4.0 Million GPD	43° 59' 02"	75° 37' 14"
Village of Brownville	Jefferson	Black River	650,000 GPD	44° 01' 00"	75° 59' 06"
Village of Deferiet	Jefferson	Black River	41,000 GPD	44° 02' 29"	75° 40' 45"
Village of Dexter	Jefferson	Black River	250,000 GPD	44° 0' 19"	76°02' 35"
Village of Herrings	Jefferson	Black River	12,650 GPD	44° 01' 18"	75° 39' 39"
Lewis County					
Beaver Falls - Croghan	Lewis	Beaver River	20,000 GPD	43° 53' 10"	75° 26' 20"
Village of Castorland	Lewis	Black River	45,000 GPD	43° 53' 40"	75° 30' 25"
Village of Copenhagen	Lewis	Deer River	110,000 GPD	43° 53' 33"	75° 40' 04"
Village of Croghan	Lewis	Beaver River	70,000 GPD	43° 53' 50"	75° 23' 45"
Village of Lowville	Lewis	Mill Creek to Black River	1.8 Million GPD	43° 47' 02"	75° 28' 35"
Town of Martinsburg	Lewis	Black River	40,000 GPD	43° 43' 04"	75° 23' 50"
Oneida County					
Village of Boonville WWTP	Oneida	Mill Creek	1.1 million GPD	43° 29 ' 30"	75° 00' 15"
Forestport Sewage Treatment Plant	Oneida	Black River	24,000 GPD	43° 26' 15"	75° 12' 30"
Herkimer County					
Old Forge Waste Water Treatment Plant-Town of Webb	Herkimer	Middle Brach Moose River	45,000 GPD	43 ° 42' 00"	74° 58' 00"
Hamilton County					
None identified					

Only Municipal Waste Water Treatment Plants (WWTP) within the Black River Watershed listed
GPD = Gallons per Day
Source of Data: NYSDEC State Pollutant Discharge Elimination System (SPDES) Reports
Note: WWTPs in Sackets Harbor (Jefferson County and Town of Remsen (Oneida County) are outside the Black River Watershed study area

3.3 Waste Sites within the Black River Watershed

A review was conducted of readily available NYSDEC and U.S. EPA environmental waste site registries for which geographic location information is accurately known. These types of sites include properties listed in NYSDEC environmental restoration programs. These programs include:

- NYSDEC Registry of Inactive Hazardous Waste Disposal Sites ("State Superfund") which includes U.S. EPA National Priority List (NPL).
- Voluntary Cleanup Program.
- Environmental Restoration Program.
- Brownfield Cleanup Program.

These types of waste sites can present potential adverse impact by release of contaminants to the subsurface or aquifer systems that are in direct contact with surface water or near-surface groundwater. The locating and development of groundwater systems can be impeded by existence of waste sites that have the potential to contaminate groundwater. Identified waste sites within the Black River Watershed are summarized in Table 4. These waste sites are shown graphically in Figure 4.

Table 4 - Identified Significant Waste Sites within the Black River Watershed

Site No.	Side Code	Name	Program	County
1	E633067	E-Z Stop	ERP	Oneida
2	B00201	Thibado Property	ERP	Herkimer
3	B00155	Bush's General Store	ERP	Lewis
4	E625012	Former Gas Station	ERP	Lewis
5	625005	Payne Jones	HW	Lewis
6	625008	AMF: Trinity Avenue	HW	Lewis
7	625009	Village of Lowville Dump	HW	Lewis
8	V00022	McAlpine Street (Alaskan Oil)	VCP	Lewis
9	E623014	Former AFMC Inc, Petrol. Bulk Storage Facility	ERP	Jefferson
10	E623021	Sewall's Island	ERP	Jefferson
11	E623025	Watertown Center Expressmart	ERP	Jefferson
12	623003	New York Air Brake Company	HW	Jefferson
13	623005	DEC Brownville Pesticide Building	HW	Jefferson
14	623006	Abe Cooper Surplus Company	HW	Jefferson
15	623007	SMI/Caelter Industries	HW	Jefferson
16	623009	Bomax Manufacturing	HW	Jefferson
17	623010	Crown Cleaners Inc. (dba Nu-Art Cleaner)	HW	Jefferson
18	623011	NM - Engine St - Watertown MGP	HW	Jefferson
19	623012	Carthage Machine Company	HW	Jefferson
20	V00019	54 West Church Street (Alaskan Oil)	VCP	Jefferson
21	V00027	1289 Arsenal Street (Alaskan Oil)	VCP	Jefferson
22	V00030	23179 Rte. 342 (Alaskan Oil)	VCP	Jefferson
23	V00031	804 State Street (Alaskan Oil)	VCP	Jefferson
Site No.	**Side Code**	**Name**	**Program**	**County**

24	V00032	1200 Washington Street (Alaskan Oil)	VCP	Jefferson
25	V00033	I-81 Center Property (Alaskan Oil)	VCP	Jefferson
26	V00034	6391 Coffeen Street (Alaskan Oil)	VCP	Jefferson
27	V00143	Carthage Machine Company	VCP	Jefferson
28	V00201	Brewster Automotive & Marine	VCP	Jefferson
29	V00473	NM - Anthony St. - Watertown MGP	VCP	Jefferson
30	V00525	FiberMark DSI Inc.(Former REXAM DSI Inc)	VCP	Jefferson

Review Date: Data as of November 2008 on U.S. EPA and NYSDEC web-based databases
ERP = NYSDEC Environmental Restoration Program
HW = NYSDEC Registry of Inactive Hazardous Waste Disposal Sites
VCP = NYSDEC Voluntary Cleanup Program

The NYSDEC maintains a directory of reported spill events. This database includes all reported petroleum spills and leaks in New York State and variety of events including leaking underground or above ground storage tanks, tank tightness failures, surface spills, spills from motor vehicle accidents and overfilling vehicles at service stations. Approximately 16,000 new spill events are reported annually, most of which are releases of small quantities which are often cleanup quickly. This directory is updated daily. Based on the volume of the directory, limited geographic data and constant additions review of the NYSDEC spills directory was beyond the scope of work for the Black River Watershed area. This database can be accessed at:
(http://www.dec.ny.gov/cfmx/extapps/derexternal/

The NYSDEC maintains a database of registered petroleum and chemical bulk storage facilities. This database maintains information on known facilities that meet the NYSDEC petroleum or chemical bulk storage registration criteria (for example, petroleum storage capacity in excess of 1,100 gallons). This registry does not include most facilities with a petroleum storage capacity of 1,000 gallons or less or information on facilities that closed or were abandoned prior to implementation of NYSDEC storage tank regulations. Review of this registry for the Black River Watershed area was beyond the scope of work for this project but can be accessed at:
http://www.dec.ny.gov/cfmx/extapps/derexternal/index.cfm?pageid=4

4.0 Geologic Setting

The Black River Watershed is located in central New York State, east of the Ontario Lake Lowlands. The watershed encompasses approximately 1.218 million acres of coverage. The watershed traverses the eastern portion of the Ontario Lake Lowlands and extends to the western portion of the Adirondack Park Highlands. The Black River along the western Adirondack Park divides the Watershed into the western Lowlands and eastern Adirondack Highlands provinces.

4.1 Overburden Geology

Overburden deposits within the Watershed comprise glacial deposits, outwash sand and gravel deposits, lacustrine sand and silt deposits, and exposed bedrock (Adirondack Uplift). Overburden deposits consist of a variety of unconsolidated sediments derived from glacial deposits, river or lake deposits or weathered bedrock. The type, relative porosity, thicknesses and potential for hydraulic recharge are elements that determine applicability of surface deposits as aquifers. The type and extent of surface materials within the Black River Watershed are summarized in Table 5 and are shown on Figure 5.

Table 5 - Overburden Deposits within the Black River Watershed

Overburden Deposit Name and abbreviation	Acres in Black River Watershed	Percentage of Cover
Recent Alluvium (al)	48,000	3.9%
Alluvium Fan (alf)	1,190	0.1%
Alluvial Inwash (Ali)	433	<1%
Dunes (d)	406	<1%
Fluvial deltaic sand (fds)	8,650	0.7 %
Fluvial Sand and/or gravel (fg)	418	<0.1%
Open water (H20)	12,300	1.0%
Kame Deposts (k)	61,900	5.1%
Kame Morane (km)	11,400	0.9%
Lacustrine Beach (lb)	812	0.1%
Lacustrine Delta (ld)	61,500	5.0%
Lacustrine Sand (ls)	79,300	6.5%
Lacustrine Silt and Clay (lsc)	32,100	2.6%
Outwash sand and gravel (og)	64,600	5.3%
Swamp deposits (pm)	6,560	0.5%
Exposed bedrock (r)	90,450	7.4%
Glacial Till (t)	717,000	58.9%
Ablation Moraine (ta)	5,640	0.5%
Till Moraine (tm)	15,700	1.3%
Total	**1,220,000 acres**	**100 %**

4.2 Bedrock Geology

The bedrock basement deposits underlying the Black River Watershed consists of two different types of geologic deposits. The Black River valley divides the Watershed into the western portion composed of sedimentary rocks and the eastern portion composed of high grade metamorphic and igneous rocks. The extent of bedrock deposits within the Watershed are depicted on Figure 6.

Information on well yields from bedrock aquifers was obtained from the Ground-Water Availability in the Black River Basin, NY USGS Report 86-4040. The bedrock in the eastern portion of the watershed in the Adirondack Mountains Uplift Physiographic Province, generally east of the Black River are comprised of pre-Cambrian age crystalline metamorphic and igneous deposits with relatively low permeability. Groundwater in such formations is limited to less than 1 gallon to 10 gallons per minute. Localized use of groundwater that has seeped into joints and fractures in this type of bedrock may be possible.

The bedrock in the western portion of the watershed consists of sedimentary deposits mapped as various sedimentary and limestone deposits. The sedimentary rocks consist of Ordovician age sedimentary rocks deposited in a marine environment and form a sequence of rocks that dip to the southwest. Ordovician age sedimentary bedrock deposits in the western portion of the Watershed include:

- Pulaski and Whetstone Gulf Formation (OPW), siltstone and shale, and Oswego Sandstone (Oo), low well yields from less than 1 gallon per minute to 10 gallons per minute.
- Utica Shale (Ou), shale deposits, moderate to high well yields, 1 to 50 gallons per minute.
- Trenton Group (Ot), limestone, moderate to high well yields, 1 to 50 gallons per minute.
- Black River Group (obr), limestone, high potential yields 51 to 500 gallons per minute.

The Pulaski and Whetstone Gulf Formations, part of the Lorraine Group is comprised of siltstone and shale deposits that comprise the bedrock in the western portion of the Watershed. These deposits have been mapped as having a low well yield and have the low potential for water supply.

The Ordovician-age Trenton Group and a thin portion of Black River Group limestone formations occur in a northwest to southeast trending band just west of the Black River Basin. These units, along with localized occurrences of the Utica Shale have been mapped as having moderate yields of 1 to 50 gallons per minute in the bedrock occurrences just west of the Black River. In this area the limestone bedrock can be utilized as productive water supply sources, depending upon aquifer thickness, yield and quality. Limestone aquifers may have relatively higher concentrations of dissolved calcium and magnesium resulting in "Hard water". The Forestport Water District in Oneida County obtains groundwater from wells in gravel and Trenton Group limestone bedrock.

Bedrock occurrences of the Black River Group limestone north and northwest of the City of Watertown extending to the Town of Champion, Villages of Black River, Deferiet and Herrings have been mapped as high yields, 51 to 500 gallons per minute.

5.0 Black River Watershed Aquifers

5.1 Unconsolidated Aquifers

An aquifer is a bedrock formation, sediment (unconsolidated) deposit or combined formation/deposit which is saturated and sufficiently permeable to transmit economic quantities of water to wells and springs (definition from Applied Hydrogeology, C. W. Fetter, 1988).

A variety of unconsolidated-unconfined, confined and consolidated-bedrock aquifers have been identified within the Black River Watershed, as depicted on the Aquifers Map, Figure 7. Available geologic resources and mapping was used to compile the aquifers within the Watershed. Information was obtained from Ground-Water Availability in the Black River Basin, NY USGS Report 86-4040 and Potential Yields of Wells in Unconsolidated Aquifers in Upstate New York – Finger Lakes, Adirondack and Hudson Mohawk Sheets.

Generalized locations of the identified aquifers that supply municipal systems within the Black River Watershed are presented on Figure 7, Aquifers Map. Mapping of unconsolidated aquifers in greater detail is presented in the mapping of Potential Yields of wells in Unconsolidated Aquifers in Upstate New York (Water-Resources Investigations Reports 87-4122, 87-4275 and 87-4276).

Information on groundwater characteristics such as hardness, total dissolved solids and iron for unconsolidated aquifers was not readily available for current municipal supply systems.

For purposes of evaluation, this report has sub-divided the unconsolidated overburden aquifers into five categories, based on the nature of the depositional environment that created the deposits, geographic location, and type of aquifer. The systems identified within the Black River Watershed as potential unconsolidated aquifer sources are summarized in Table 6. The aquifers are divided by the 19 subwatersheds in Table 7.

One nearby groundwater aquifer, Tug Hill Plateau, is designated by the U.S. Environmental Protection Agency (EPA) as a sole source aquifer, and as a NYS Department of Environmental Conservation (DEC) Principal Aquifer. This aquifer is within the Salmon-Sandy Watershed, the delineated boundary abuts a portion of the study area. None of the aquifer systems within the Black River Watershed are designated U.S. EPA sole source aquifer. The NYSDOH has not designated any of the identified aquifers within the Black River Watershed as Primary aquifers.

Aquifers in New York State can be designated Principal or Primary Aquifers. The NYSDEC provides criteria for designation of Principal and Primary Aquifers in Technical and Operational Guidance Series (TOGS) 2.1.3 dated 1990. Principal Aquifers are defined as “Known to be highly productive or whose geology suggests abundant potential but which are not intensively used as sources of water supply by major municipal systems at the present time”.

Primary Aquifers are defined in the NYSDEC Technical and Operational Guidance Series 2.1.3 as “Highly productive aquifers presently being utilized as sources of water supply by major municipal water supply systems”. The document includes a formal list of designated Primary Aquifers. None of the aquifers identified within the Black River Basin are included in the list of Primary Aquifers.

Based on utilization and potential yield, several aquifers within the Black River Watershed may meet the criteria for designation as a principal aquifer. New York does not have a formal application process for listing an aquifer but this may be accomplished by petition to the NYSDOH.

Although the Watertown area aquifer is not formally designated as a Primary Aquifer, existing utilization of groundwater may meet the State criteria for classification as a Primary Aquifer.

Table 6 - Unconsolidated Aquifers within the Black River Watershed

Aquifer Designation	Aquifer Designation	Area (Acres)	% of Black River Watershed	Type	Potential Yield
Watertown Area Lacustrine Delta	1	21,870	1.7 %	Lacustrine Delta Portions are confined	More than 100 gpm
Black River Valley Recent Alluvium	2	73,450	5.7%	Recent Alluvium Deposits, Unconfined aquifer	10 to 100 gpm
Lewis County Gravel Outwash Deposits	3	204,030	16.0 %	Gravel Outwash Unconfined aquifer	10 to 100 gpm
Boonville-Woodgate Area Kame Delta	4	10,630	0.8 %	Kame Delta Unconfined Aquifer	More than 100 gallons per minute
Minor Lacustrine Outwash Sand and Gravel Deposits	5	160,990	12.6 %	Sand & Gravel Deposits Isolated Unconfined Aquifers	10 to 100 gpm
Bedrock Aquifers-Limestone	6	11,120	0.9%	Consolidated Limestone	1 to 500 gpm

gpm = Gallons per Minute

5.1.1 Watertown Area Lacustrine Delta (Designated Aquifer 1)

The area north of the City of Watertown, including the Fort Drum Area is underlain by an extensive lacustrine outwash deposits. This area is designated Aquifer 1 and encompasses approximately 21,870 acres. These deposits consist of saturated sands and gravels with variable thicknesses and have been determined to have a yield greater than 100 gallons per minute.

Several municipal systems in the portion of Jefferson County located within the Black River Watershed utilize groundwater from this aquifer and from the underlying bedrock aquifer (Black River Group Limestone) as water supply sources. These municipalities include the Village of Brownville, Town of Champion, Village of Black River and Village of Deferiet (Town of Wilna)

The Fort Drum area, which extends beyond the Black River Watershed, has been the focus of several groundwater availability investigations. Since the late 1980s utilization of this aquifer has expanded to accompany the development at Fort Drum. Based on development of groundwater in the Watertown area and potential yields the Watertown Area Lacustrine Delta may meet the qualifications as a Primary Aquifer, although not designated as such at the present time.

Table 7 - Black River Sub Watersheds Acres per Designated Aquifers

	Acres per Designated Aquifers						
Sub Watershed	**1**	**2**	**3**	**4**	**5**	**6**	**Total Aquifer coverage (acres)**
Beaver River	0	5,470	49,530	0	0	140	55,140
Crystal Creek	0	4,930	9,080	0	0	220	14,220
Cummings Creek	0	0	9,950	0	1,200	0	11,160
Deer River	370	4,570	0	0	0	0	4,940
Fish Creek	0	500	9,670	0	220	0	10,390
Independence River	0	1,640	33,740	0	3,850	20	39,250
Lower Black River	4,740	0	0	0	0	0	4,740
Lower Middle Black River	16,740	810	0	0	0	0	17,550
Middle Black River	20	20,050	2,090	0	0	6,930	29,090
Middle Branch Moose River	0	0	0	0	32,720	0	32,720
Mill Creek	0	3,850	0	0	0	60	3,910
Moose River	0	480	13,980	0	14,180	0	28,640
Otter Creek	0	500	15,490	0	9,660	0	25,650
South Branch Moose River	0	0	0	0	47,620	0	47,620
Stillwater Reservoir	0	0	980	0	30,140	0	31,120
Sugar River	0	10,910	0	0	0	0	10,910
Upper Black River	0	0	14,300	10,270	10,470	0	35,040
Upper Middle Black River	0	19,740	21,870	360	1,830	3,750	47,550
Woodhull Creek	0	0	23,350	0	9,100	0	32,450
19 Sub Watershed Segments	**21,870**	**73,450**	**204,030**	**10,630**	**160,990**	**11,120**	**482,090**

5.1.2 Black River Recent Alluvium (Designated Aquifer 2)

Deposits along the Black River channel and adjacent terraces to the Black River have been mapped as recent alluvium deposits (unconsolidated sediments of various texture and thickness) that are generally less than 15,000 to 10,000 years old. These sediments are in direct contact with the Black River and are hydraulically recharged by the Black River and by tributaries near their Black River confluences. These deposits have been designated Aquifer 2 and encompasses approximately 73, 450 acres or 5.7 % of the Black River Watershed. Based on potential yield this aquifer segment could be developed as a major source of water and has the potential to be classified as a Principal Aquifer.

5.1.3 Lewis County Gravel Outwash (Designated Aquifer 3)

The overburden deposits in the eastern portion of Lewis County, east of the Black River and adjacent to the Adirondack Uplift, consist of various outwash deposits that comprise unconfined aquifers. This area forms the largest aerial extent of unconsolidated aquifer systems in the Black River Watershed, covering approximately 204,030 acres. These deposits cover approximately 16.0 % of the Watershed. These unconfined deposits can yield 10 to 50 gallons of water per minute. Portions of these aquifers merge easterly to isolated sand gravel and deposits that have developed along valleys, stream outfalls, and lakes on the Adirondack Uplift Province. Based on geographic extent potential yield this aquifer segment could be developed as a major source of water and has the potential to be classified as a Principal Aquifer.

5.1.4 Boonville-Woodgate Kame Delta (Designated Aquifer 4)

In the vicinity of Boonville and Woodgate in Oneida County an extensive glacial deposit, a kame delta has been mapped. This deposit consists of various thicknesses of sand and gravel deposits that encompass approximately 10,630 acres in Oneida County along the Upper Black River and Upper Middle Black River subwatersheds. The sediments in this formation form an unconfined aquifer. Based on potential yield this aquifer segment could be developed as a major source of water and has the potential to be classified as a Principal Aquifer. This aquifer is currently utilized by Boonville and the town of Forestport as municipal water sources with production over 270,000 gallons per day. Based on the reported utilization the Boonville-Woodgate Kame Delta aquifer may also meet criteria for classification as a Primary Aquifer.

5.1.5 Minor Lacustrine Outwash Sand & Gravel Deposits (Designated Aquifer 5)

The majority of the Black River Watershed overlying the Adirondack Uplift in Herkimer and Hamilton Counties consists of glacial till with minimal porosity and poor yield. Areas of exposed bedrock also occur in this area. Limited occurrences of outwash sand and gravel deposits have developed along streams and lakes. These deposits can serve as local groundwater sources. Although generally isolated from each other, these deposits together comprise 160,990 acres within the Black River Watershed, comprising approximately 12.6 % of the total watershed. These aquifers trend in a general southwest to northeast pattern along valleys and lake systems (such as the Fulton Chain of Lakes).

The lacustrine (lake deposits) outwash sand and gravel deposits that comprise the aquifers in this area are not continuous and may be separated by bedrock outcroppings. These deposits may provide locally significant sources of water this area. The Village of Speculator (Lake Pleasant) and Raquette Lake Water District in Hamilton County at the eastern extent of the watershed utilize groundwater for local municipal supply sources. The Old Forge Water District in the Town of Webb serves the Hamlets of Old Forge and Thendara utilizing groundwater from two sand and gravel aquifers (well descriptions provided by the Town of Webb) providing an average of 118,000 gallons of water per day. During periods of high demand and seasonal use groundwater utilization increases to 400,000 gallons per day. Thus the Lacustrine Outwash Sand & Gravel deposits are locally significant, but based on the localized utilization these aquifers may have difficulty for consideration as a Principal Aquifer.

6.0 Black River Watershed Consolidated Bedrock Aquifers (Designated Aquifer 6)

The Black River Watershed encompasses geologic deposits that include sedimentary units that have been developed as aquifers and water supply sources. Based on mapping of Groundwater Availability in the Black River Watershed (Walker, USGS 86-4040) a band of limestone extends from Watertown to the southeast, following the Black River valley. Consolidated aquifers comprise approximately 11,120 acres. The Pulaski and Whetstone Gulf Formation (shale and siltstone) and the Oswego Sandstone on the western portion of the Watershed have been mapped as having a low well yield. These deposits have a low potential for development as municipal water systems but may provide adequate groundwater for local or private use.

Two major bedrock aquifers have been identified with the watershed, shown on the Aquifer Map, Figure 7. Detailed mapping of the bedrock aquifer is presented in "Groundwater Availability in the Black River Watershed" (Water Resources Investigations Report 86-4040). The bedrock aquifers and potential yield are summarized in Table 8.

6.1 Black River Group Limestone, Watertown Area

The limestone Black River Group bedrock underlying the Watershed the vicinity of Watertown in Jefferson County has been mapped as a productive bedrock aquifer. This unit consists of limestone mapped as providing a potential 51 to 500 gallons per minute (gpm). The Black River Group limestone bedrock in Jefferson County east and northeast of the City of Watertown is a productive aquifer. Several municipalities in Jefferson County utilize groundwater from the Black River Group Limestone as supply sources. Production wells may penetrate both overburden and bedrock deposits and groundwater may be obtained from unconsolidated and bedrock aquifers concurrently.

6.2 Trenton Group Limestone, Lewis County

The Trenton Group Limestone and portions of the Black River Group and localized occurrences of the Utica Shale form a linear formation extending in a general northwest to southeast band in Lewis County. This consists of limestone mapped as providing 1 to 50 gallons per minute (gpm). Recovery wells in Oneida County obtain water at least in part from the Trenton Group limestone formation. The Trenton Group Limestone band in Lewis County has been proposed for future consideration as favorable development (Zones E and F, HydroSource Associates 2008 report).

Table 8 - Bedrock Aquifers within the Black River Watershed

Formation	Location	Potential Yield	Comments
Black River Limestone	Jefferson County, Watertown area	51 to 500 gallons per minute	Currently utilized, presents potential for development as significant water supply
Trenton Group Limestone/Utica Shale band	Jefferson County-Lewis County, follows Black River Valley	1 to 50 gallons per minute	May supply local springs and seeps and have local use as a water supply
Whetstone Gulf and Pulaski siltstone and Shale	Western Lewis County	< 1 to 10 gallons per minute	Low potential for water supply, localized use possible

7.0 Existing Utilization of Groundwater within the Black River Watershed

Existing utilization of groundwater and aquifer systems within the Black River Watershed was determined from review of existing literature, groundwater reports, information provided by the New York State Department of Health and direct contact with municipalities. In addition to municipal water sources, private and residential utilization of groundwater occurs throughout the Black River Watershed. Municipal utilization of groundwater with quantities is listed in Table 2.

Existing utilization of groundwater within the Black River Watershed includes the following:

- Municipal Water Supply Systems that utilize aquifers.
- Industrial sources that utilize aquifers.
- Residential properties, campgrounds, and private water supply systems that utilize water supply wells, surface water sources or springs.
- Agricultural and farms that utilize groundwater.

Identification of municipalities that utilize groundwater within the Black River Watershed was completed for this project. Municipal water systems are summarized in Table 2. Evaluation of small users of groundwater such as private residences, campgrounds and private businesses was beyond the scope of this evaluation.

Within the Black River Watershed 22 municipal water systems have been identified that utilize groundwater as a supply source, summarized in Table 2 and Figure 3. Some systems share sources. Only municipalities within the Black River Watershed were included for this evaluation.

7.1 Hamilton County

The Village of Speculator (Lake Pleasant) and Raquette Lake Water District in Hamilton County at the eastern fringe of the watershed utilize groundwater for local municipal supply sources (193,000 gallons per day). No other municipal water supply systems were identified within the Black River Watershed that lies in Hamilton County. Private use of water supply wells may occur in this area.

7.2 Jefferson County

Approximately 600,000 gallons per day of water obtained from aquifers for Black River Watershed municipalities in Jefferson County. This value may include water purchased from other systems that may utilize groundwater and/or surface water. Identified significant groundwater use includes:

- Town of Brownville, 150,000 gallons per day, water wells & purchase from other systems.
- Town of Wilna, 87,500 gallons per day, obtained from bedrock and unconsolidated aquifers.
- Town of Rutland, 122,000 gallons per day, groundwater purchased from Town of Palmelia.
- Black River, 150,000 gallons per day, obtained from Bedrock and unconsolidated aquifers.

The City of Watertown is the largest provider of water, 5.8 million gallons of day. The City municipal system reportedly utilizes surface water from the Black River, not from groundwater.

7.3 Lewis County

There are portions of nine villages and one town in Lewis County that have various municipal water supply systems that in part utilize groundwater (2006 Lewis County CEDS). Approximately 1 million gallons per day of groundwater (970,000 gallons) obtained from aquifers in Lewis County. Identified municipal water supply systems in the Lewis County portion of the watershed include:

- Town of Castorland, 43,000 gallons per day obtained from two wells, undetermined source.
- Village of Constableville, 50,000 gallons per day from springs (inferred as a groundwater source).
- Village of Copenhagen, 80,000 gallons per day obtained from wells, undetermined source.
- Croghan-Beaver Falls, 200,000 gallons per day from gravel wells (shallow aquifer).
- Martinsburg Water District, 54,000 gallons per day from undetermined groundwater wells.
- Glenfield Water District-Town of Martinsburg, 30,000 gallons per day obtained from wells.
- Hillside Water Users/Osceola, 2,000 gallons per day obtained from springs (inferred as a groundwater source).
- Village of Harrisville, 100,000 gallons per day obtained from 3 drilled wells.
- Village of Lyons Falls, 140,000 gallons per day obtained from gravel packed wells.
- Village of Martinsburg, 60,000 gallons per day obtained from five drilled wells.
- Village of Port Leyden, 200,000 gallons per day reported as obtained from two infiltration galleries which may include a shallow aquifer.
- Village of Turin, 65,000 gallons per day obtained from two drilled wells.

The Village of Lowville is reporting as obtaining water from Young's Pond and from two streams with a daily rate of approximately 1,100,000 gallons. This utilization of water is surface water and is not assumed to be obtained from an aquifer or using groundwater as a water source.

7.4 Oneida County

- Boonville Municipal Commission: 75 foot deep sand and gravel wells, approximately 270,000 gallons per day recovery.
- Forestport Water District, Three recovery wells, combined overburden and bedrock wells, approximately 25,000 gallons per day recovery.

7.5 Herkimer County

- The Town of Webb municipal water system supplies adjacent hamlets of Old Forge and Thendara. Groundwater is obtained from Lacustrine Sand and Gravel deposits with an average yield of 118,000 gallons per day, seasonal increases to 400,000 gallons per day.

8.0 Potential for Expanded Utilization and Protection of Groundwater Resources

8.1 Adirondack Uplift Region: Herkimer and Hamilton Counties

Expanded development of groundwater resources in the eastern portion of the Black River Watershed may be restricted to the Minor Lacustrine Outwash Sand & Gravel Deposits (designated Aquifer 5) that have formed in isolated valleys and adjacent to lake outfalls. These deposits supply the Old Forge municipal water system serving Old Forge and Thendara. The underlying bedrock in this portion of the Black River Watershed in the Adirondack Uplift region consists of relatively impermeable igneous and metamorphic deposits that have minimal permeability and very low groundwater yield potential. Available bedrock groundwater resources are limited to secondary porosity from joints and fractures in the bedrock.

Surface deposits consist primarily of glacial till with various permeability and exposed bedrock. Limited occurrence of lacustrine sand and gravel deposits do occur. The lacustrine sand and gravel deposits in this vicinity may be limited to localized utilization of the relatively minor sand and gravel deposits.

8.2 Eastern Lewis County Gravel Outwash Deposits

The gravel outwash deposits in eastern Lewis County (designated Aquifer 3) present a significant potential for future development for groundwater resources. These deposits are variable in thickness and have been determined to be permeable with a significant potential yield. Portions of this aquifer are utilized by various municipalities in Lewis County for water supply. Further development of these deposits may result in the establishment of a Primary Aquifer.

8.3 Lewis County Favorable Zones for Development

The May 2008 Phase I Report on Favorable Zone Delineation for Development of New Groundwater Sources in Lewis County prepared by HydroSource Associates for Lewis County identified six separate zones that may present favorable potential for further development. These zones include both unconsolidated-overburden deposits and bedrock deposits. These zones include both overburden deposits and bedrock formations. These zones are summarized in Table 9.

Copies of the maps delineating the six favorable Zones in Lewis County, as identified in the HydroSource Associates May 2008 report, are included as Figures 8 thru 11 within this report.

8.4 Watertown Area Lacustrine Delta

Based on current use of groundwater in the Watertown area and potential yields the Watertown Area Lacustrine Delta, this area may present favorable options for additional development. Based on current utilization the Watertown Area Lacustrine Delta may meet the qualifications as a Primary Aquifer, although not designated as such at the present time.

Table 9 - Lewis County Favorable Zones for Groundwater Development

Zone	Location	Description	Aquifer Type
Zone A	Hamlet of Watson along River Road	Unconsolidated sediments, Sand and Gravel Deposits	Black River Valley Recent Alluvium
Zone B	New Bremen, north of Crystal Creek East of Black River	Unconsolidated sediments, Sand and Gravel Deposits	Black River Valley Recent Alluvium
Zone C	New Bremen, south side of Crystal Creek along Wagner Road	Unconsolidated sediments, Sand and Gravel Deposits	Lewis County Gravel Outwash Deposits
Zone D	Current Village of Lowville Current water supply	Combined springs and 2 wells	Combined unconsolidated, bedrock and surface water
Zone E	West of Hamlet of Deer River	Bedrock aquifer with substantial fracturing indicated	Confined Bedrock, Black River Group Limestone
Zone F	Village of Copenhagen	Bedrock aquifer with substantial fracturing indicated	Confined Bedrock, Trenton Group Limestone

Reference: Phase I Report, Favorable Zone Delineation for Development of New Groundwater Sources, Lewis County, New York, prepared by HydroSource Associates, Inc. May 13, 2008

8.5 Future Groundwater Development Considerations

A variety of criteria has been developed for consideration of future groundwater development in the Black River Watershed. These criteria include potential for future yields, accessibility, wellhead protection and groundwater quality. These criteria include:

- Establishing formal listings of aquifers currently utilized as municipal water sources and Primary Aquifers. This may include the Watertown and East Lewis County segments. The State of New York does not have a formal application process for listing an aquifer but this may be accomplished by petition to the NYSDOH with a request for determination.

- Formal listing of these areas as Primary Aquifers would increase public awareness of the current utilization when future developments are reviewed as part of the State Environmental Quality Review (SEQR) process.

- The Watertown Area Lacustrine Delta is utilized as a municipal water supply source and may meet the qualifications as a Primary Aquifer, although not designated as such at the present time.

- Based on geographic extent potential yield the Lewis County Gravel Outwash aquifer segment could be developed as a major source of water and has the potential to be classified as a Principal Aquifer.

- Boonville-Woodgate Kame Delta aquifer is currently utilized by Boonville and the town of Forestport as municipal water sources with production over 270,000 gallons per day. This aquifer may have the potential to be designated either a Primary or Principal Aquifer.

- Expanded use of known aquifers, including identified areas in Lewis County. This expansion can utilize the identified six zones of favorable delineation as identified in the HydroSource Associates Favorable Zone Delineation for Development of New Groundwater Sources May 2008 report. These zones include overburden and bedrock aquifer segments.

- Locating future Sewage Treatment Plants (POTWs) or industrial discharge outfalls down-gradient from unconsolidated aquifer recharge areas and municipal water supply wellheads.

- Development of a Geographic Information System (GIS) type database to track municipal water system coverage areas. Such a database could present a visual representation of coverage areas for which municipally-supplied water is available and to indicate source areas such as groundwater, surface water, reservoirs or purchased from other systems.

- Development of a GIS-type database to accurately plot the geographic locations of municipal water supply system groundwater wells. Such a database and mapping could include type of aquifer utilized (overburden or bedrock), production rates and treatment plants. Visual representation of supply wells could assist in establishment of wellhead protection land use restrictions or to target areas for installation of future production wells.

- Development of a GIS-type database to compile information on groundwater quality and availability for the aquifers currently utilized by municipalities within the watershed. Differences in groundwater chemistry between overburden and bedrock aquifers and production rates could be tracked. Groundwater characteristics from production wells such as total dissolved solids, hardness and iron may be obtained on a consistent and reliable basis for tracking purposes.

- Bedrock aquifers qualities may include higher potential yields due to the confined hydrostatic pressures on bedrock formations, but based on the geologic formation bedrock aquifers may have higher concentrations of iron and hardness from dissolved calcium and magnesium. Overburden aquifers can be easier to develop due to relatively shallow access and unconsolidated sand and gravel deposits but can be susceptible to changes in water table elevations due to seasonal changes in precipitation and resulting recharge, and can also have a higher potential for impact from surface runoff. Implementation of a GIS-type database to track available information and future data on water quality would allow for monitoring long-term trends to assist in locating future recovery wells or service area expansion.

- Utilization of bedrock aquifers as municipal water sources may be integrated with municipal overburden monitoring wells. Municipal systems may utilize both bedrock and overburden, unconsolidated supply wells. Information on types of wells was inconsistent or not accurately determined. Differentiation concerning aquifer types currently utilized by municipal water supply systems could also be a component of a GIS-type database.

- Establish groundwater and aquifer protective measures. Such measures may include restrictions for development at areas of high potential yield especially for overburden sand and gravel deposits which may be susceptible to contamination from infiltration from excess application of agricultural fertilizers or improper storage of farm-generated animal waste such as manure pits. The NYSDEC has a Wellhead Protection Program which provides guidelines that includes identification of aquifers, delineation of watershed areas, development an inventory of contamination sources that could impact drinking water sources and establish or expand existing municipal supply wellhead protection controls.

- Development of zoning or land use restrictions to manage future commercial activities that would disturb surface water drainage patterns, surface recharge or groundwater flow patterns. Controls may include zoning or land use restrictions on future development near municipal water supply wells to prevent potential contamination and to establish areas for future production wells to expand water system supplies. These activities would include:

    - Establishment of new or expansion of existing Sand and Gravel mining operations.
    - Bedrock mining or excavation operations.
    - Landfills, recycling facilities and construction and debris processing operations.
    - Installation of geothermal recovery wells.
    - Installation of natural gas supply wells.
    - Brine injection wells.

- Restrict future construction of petroleum or chemical storage facilities or other possible contaminant sources adjacent to existing municipal supply wells, or requiring special use permits for such facilities within wellhead recharge areas. The intent of such restrictions would be to allow for review of such facilities to control possible adverse impact to aquifers that serve as municipal sources of water. Such facilities may include:

  - Retail gasoline service stations.
  - Major Oil Storage Facilities.
  - Vehicle repair garages.
  - Dry cleaning operations.
  - Photography studios that perform in-house film development.
  - Industrial or commercial operations that use hazardous substances or which generate hazardous wastes.
  - Commercial operations that may have on-site septic systems and leach distribution fields.
  - Fertilizer storage or distribution facilities.
  - Municipal salt storage facilities.

9.0 References

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Figure 1 – Watershed Project Location Map

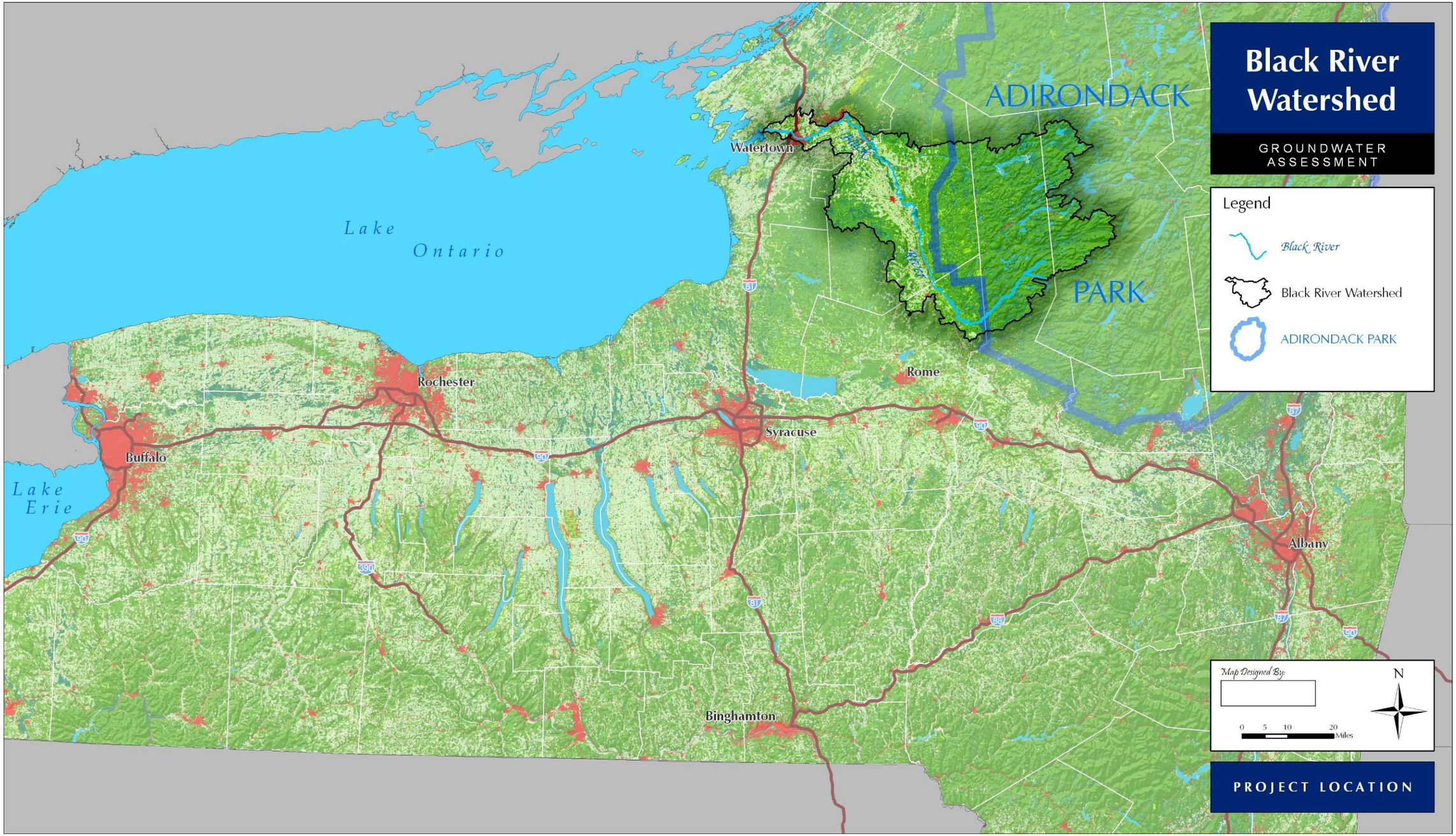

Figure 2 – Subwatersheds

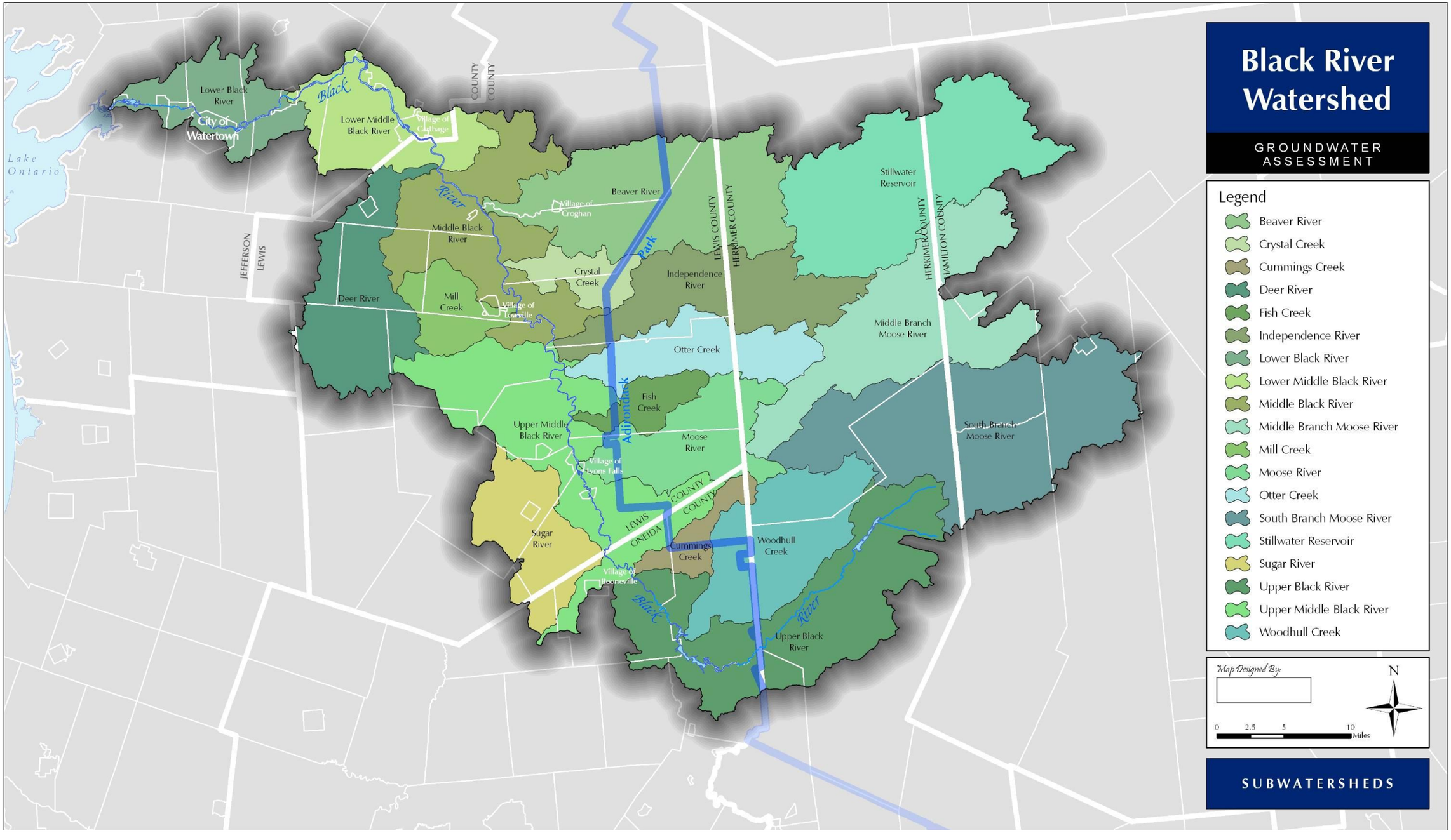

Figure 3 – Municipal Water Supply Systems Map

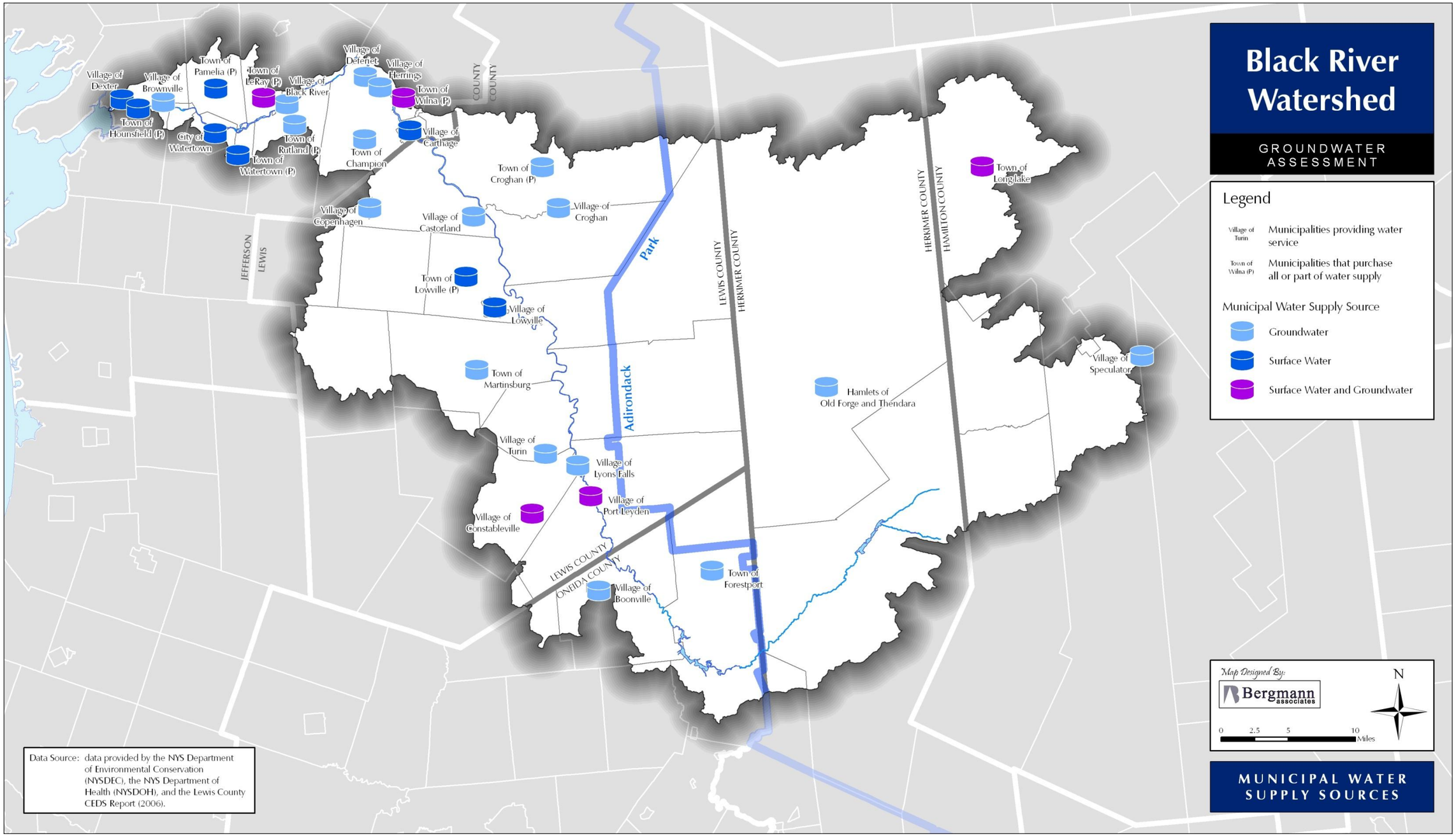

Figure 4 – Waste Sites Location Map

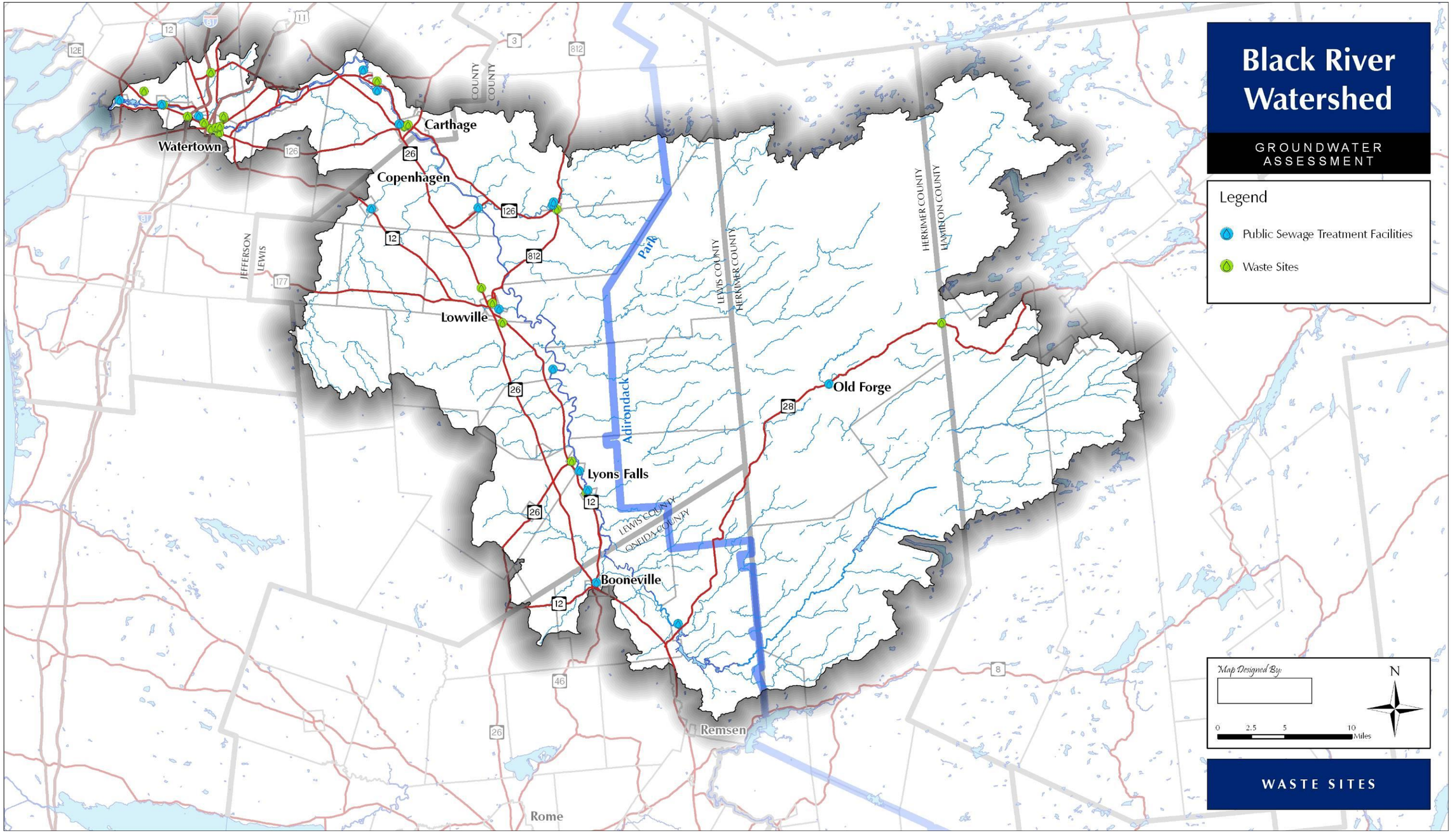

Figure 5 – Surface Geology Map

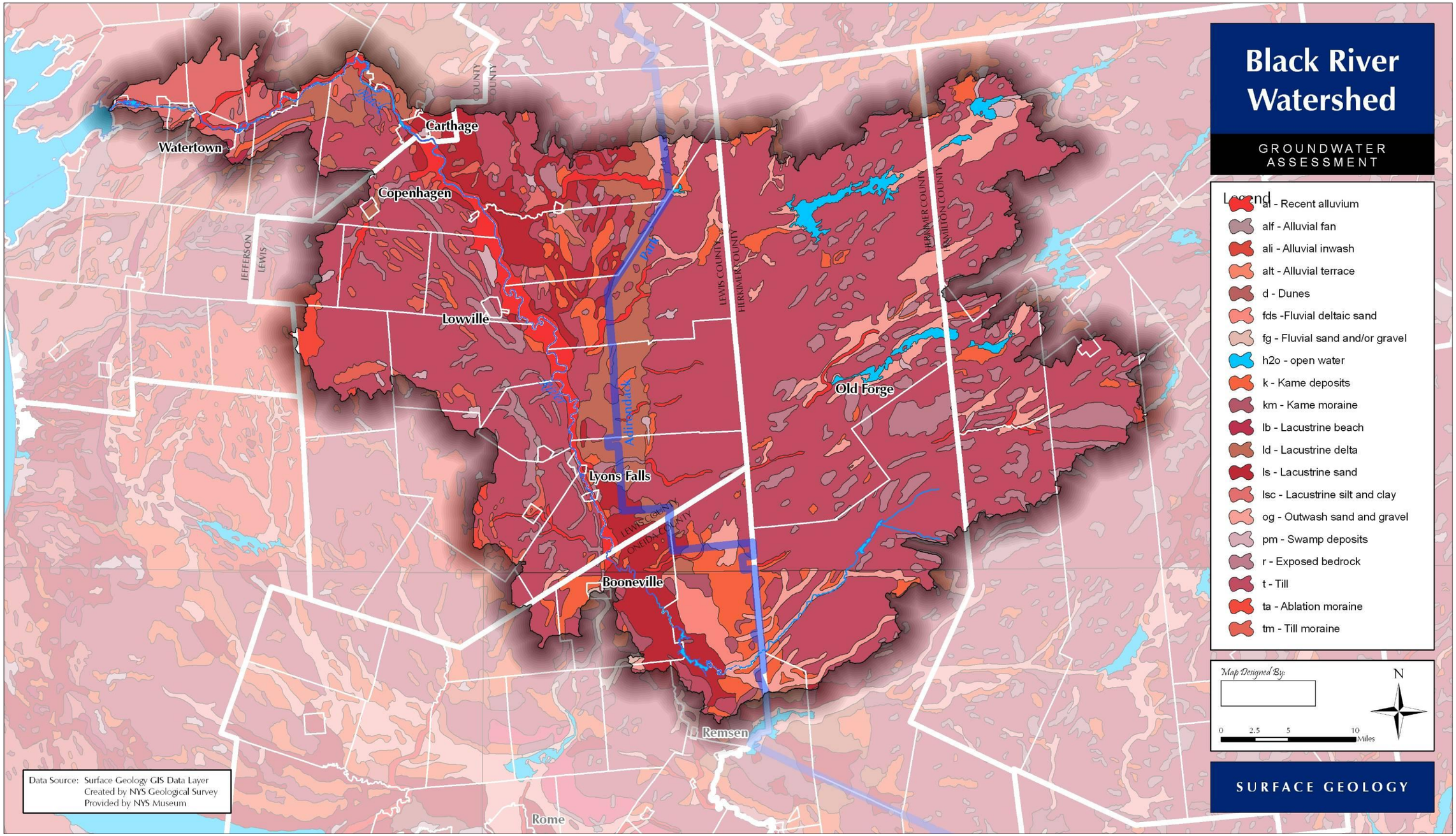

Figure 6 – Bedrock Geology Map

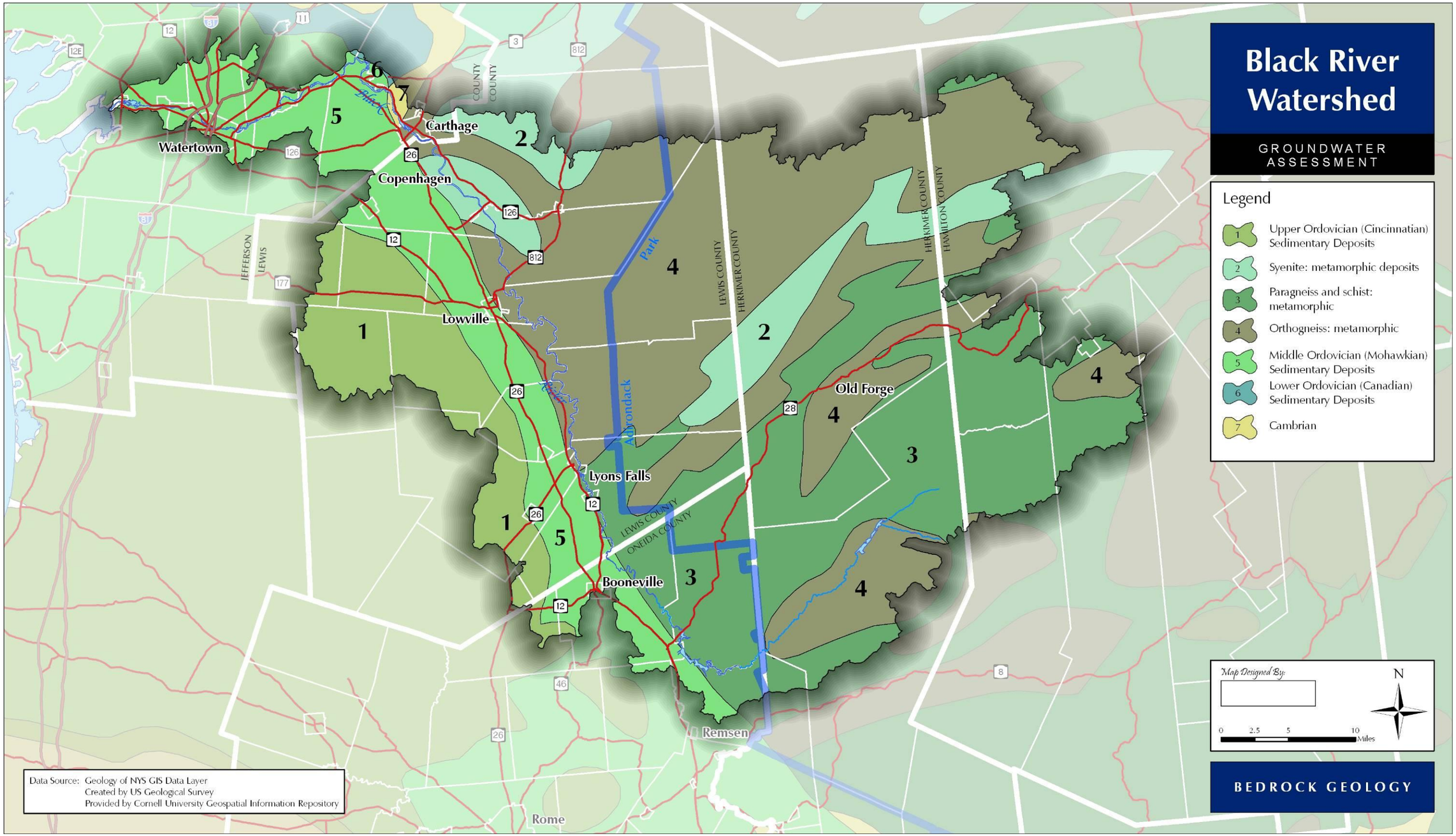

Figure 7 – Aquifers Map

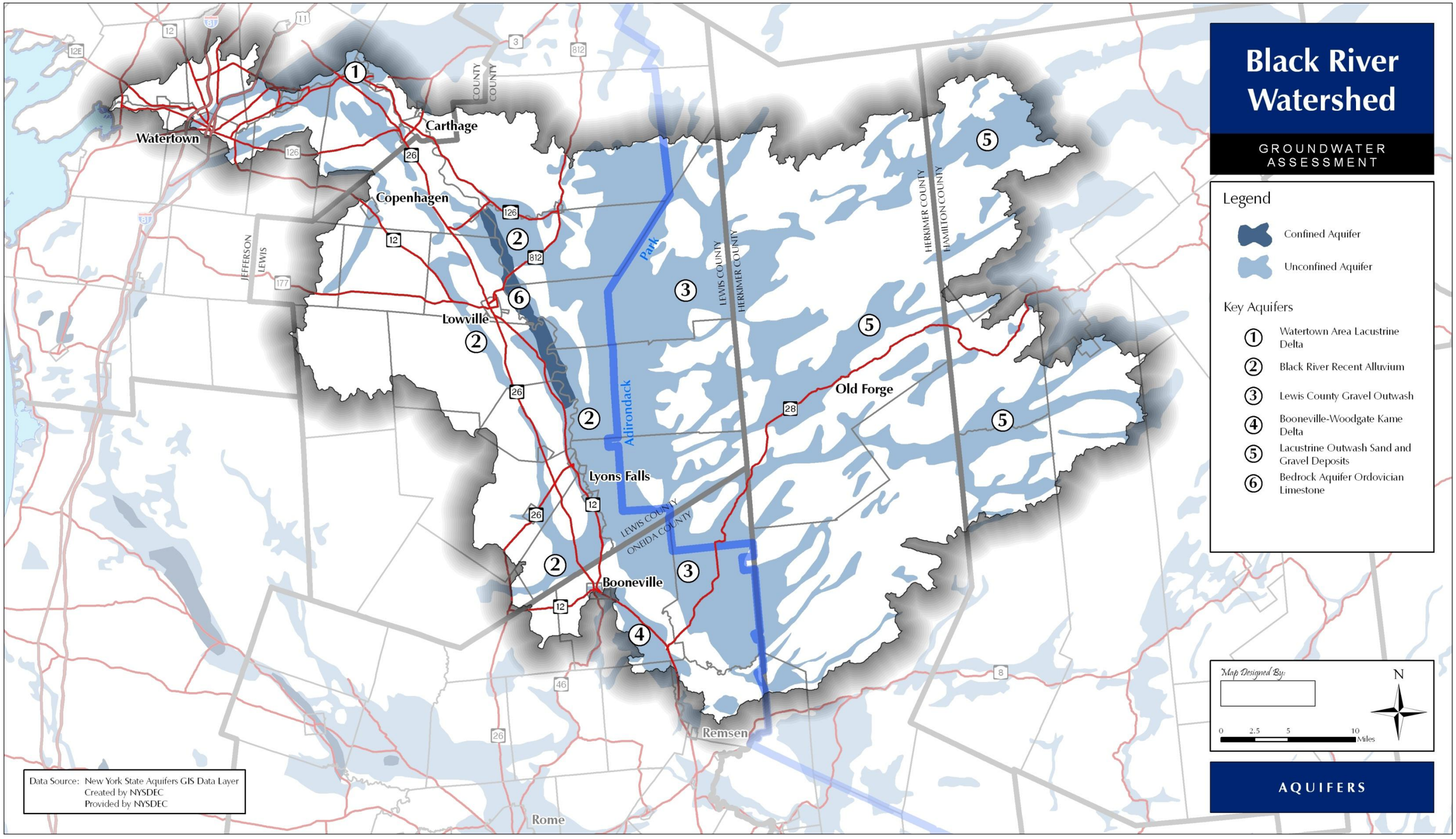

Figure 8 – Map of Favorable Zone A

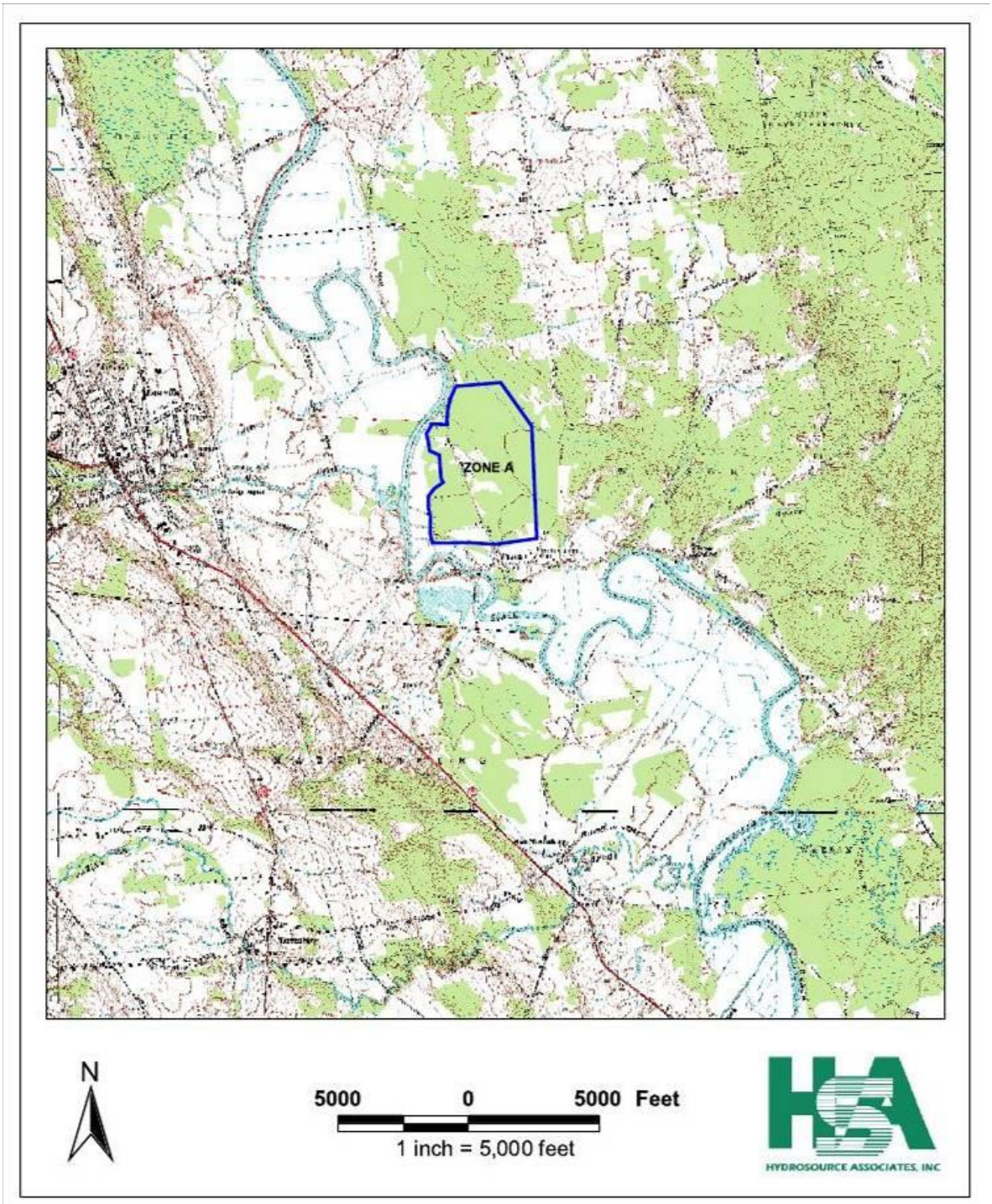

Figure 9 – Map of Favorable Zones B & C

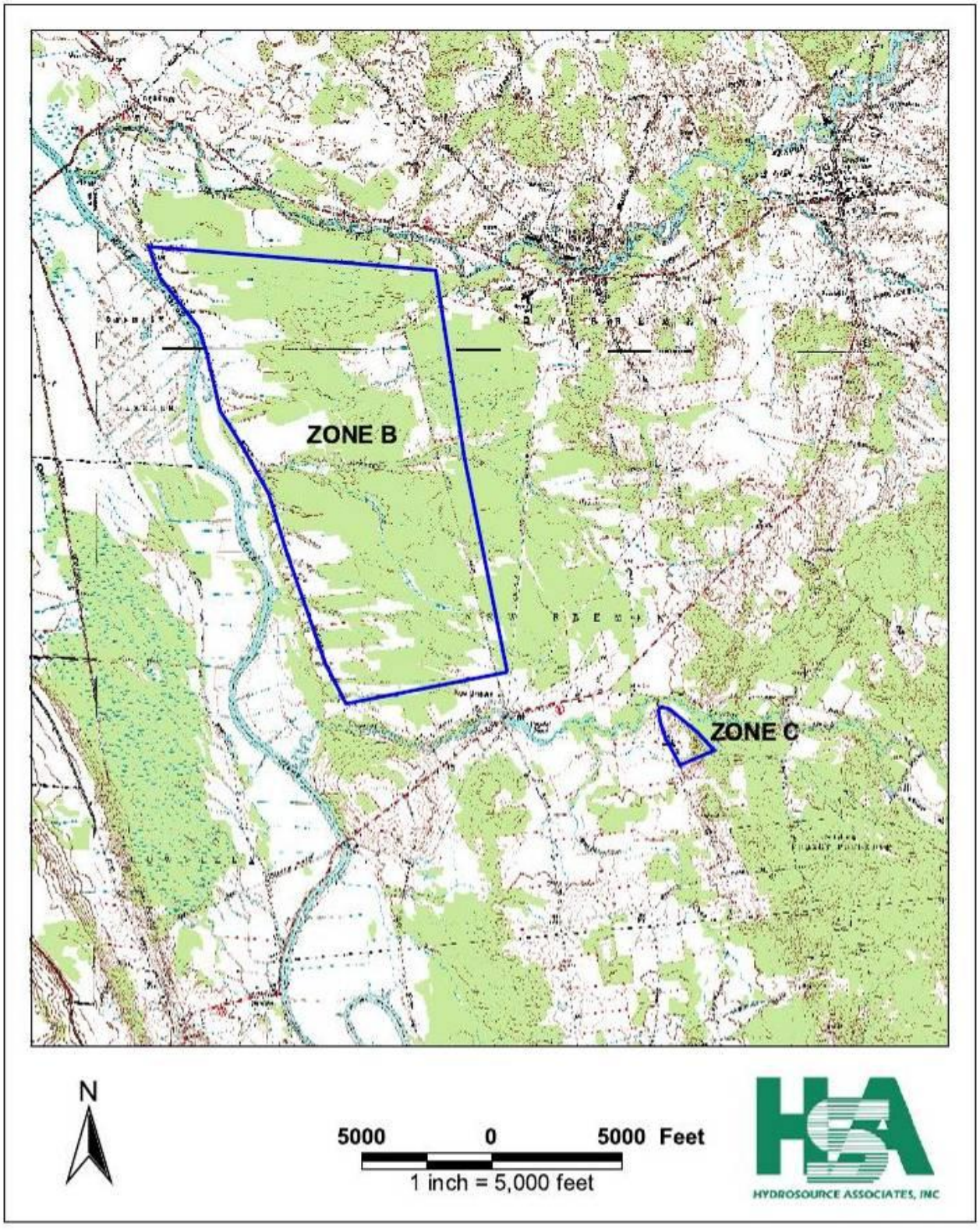

Figure 10 – Map of Favorable Zone D

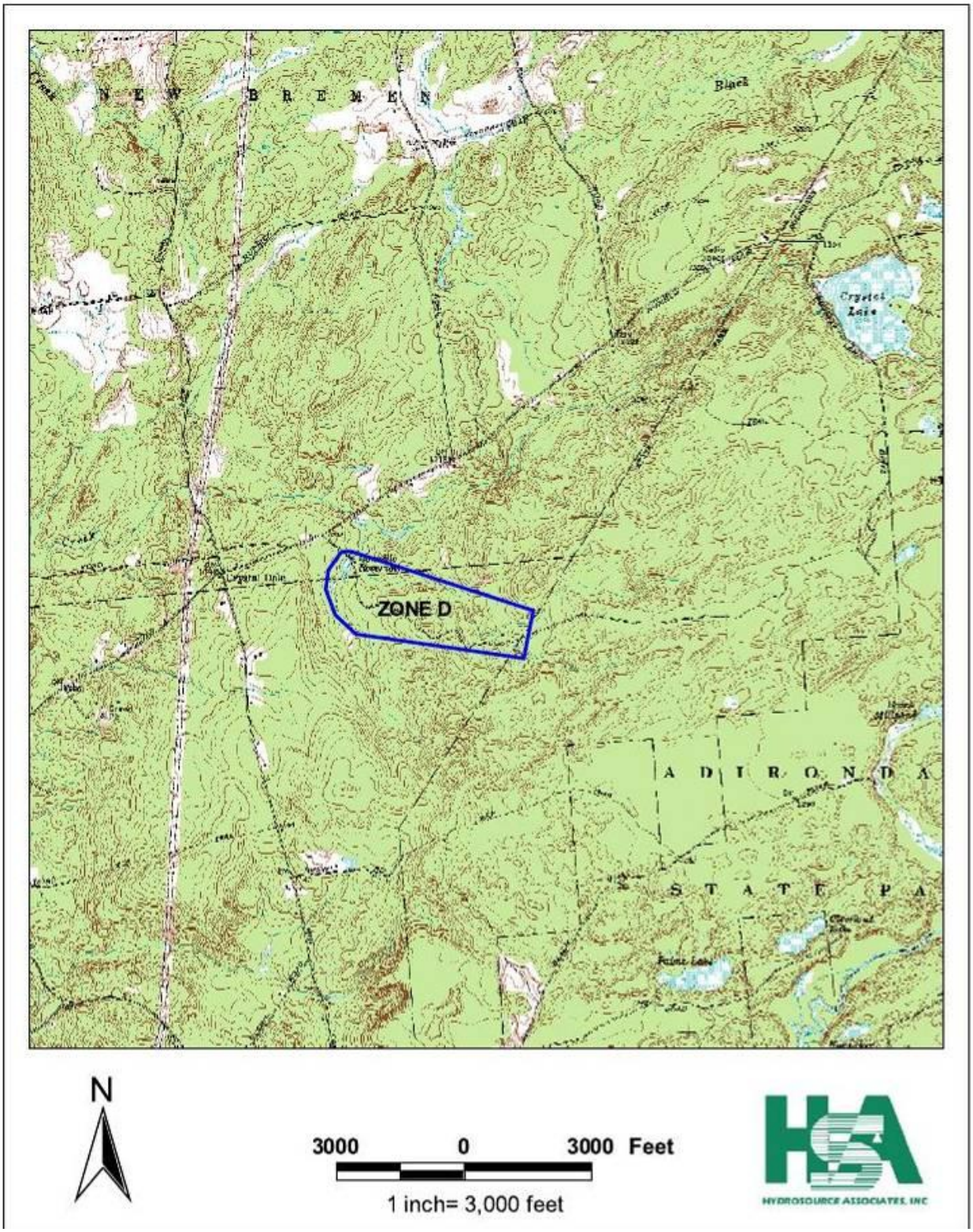

Figure 11 – Map of Favorable Zones E & F