- 47-mile long, 103 mi^2 aquifer system
- Occupies portions of Jefferson, Oneida, and Oswego counties
- Large source of excellent quality water
- Supplies eleven municipalities, several businesses, a fish hatchery, farms, homeowners

NEW SOLE SOURCE AQUIFER DESIGNATED IN NEW YORK

- On November 2, 2006, the U.S. Environmental Protection Agency announced that it has designated the Northern Tug Hill Glacial Aquifer as a Sole Source Aquifer.
- The Sole Source Aquifer designation was initiated by a 2003 petition from the Village of Lacona. New York Rural Water Association worked with the Village of Lacona to prepare the document.

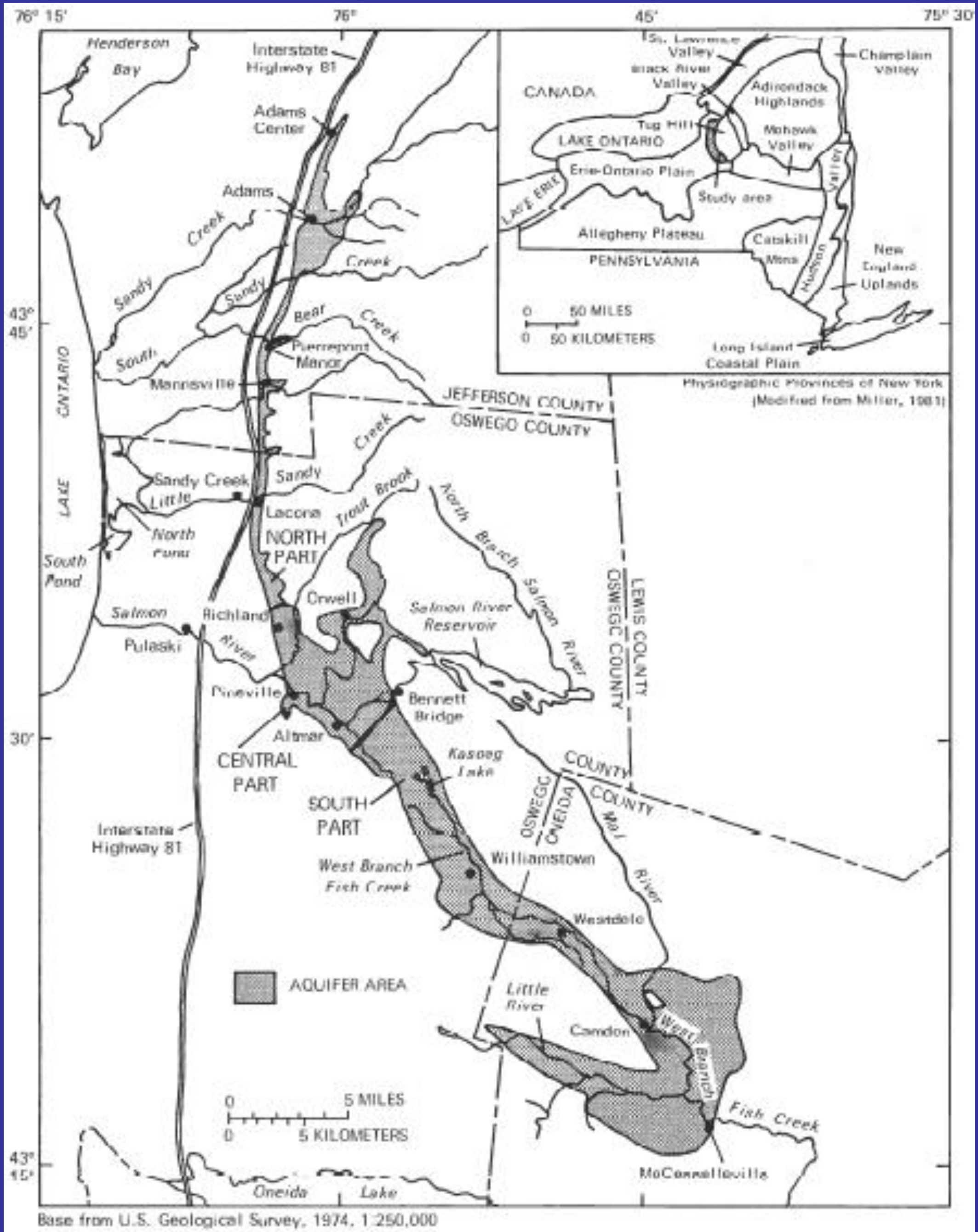
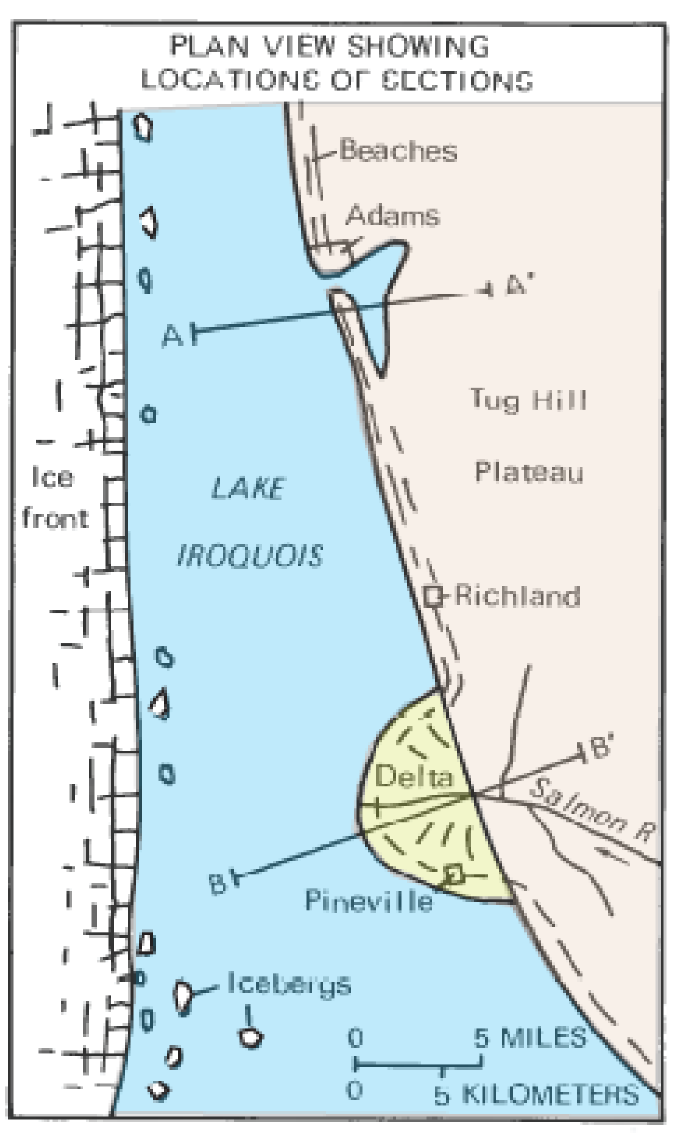


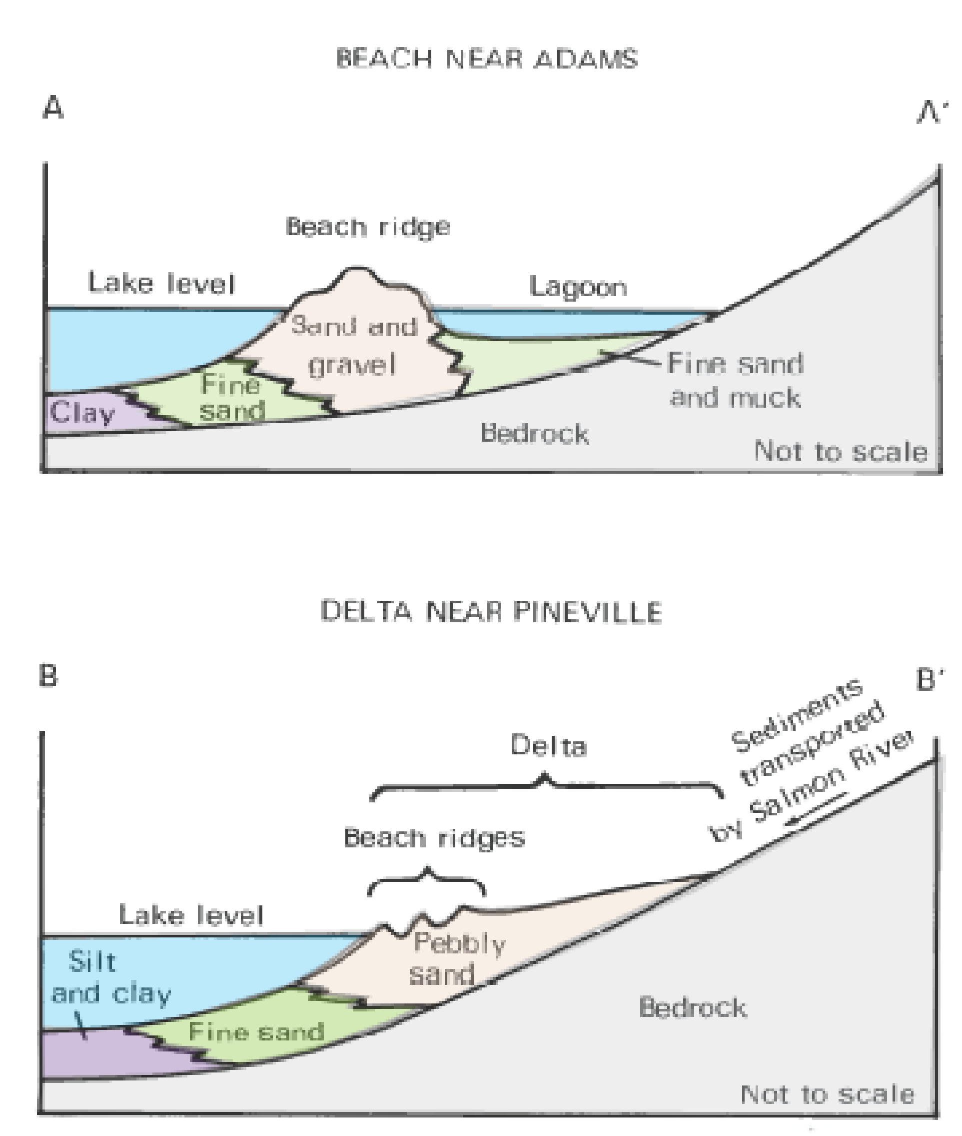
Figure 1.--Location and major geographic features of the Tug Hill aquifer area.

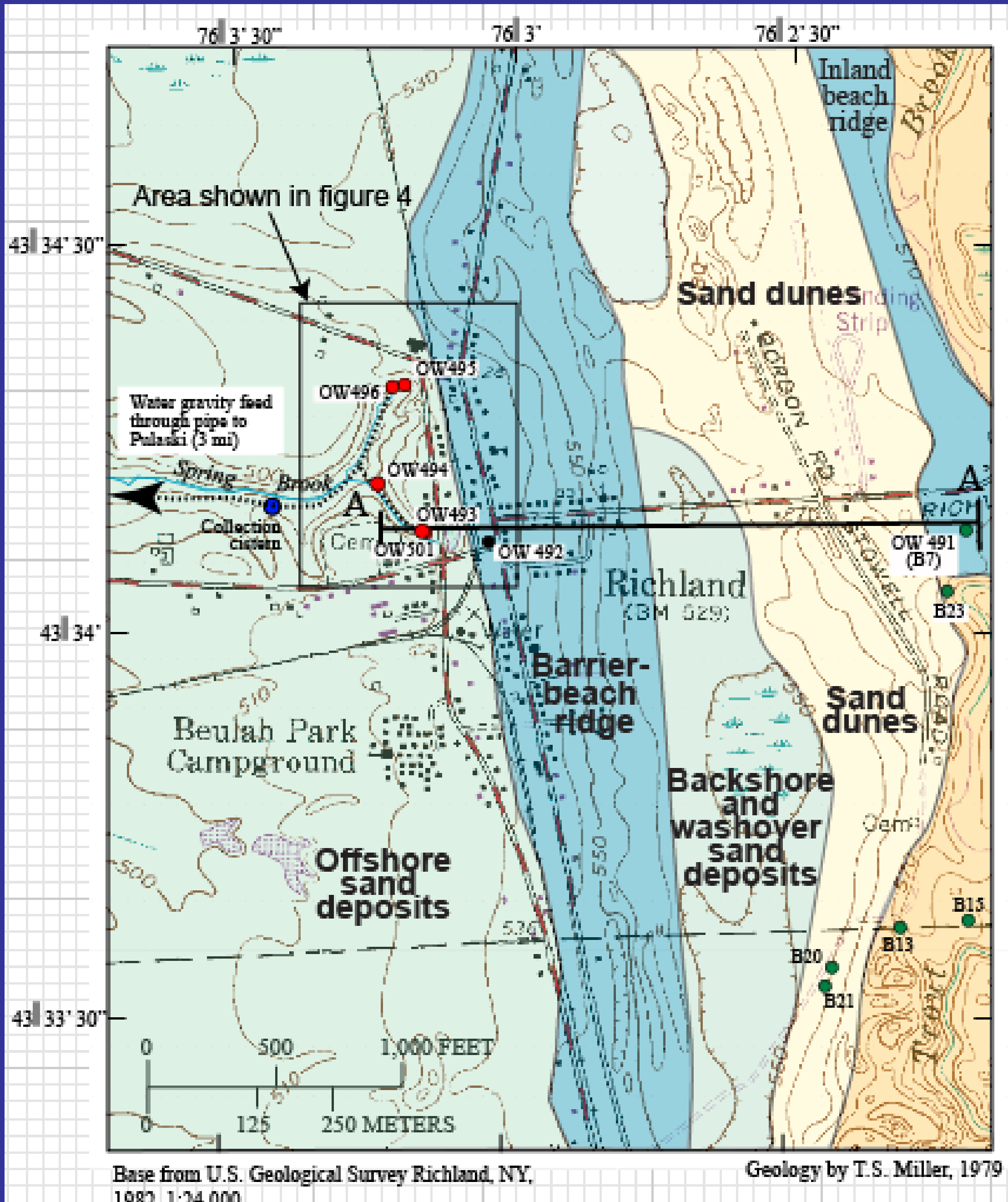
THREE HYDROPHYSIOGRAPHIC PROVINCES

1. North- Thin and narrow beach and alluvial S&G
2. Central- Extensive beach, delta, and morainal S&G
3. South- Valley-fill consisting mostly outwash & deltaic pebbly sand & sand near surface- lake silt/vf sand at depth

TYPICAL GLACIOLACUSTRINE DEPOSITS IN THE NORTH AND CENTRAL PARTS OF THE TUG HILL AQUIFER

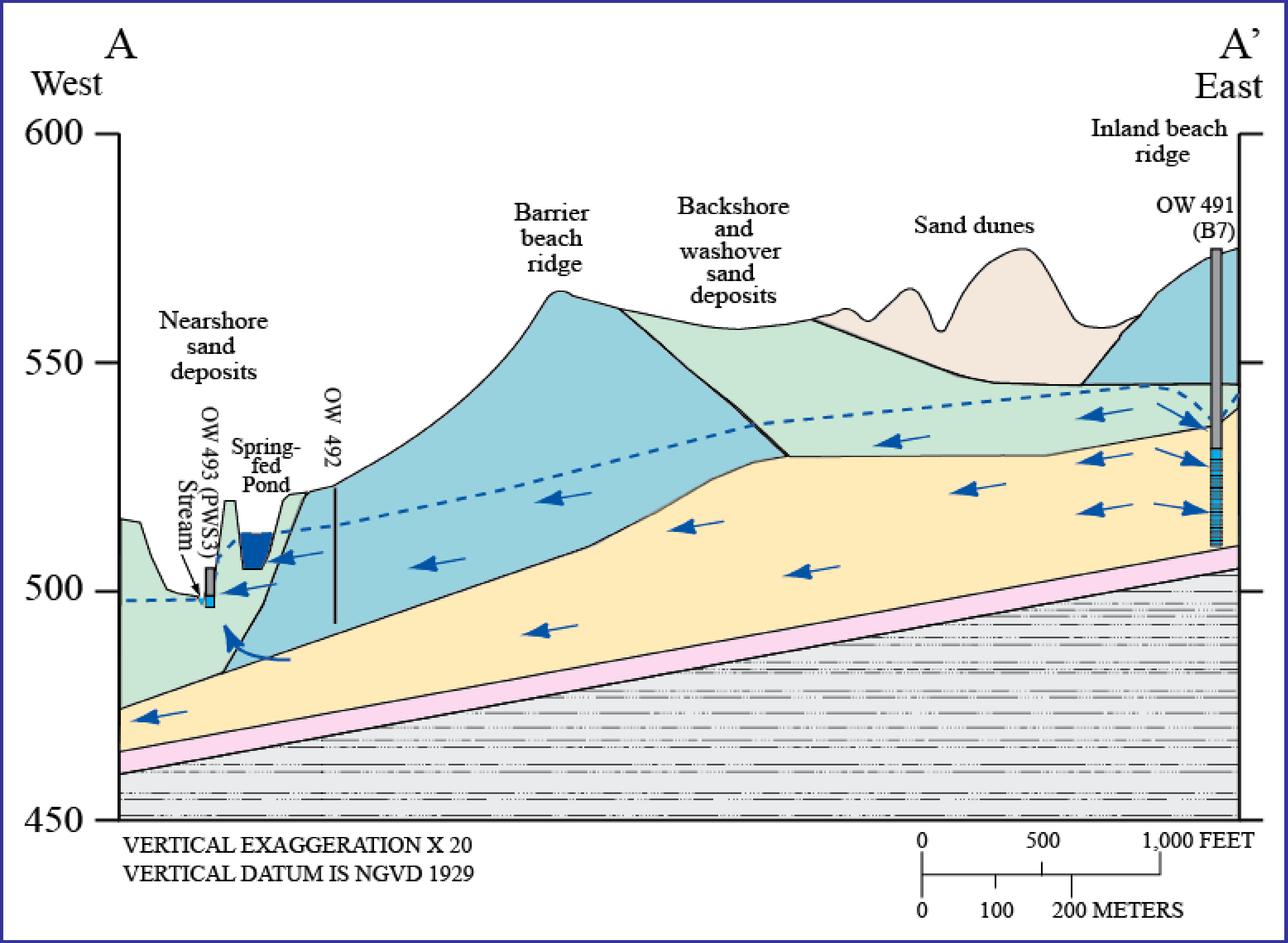


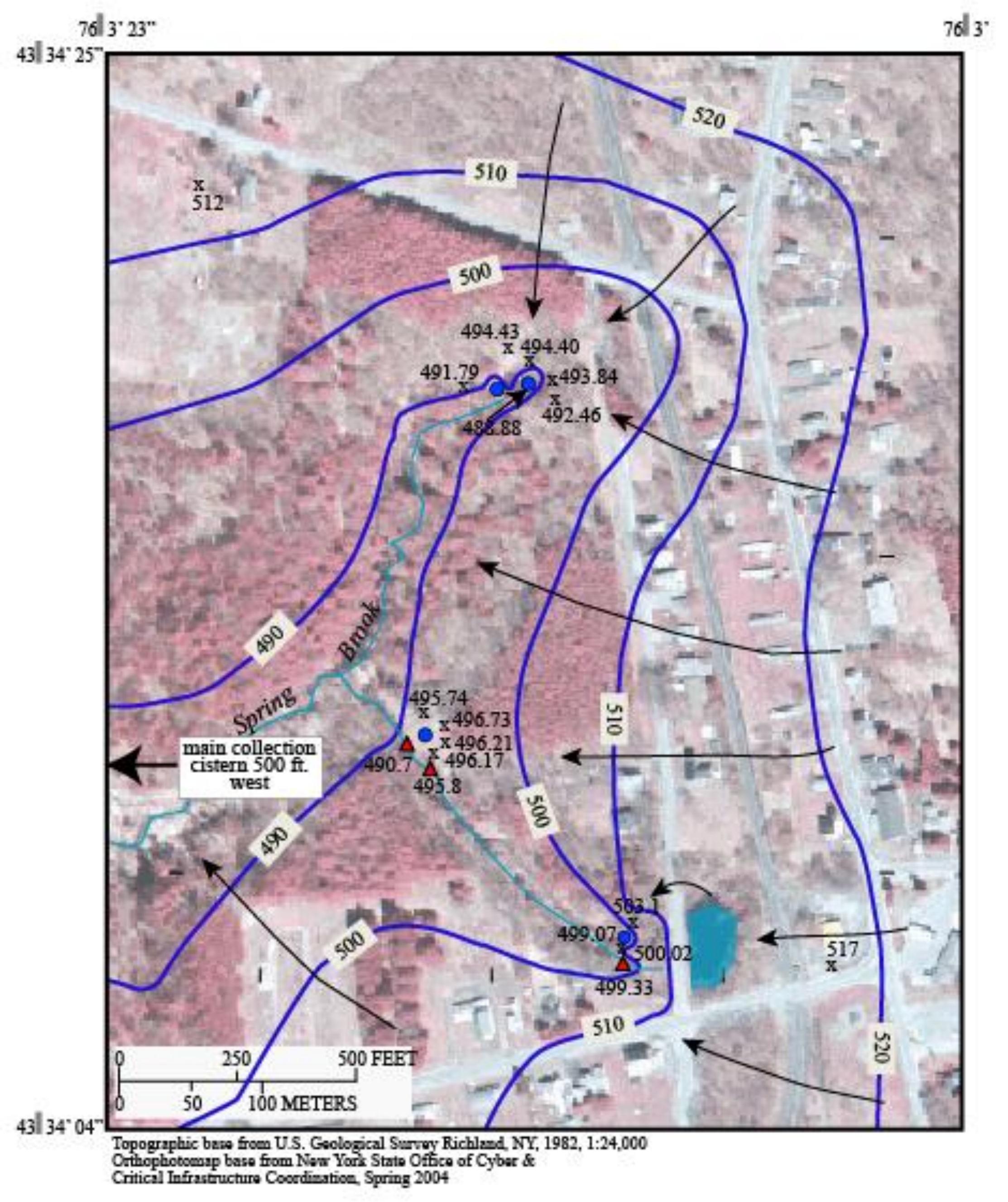




Geohydrologic setting of the Pulaski well field at Richland

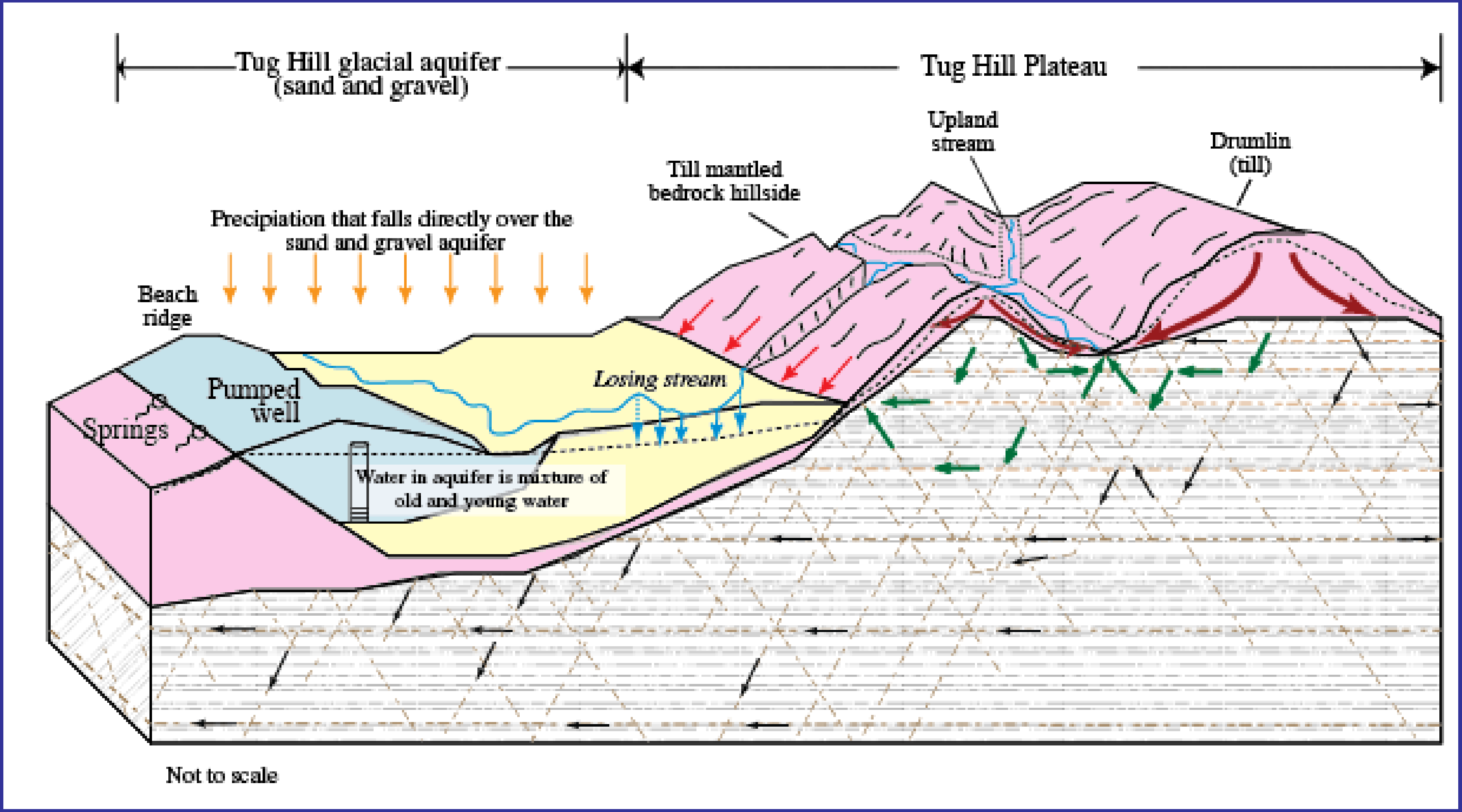
GEOLOGIC SECTION RICHLAND



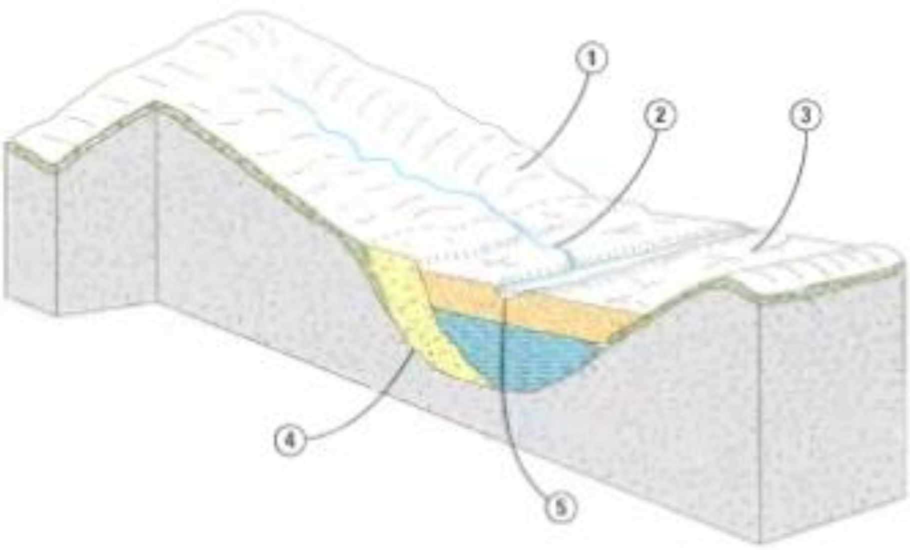


Water table and direction of GW flow at Pulaski well field (Richland)

Sources of recharge to the Tug Hill sand and gravel aquifer



Typical Physical Settings of Valley-fill Aquifers (ex. Southern Part of Tug Hill Aquifer



① A significant amount of water can recharge the aquifer as unchanneled runoff from adjacent upland areas.

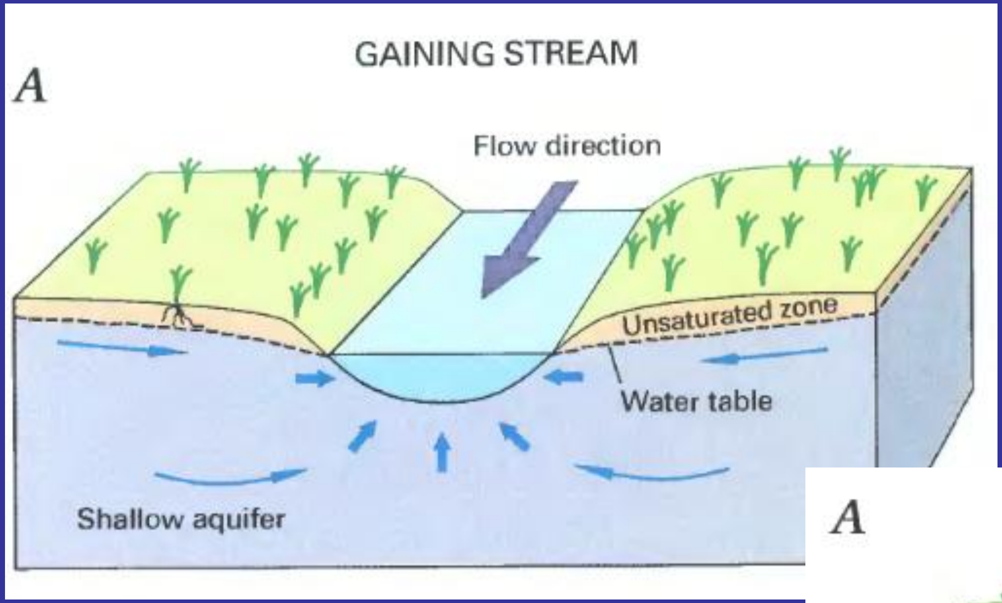
② A significant amount of water can recharge the aquifer as seepage from tributary streams draining the uplands.

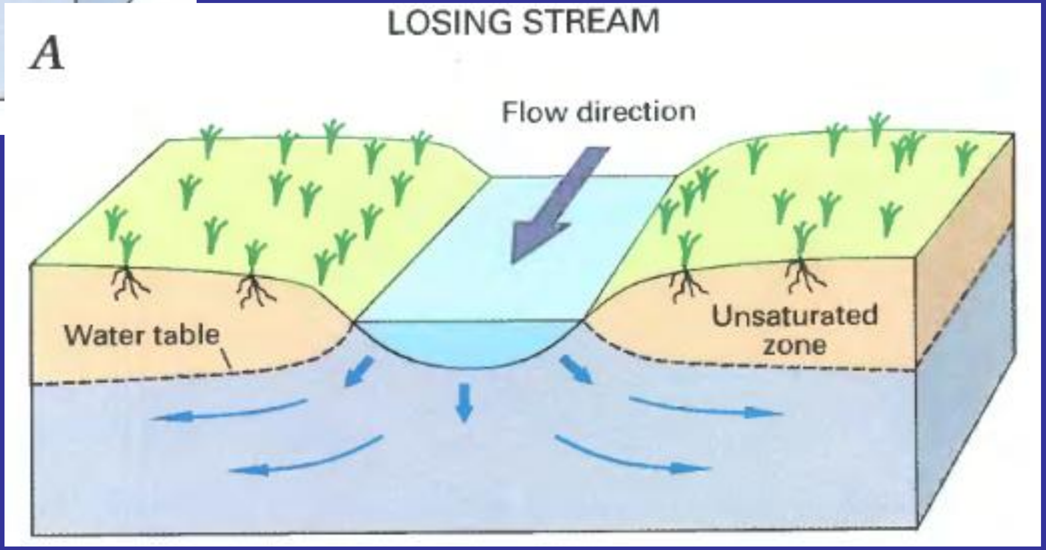
③ Some water recharges the aquifer directly from precipitation.

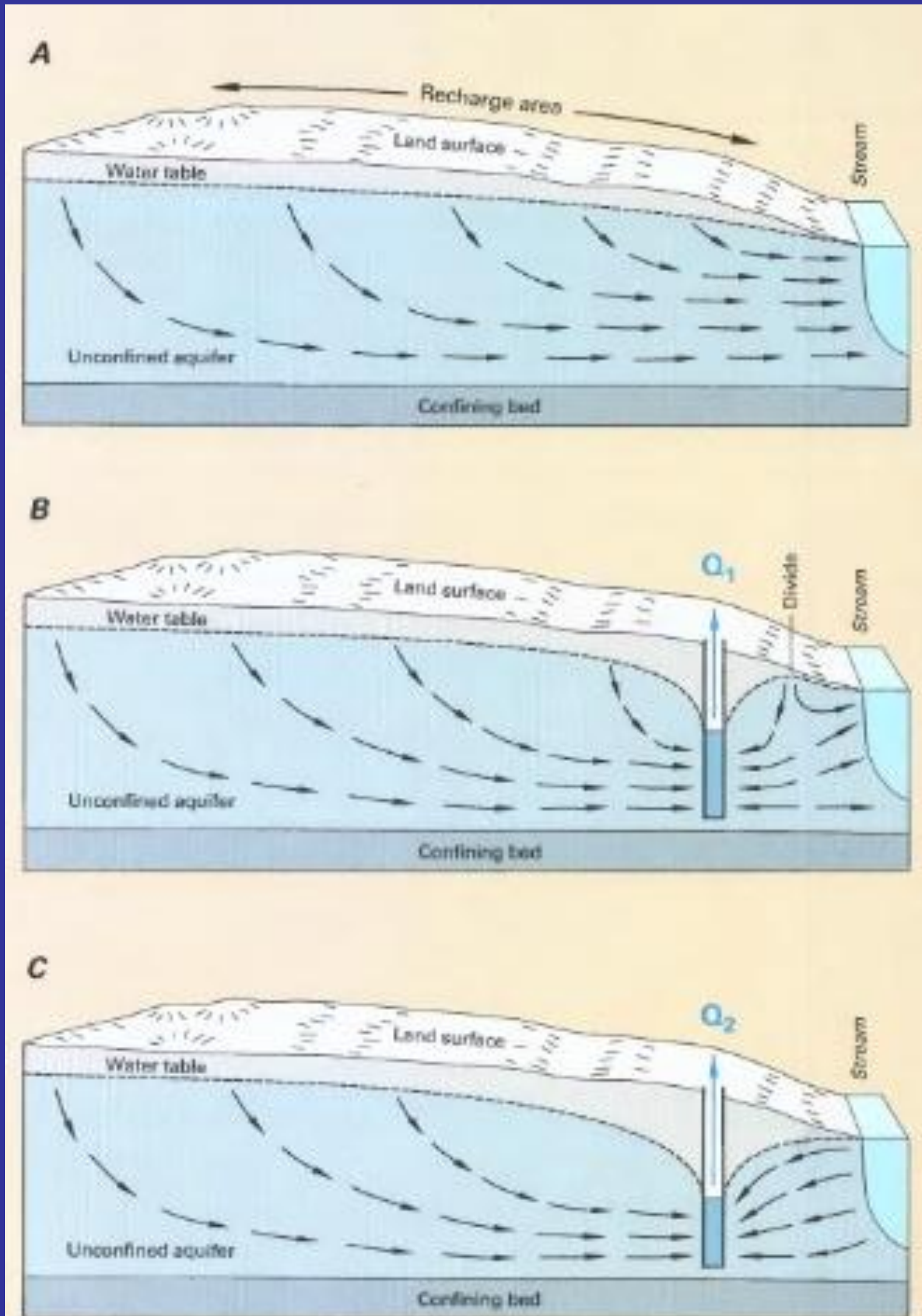
④ Small amounts of water may recharge the aquifer as subsurface flow from bedrock.

⑤ Perennial streams flowing across valley fill have the potential to be major sources of recharge under pumping conditions when ground-water levels fall below the stream.

SURFACE WATER/GROUND WATER INTERACTION IS AN IMPORTANT CHARACTERISTIC IN UNCONFINED AQUIFERS SUCH AS THE TUG HILL AQUIFER







Schematic hydrologic setting where ground water discharges to a stream under natural conditions (A), placement of a well pumping at a rate (Q1) near the stream will intercept part of the ground water that would have discharged to the stream (B). If the well is pumped at an even greater rate (Q2), it can intercept additional water that would have discharged to the stream in the vicinity of the well and can draw water from the stream to the well

Some Questions from Oswego County EMC Regarding Possible Effects of a Proposed Water Bottling Operation

- At proposed full withdrawal capacity of 1.4 million gallons per day, what, if any, changes will occur to the aquifer?
- How will it effect businesses, municipalities, and residents that use the aquifer for their water supply?
- What seasonal changes may occur in river and streams?
- How will it influence seasonal water level fluctuations in the Salmon River and what will the consequences be for the Oswego County Fishing and Tourism Industry.

Other Questions- Effects of Schoeller Paper Co. well field

- What are the affects of decreased withdrawal from the Schoeller Paper Co. well field?
- Rebounding water table?
- Will rising water levels affect the integrity of septic systems and cause a bacteriological plume
- Will the Village of Pulaski well field be affected by a rebounding water table? – more water?

Questions Regarding the Salmon River Fish Hatchery at Altmar

- Declining well yields from an aging well field. Where to add new wells?
- Will large withdrawals from other pumping wells significantly impact the ecology of Orwell and Trout Brooks?-- especially regarding Steelhead Trout.
- Possiblilty of induced infiltration. How will water temp be affected by changes in pumping stresses in the aquifer)?

Develop Management Tools

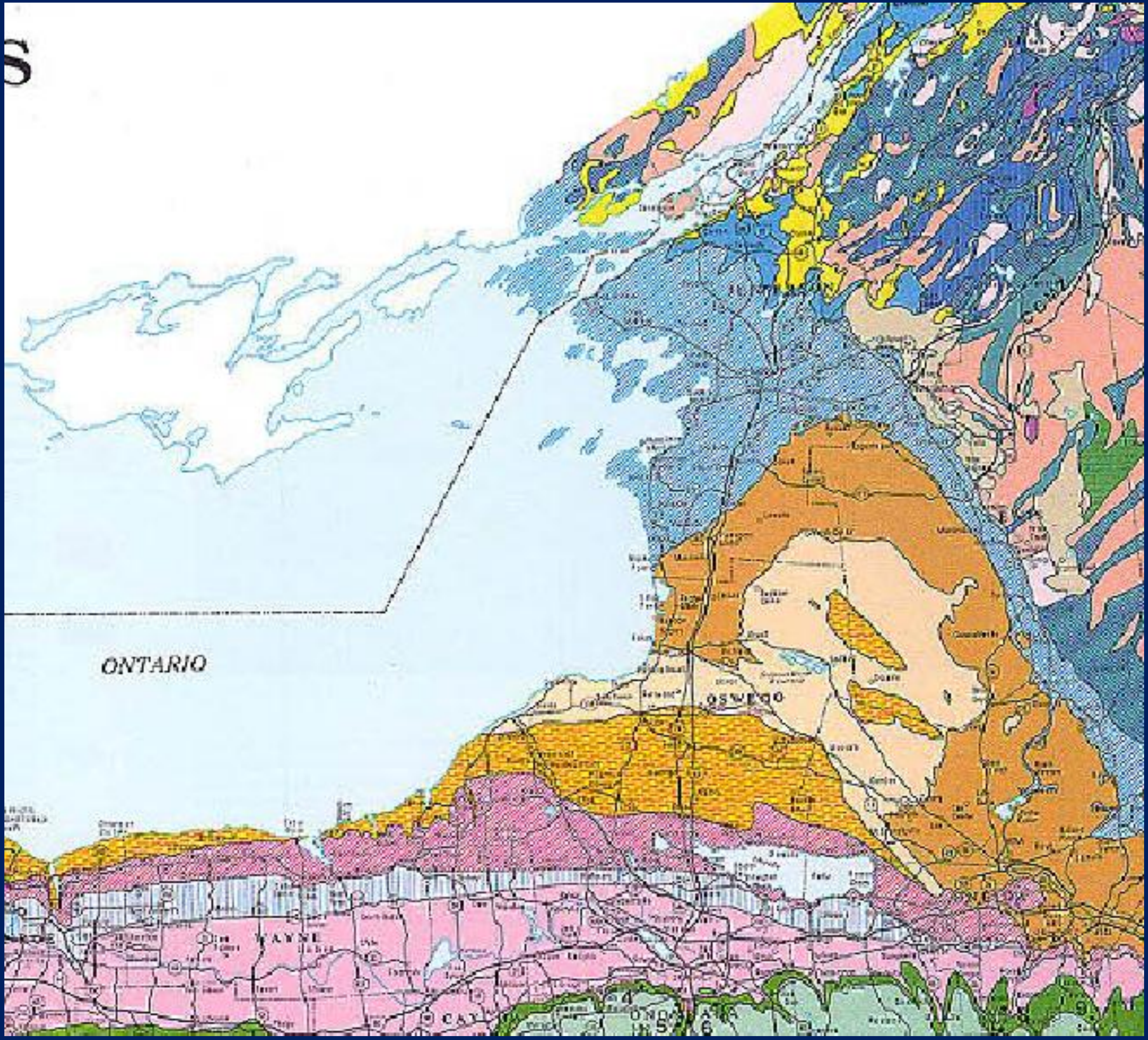
MODFLOW- a numerical GW flow model that can simulate a wide variety of hydrologic features and processes such as rivers, streams, drains, springs, reservoirs, wells, evapotranspiration, and recharge from precipitation and irrigation

SPECIAL POINTS OF INTEREST IDENTIFIED AT LAST MEETING

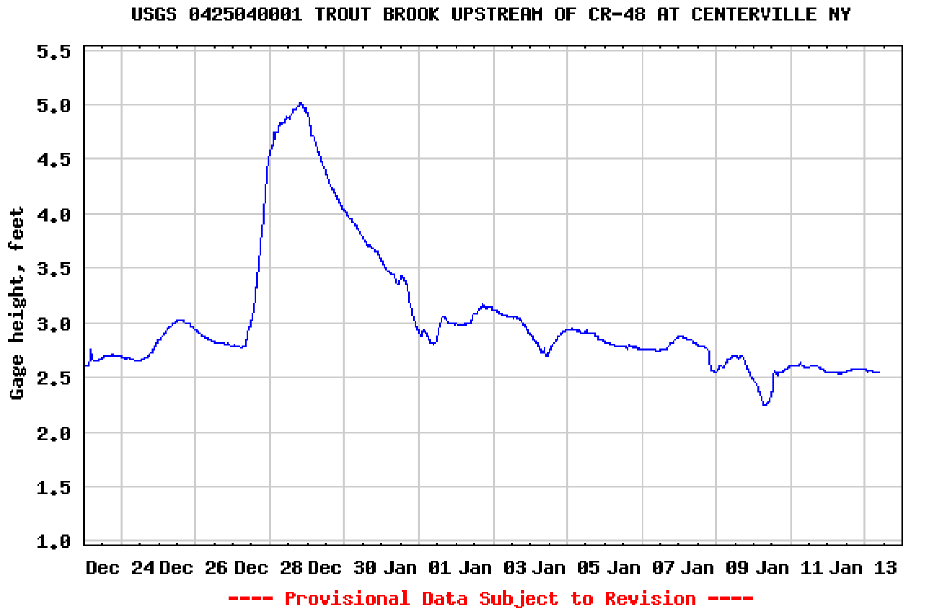
- Spring Brook at Richland (Large GW discharge area, buried valley?)
- Seepage measurements and WQ in Adams area
- Trout Brook at Centerville gage
- Sandy Cr valley east of Adams (buried valley?)
- Possible extension of aquifer up Sandy Creek valley towards Rodman

WORK DONE SO FAR (2008-2011)

- Compiled GIS basemaps
- Inventory of post-2000 wells (field verify locations)
- Installed real-time stream gage on Trout Brook (operated for 3 years)
- Deployed 4 stream temperature loggers
- Collected WQ samples in streams (north & central)
- Seepage measurements in streams (north & central)
- Deployed three WL data loggers (Richland well field)
- Collected several GW samples (Municipal wells only)
- Revisions to Aquifer Boundary and Geology maps
- Passive seismic (north and central)



Distribution of limestone units (light blue) have large effect on buffering acidic rainwater

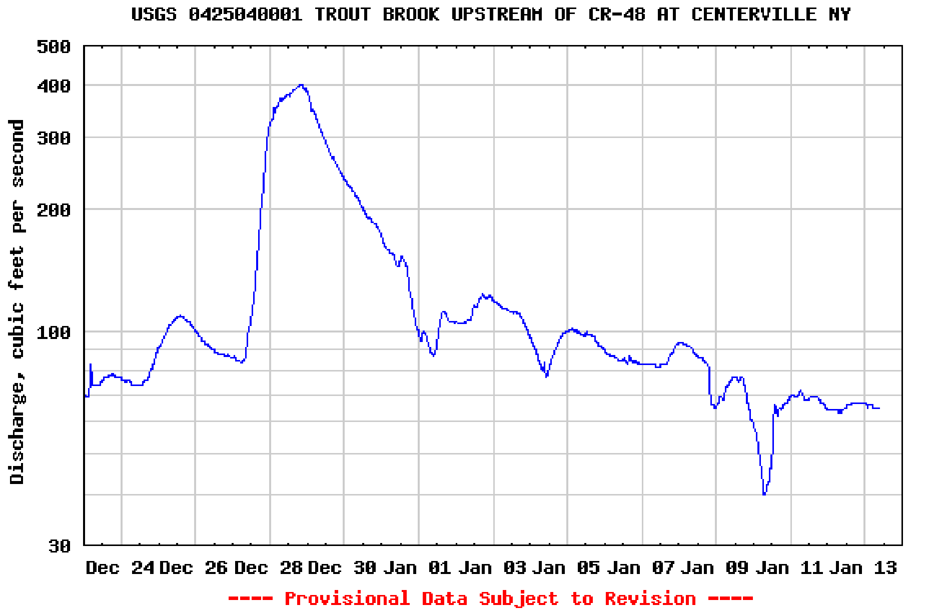


Create presentation-quality graph

Parameter 00065

charge, cubic feet per second

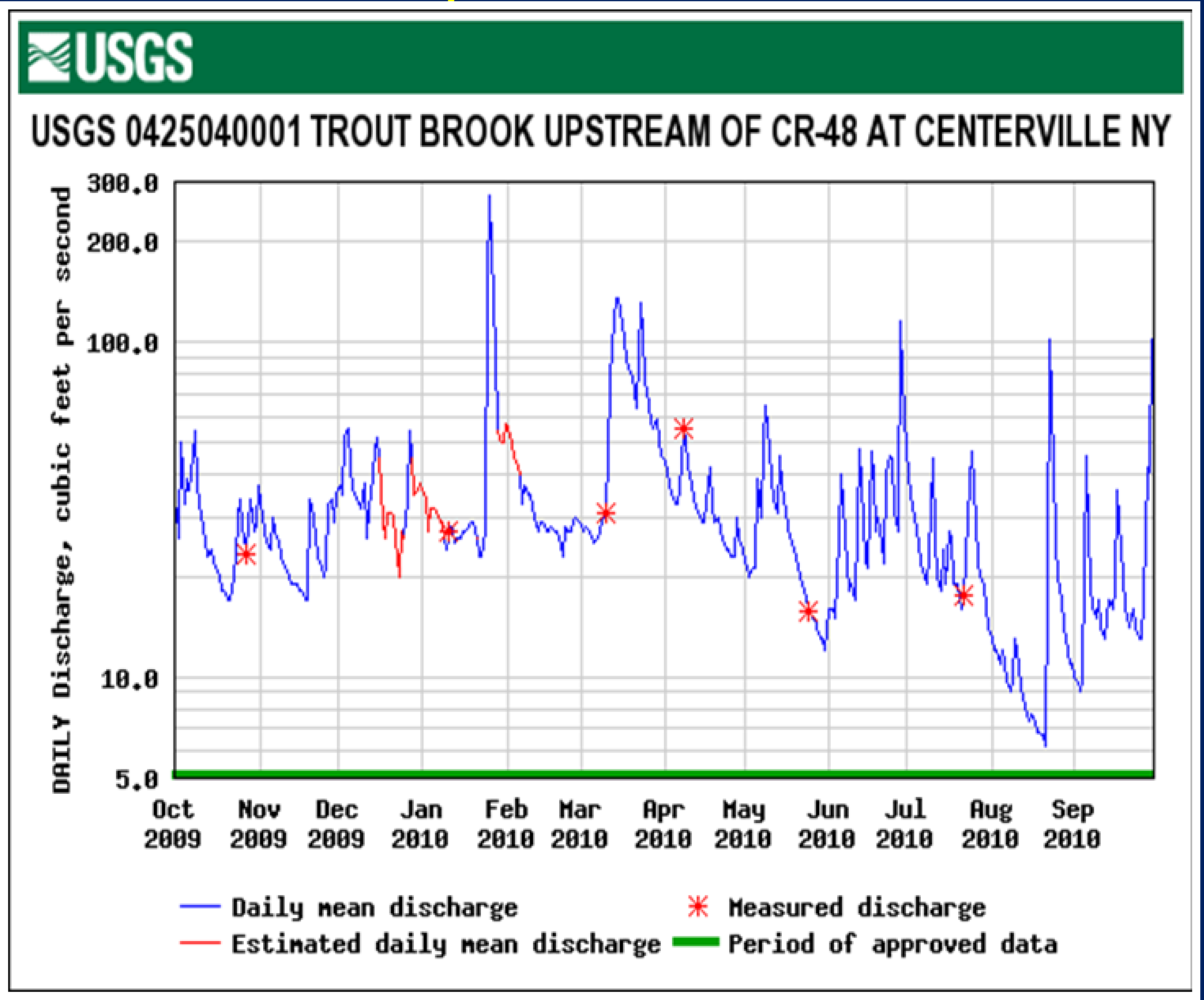
Most recent instantaneous value: 65 01-13-2009 09:15



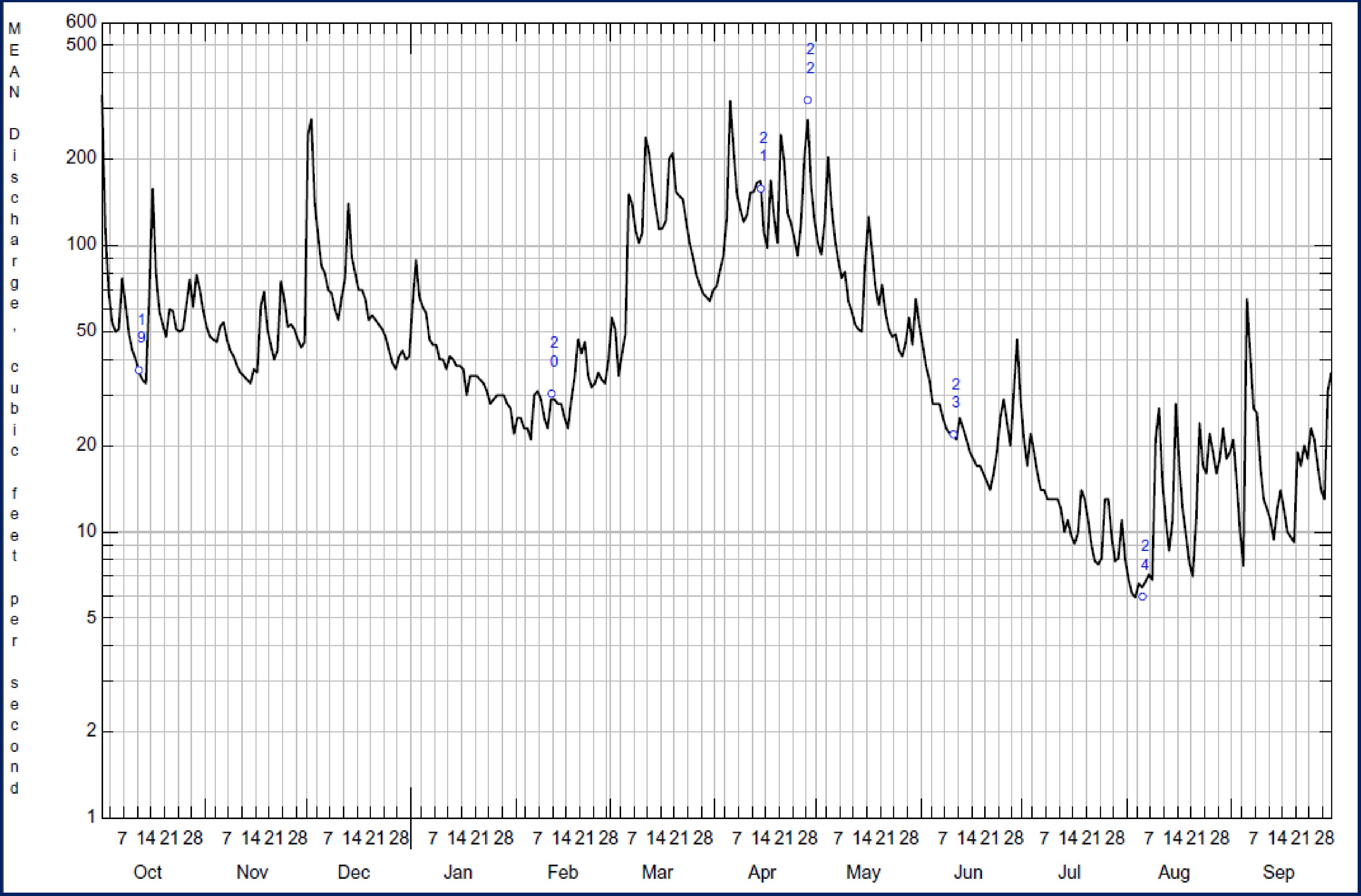
REAL-TIME STREAM GAGE TROUT BROOK, NEAR CENTERVILLE

Trout Brook gage site

Trout Brook upstream of CR-48 at Centerville, NY Water Year 2010

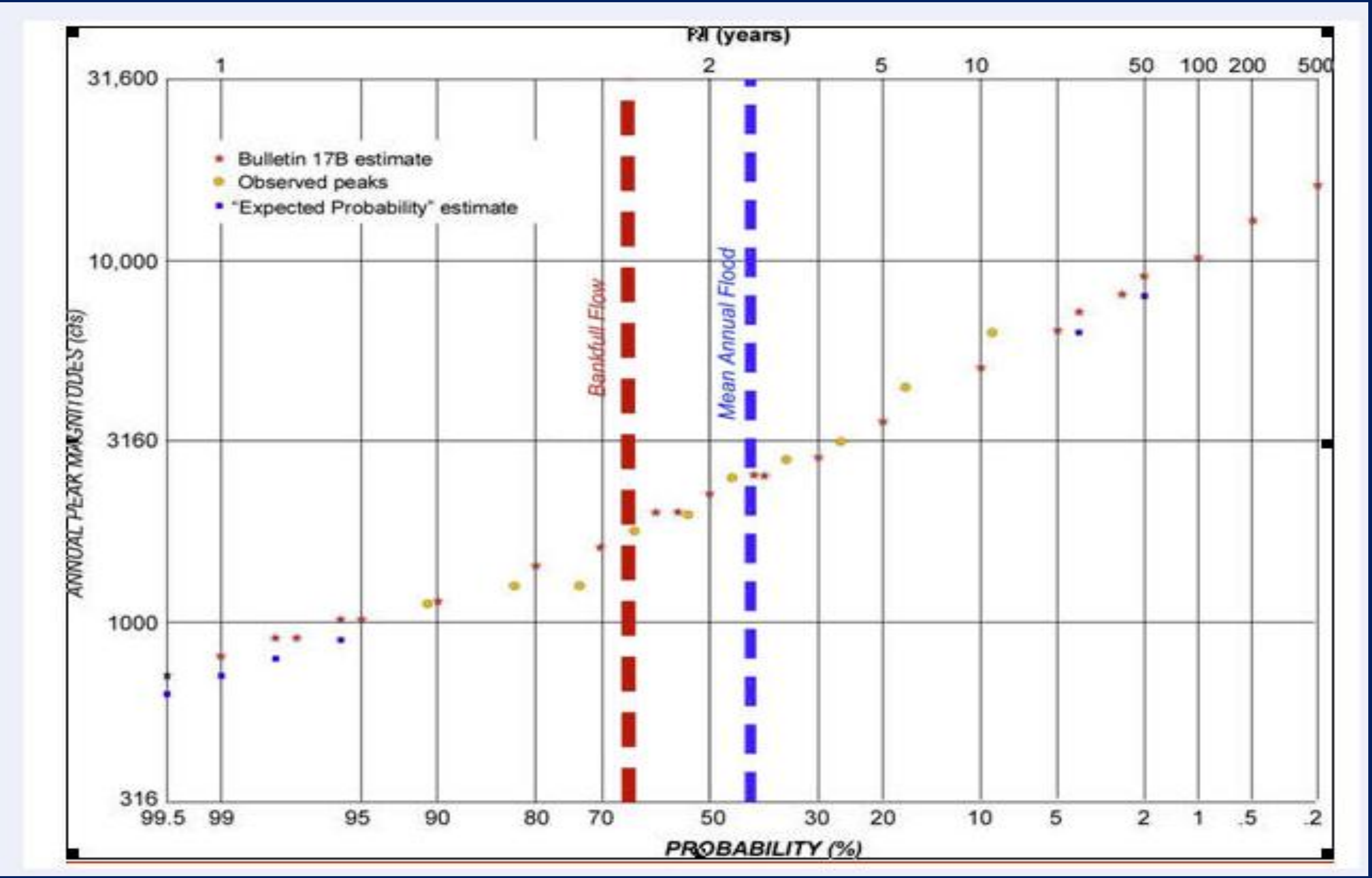


Trout Brook upstream of CR-48 at Centerville, NY
Water Year 2011



2010 2011

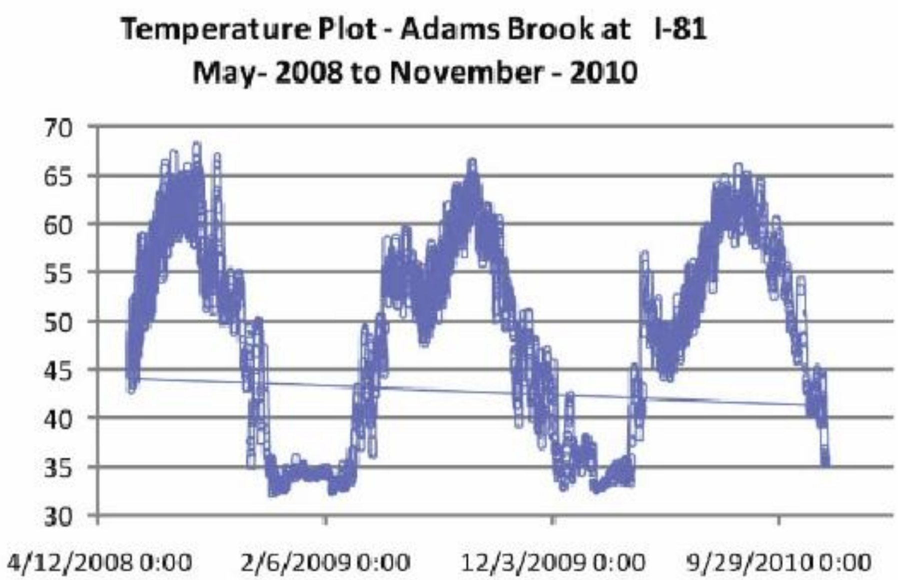
FLOOD FREQUENCY (need minimum 10 years record

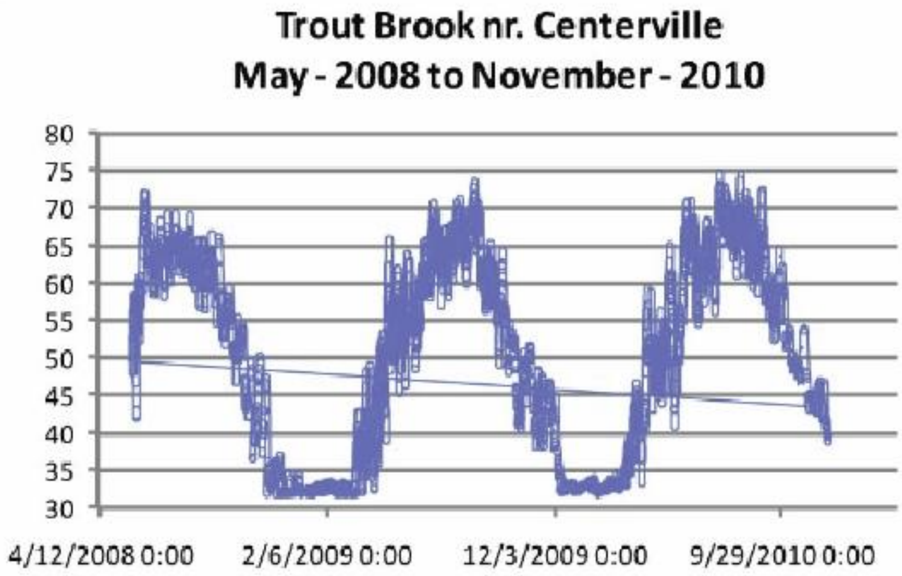


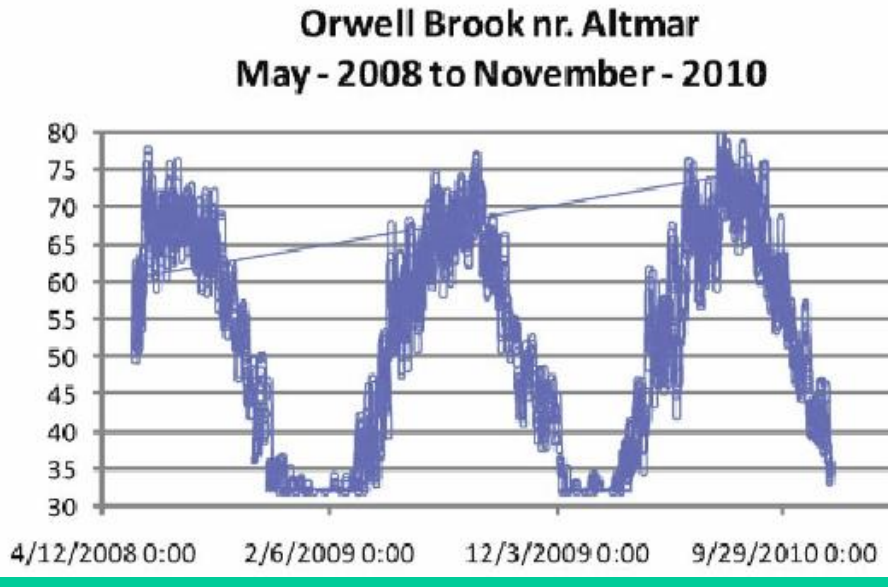
SUMMARY STREAMFLOW STATISTICS FOT TROUT BROOK

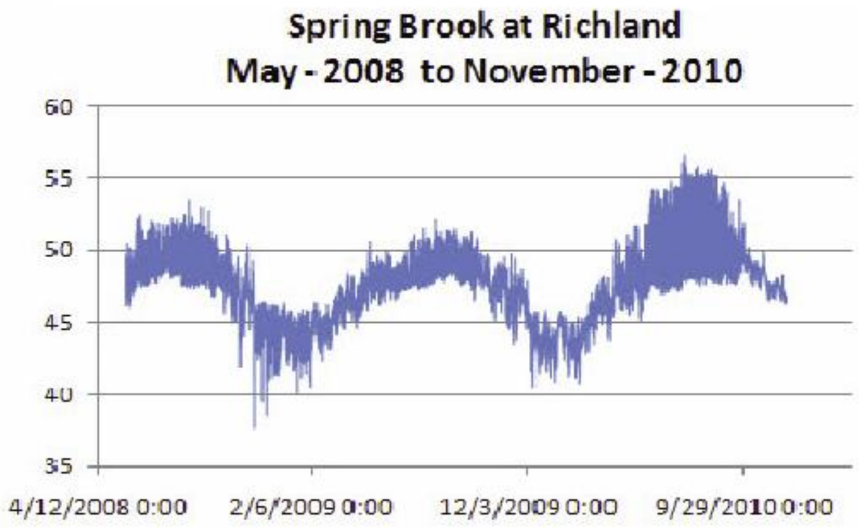
SUMMARY STATISTICS	2009 CALENDAR YR	2010 CALENDAR YR	2011 CALENDAR YR	2008-2011
ANNUAL MEAN	63.2	41.7	56.6	50.8
HIGHEST ANNUAL MEAN				63.2 FOR 2009
LOWEST ANNUAL MEAN				32.6 FOR 2010
ANNUAL 7-DAY MINIMUM	5.9 FOR SEPT 15	7.0 FOR AUG 15	6.5 FOR AUG 1	
50 PERCENT EXCEEDS				34
PEAK FLOWS	503 APR 4, 2009	384 JAN 26, 2010	522 DEC 1, 2010	522 DEC 1, 2010

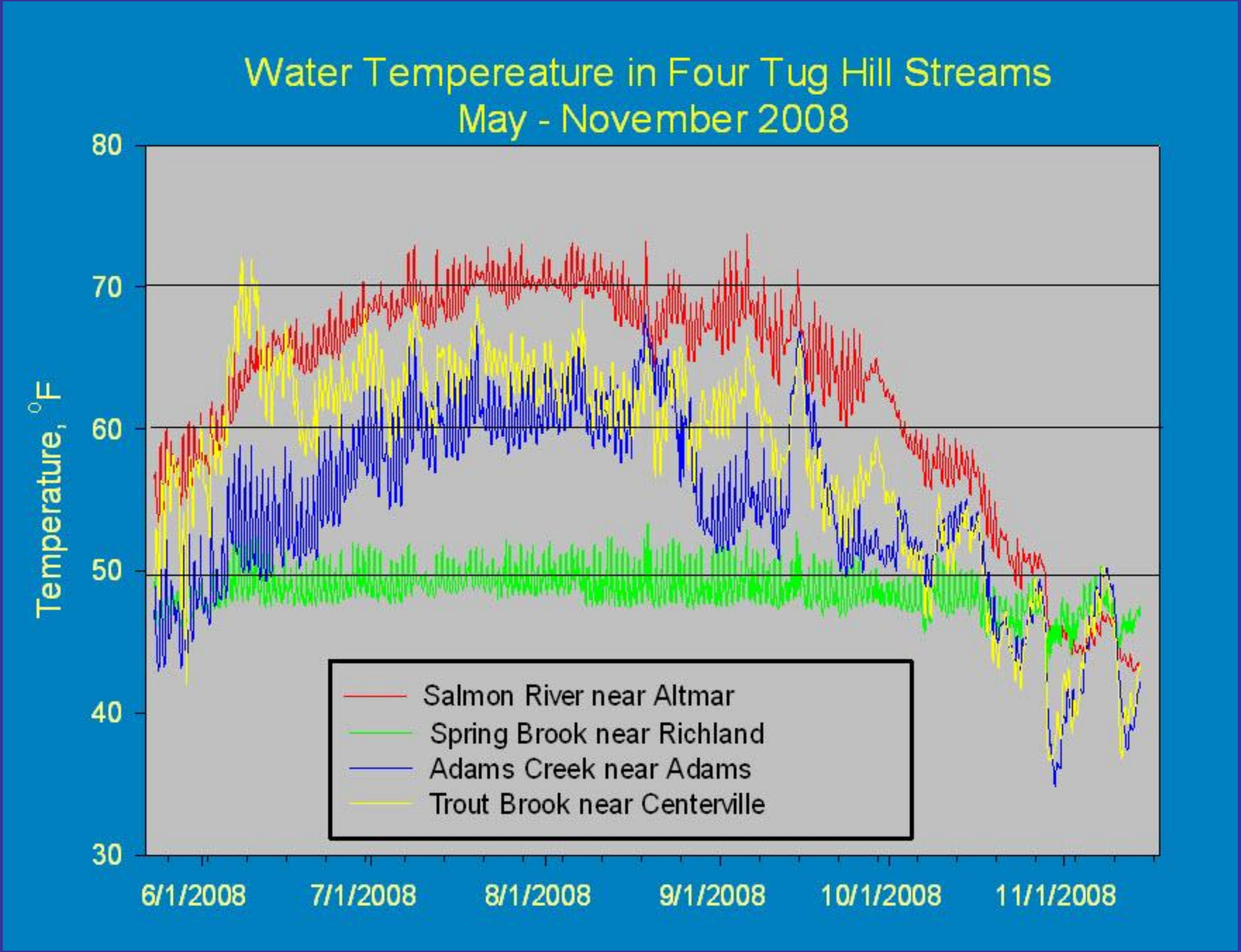
WATER TEMPERATURE OF SPRING-FED STREAMS



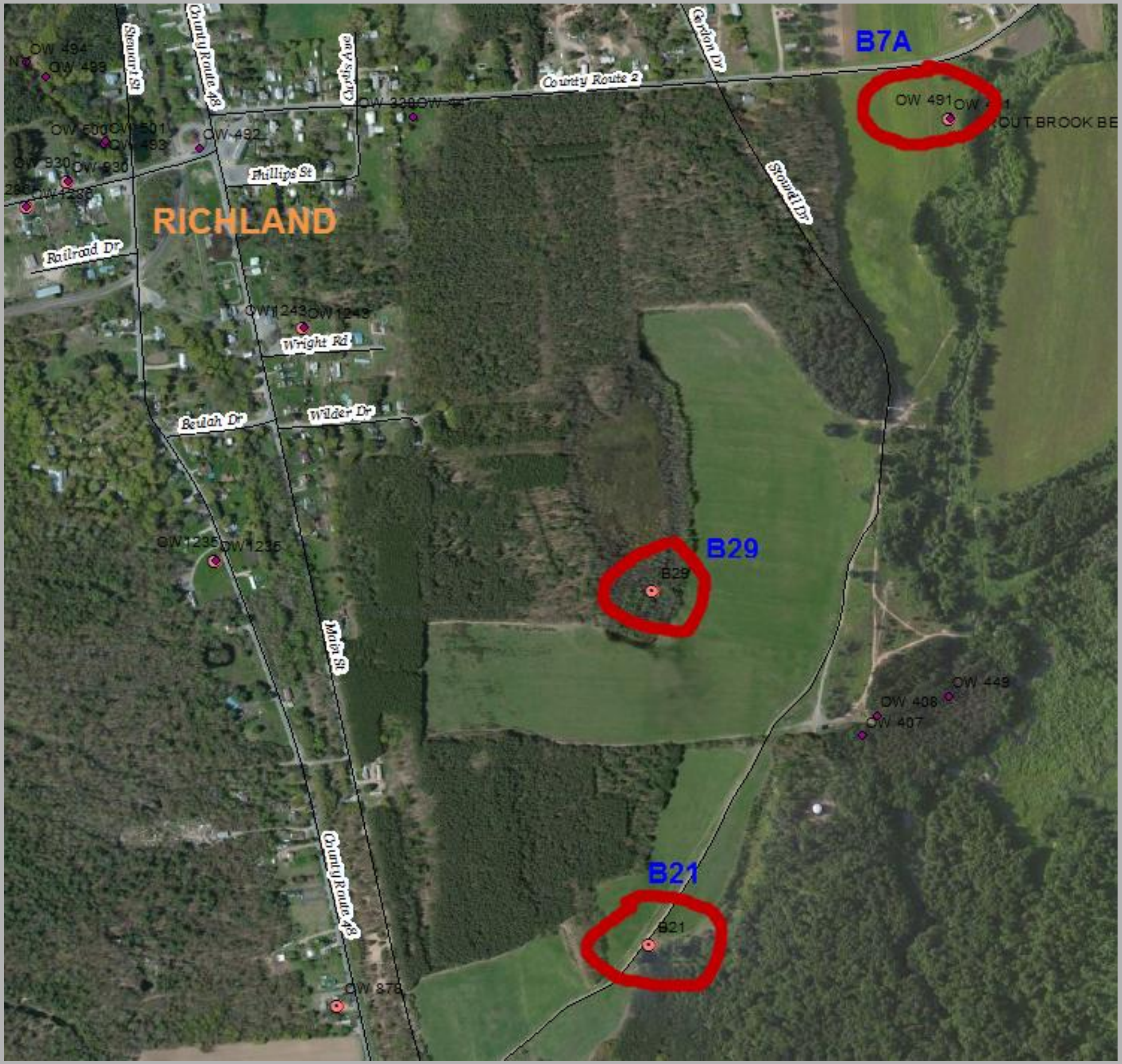








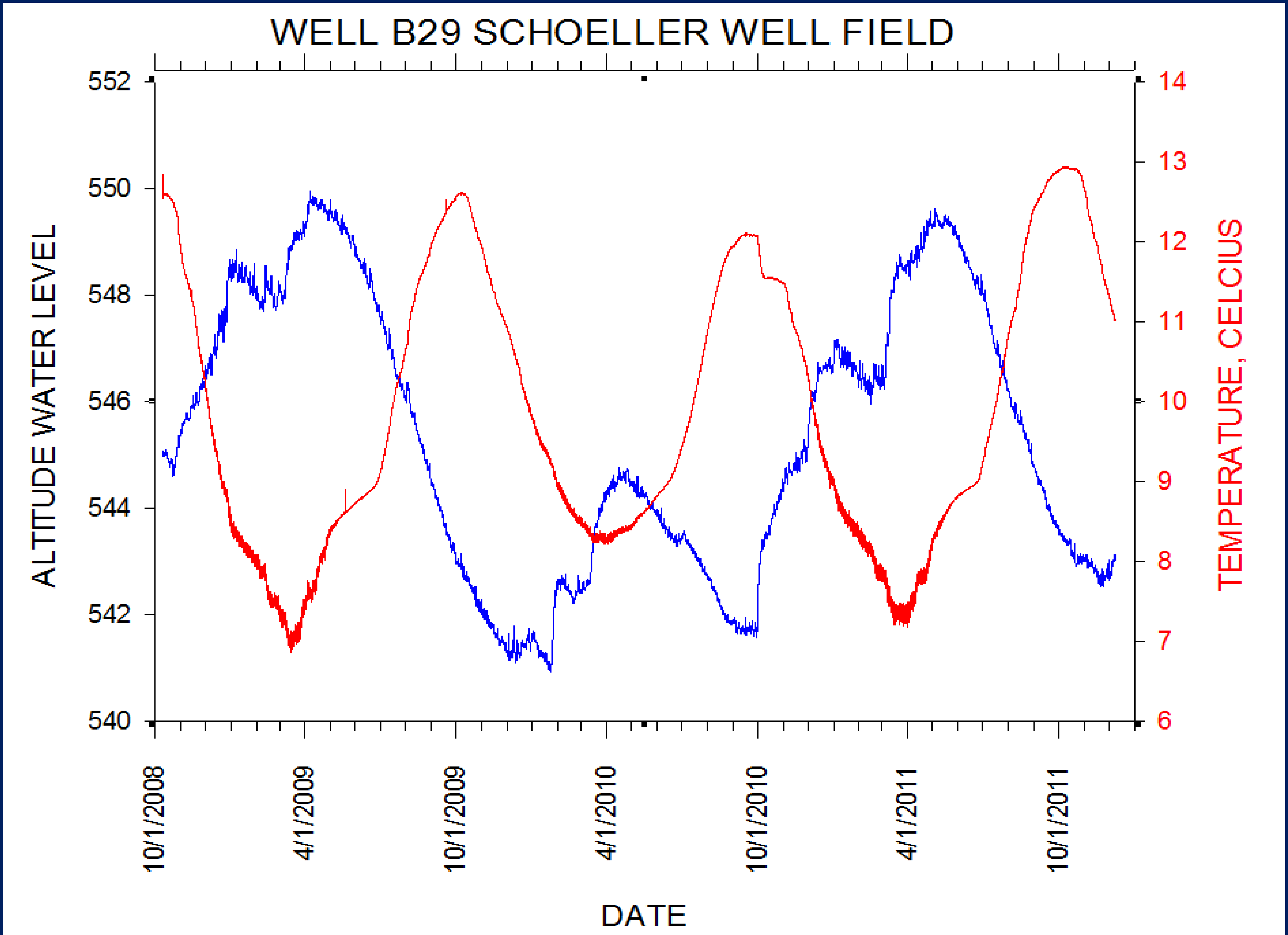
Water Tempereature in Four Tug Hill Streams
May - November 2008
80
70
60
50
40
30
Temperature, °F
6/1/2008
7/1/2008
8/1/2008
9/1/2008
10/1/2008
11/1/2008
Salmon River near Altmar
Spring Brook near Richland
Adams Creek near Adams
Trout Brook near Centerville



Continuous groundwater level monitoring in three wells at Richland well field

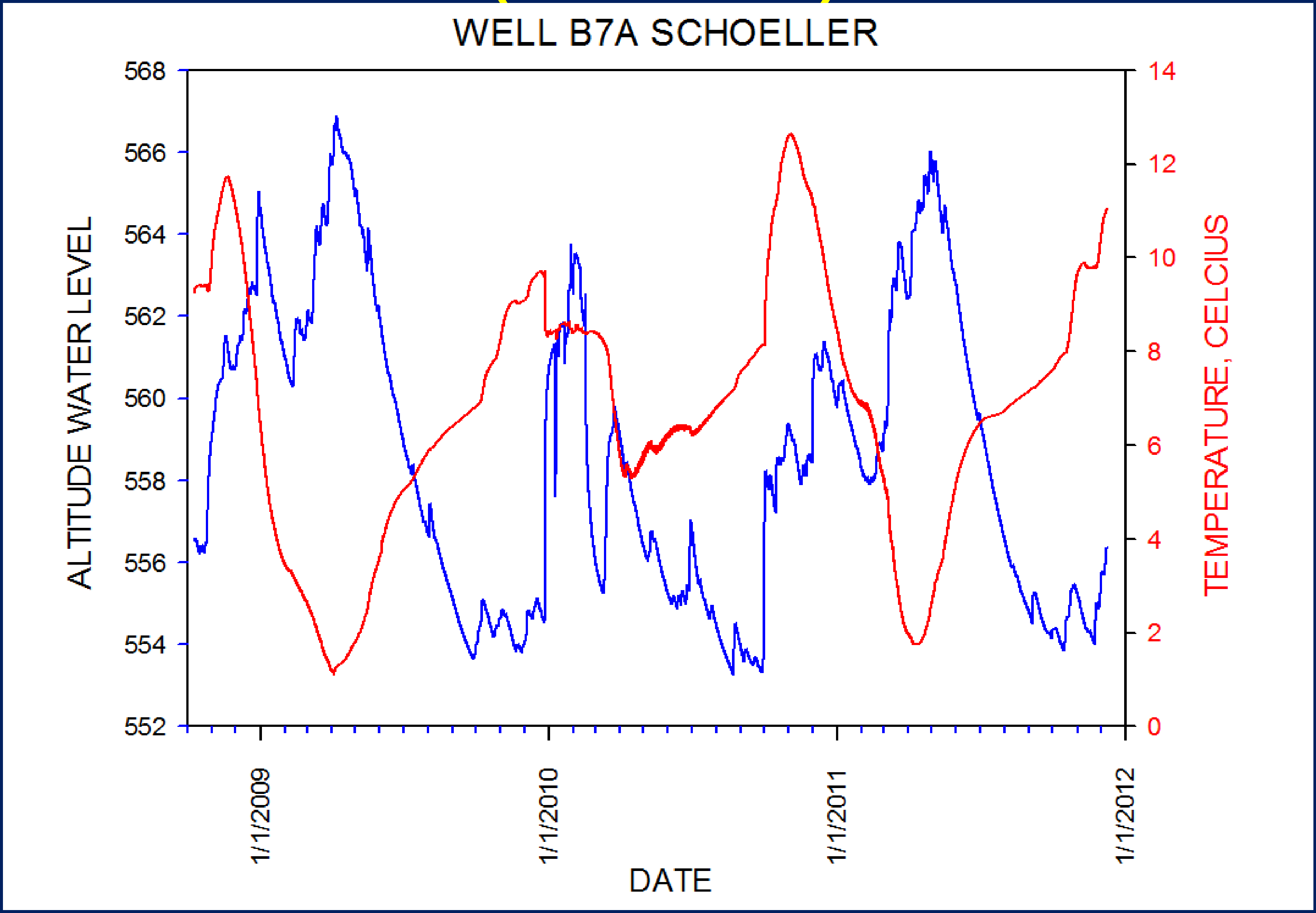
Richland well field (photo is well B29)

Well B29 (distal from stream)

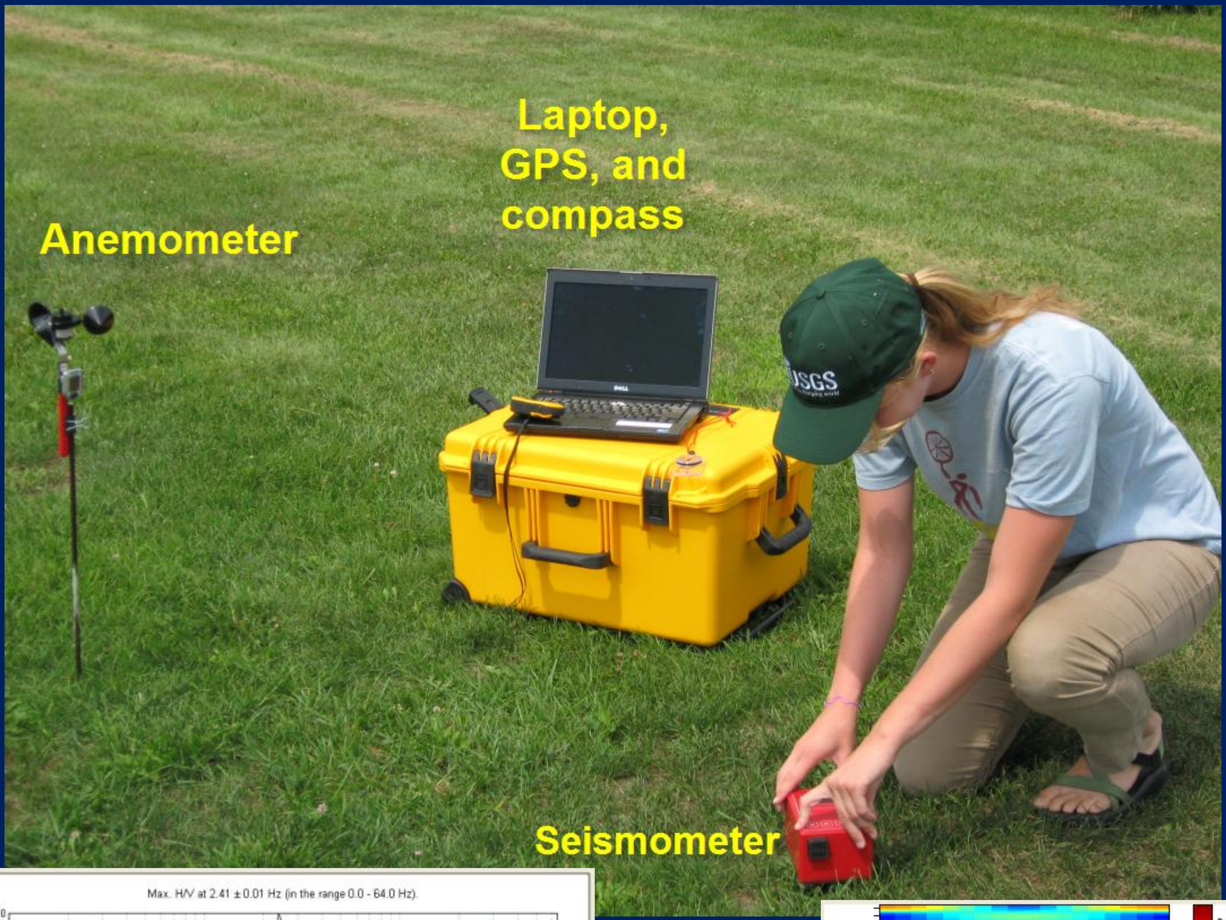


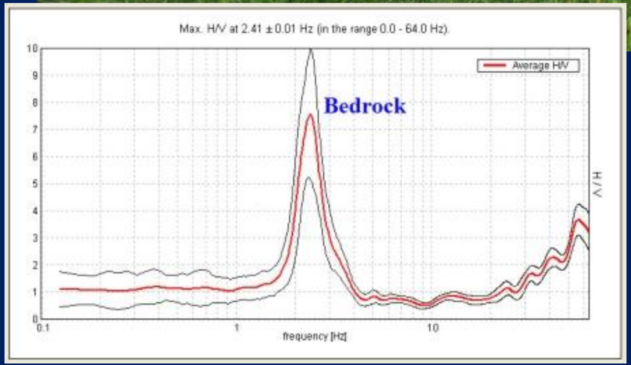
Well B29 (30 ft west of Trout Brook)

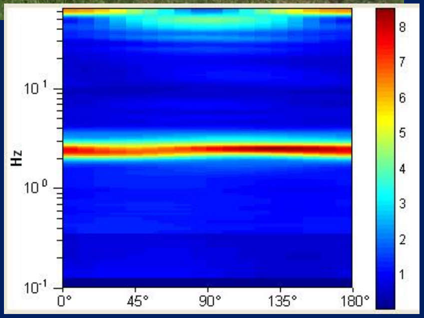
CONTINOUS GROUNDWATER-LEVEL MONITORING (near stream)



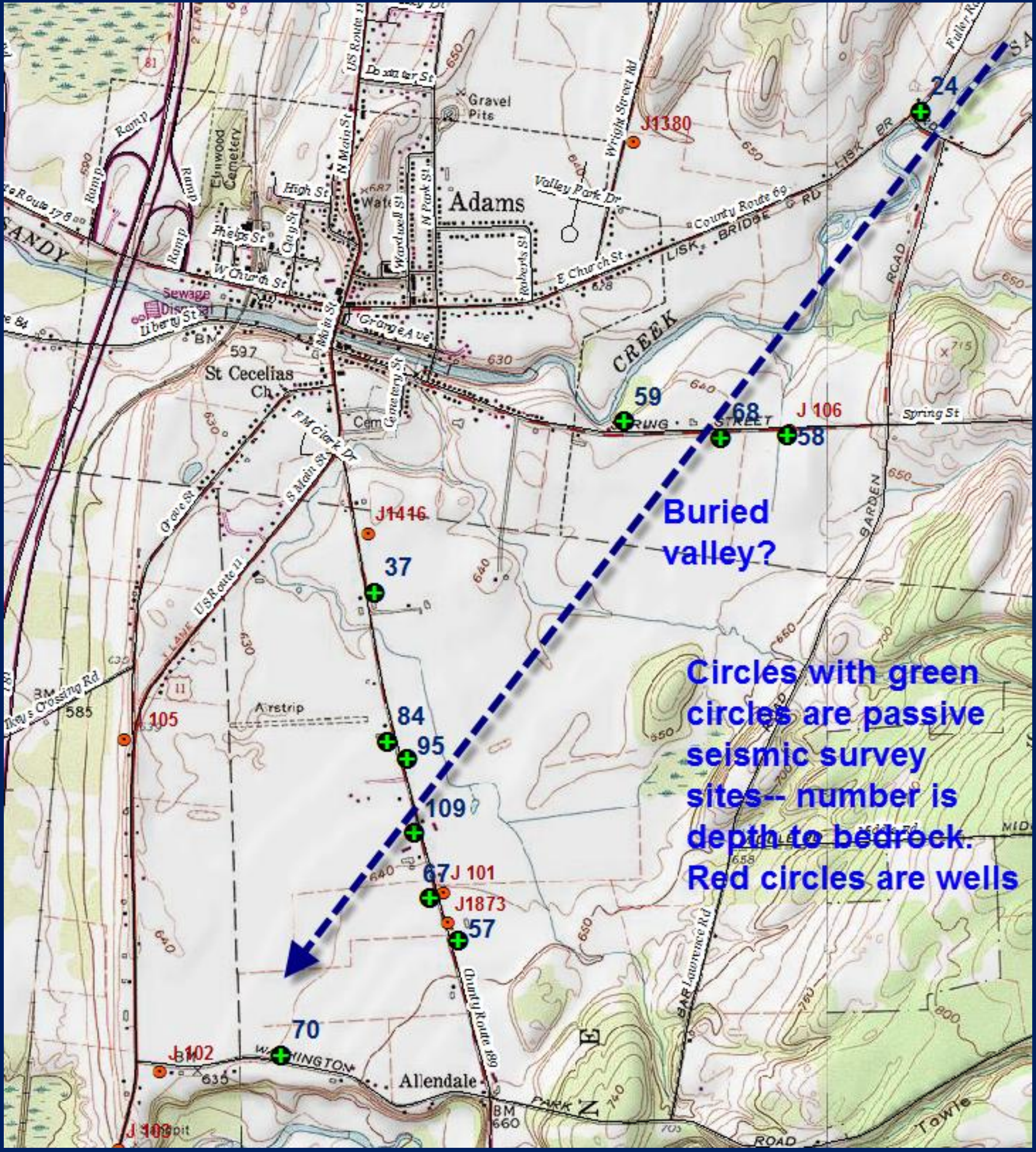
Passive seismic to determine depth to bedrock



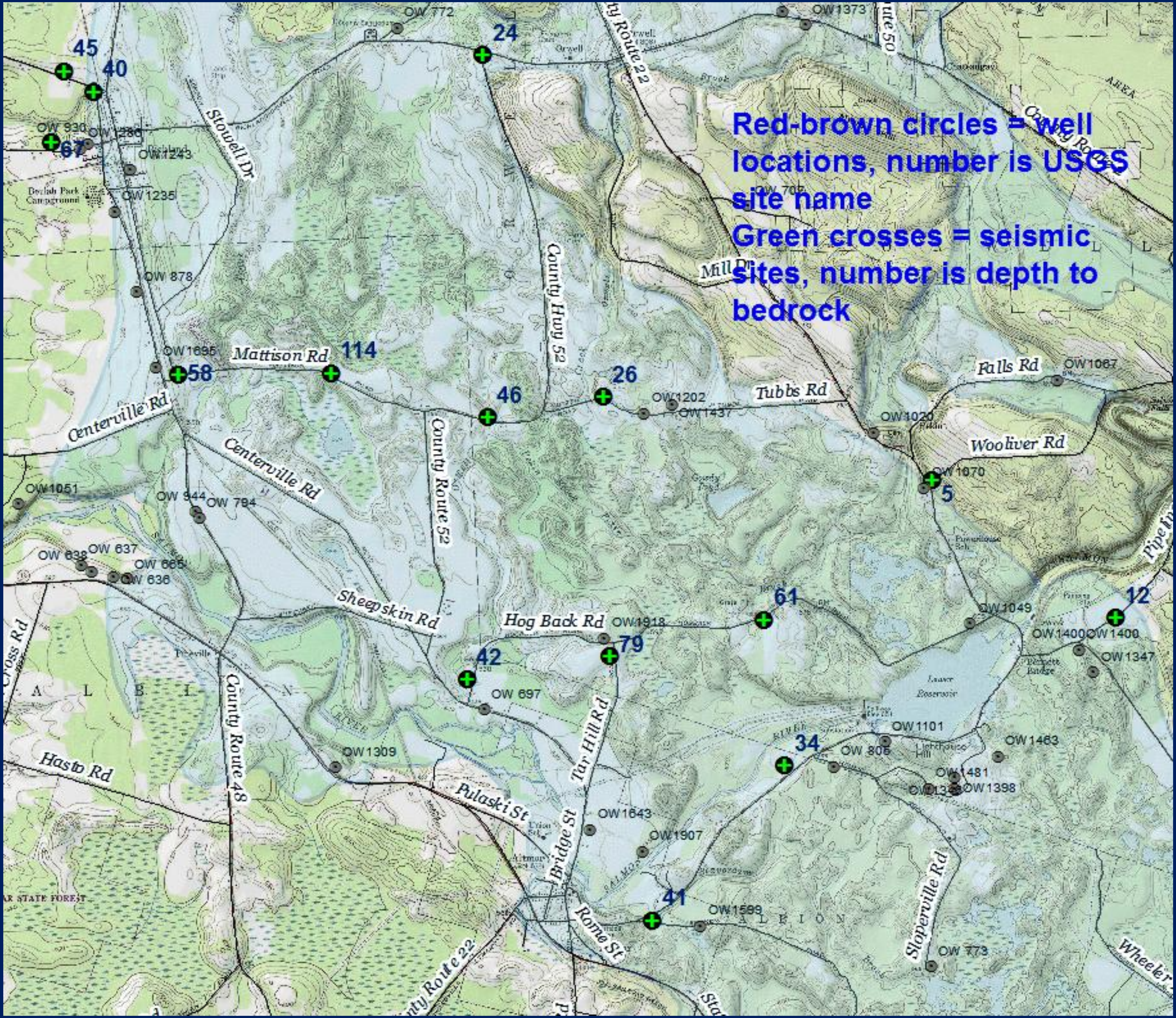


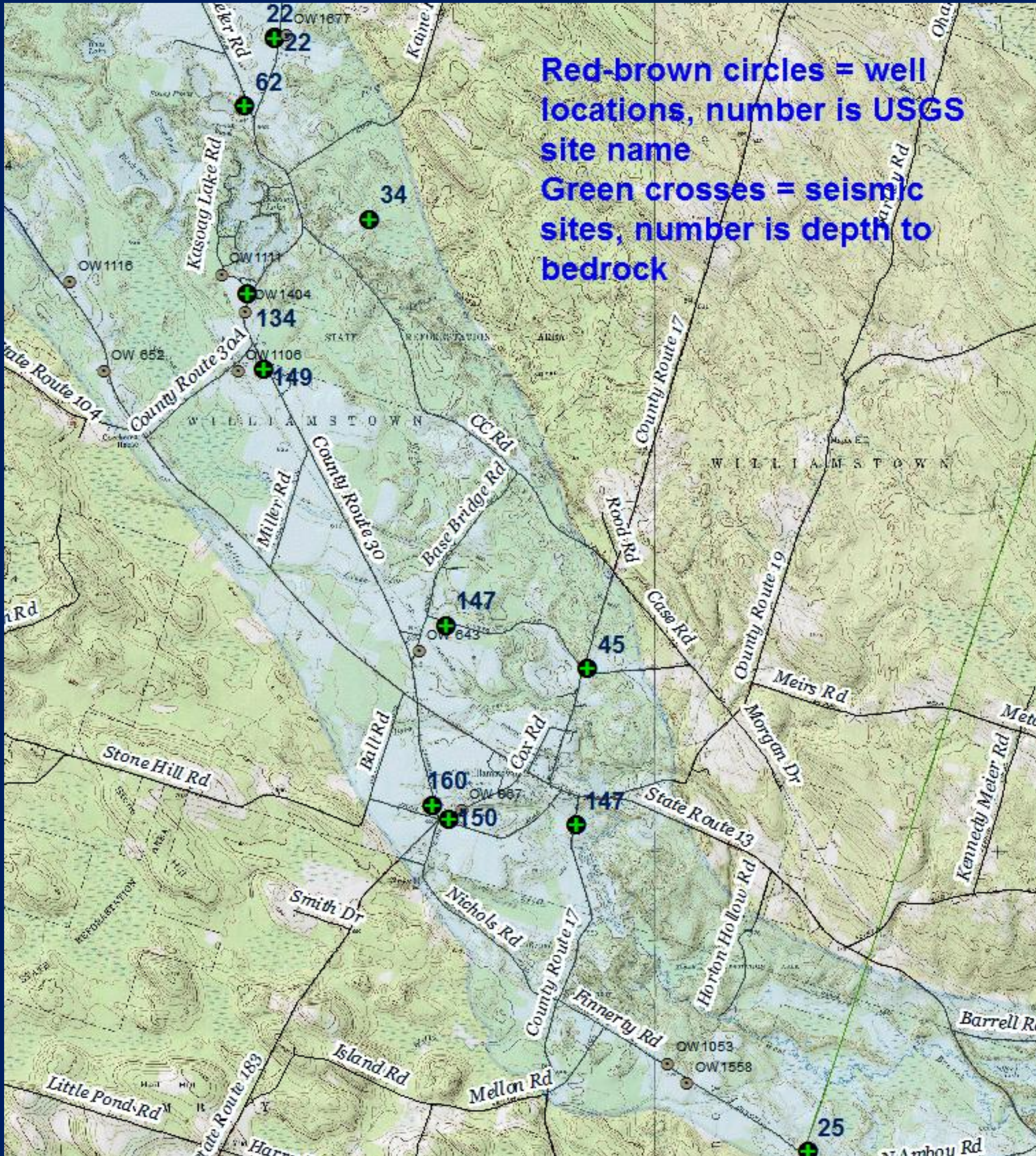


Traditionally regarded as a nuisance by seismologists, ambient noise has been recently shown to be rich in information that contributes to understanding the local structure of the sediment and depth to bedrock.



Results of passive seismic surveys indicate that there is a buried valley


Red-brown circles = well locations, number is USGS site name
Green crosses = seismic sites, number is depth to bedrock
45
40
24
67
114
58
46
26
5
61
12
79
42
34
41
OW 772
OW1373
OW 930
OW1280
OW1243
OW1235
OW 878
OW1695
OW1202
OW1437
OW1067
OW1020
OW1070
OW1051
OW 944
OW 794
OW 637
OW 638
OW 665
OW 636
OW1918
OW1049
OW1400
OW1347
OW 697
OW1309
OW1101
OW 806
OW1463
OW1481
OW1398
OW1643
OW1907
OW1599
OW 773
Mattison Rd
Centerville Rd
Stowell Dr
County Hwy 52
County Route 52
Tubbs Rd
Falls Rd
Wooliver Rd
Sheepskin Rd
Hog Back Rd
Tar Hill Rd
County Route 48
Hasto Rd
Pulaski St
Bridge St
Rome St
Sloperville Rd



South-central part of Tug Hill aquifer is where greatest depths to bedrock were encountered

Original proposal budget

Data collection and modeling phases

PROJECT: TUG HILL AQUIFER STUDY (NY07K) FY-2008-2013 BUDGET	FY-2008	FY-2009	FY-2010	FY-2011	FY-2012	FY-2013	Totals	Percent
USGS	$88,400	$106,704	$81,212	$50,996	$122,365	$52,166	$501,844	30%
COOPERATOR(S)	$206,267	$248,977	$189,494	$118,991	$285,519	$121,721	$1,170,969	70%
TOTAL	$294,667	$355,681	$270,706	$169,988	$407,884	$173,887	$1,672,813	100%

Original proposal budget

BUDGET BY PHASE AND FISCAL YEAR						
	FY-2008	FY-2009	FY-2010	FY-2011	FY-2012	FY-2013
PHASE-I	total					
Entire Tug Hill aquifer data collection	$812,905					
USGS	$111,606	$126,937	$5,328			
COOPERATOR(S)	$260,414	$296,187	$12,432			
TOTAL	$372,020	$423,124	$17,761			
PHASE-II	total					
	$1,079,060					
	total					
Northern aquifer segment	$359,687					
USGS			$25,850	$26,054	$56,002	
COOPERATOR(S)			$60,318	$60,792	$130,671	
TOTAL			$86,168	$86,845	$186,673	
	total					
Central aquifer segment	$359,687					
USGS			$25,850	$26,054	$56,002	
COOPERATOR(S)			$60,318	$60,792	$130,671	
TOTAL			$86,168	$86,845	$186,673	
	total					
Southern aquifer segment	$359,687					
USGS				$12,363	$40,207	$46,114
COOPERATOR(S)				$28,846	$93,815	$138,342
TOTAL				$41,209	$134,022	$184,456
PROGRAM TOTAL	**$1,891,965**					

Planned vs. actual budget

Data collection phase of project

BUDGET PHASE-I (data collection) AND FISCAL YEAR (original agreement)	FY-2008	FY-2009	FY-2010	FY-2011	FY-2012	FY-2013	TOTAL
PHASE-I	total						
Entire Tug Hill glacial aquifer data collection	$812,905						
USGS	$111,606	$126,937	$5,328				$243,872
COOPERATOR(S)	$260,414	$296,187	$12,432				$569,034
TOTAL	$372,020	$423,124	$17,761				$812,905

Planned

ACTUAL AMOUNT CONTRIBUTED TO DATTE	FY-2008	FY-2009	FY-2010	FY-2011	FY-2012	FY-2013	TOTAL
USGS	$47,117	$42,171	0		$20,000		$109,288
COOPERATORS	$72,667	$47,500	0		$20,000		$140,167
TOTAL	$119,784	$89,671	0		$40,000		$249,455

Actual

DIFFERENCE FROM ORIGINAL AGREEMENT	FY-2008	FY-2009	FY-2010	FY-2011	FY-2012	FY-2013	TOTAL
USGS	-$64,489	-$84,766	-$5,328		$20,000		-$134,584
COOPERATORS	-$187,747	-$248,687	-$12,432	$0	$20,000		-$428,867
TOTAL	-$252,236	-$333,453	-$17,761	$0	$40,000		-$563,450

- **About 2/3'd less $$ invested for project vs what was planned as needed**
- **Therefore, only about 1/3 of Phase I work is complete to date**

Current expended budget

Data collection phase

	FY-2008	FY-2009		FY-2010	FY-2011	FY-2012	FY-2013	
USGS	$47,117							establish Trout brook gage; compile basemaps; well inventory; stream gain-loss at selected streams; four seasonal water-quality samples on selected streams;
THC	$72,667							
total	**$119,784**							
USGS		$9,000						measure discharge and sample 7 strams as they cross the northern aquife segment in Jefferson Co.; continue other well-data collection
JC_SWCD		$9,000						
total		**$18,000**						
USGS		$4,671	$10,000					continue gage @ Trout Brook for FY-10 and FY-11; continue basic data collection at selected wells and update well database
OC-SWCD		$10,000	$10,000					
total		**$14,671**	$20,000					
USGS			$18,500					conduct H/V seismic sureveys; continue basic well dta collection
THLT			$18,500					
total			**$37,000**					
USGS						$20,000		continue hydrogeologic mapping and well data collection in Jefferson Co. and near Adams; additional H/V seismic surveys; install water-level monitors in selected wells
JC_SWCD						$20,000		
total						**$40,000**		
YEARLY TOTALS	**$119,784**	**$32,671**	**$57,000**	**$0**		**$40,000**	**$249,455**	TOTAL to FY-2012
								percentage
total USGS	**$47,117**	**$13,671**	**$28,500**			**$20,000**	**$109,288**	44%
all cooperators	**$72,667**	**$19,000**	**$28,500**			**$20,000**	**$140,167**	56%
	$119,784	$32,671	$57,000	$0		$40,000	**$249,455**	100%

Where do we go from here?

WORK FOR 2012

- Using passive seismic, define aquifer thickness (depth to bedrock) in the outer fringe areas in the northern part of the study area, with a concentration in the Sandy Cr. Valley from Lisk Br. to Rodman.
- Continue to collect well records.
- Install 2-3 data loggers in northern part of aquifer.
- Construct geologic columns that depict subsurface geology.

BEYOND 2012

- Collect and analyze groundwater samples (northern and central parts).
- Install additional streamflow gages (Spring Brook at Richland and two gages in Adams area).
- Select a set of wells to conduct a synoptic GW level measurement survey during average annual conditions to construct a water table map and to calibrate a GW flow model.
- Identify were well data is lacking and conduct test drilling.
- Construct numerical GW flow models.