Tomorrow's Drinking Water

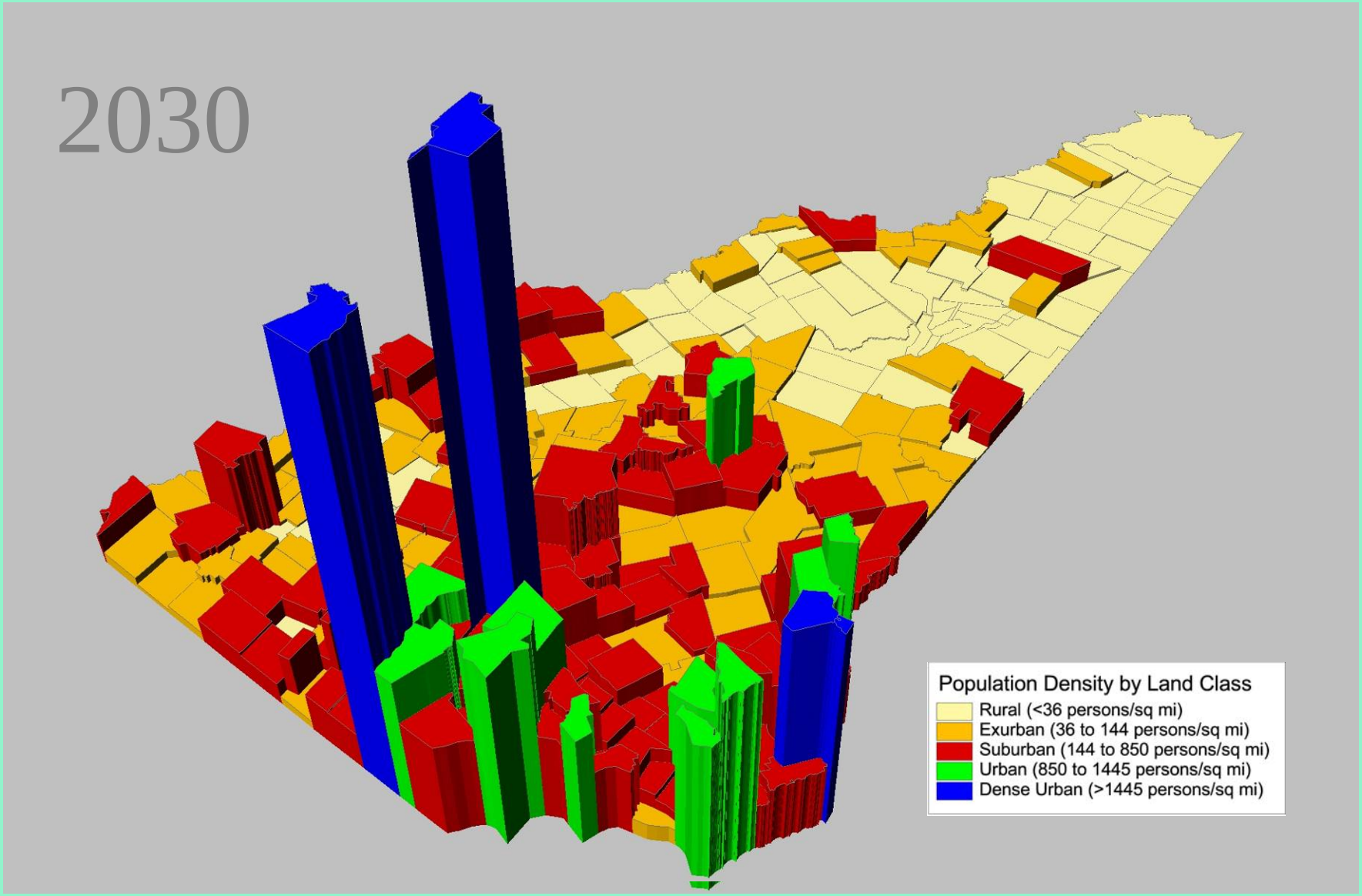
Identifying New Hampshire's Best Prospects For New Municipal Water Supplies in Stratified Drift Aquifers

A Project of the Society for the Protection of NH Forests
Land Protection Department
Dan Sundquist
Director of Land Conservation Planning

Funding to complete this project has been provided by
the New Hampshire Department of Environmental Services
Local Source Water Protection Grant Program

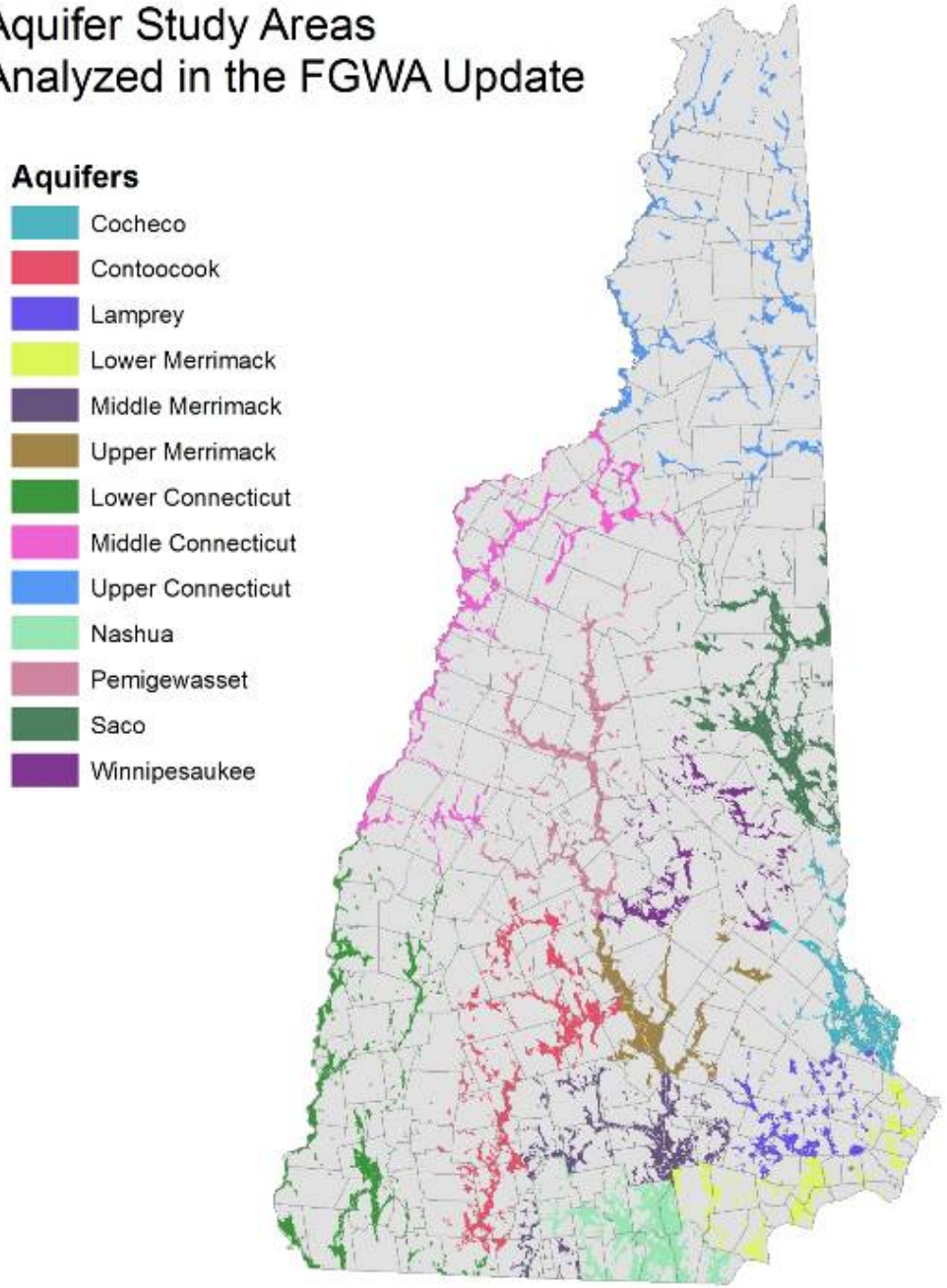
Why is this Important Now?

Because we need to think about future generations…

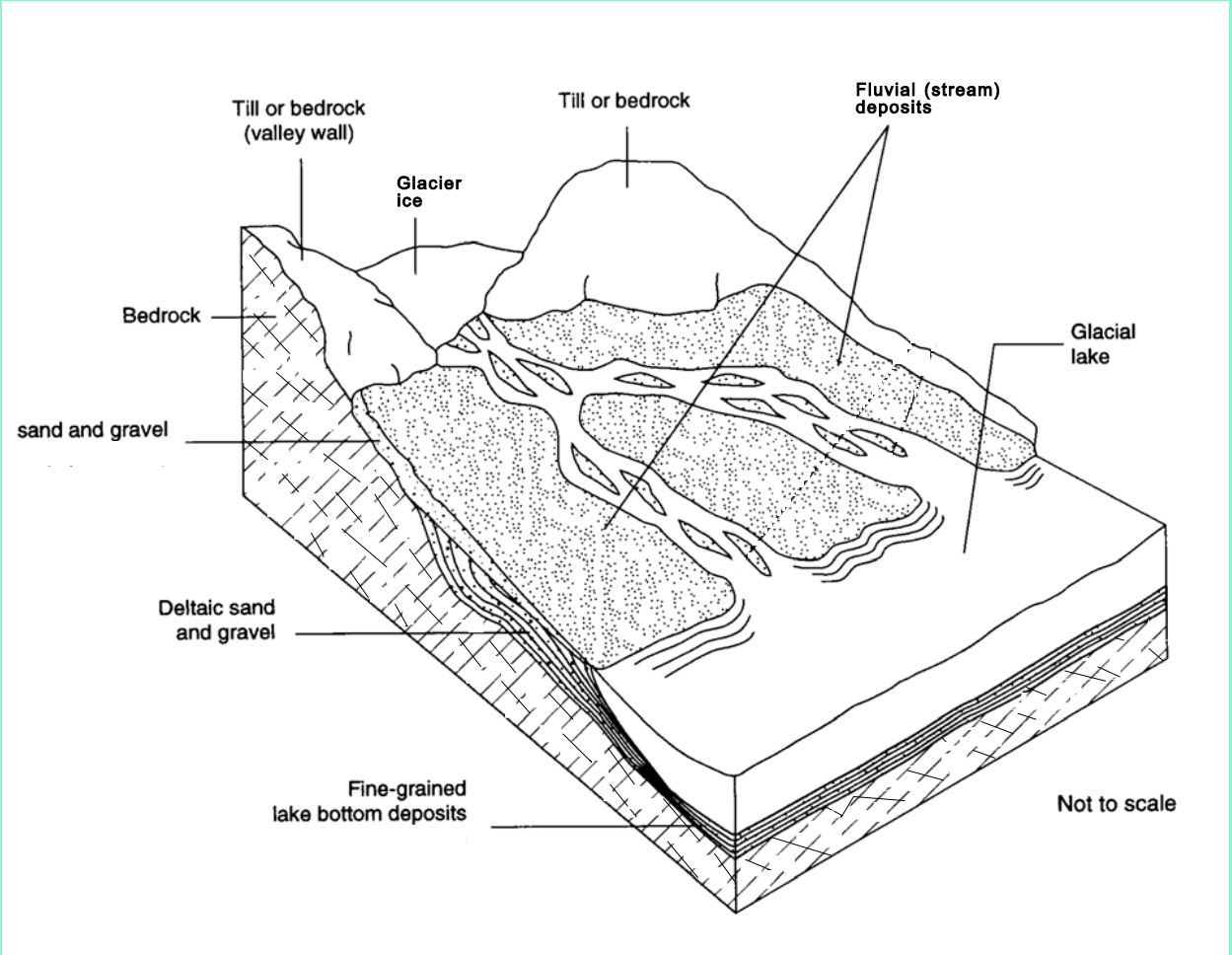


NH uses 98,000,000 gallons of groundwater per day; 800,000 people or 60 percent of NH residents rely upon groundwater as a water supply

Aquifer Study Areas Analyzed in the FGWA Update



Stratified-Drift Aquifers

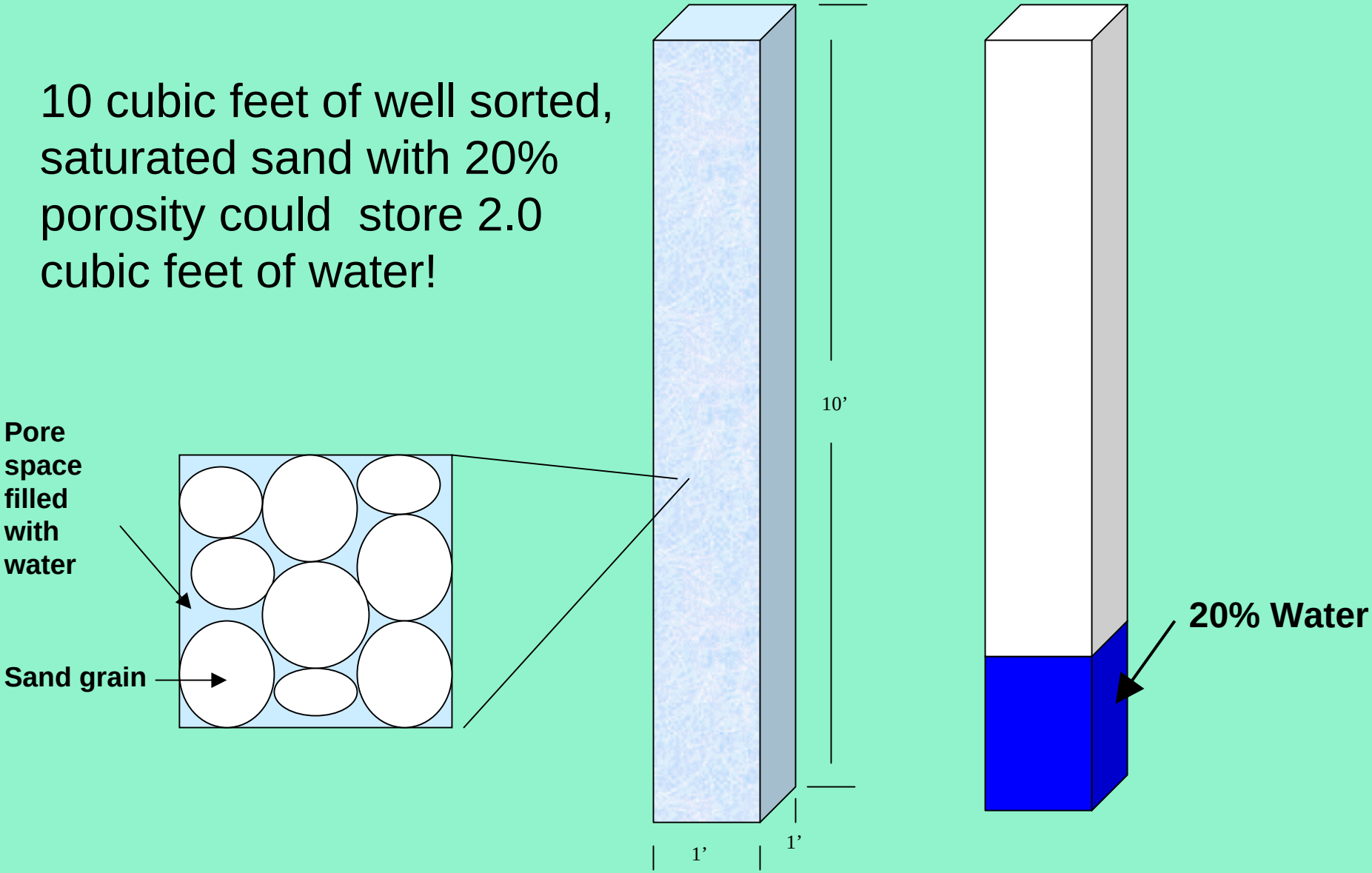


Transmissivity

- Transmissivity is a measure of how much groundwater can be transmitted horizontally based upon the porosity and thickness of subsurface materials.

Groundwater Storage in Stratified-Drift Deposits

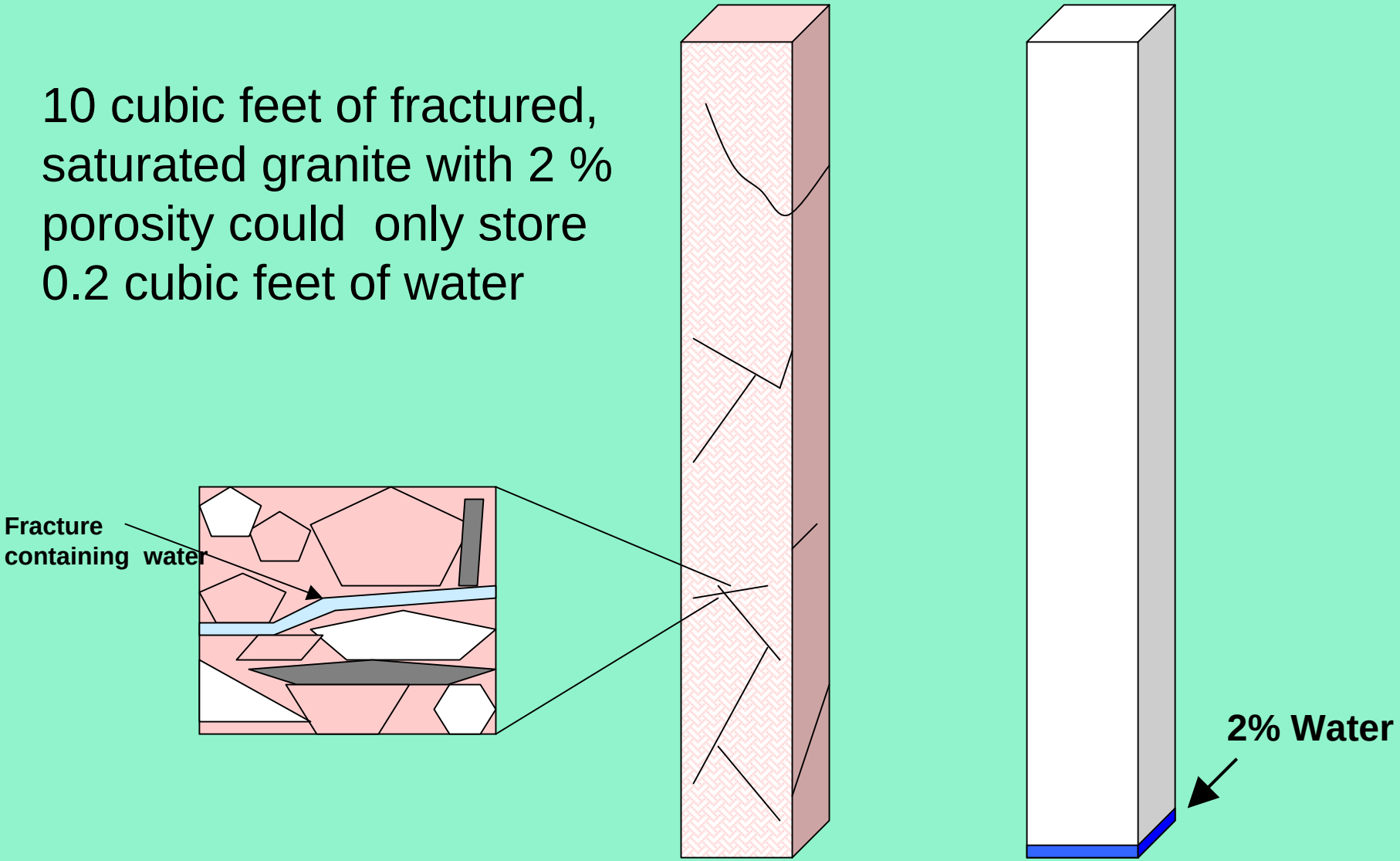
10 cubic feet of well sorted, saturated sand with 20% porosity could store 2.0 cubic feet of water!



(NHGS, 2002)

Groundwater Storage in Crystalline Bedrock

10 cubic feet of fractured, saturated granite with 2 % porosity could only store 0.2 cubic feet of water

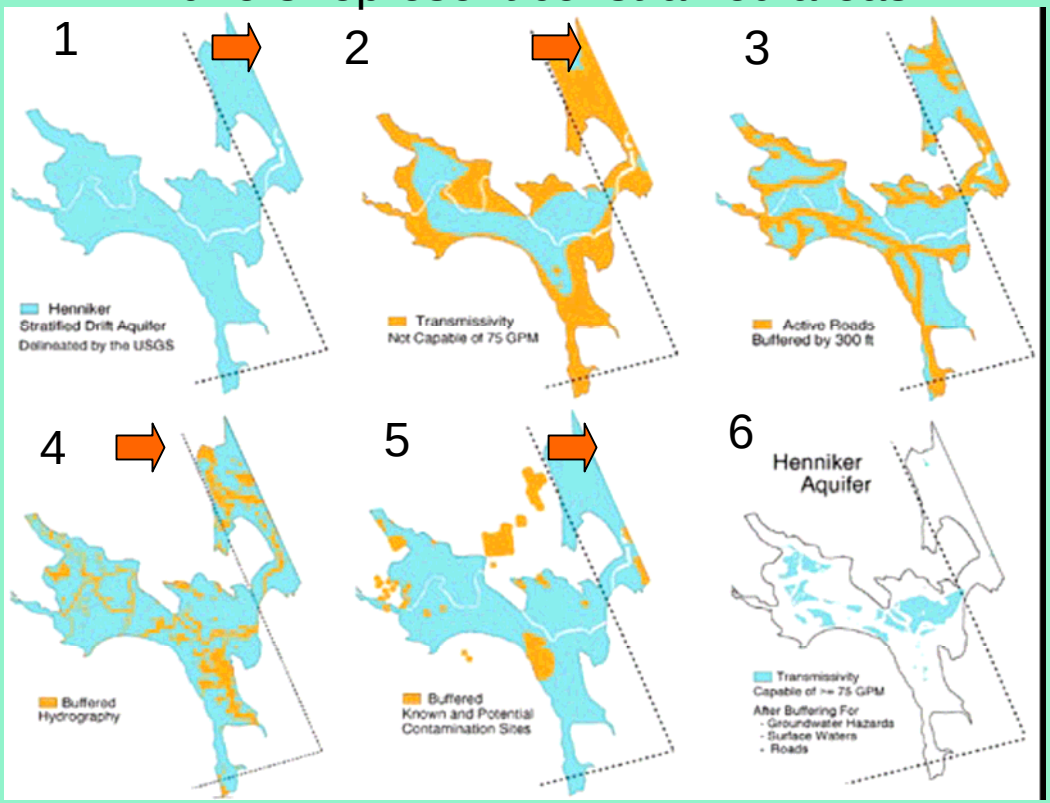


(NHGS, 2002)

Buffer Regimes: Constraints

- Transportation Buffers
- Hydrological Buffers
- Known & Potential Contamination Sites
- Urban Features

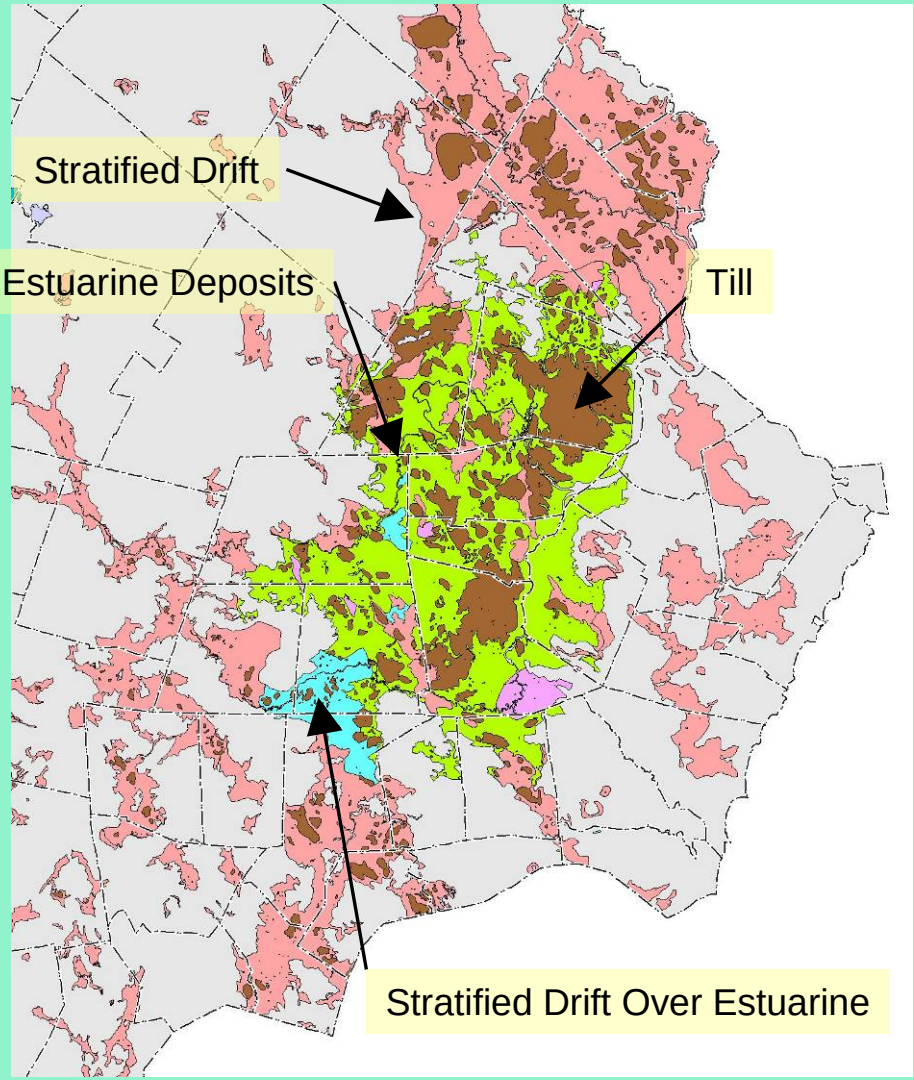
Buffers represent constrained areas

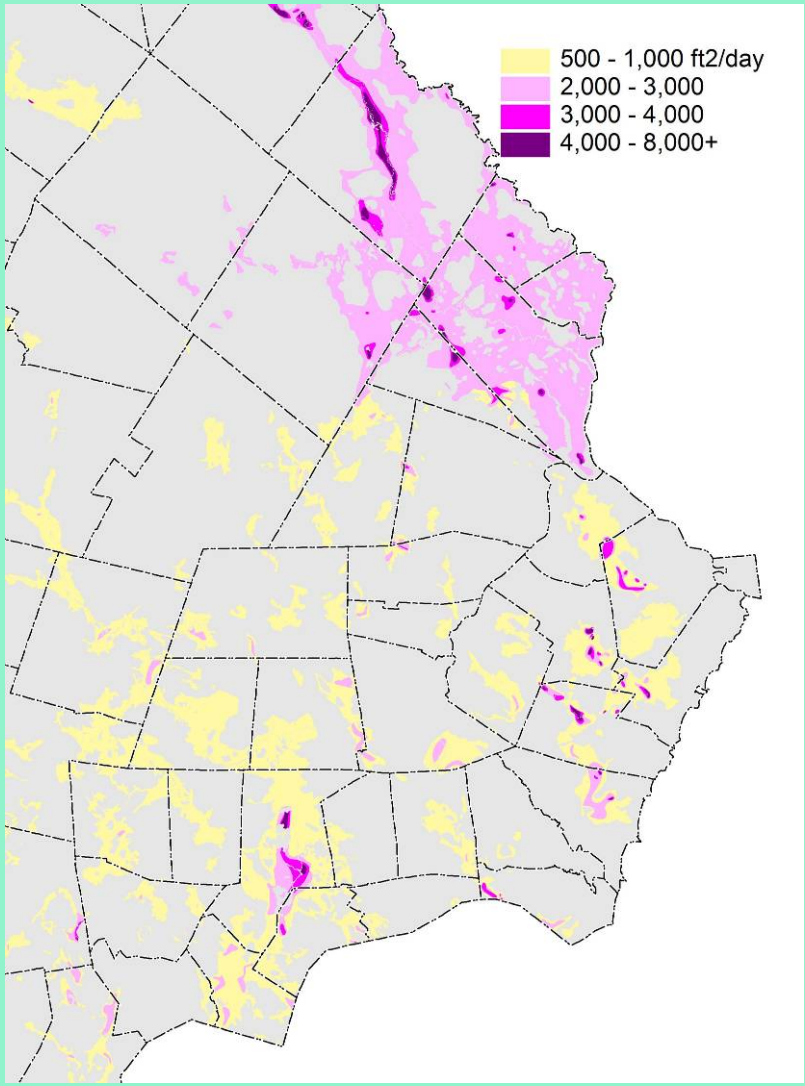


References: *A Guide to Identifying Potentially Favorable Areas to Protect Future Municipal Wells in Stratified Drift Aquifers, Volume 1*, (DES,1999)

Ibid., *Volume 2 GIS Operators Manual*, 1999.

Aquifer Materials v. Transmissivity





Transmissivity Determines Well Yield Class

Transmissivity		**Well Yield Class**
T min	***T max***	
0	500	< 75 gpm
0	1000	< 75 gpm
0	2000	>=75 gpm but <150 gpm
2000	2000	150 gpm
2000	4000	>=150 gpm but <300 gpm
3000	99999	>=150 gpm but upper limit unknown
4000	99999	>=150 gpm but upper limit unknown
4000	8000	>=300 gpm
8000	99999	>=300 gpm

Sanitary Protective Radius

- 75 gpm pumping rate = 300’ minimum SPR
- >100 gpm = 400’ minimum SPR
- 400’ SPR is the maximum specified by DES for any public water supply well pumping at more than 100 gpm

Transportation Buffers

- 2010 NH DOT vector data for local roads and highways, including private roads
- Varies by functional class to accommodate differing right-of-way widths
- Class 6 roads not included in analysis

Transportation Buffers

DOT Functional Class	ROW	SPR 300 Buffer	SPR 400 Buffer
Interstate	100 - 150	375	475
Primary	100 - 150	375	475
Secondary	50 - 100	350	450
Municipal (Class 5)	50 - 75	338	438
Private	50 - 75	338	438
Federal	50 - 75	338	438
Recreation	50 - 75	338	438

Hydrological Buffers

- All sand & gravel wells are required to be at least 50 feet from any surface water feature including intermittent streams.
- USGS *National Hydrography Dataset*
- NHD streams, rivers, water features, and wetlands
- NWI wetlands included

Contamination Buffers

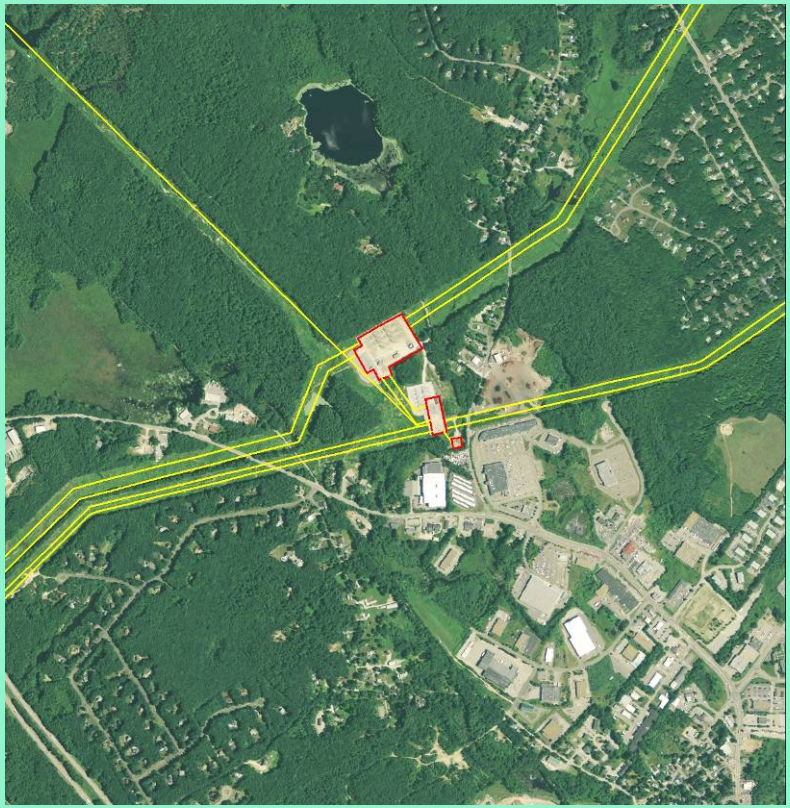
- Known & Potential Sites and Areas
- 29 DES “project types” are buffered
- Examples = Hazardous materials, landfills, leaking storage tanks, spill sites, transfer stations, septage lagoons, fuel storage sites, spray irrigation of treated effluent, etc.
- Buffers = 1,000’ or SPR 300’/400’

Urban Feature Buffers

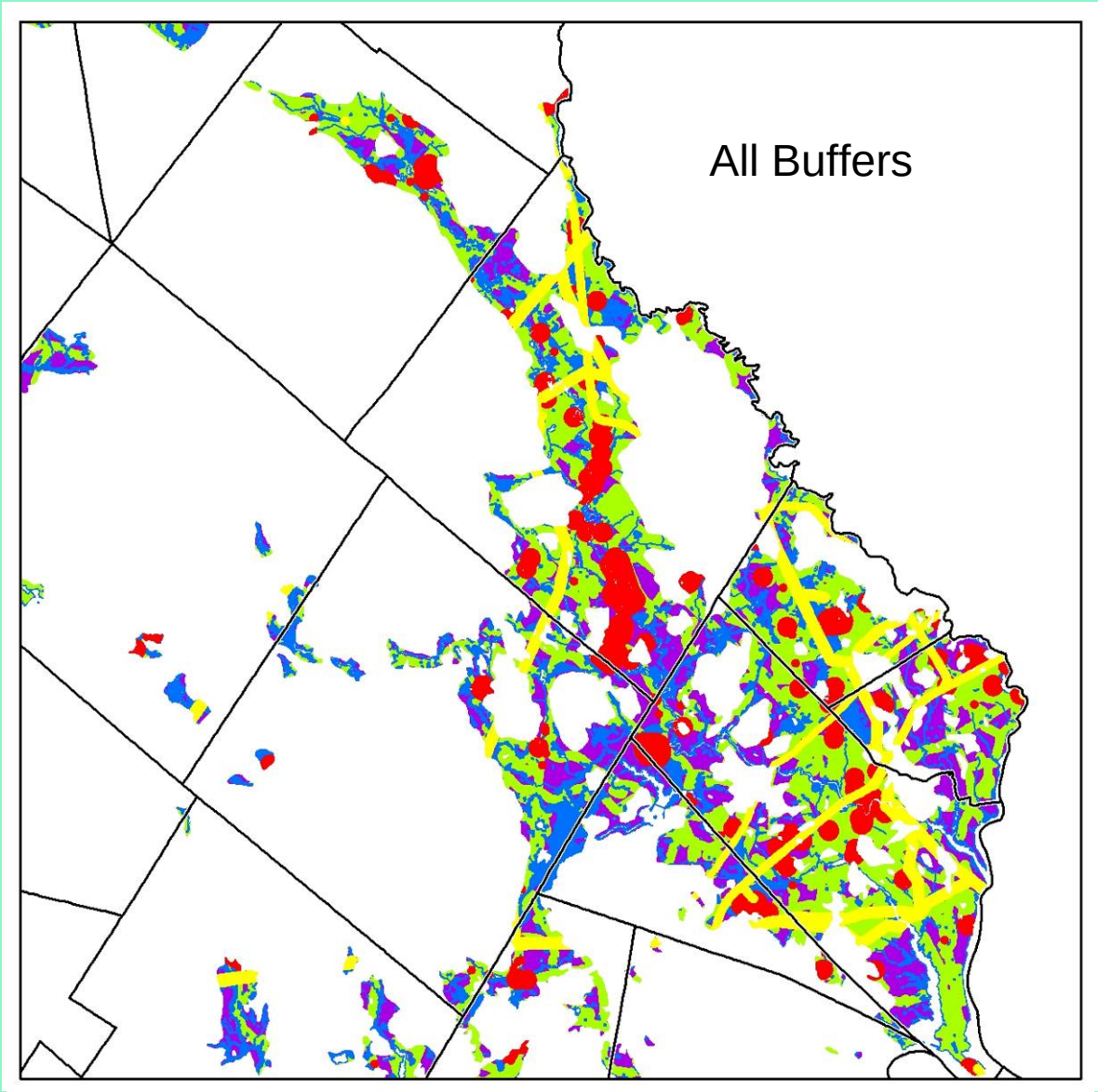
- Active Railroads
- Pipelines (non-water)
- Transmission Lines
- Power Plants & Substations
- Telephone Lines
- Airports
- Other

Urban Feature Buffers

Urban Feature	SPR 300 Buffer	SPR 400 Buffer
Transmission Lines	475	575
Pipeline	338	438
Telephone Line	338	438
Power Station	300	400
Substation	300	400
Hydro Plant	300	400
Airport	300	400
Other	300	400



Aggregate Effect of Buffers



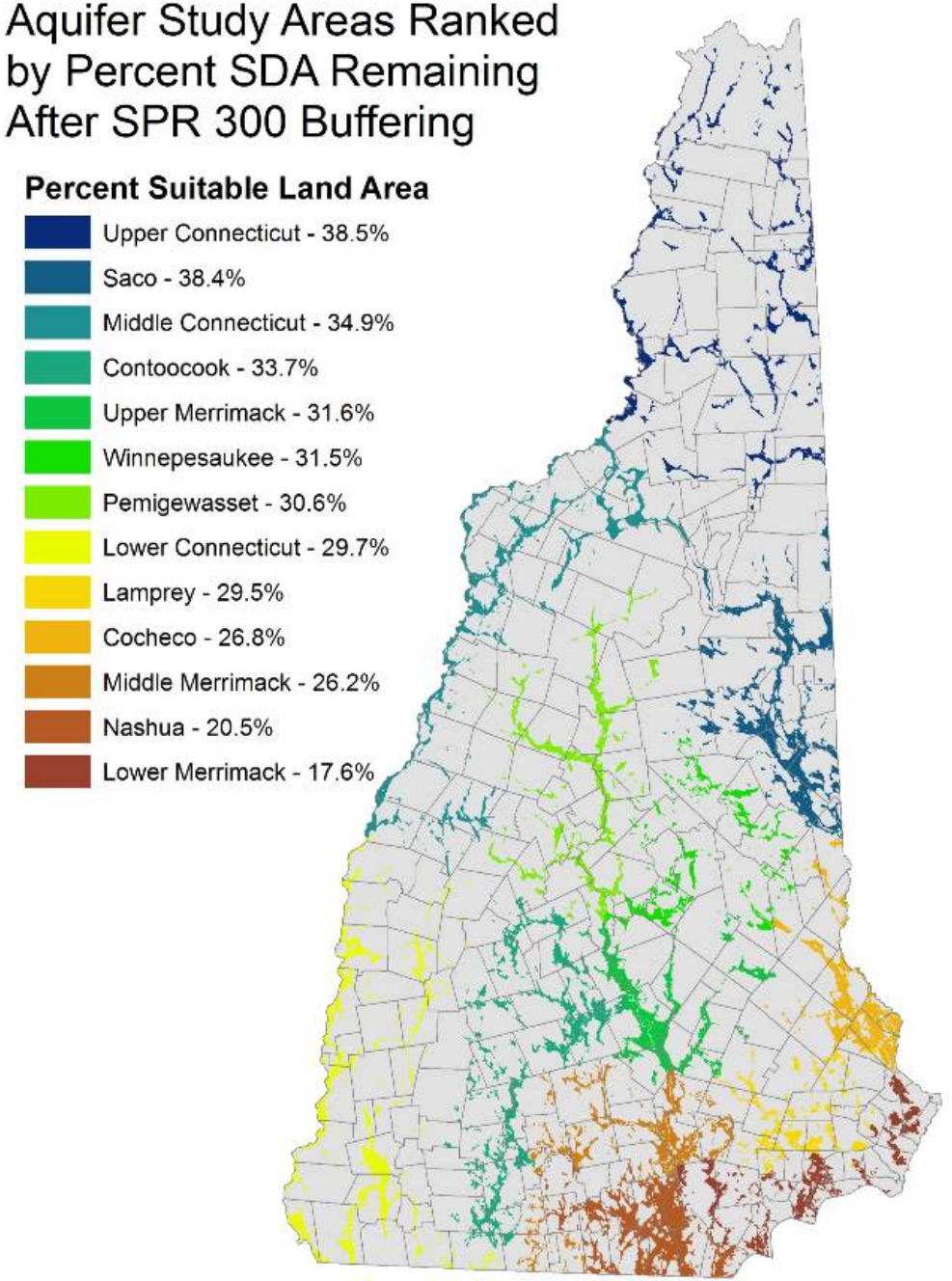
What's Left After All That?

2010 Stratified-Drift Aquifer
Remaining After Removing Buffered Areas

By Yield Class and Estimated Yield (GPM) and Targeted Pumping Rate

	SPR 300 (>= 75 gpm)		SPR 400 (>= 150 gpm)	
Yield Class	Acres	Percent Total Area	Acres	Percent Total Area
<75 gpm	130,324.1	53.0%	110,537.9	52.9%
>=75 gpm but <150 gpm	55,176.4	22.4%	45,135.9	21.6%
150 gpm	2,896.8	1.2%	2,414.5	1.2%
>=150 gpm but <300 gpm	15,664.2	6.4%	13,357.4	6.4%
>=150 gpm but upper limit unknown	50.5	0.0%	38.0	0.0%
>=300 gpm	10,787.9	4.4%	9,146.1	4.4%
Undefined	31,166.7	12.7%	28,282.8	13.5%
Total Area Outside Buffers	**246,066.6**		**208,912.6**	
Total Area Outside Buffers with Sufficient Yield	**84,575.8**	**34.4%**	**24,956.0**	**11.9%**

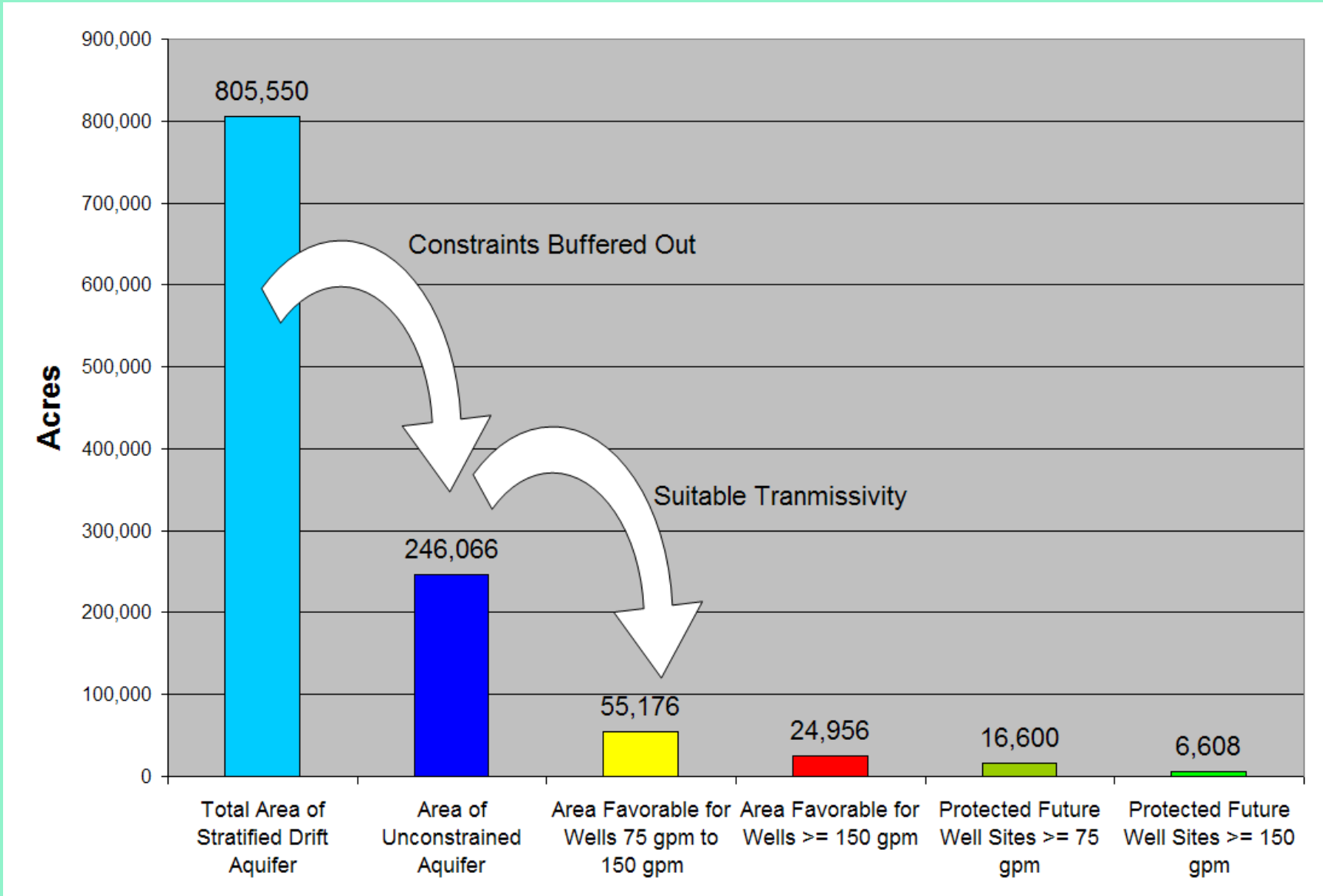
Aquifer Study Areas Ranked by Percent SDA Remaining After SPR 300 Buffering



Protection Status – 2010

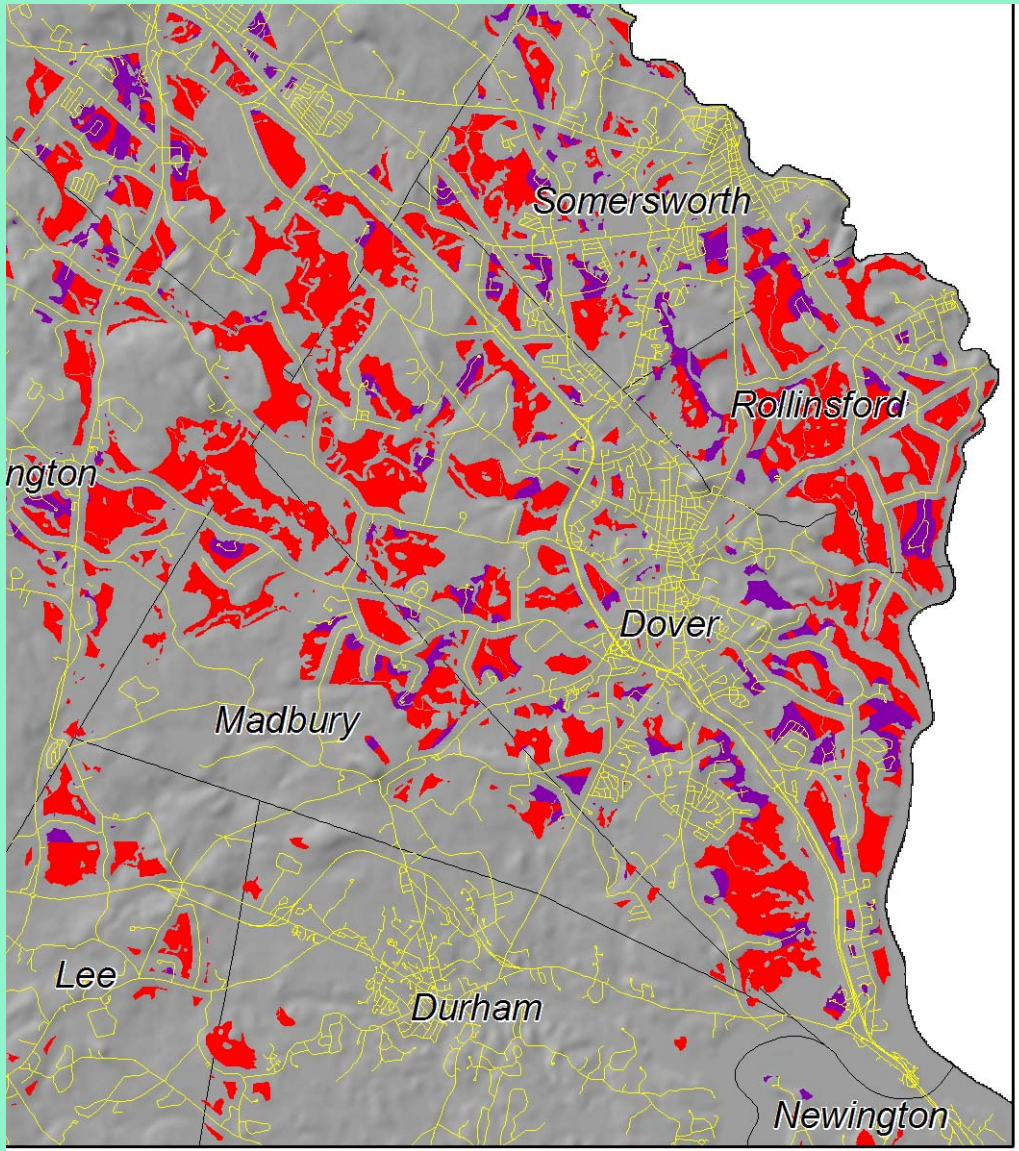
	SPR 300			SPR 400		
Yield Class	Acres	Acres Protected	Percent Protected	Acres	Acres Protected	Percent Protected
<75 gpm	130,324.1	**25,169.2**	**19.3%**	110,537.9	**22,748.1**	**20.6%**
>=75 gpm but <150 gpm	55,176.4	**9,992.3**	**18.1%**	45,135.9	**8,951.4**	**19.8%**
150 gpm	2,896.8	**1,129.2**	**39.0%**	2,414.5	**991.4**	**41.1%**
>=150 gpm but <300 gpm	15,664.2	**3,756.6**	**24.0%**	13,357.4	**3,418.0**	**25.6%**
>=150 gpm but upper limit unknown	50.5	**13.7**	**27.1%**	38.0	**12.2**	**32.1%**
>=300 gpm	10,787.9	**2,411.9**	**22.4%**	9,146.1	**2,186.8**	**23.9%**
Undefined	31,166.7	**11,783.5**	**37.8%**	28,282.8	**10,930.2**	**38.6%**
Total All Yield Classes	**246,066.6**	**54,256.4**	**22.0%**	**208,912.6**	**49,238.1**	**23.6%**
Total FGWA 300/FGWA 400	**84,575.8**	**17,307.8**	**20.5%**	**24,956.0**	**6,609.8**	**26.6%**

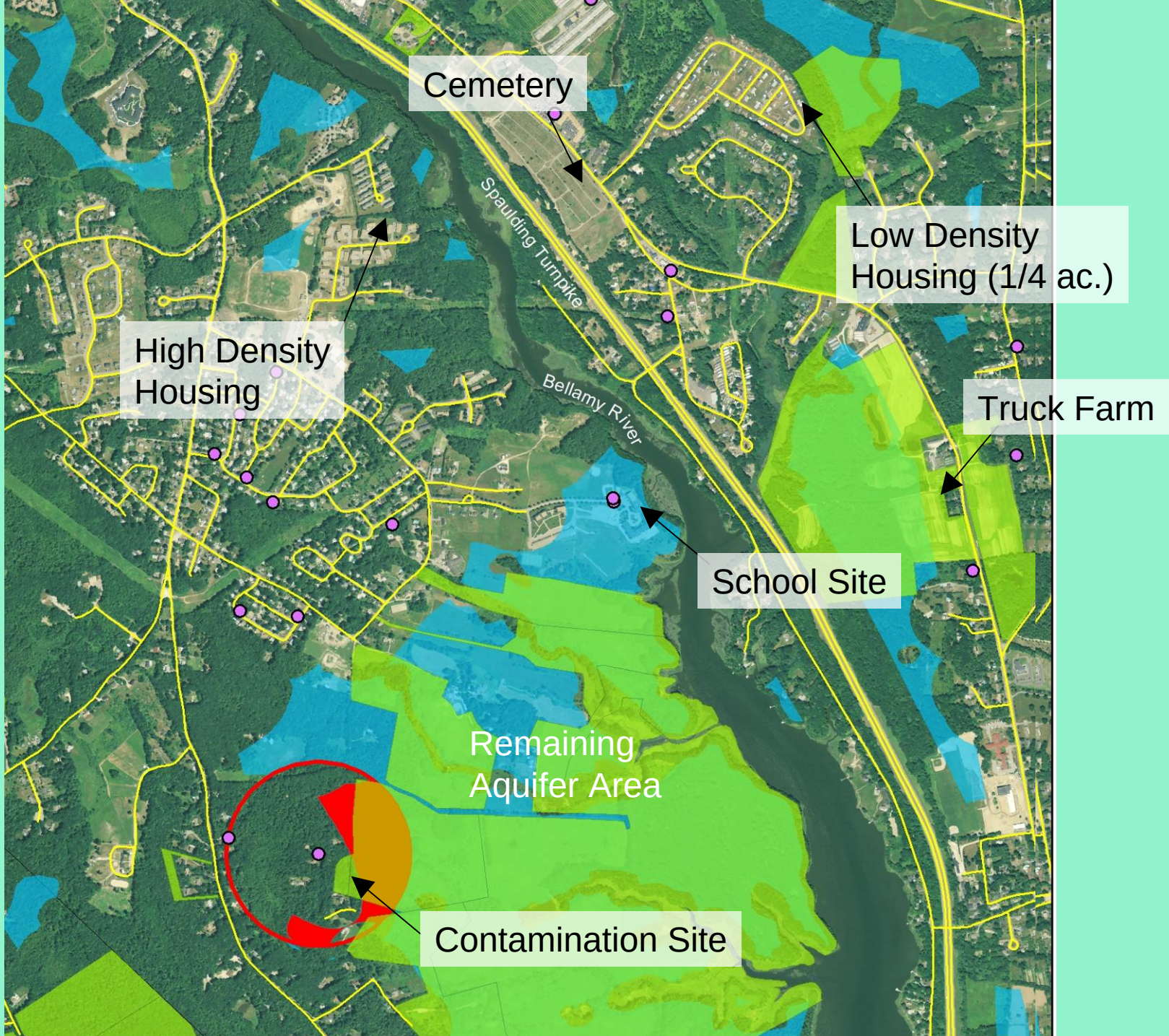
Scarcity Recap



Trends 2002 to 2010

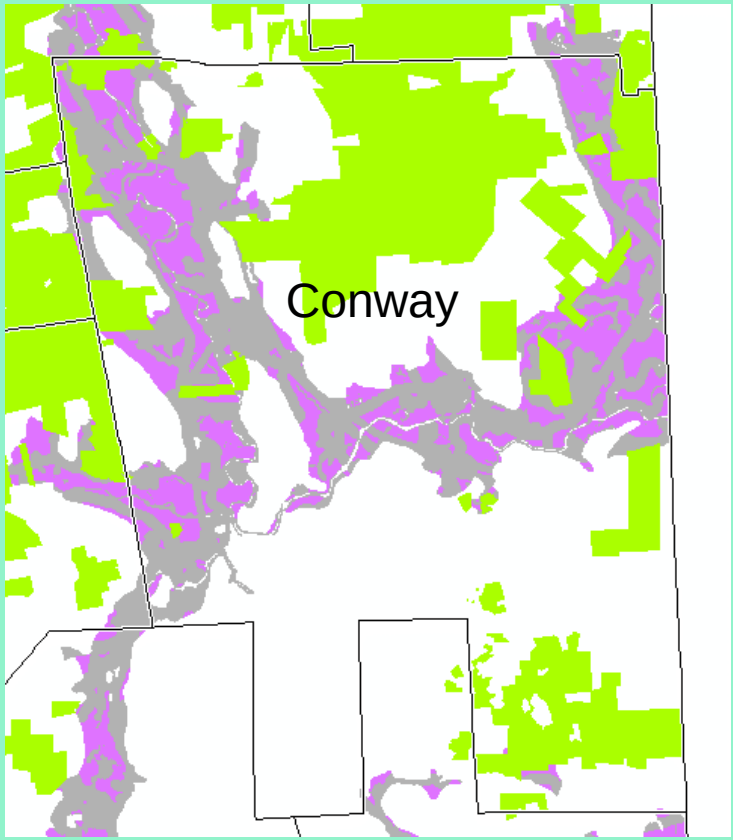
- 19,600 acres lost to new road construction & associated buffers, or about 9% of FGWA in 2002
- Most new roads are associated with residential development
- 325 acres lost due to new contamination sites




Cemetery
Spaulding Turnpike
Low Density
Housing (1/4 ac.)
High Density
Housing
Bellamy River
Truck Farm
School Site
Remaining
Aquifer Area
Contamination Site

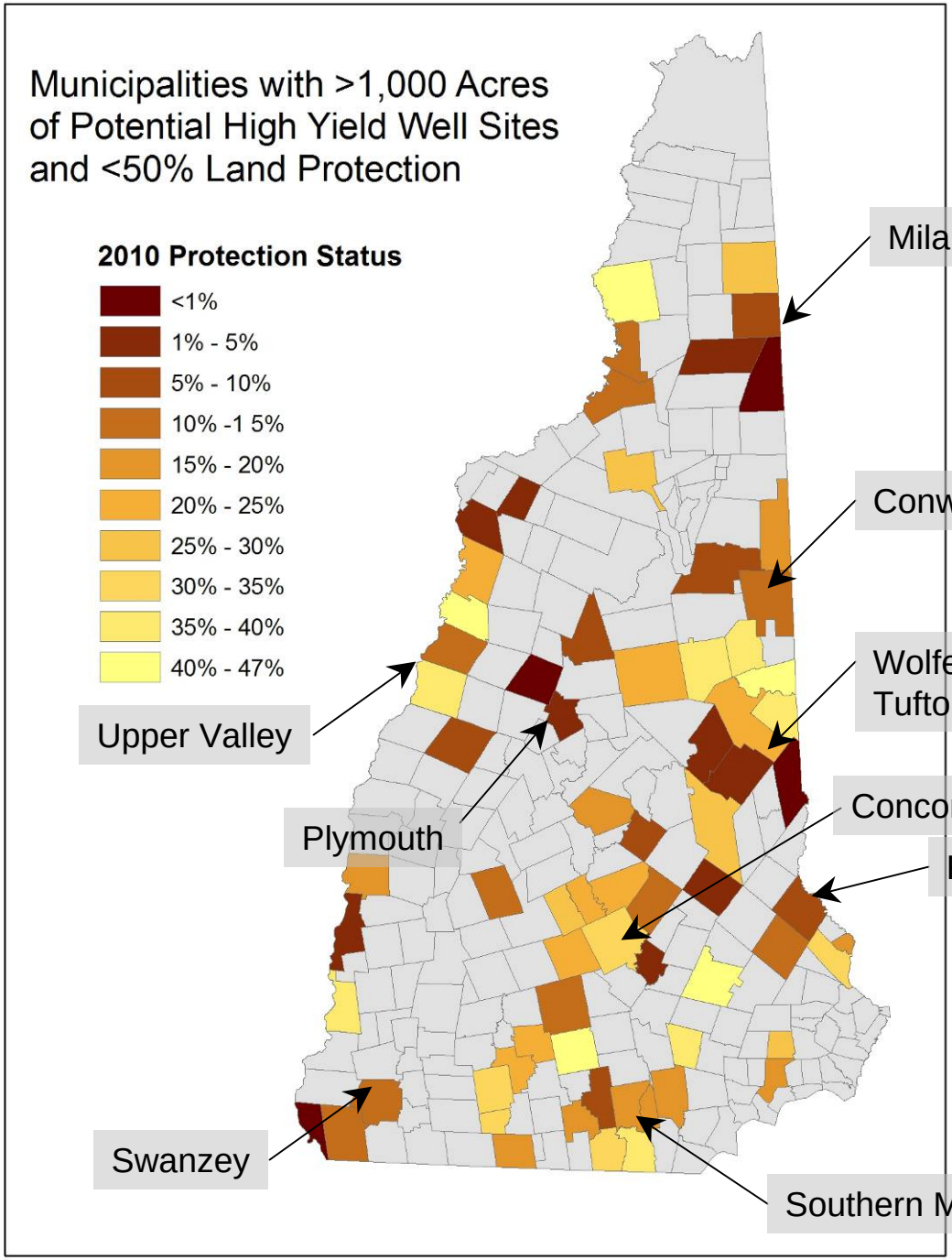
Where to First?

Top 24 Municipalities Ranked by Total Acres of Potential Well Sites 75 GPM or greater



Towns with Most Protected FGWA

Municipality	Total SPR 300 Acres	Acres Protected	Percent Protected
Ossipee	6,482.2	1,396.4	21.5%
Pittsburg	5,734.2	4,162.7	72.6%
Conway	**5,207.9**	**707.3**	**13.6%**
Concord	5,189.7	1,525.5	29.4%
Hopkinton	4,312.9	1,013.1	23.5%
Tamworth	3,999.6	1,414.6	35.4%
Effingham	3,689.7	1,364.6	37.0%
Dover	3,671.4	1,101.5	30.0%
Haverhill	3,566.3	729.3	20.5%
Bethlehem	3,092.6	1,528.8	49.4%
Belmont	**2,975.1**	**271.5**	**9.1%**
Cambridge	**2,844.5**	**229.4**	**8.1%**
Bath	**2,811.1**	**130.9**	**4.7%**
Carroll	2,724.8	678.6	24.9%
Rochester	**2,551.4**	**220.2**	**8.6%**
New Boston	2,502.1	1,001.4	40.0%
Tuftonboro	**2,419.7**	**64.0**	**2.6%**
Hollis	2,370.8	629.9	26.6%
Litchfield	**2,330.1**	**329.1**	**14.1%**
Freedom	2,283.5	963.4	42.2%
Madison	2,233.3	749.1	33.5%
Albany	2,204.5	1,576.8	71.5%
Greenfield	2,149.1	462.3	21.5%
Walpole	2,146.0	729.2	34.0%


Municipalities with >1,000 Acres
of Potential High Yield Well Sites
and <50% Land Protection
2010 Protection Status
<1%
1% - 5%
5% - 10%
10% -1 5%
15% - 20%
20% - 25%
25% - 30%
30% - 35%
35% - 40%
40% - 47%
Milan/Berlin
Conway
Wolfeboro
Tuftonboro
Upper Valley
Plymouth
Concord Metro
Rochester
Swanzey
Southern Merrimack Valley

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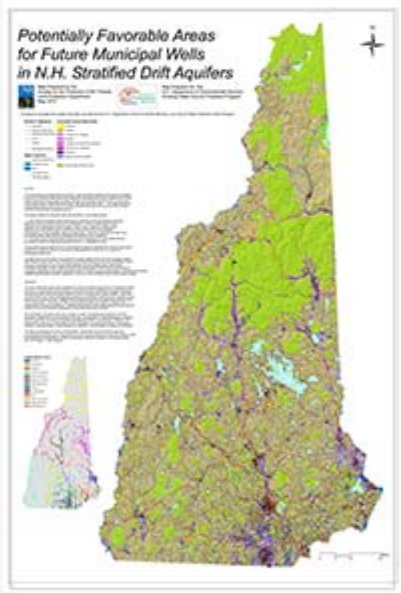
New Hampshire's Changing Landscape

Helping Protect what Makes New Hampshire Special

Favorable Gravel Well Analysis



For more than a decade, the Forest Society and the NH Department of Environmental Services have collaborated on a variety of projects aimed at better understanding the development pressures impacting the state's critical water supply resources and building a case for the protection of those resources. Over the years, the Forest Society has developed an extensive database of New Hampshire's water resources, the protection status of those resources, and the development pressures that impact them.

In 2009, the Forest Society contracted with the NH DES to update an analysis of favorable gravel well locations (FGWA). The goal of this update is to promote better understanding and stewardship of New Hampshire's groundwater resources.

This *Guide to Identifying Potentially Favorable Areas to Protect Future Municipal Wells in Stratified-Drift Aquifers* (1.7 MB PDF) reports that:

References and Resources

- NHDES N.H. *Water Resources Primer*
- Full technical report will be available on the DES/SPNHF web
- GeoPDF map of favorable gravel well areas on the Forest Society's website as part of *NH's Changing Landscape* project
- SPNHF web will provide detailed municipal data in database form to allow independent queries of FGWA area and protection status

For more information…

- For regulatory and policy background, contact Pierce Rigrod at the NHDES *Source Water Protection Program*

  Pierce.Laskey-Rigrod@des.nh.gov

- For technical guidance and interpretation of the updated favorable gravel well analysis, contact Dan Sundquist at the Forest Society

  dsundquist@forestsociety.org


Is Everything Perfectly Clear?
Questions??