

# Land use planning for the protection of drinking water from ground and surface water

*DEC Municipal Day  
November 4, 2024*

Laura Ranker

Source Water Protection Specialist, DWGPD

[Laura.Ranker@vermont.gov](mailto:Laura.Ranker@vermont.gov)

802-585-9478

Julia Beaudoin

Hydrogeologist, DWGPD

[Julia.Beaudoin@vermont.gov](mailto:Julia.Beaudoin@vermont.gov)

802-661-8281



# Workshop Outline

## Welcome and Overview

*Laura Ranker*

## Groundwater Science and Aquifer Protection

*Julia Beaudoin*

- Groundwater aquifer types
- Protecting aquifers & intro to source protection areas
- Important considerations for groundwater protection

## Land Use Planning Strategies

*Laura Ranker*

- Town Plans and Local Regulations (Zoning and Overlay Districts)
- Land Acquisition and control
- Groundwater Reclassification
- VT Geological Survey

## Questions, Answers, and Sharing Experiences



*Sleepers River Research Watershed, Danville, VT. Photo: J. Beaudoin*



- How many of you have public water systems in your community? Do you know where they are located?
- How many of you have regular contact and conversations with the public water systems in your community? Do you know who they are?
- How many of you, serving as a public water system, actively engage with your municipality in land use planning, regulations, policies, emergency management, forestry and conservation efforts?
- How many of you, a question for everyone, are familiar with your public water systems capacity to serve?

As we look at the what, why and how of Land Use Planning for the protection of drinking water from ground and surface waters, reflect on these questions.



# Groundwater Aquifer Types

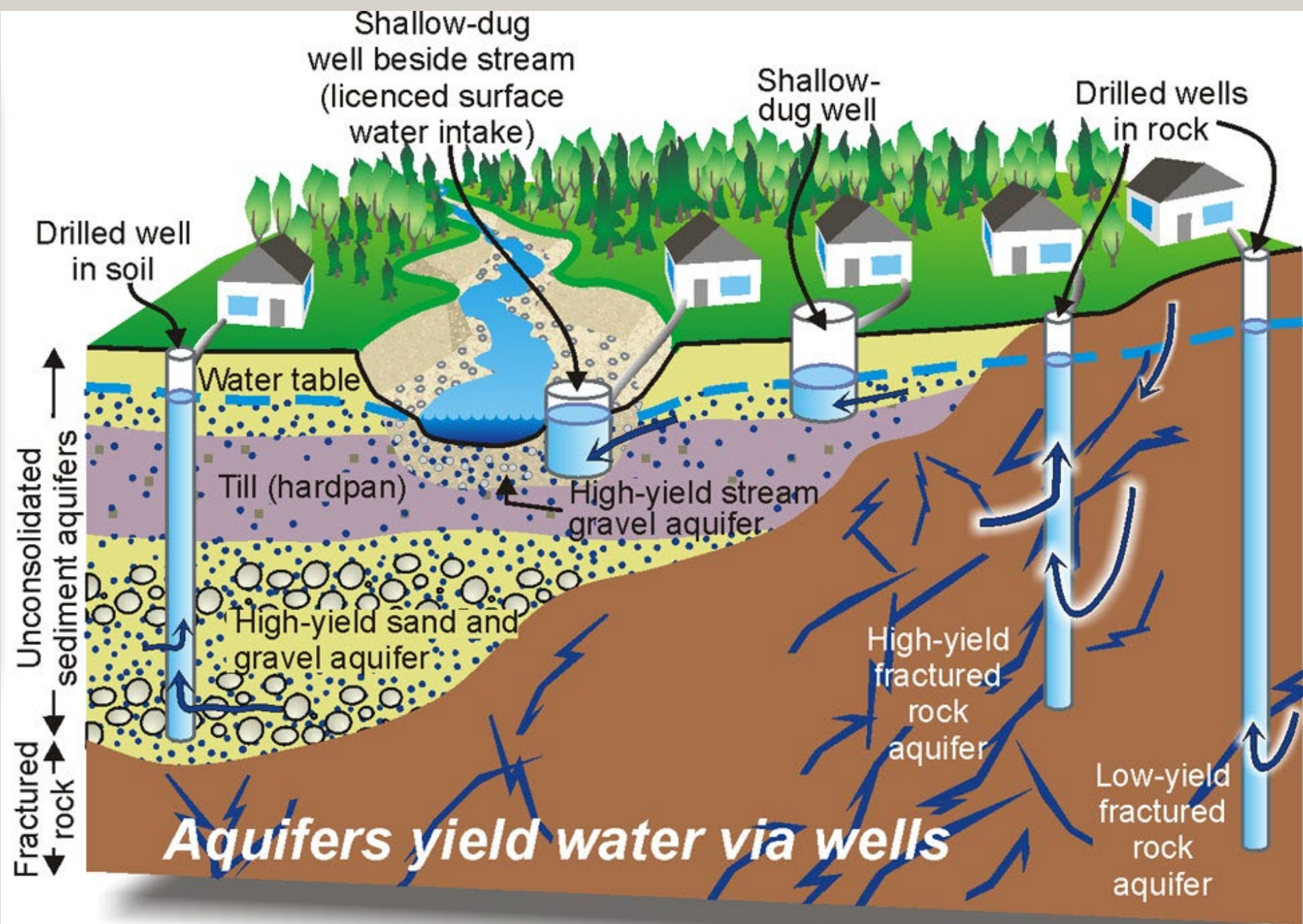
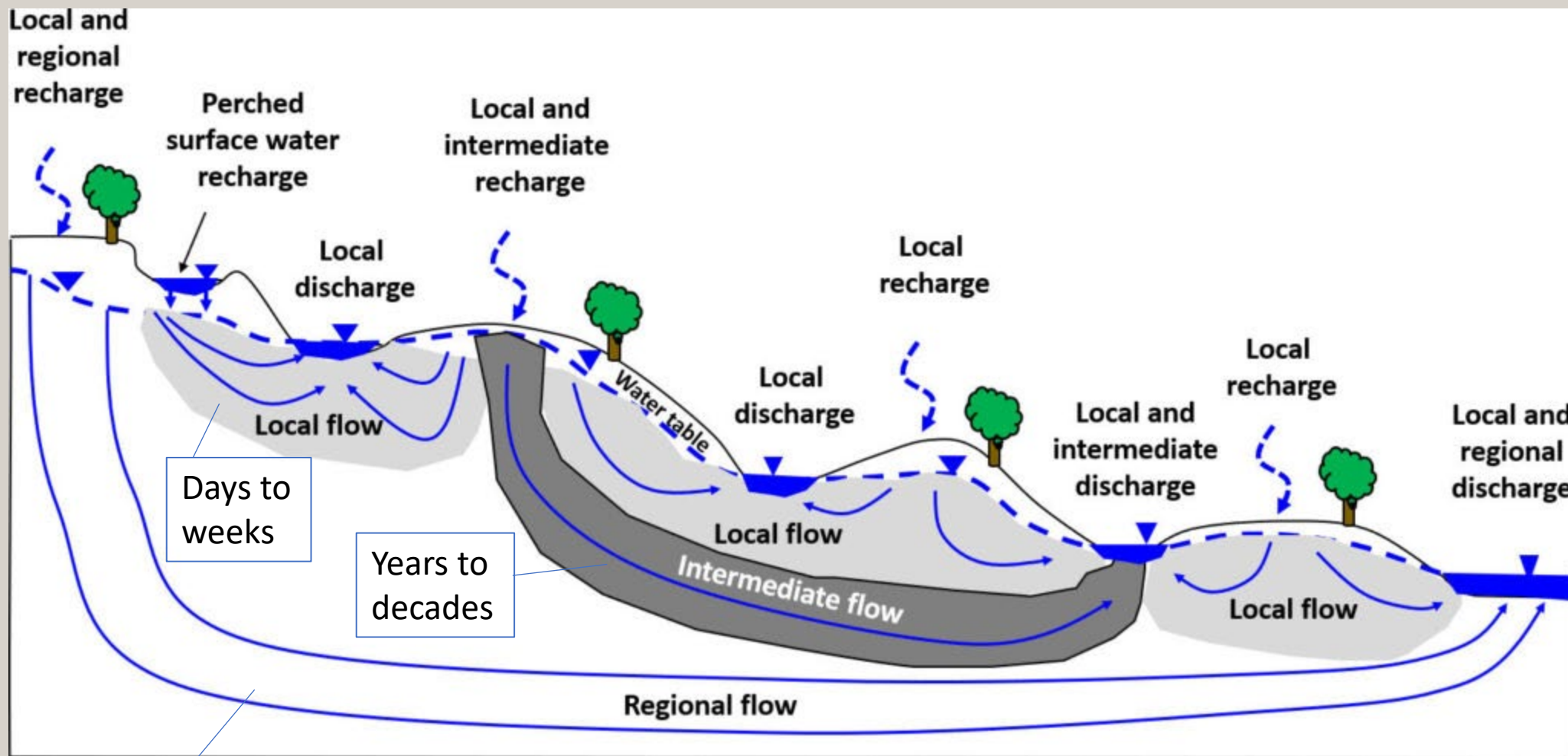


Image: Canadian Geoscience Education Network



Days to weeks

Years to decades

Centuries to millennia

Modified from Woessner, W.W. & Poeter, E.P. (2020). *Hydrogeologic Properties of Earth Materials and Principles of Groundwater Flow*. The Groundwater Project. <https://doi.org/10.21083/978-1-7770541-2-0>



# How to protect aquifers from contamination or over-pumping?

- Source protection areas (SPAs) offer a way for municipalities to plan and manage their water source's vulnerable areas
- SPAs can help municipalities protect the **quality** and **quantity** of their drinking water source

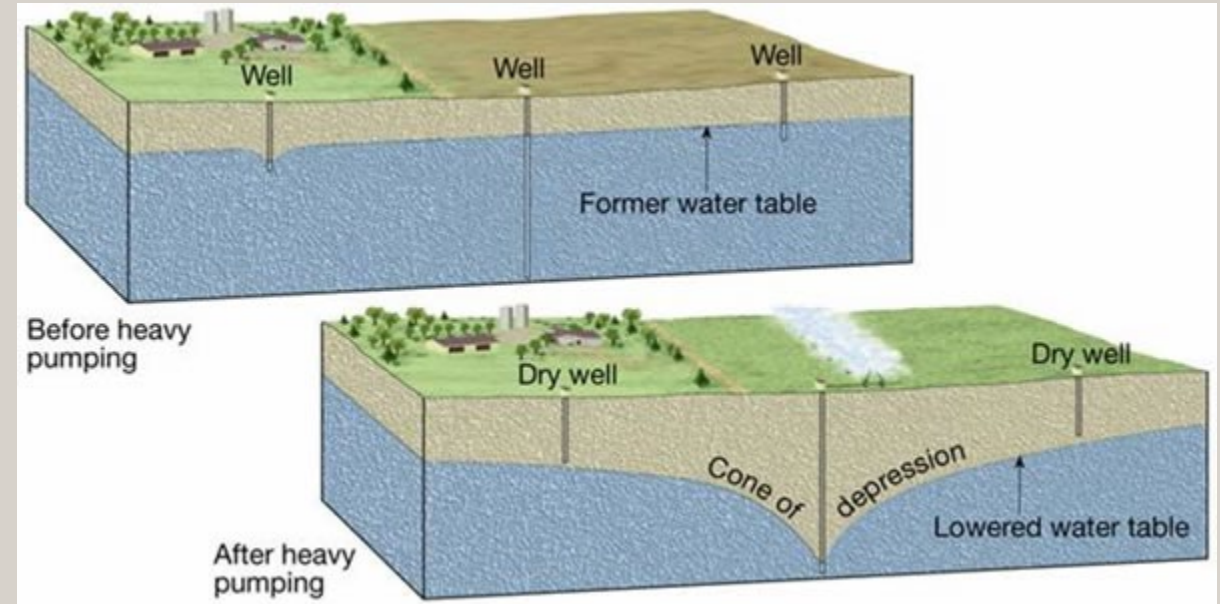


Image: AP Environmental

# Potential Sources of Contamination (PSOC) to the Aquifer

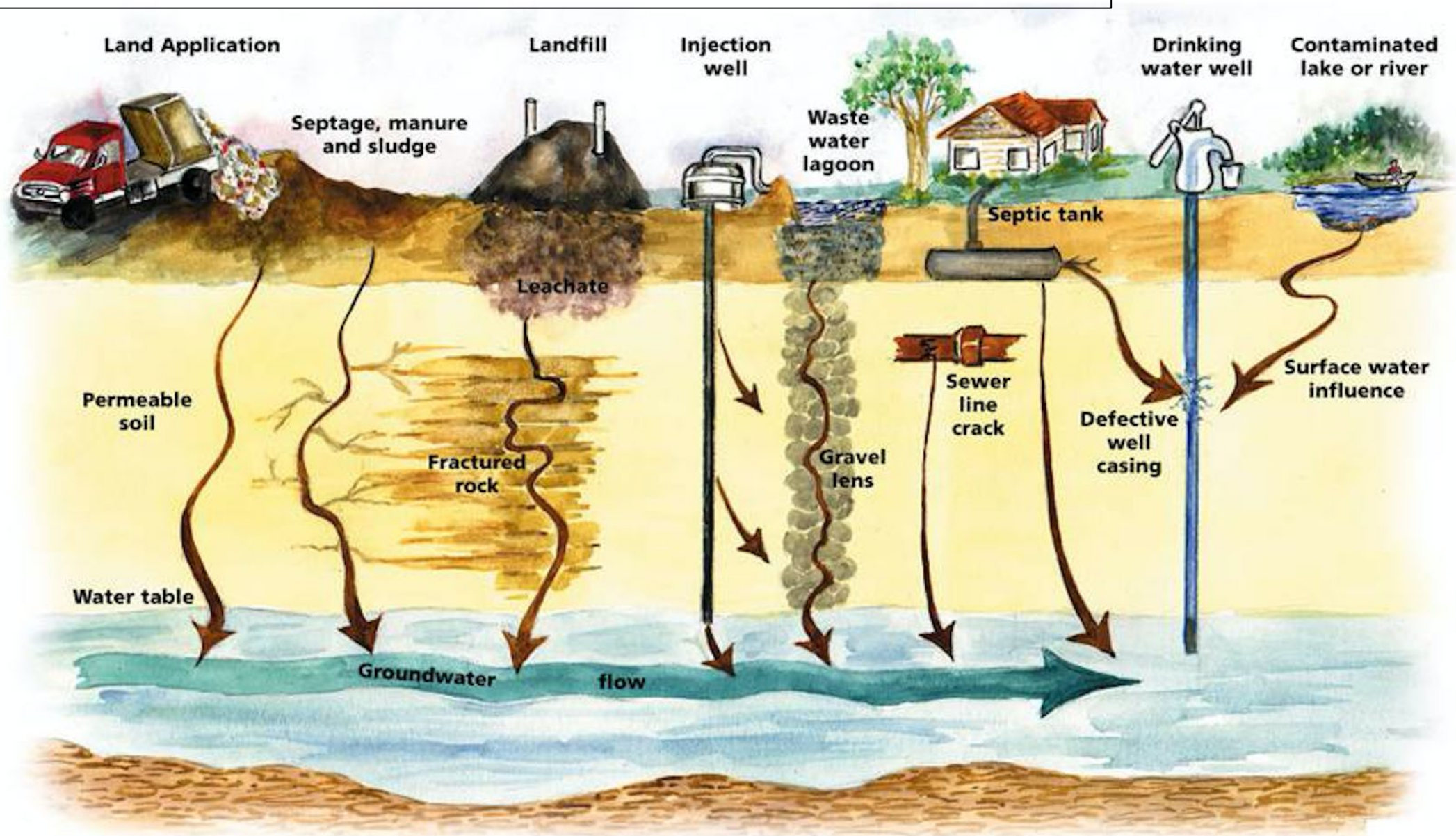
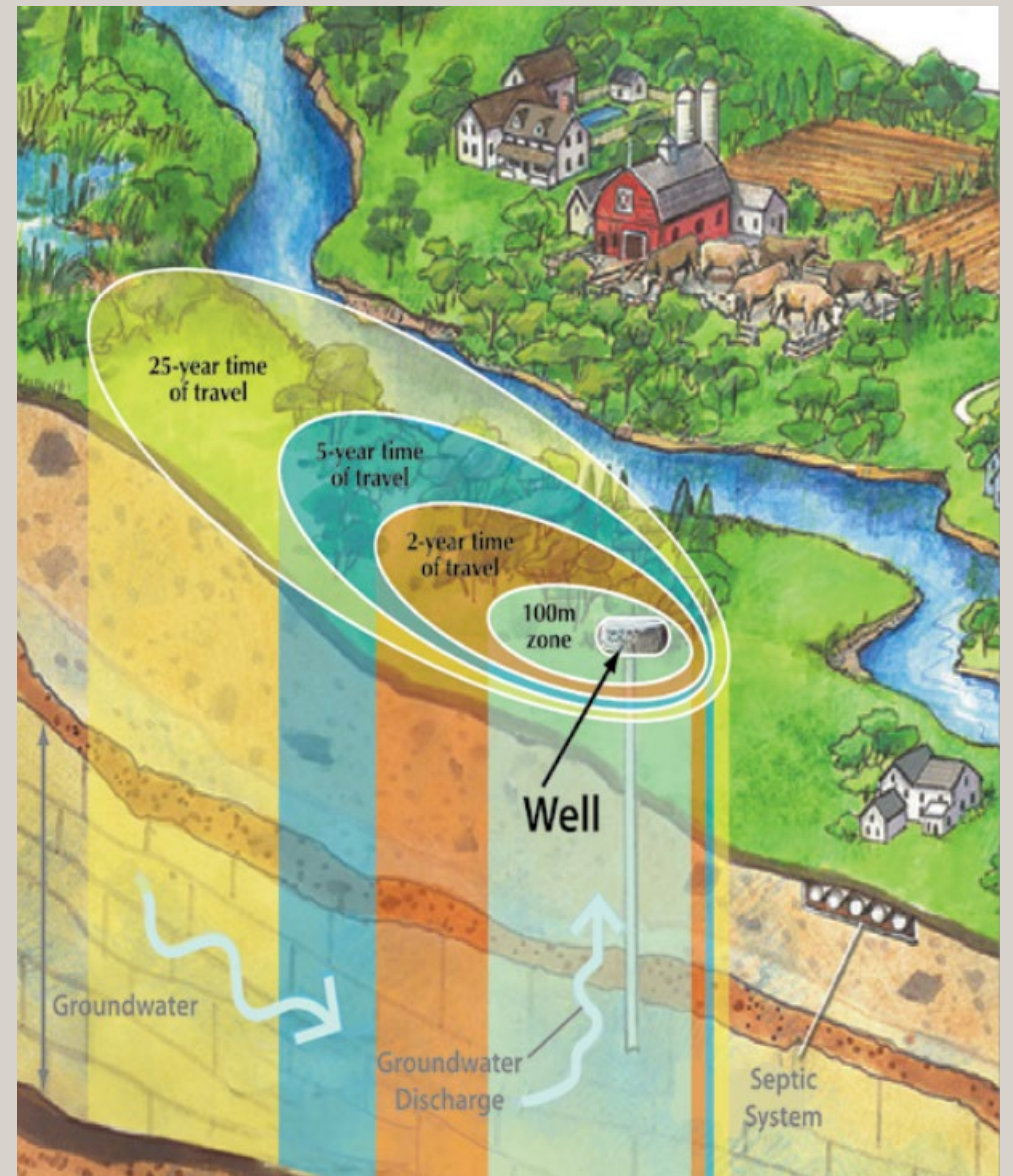


Image: Morwick G360 Groundwater Research Institute



- **Source protection areas (SPAs):** Surface and subsurface area from or through which contaminants are reasonably likely to reach a public water system source.



*Image: Credit Valley-Toronto and Region-Central Lake Ontario (CTC) Source Protection Region (SPR). 2019. Protecting our Drinking Water Sources.*



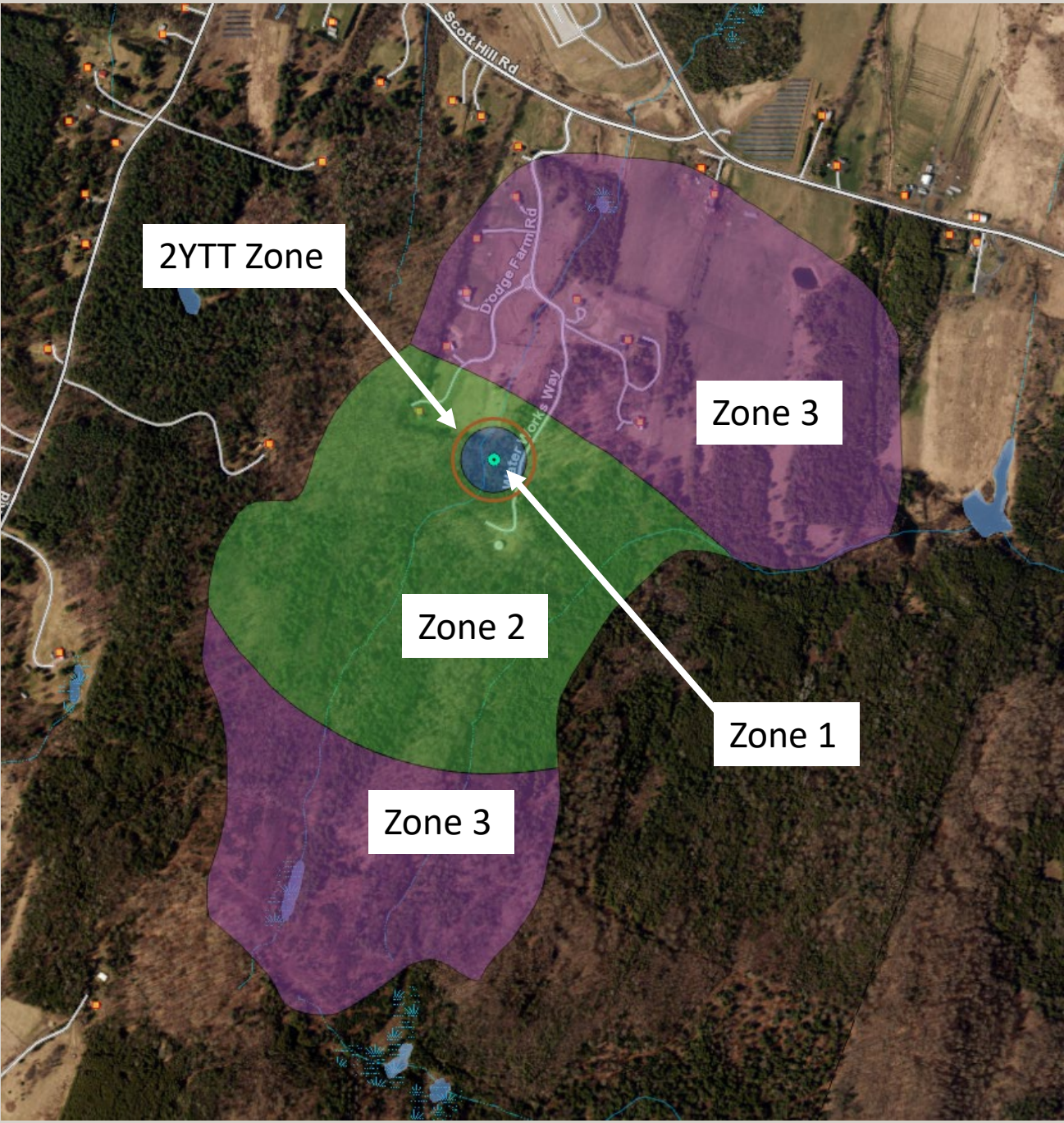
# Groundwater SPA Zones

**Zone 1 (Isolation Zone)** – circle around well/spring (usually 200 ft radius) where impacts from potential sources of contamination are likely to be immediate and certain. Only zone a new system is required to own/control.

**Zone 2** – areas outside Zone 1 where there will be probable impacts from potential sources of contamination.

**Zone 3** – remaining recharge area or area of contribution to the source not delineated as Zone 2, and where there may be possible impacts from potential sources of contamination.

**Two-year time of travel zone** – zone through which it takes groundwater to travel two years to the pumping well. This area is used to provide adequate protection from pathogen threats resulting from onsite disposal of sewage.





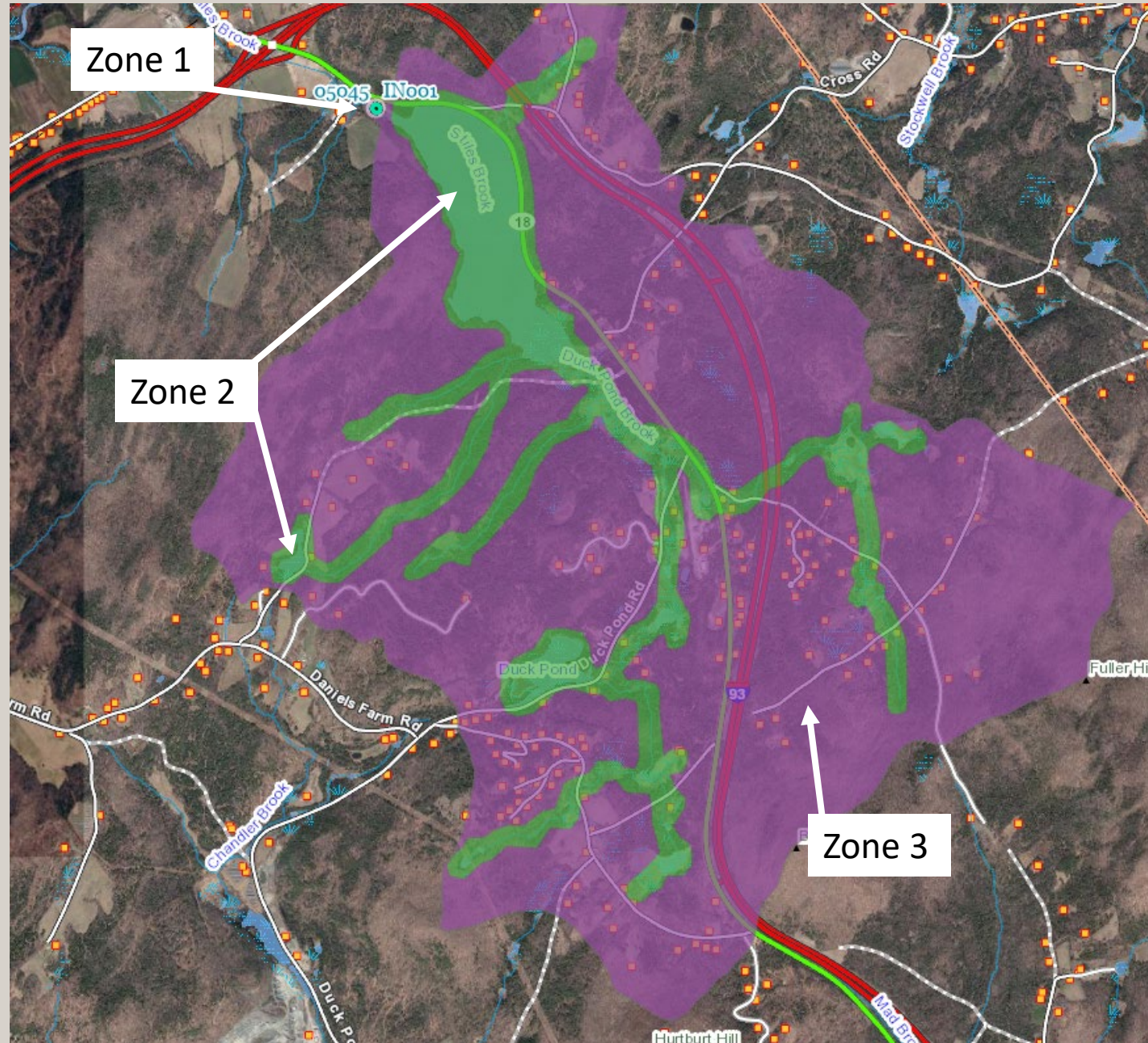
## Surface Water SPA Zones:

**Zone 1** – circle around intake (usually 200 ft radius).

**Zone 2** – areas within the watershed located within 200 feet of perennial surface water and limited to 17,000 acres.

**Zone 3** – remaining watershed area beyond Zones 1 and 2. May be reduced on a case-by-case basis considering the size of the watershed and the likelihood of contamination of the source.

Watershed: “a land area that channels rainfall and snowmelt to creeks, streams, and rivers, and eventually to outflow points such as reservoirs, bays, and the ocean.” - NOAA

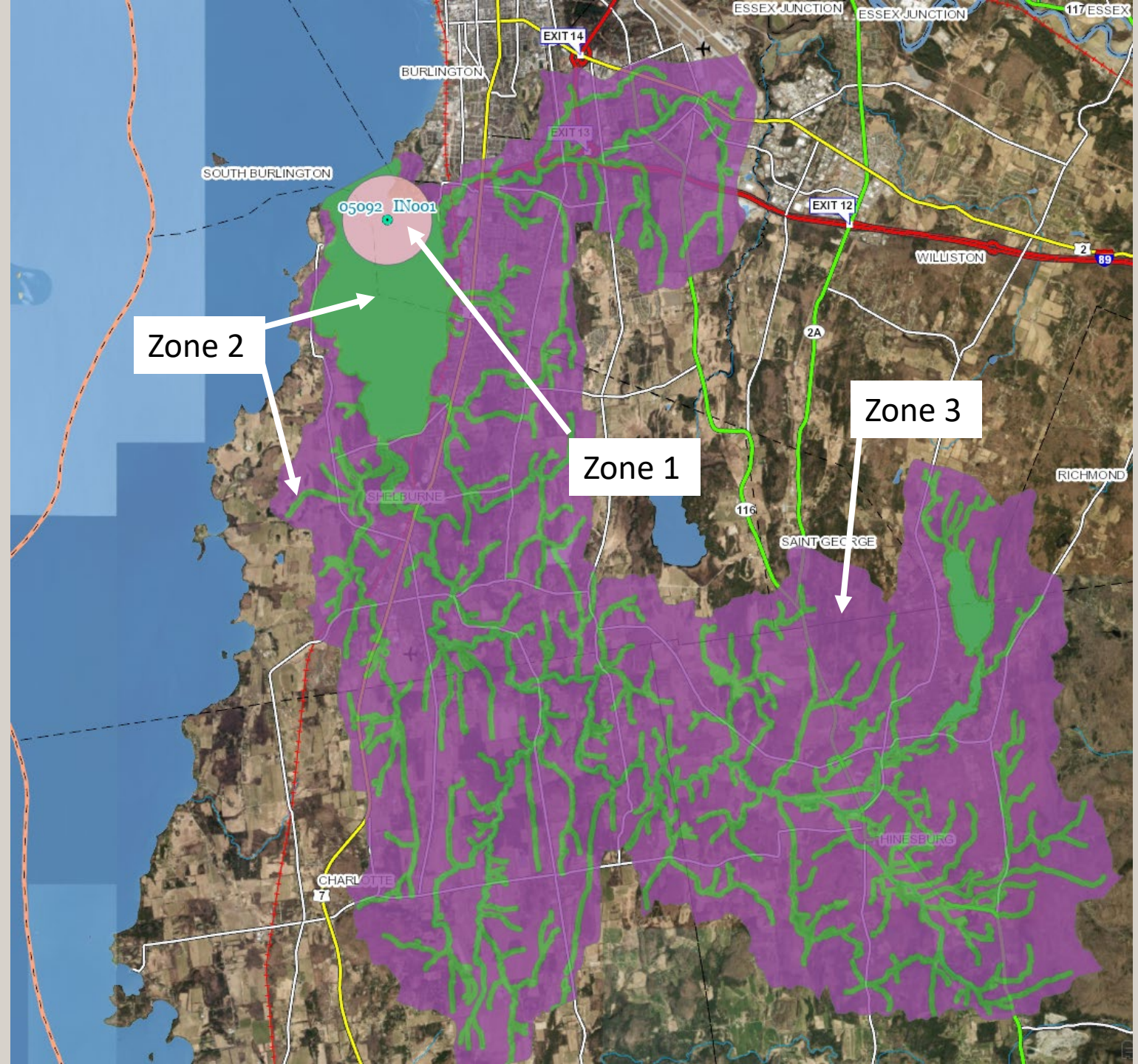




Surface water SPAs encompass a larger watershed area and present a different challenge for protection.

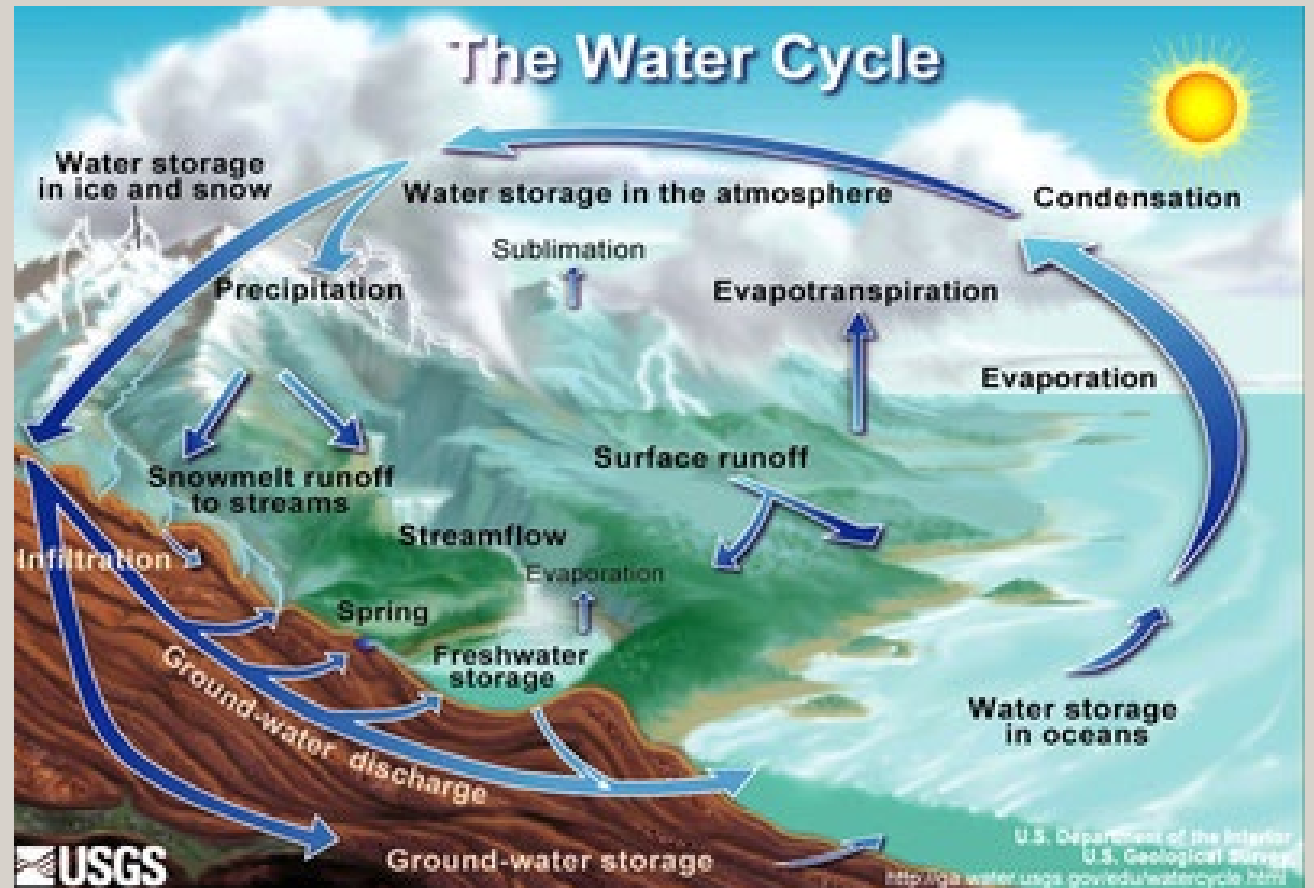
The old saying “*the solution to pollution is dilution*” is not always the gold standard for PSOC management.

Some contaminants (e.g., PFAS chemicals) do not degrade quickly in the environment and are harmful at extremely low levels. Adequate watershed management is key to surface water intake protection.



# Groundwater-Surface Water Interaction

- Groundwater and surface water are an interconnected system, and they interact with each other.
- Groundwater can affect surface water levels, and vice versa.
- It is imperative that planners consider water as a system rather than two discrete sources.





# Important considerations for protection

- Example: two small public community water systems sited in a residential area in the 1970s.
- Systems do not own or control 200-ft isolation distance around wells (Zone 1) and have a lot of PSOCs in both Zone 1 and Zone 2 from on-site septic systems and other activities.
- Quality concerns: one production well at System A has PFAS contamination.
- Quantity concerns: other wells are experiencing water shortages.



# Source Water Protection Public Drinking Water

Source Water refers to sources of water (such as rivers, streams, lakes, reservoirs, springs, and groundwater) that provide water to public drinking water supplies and private wells. ([epa.gov](http://epa.gov))

## Why Protect Drinking Water Sources

- ✓ Protect Public Health – provide safe, clean drinking water
- ✓ Reduce water treatment costs
- ✓ Reduce costs to water systems and customers
- ✓ Vitality of your community depends on it; economic and housing development.
- ✓ Planning for the future.



# LOCAL PLANNING



## LAND USE REGULATIONS & Policies

- ▶ Town Plan
- ▶ Zoning Ordinance
- ▶ Overlay District
- ▶ Groundwater Ordinance
- ▶ Groundwater Reclassification
- ▶ Hazard Mitigation Plan
- ▶ Emergency Management Plan
- ▶ Road Salt Reduction Policy
- ▶ Participate in Act 250 & Section 248 Permit applications
- ▶ Stormwater planning & MRGP (Municipal Roads General Permit)
- ▶ Watershed Management Plan

# TOWN PLANS

- Express objectives and policies to guide future growth & to protect the environment, including water supply.
- Provides guidelines for zoning bylaws, subdivision regulations, and official Maps
- Future land use

## Include

- ❖ public groundwater and surface water sources
- ❖ Source Protection Areas, aquifer areas
- ❖ Use maps from the VT Geological Survey

**Act 250 projects must comply with the local Town Plan and the Regional Plan**



# ZONING BYLAWS

## *Provide An Extra Layer of Protection*

### Vermont Statutes

Title 24 : Municipal and County Government

Chapter 117 : Municipal and Regional Planning and Development

Subchapter 007 : Bylaws

- ▶ PURPOSE: Permit, prohibit, restrict, regulate and determine land development.
- ▶ In conformance with the Town Plan

### Permissible Types of regulations

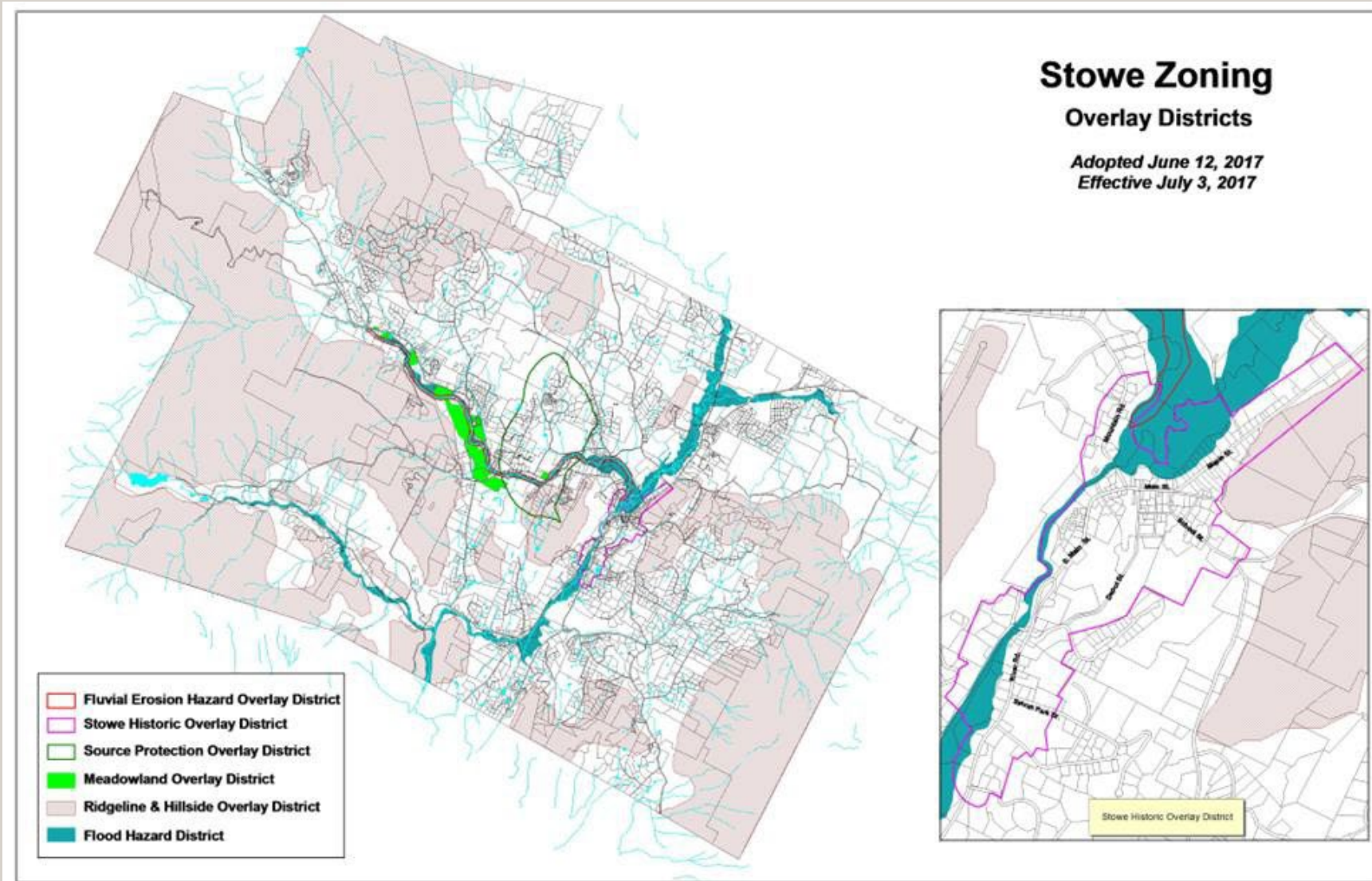
24 V.S.A. § 4414

- ▶ Zoning Districts
- ▶ Protection of Surface waters
  - ▶ (D) Shorelands
  - ▶ (G) River corridors and buffer
- ▶ **(2) Overlay Districts**
  - ▶ Shorelands and floodplains
  - ▶ Aquifer and Source Protection Areas
- ▶ **(3) Conditional Uses**

# OVERLAY DISTRICTS

Special districts.

Add layers of protection to those already existing in the underlying zoning district.





# Town of Stowe - OVERLAY DISTRICT

## Zoning Regulations

adopted 1/10/2024, Effective 1/31/2024

### ► PURPOSE

- (1) Promote the health, safety, and general welfare of the community by ensuring an adequate quality and quantity of drinking water for the residents, institutions, and businesses of the Town of Stowe who rely on the Town's municipal water supplies;
- (2) Preserve and protect existing and potential sources of drinking water supplies; and
- (3) Conserve the natural resources of the town and prevent temporary and permanent contamination of the environment.

### ESTABLISHMENT AND DELINEATION OF OVERLAY DISTRICT

The Source Protection Overlay District encompasses an area surrounding the Village Green municipal well where a contaminant released to the land surface or subsurface would be reasonably likely to move toward and reach the well. The Overlay District coincides with the Source Protection Area developed by the State of Vermont, Department of Environmental Conservation, Water Supply Division. The boundary of the District is delineated on the Stowe Zoning map of overlay districts as adopted by the Stowe Selectboard on June 12, 2017.

## TOWN OF STOWE OVERLAY DISTRICT PERMITTED USES:

“All uses permitted within the underlying primary zoning districts are permitted within the Overlay District after a determination that the proposed use will not have an undue adverse impact on groundwater resources.”

All geothermal heating systems and underground fuel tanks within the Overlay District require a zoning permit.”

**This gives the Town added control and knowledge of where UST and geothermal wells are located and can be used in planning decisions.**



## PROHIBITED USES:

- Landfills and open dumps.
- Automobile graveyards and junkyards.
- The release of any hazardous materials into surface waters, groundwater or onto the land. Any proposed use that will generate hazardous waste shall be required to submit a groundwater protection plan for approval by the Stowe Public Works Director.
- Storage of deicing chemicals unless such storage, including loading areas, is within a structure designed to prevent the generation and escape of contaminated runoff or leachate.
- Storage of animal manure unless covered or contained in accordance with the specifications of the Vermont Agency of Agriculture.
- Earth removal, consisting of the removal of soil, loam, sand, gravel, or any other earth material (including mining activities) to within 4 feet of historical high groundwater as determined from monitoring wells and historical water table fluctuation data compiled by the United States Geological Survey, except for excavations for building foundations, roads, or utility works.
- Discharge to the ground of non-sanitary wastewater including industrial and commercial process waste water.
- Stockpiling and disposal of snow and ice containing deicing chemicals brought in from outside the District.
- Storage of commercial fertilizers, unless such storage is within a structure designed to prevent the generation and escape of contaminated runoff or leachate.
- Single-walled underground fuel storage tanks.
- Closed loop geothermal heating systems, unless they use non-toxic, environmentally friendly, food-grade antifreeze.

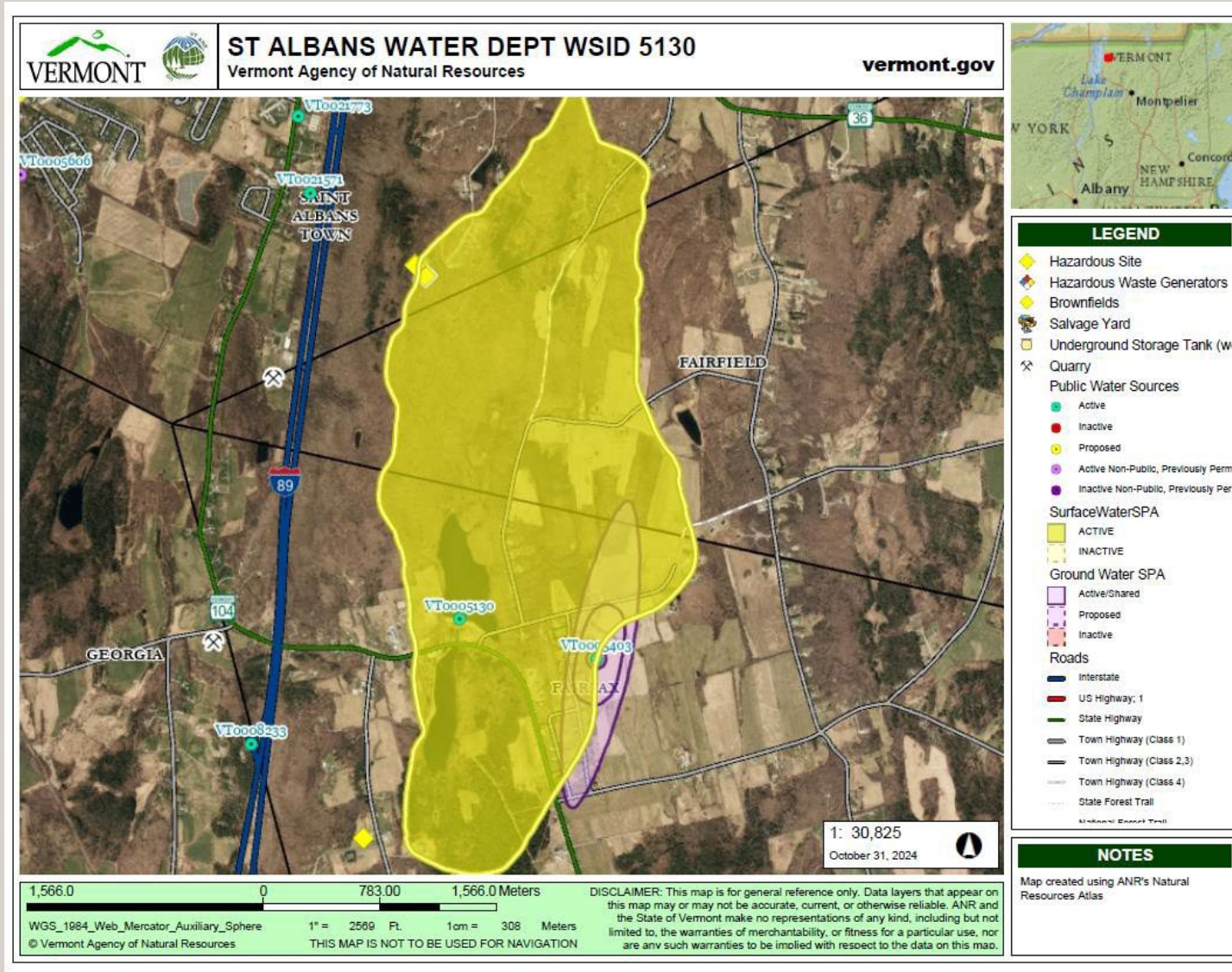
# ACQUISITION/CONTROL

- Landownership - minimum 200 feet around water source(s)
- Own or acquire land in the SPA or aquifer
- Easements
- Restrictive covenants
- Deed Restrictions
- Land Trusts
- Drinking Water State Revolving Fund-
  - Source Protection Loan Program





# ST Albans Water Department Surface Water SPA and Fairfax Fire District 1 Groundwater SPA





**NRCS**  
**Natural Resources**  
**Conservation Service**

# Forestry Stewardship

- Current Use Program (Use Value Appraisal)
- Forest Stewardship Practices
- Conservation Practices
- Forest Management Plan and Timber Harvest Plan
- Acceptable Management Practices for Maintaining Water Quality on Logging Jobs in VT, rev Aug. 2018
- County Foresters
  - <https://fpr.vermont.gov/forest/list-vermont-county-foresters>
- Woodlot management on small parcels
- Tree Farms
- Federal and State SPA initiatives for forested lands
  - located within a Source Protection Area



# GROUNDWATER RECLASSIFICATION

Groundwater Protection Law (10 V.S.A. Chapter 48) passed 1985, effective July 1, 1985

This law provides for four classes of groundwater based on

1. existing use and probable use for drinking water supply
2. exposure to risk of contamination

## Class III groundwater

All groundwater in VT, unless reclassified to I. II. Or IV groundwater.

Suitable as a source of water for

- ❖ individual domestic water supplies,
- ❖ irrigation,
- ❖ agricultural use
- ❖ general industrial and commercial use.



## Class I and II groundwaters

- uniformly excellent character
- aquifers in use as a public water supply source or have a high probability for such use.

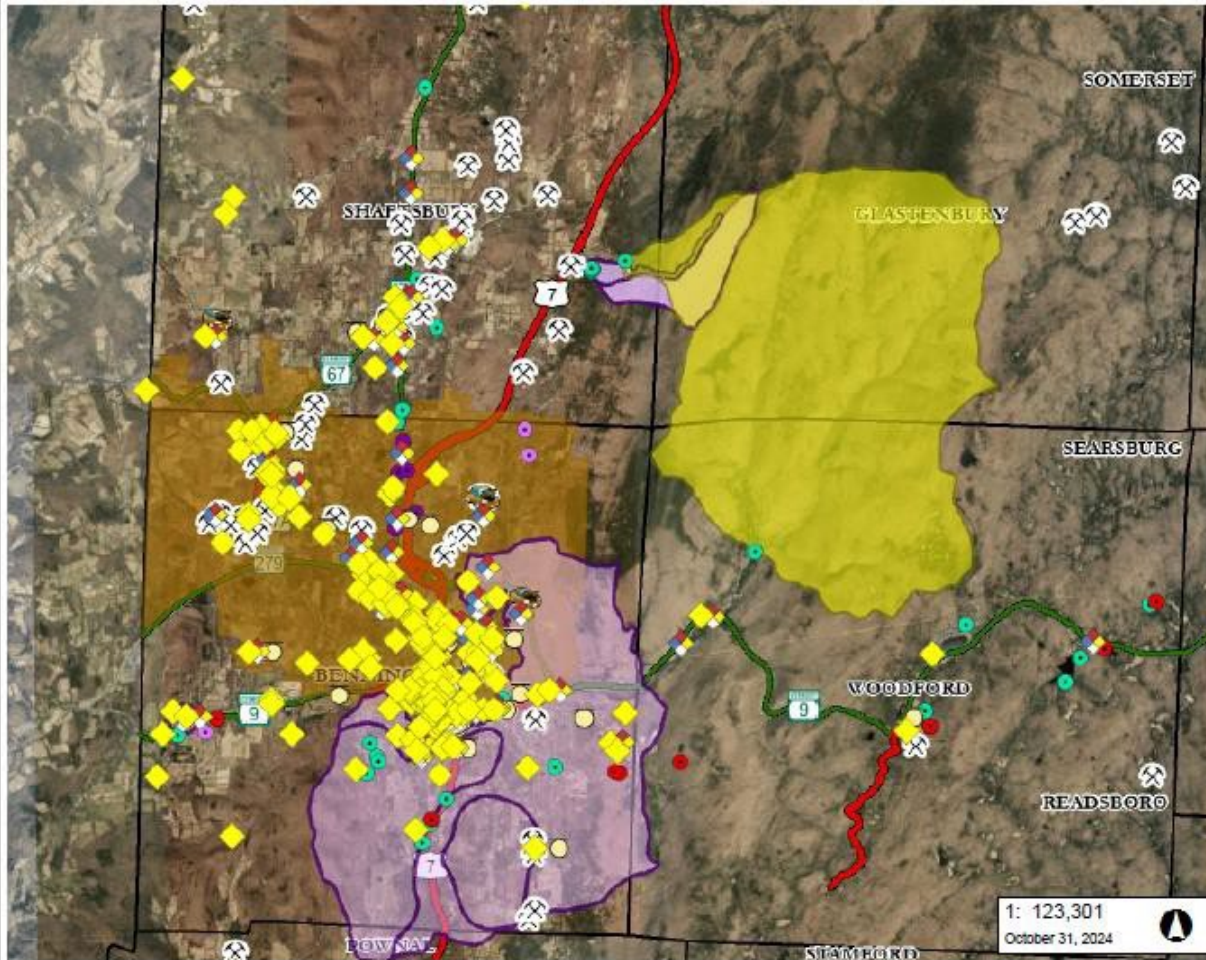
Class I groundwater is free from exposure to activities which pose a risk to its current or potential use as a public water supply.

Class II groundwater is exposed to such activities.



Class IV groundwater is not suitable as a source of potable water.

The purpose of reclassification to Class IV is to prevent people from accidentally drinking non-potable groundwater and to prevent spreading of subsurface contamination



**LEGEND**

- Hazardous Site
- Hazardous Waste Generators
- Brownfields
- Salvage Yard
- Underground Storage Tank (w/ Quarry)
- Public Water Sources
  - Active
  - Inactive
  - Proposed
  - Active Non-Public, Previously Perm
  - Inactive Non-Public, Previously Per
- Surface Water SPA
  - ACTIVE
  - INACTIVE
- Ground Water SPA
  - Active/Shared
  - Proposed
  - Inactive
- Groundwater Classification
  - II - Designated Drinking Water
  - IV - Contaminated
- Roads
  - Interstate
  - US Highway, 1
  - State Highway
  - Town Highway (Class 1)

1: 123,301  
October 31, 2024

6,264.0 0 3,132.00 6,264.0 Meters  
WGS\_1984\_Web\_Mercator\_Auxiliary\_Sphere 1" = 10275 FL 1cm = 1233 Meters  
© Vermont Agency of Natural Resources THIS MAP IS NOT TO BE USED FOR NAVIGATION

DISCLAIMER: This map is for general reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable. ANR and the State of Vermont make no representations of any kind, including but not limited to, the warranties of merchantability, or fitness for a particular use, nor are any such warranties to be implied with respect to the data on this map.

**NOTES**  
Map created using ANR's Natural Resources Atlas



# PURPOSE OF RECLASSIFICATION TO CLASS I or II

- To delineate areas of groundwater requiring **extra protection** for current or future public drinking water supplies.
- Managed for activities.
- Requires activities to be consistent with SPPs and requirements of Overlay Districts
- Differs from a SPA - can be used to designate an estimated zone of contribution for a future public water supply without incurring the immediate expense of fully developing and permitting a supply source.

A groundwater reclassification applies to all groundwater under a site, regardless of depth, in accordance with statutory language.

# MANAGEMENT OF GROUNDWATER by ACTIVITIES

## Class I Groundwater

- ❑ shall not permit **high potential risk activities** or **moderate potential risk activities**.
- ❑ shall not permit wastewater systems
- ❑ shall not permit stormwater discharge systems that infiltrate to groundwater from stormwater “hotspots”
- ❑ shall not permit other activities unless the applicant seeking approval for the activity demonstrates the activity complies with the requirements in Section 12-604 of the GW Rule
- ❑ Participation in Act 250 and Section 248 project application reviews and recommendations

## Class II Groundwater

- ❑ shall not permit **high potential risk activities**
- ❑ shall not permit other activities in Class II groundwater areas unless the applicant seeking approval for the activity demonstrates the activity complies with the requirements in Section 12-604 of the GW Rule
- ❑ Participation in Act 250 and Section 248 project application reviews and recommendations



(15) **“Moderate potential risk activities”** means the following activities:

- (A) the storage of a regulated substance in an underground storage tank with a capacity less than or equal to 1,100 gallons;
- (B) the storage of a regulated substance in an aboveground storage tank with a capacity less than or equal to 1,100 gallons;
- (C) a solid waste storage or transfer facility with a leachate collection system;
- (D) a hazardous waste storage facility;
- (E) a hazardous waste generator that meets the requirements of Section 7-308(a) of the Vermont Hazardous Waste Management Regulations (Large Quantity Generators); and
- (F) a new indirect discharge of sewage using a disposal system with a design with a capacity less than 50,000 gallons per day.

(11) **“High potential risk activities”** means the following activities:

- (A) a solid waste landfill, except those that are closed in accordance with an enforcement action or a certification under the Solid Waste Management Rules;
- (B) a hazardous waste treatment or disposal facility;
- (C) the storage of a regulated substance in an underground storage tank with a capacity greater than 1,100 gallons;
- (D) the storage of a regulated substance in an aboveground storage tank with a capacity greater than 1,100 gallons;
- (E) an automobile graveyard, as defined by 24 V.S.A. § 2241;
- (F) a new indirect discharge of sewage using a disposal system with a design capacity greater than 50,000 gallons per day;
- (G) the land application of biosolids or stabilized septage; and
- (H) injection wells.

# When to Reclassify:

1. Identifying and Mapping Potential Future Water Supplies. (First step in identifying community water needs).
2. Establishing a High Probability of Future Use
3. Reclassifying New Source Protection Areas
4. Reclassifying Existing Source Protection Areas

A hydrogeological study performed by a Hydrogeologist is required for the delineation of the SPA for the reclassified GW Area.

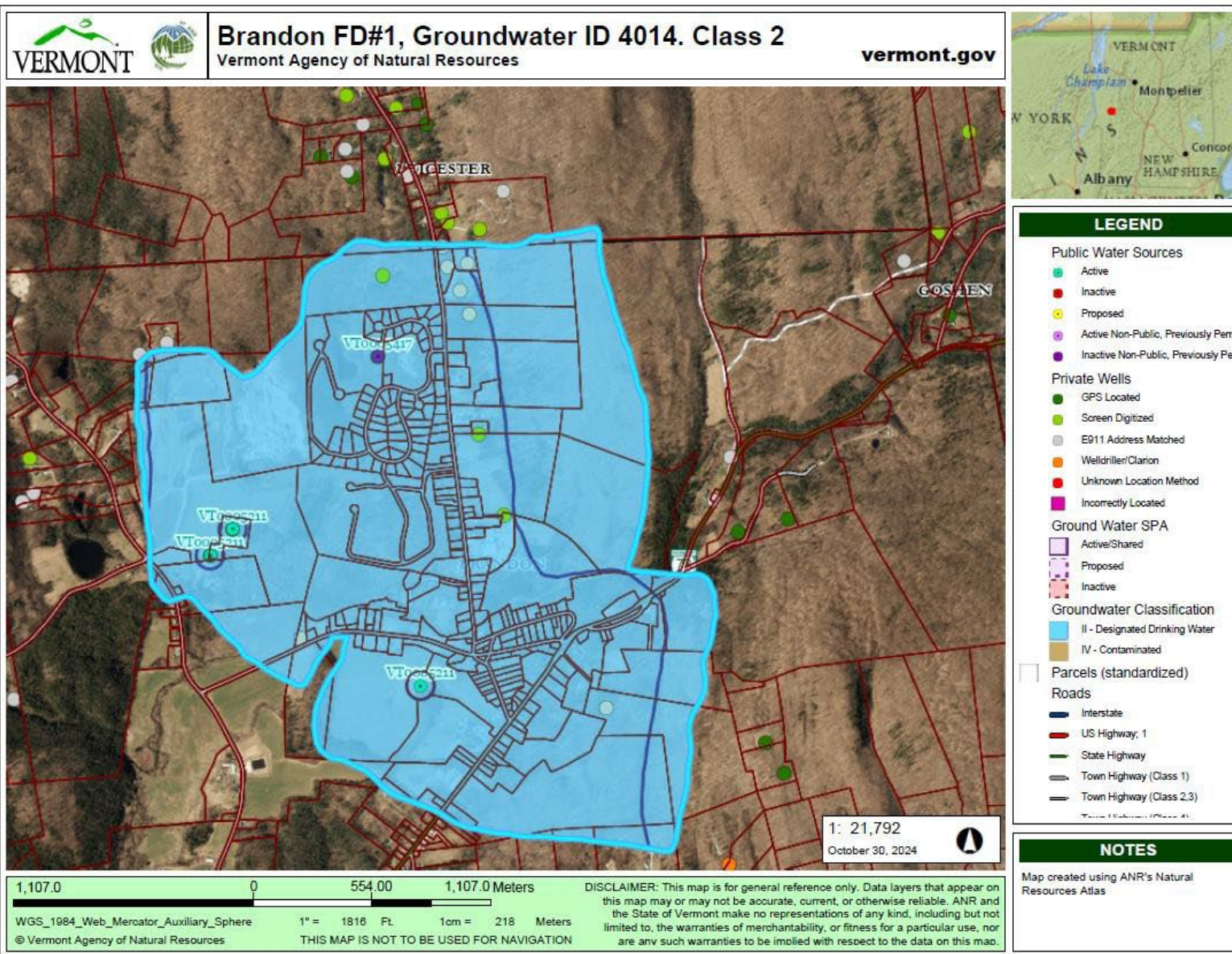




## WHO CAN PETITION FOR A RECLASSIFICATION OF GROUNDWATER?

- Secretary of ANR on own motion
- State Agency
- Municipality
- 25 or more potentially affected persons







# What is the Hydrogeology of your Community? Vermont Geological Survey

## Town Resource Maps

- ◆ Surficial and Bedrock Geology
- ◆ Locate Water Well Data
- ◆ Depth to Bedrock
- ◆ Flow Directions – Generalized
- ◆ Hydrogeologic Units – Bedrock
- ◆ Recharge Potential to Bedrock
- ◆ Potential Overburden Aquifer with Direct Recharge
- ◆ GW – Plan, Map, Test, Protect



FIGURES 2-5. WATER WELL DATA, BEDROCK TYPE, AND IDW ANALYSES

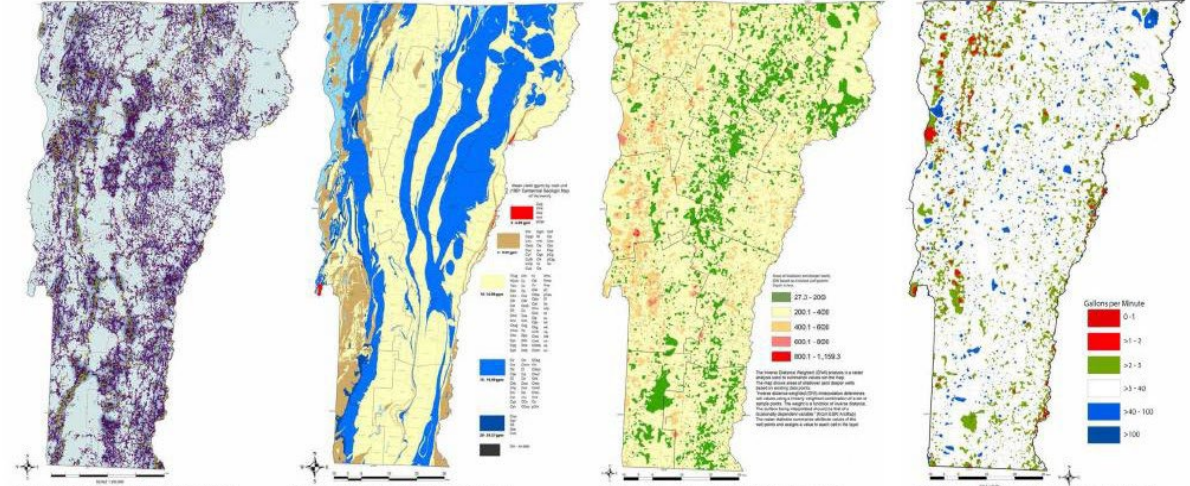


FIGURE 2. Distribution of 93,788 water wells completed in 1966-2006. Database has 76 fields including use, yield, depth, type (gravel or bedrock), and materials at various depths. Locations are suspect; ~11% had E911 or GPS locations in 2006; 17% have updated E911 or GPS locations in 2014.

FIGURE 3. Wells were selected and average yields were calculated by bedrock formation (1961 map of Vermont). Formations were then grouped to produce a generalized yield map. Moore and others (2002) discussed factors which correlated negatively and positively with well yield. Among these are year drilled, drilling method, thickness of overburden, depth, elevation, proximity to streams, and type of bedrock.

FIGURE 4. Inverse distance weighted (IDW) analyses of well depths based on 6 nearest points. Map indicates some areas where deeper wells could be anticipated. There are large areas of no data (see Fig. 2).

Depth in feet	# of wells	Mean yield in gpm
Well depth ≤ 200	21540	18.43
Well depth > 200 and ≤ 400	41539	13.75
Well depth > 400 and ≤ 800	19142	7.64
Well depth > 800	664	0.90

FIGURE 5. Inverse distance weighted analysis (IDW) of well yield based on 6 nearest points. Map indicates some general areas where higher or lower yields could be anticipated. There are large areas of no data (see Fig. 2).

A reported well yield of 1 gpm was selected as the high value for low yield wells; actual yield may be much less. 1 gpm is 1440 gallons per day and the average person uses 75 gallons per day. The percent of low yield wells is 14% and 28% have a yield of  $\leq$  20 gpm.

## Water Well Data and Analysis





# Partners in SWP:

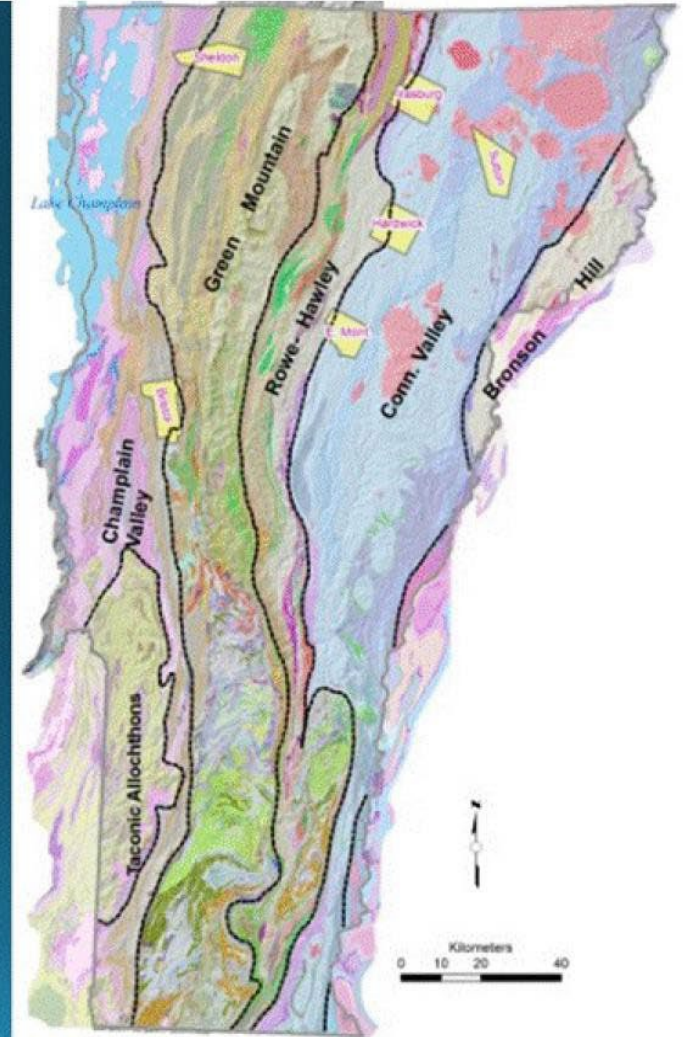
Vermont Geological Survey  
and the  
Agency of Agriculture  
Food and  
Markets

## Vermont Geological Survey and AAFM Collaboration on Nitrate Contamination



“Completed”  
East Montpelier  
Sheldon

Ongoing  
-Sutton  
-Hardwick  
-Bristol  
-Irasburg



Jonathan Kim, Ph.D., P.G. | Geologist  
Vermont Department of Environmental Conservation  
Vermont Geological Survey



# Communication

## The key tool for promoting protection

- Talk with landowners
- Promote voluntary participation
- Perform field visits
- Attend town/board/zoning meetings
- Reach out to Emergency Contacts
- Hold Informational Gatherings
- Present/Display at Town Meeting Day
- Annual letters, notes in billing statements, and or CCR (Consumer Confidence Report)

# FORM STRONG PARTNERSHIPS

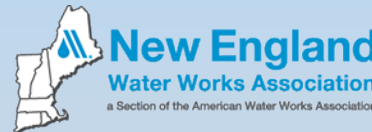
SWP is everyone's responsibility!  
Water Systems can't do it alone.

## Water System



- Operators
- Administrators
- Committees
- Customers
- Landowners
- Well Drillers Association
- Consultants

## Agencies

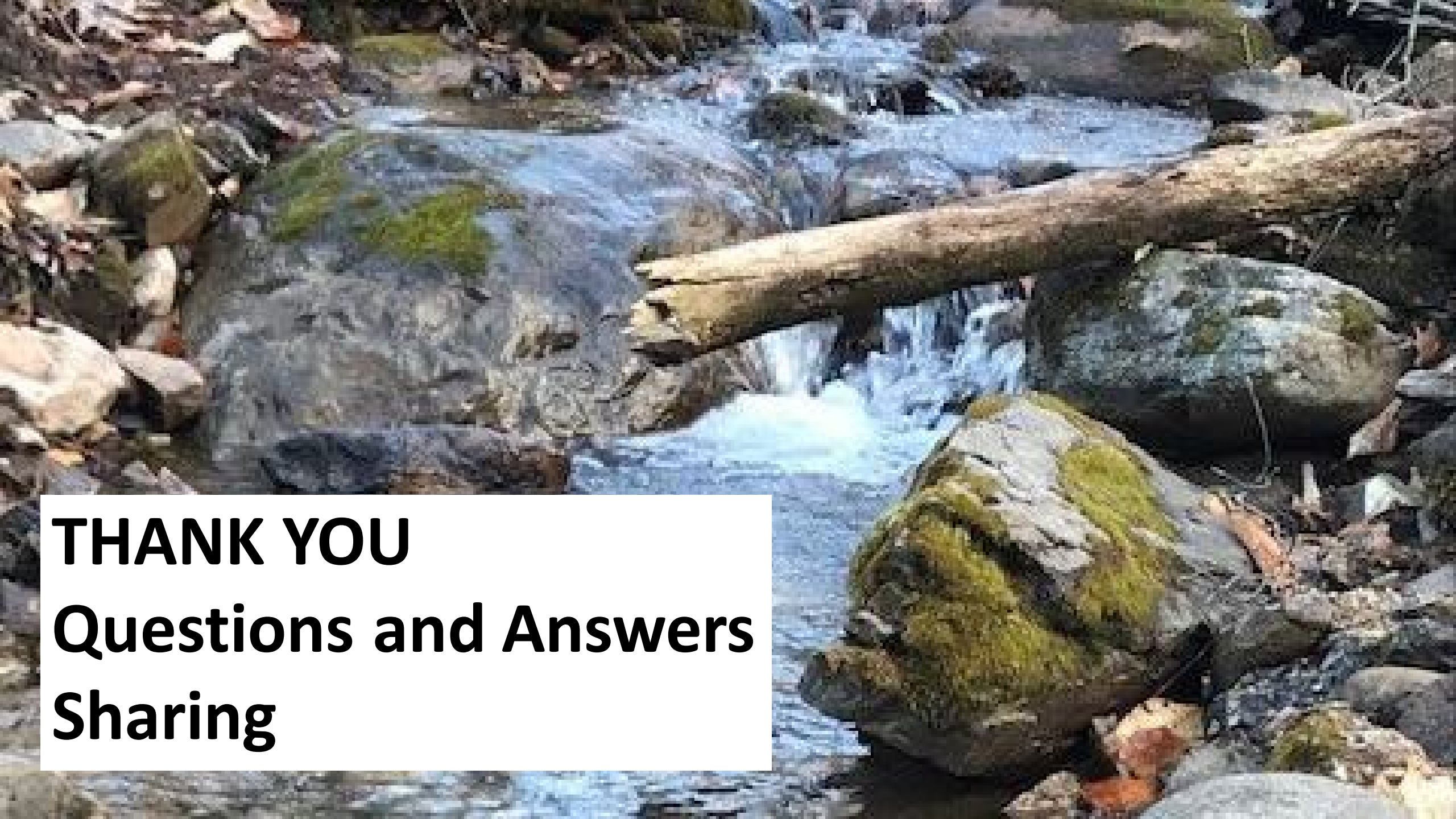


## Community



- **Local Boards and Committees:**
- (Selectboard, Conservation, Planning, Zoning, Recreation, etc.)
- Public Works Department
- Town Clerk
- Emergency Responders
- Local Schools
- Solid Waste Management District
- Non-profit organizations
- Utilities
- Businesses, including utilities
- Lake Shore Associations
- Municipal Officials



A photograph of a stream flowing over mossy rocks. A large, weathered log lies horizontally across the middle ground, partially submerged in the water. The water is clear and blue, creating white foam as it flows over the rocks. The rocks are dark and covered in green moss. The background shows more rocks and some dry leaves.

**THANK YOU**  
**Questions and Answers**  
**Sharing**