# 50 Good Reasons to Enjoy (and Protect!) Your Water

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Presented to the Butternut Valley Alliance
Butternut Valley Grange, Gilbertsville, NY
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# Acknowledgements


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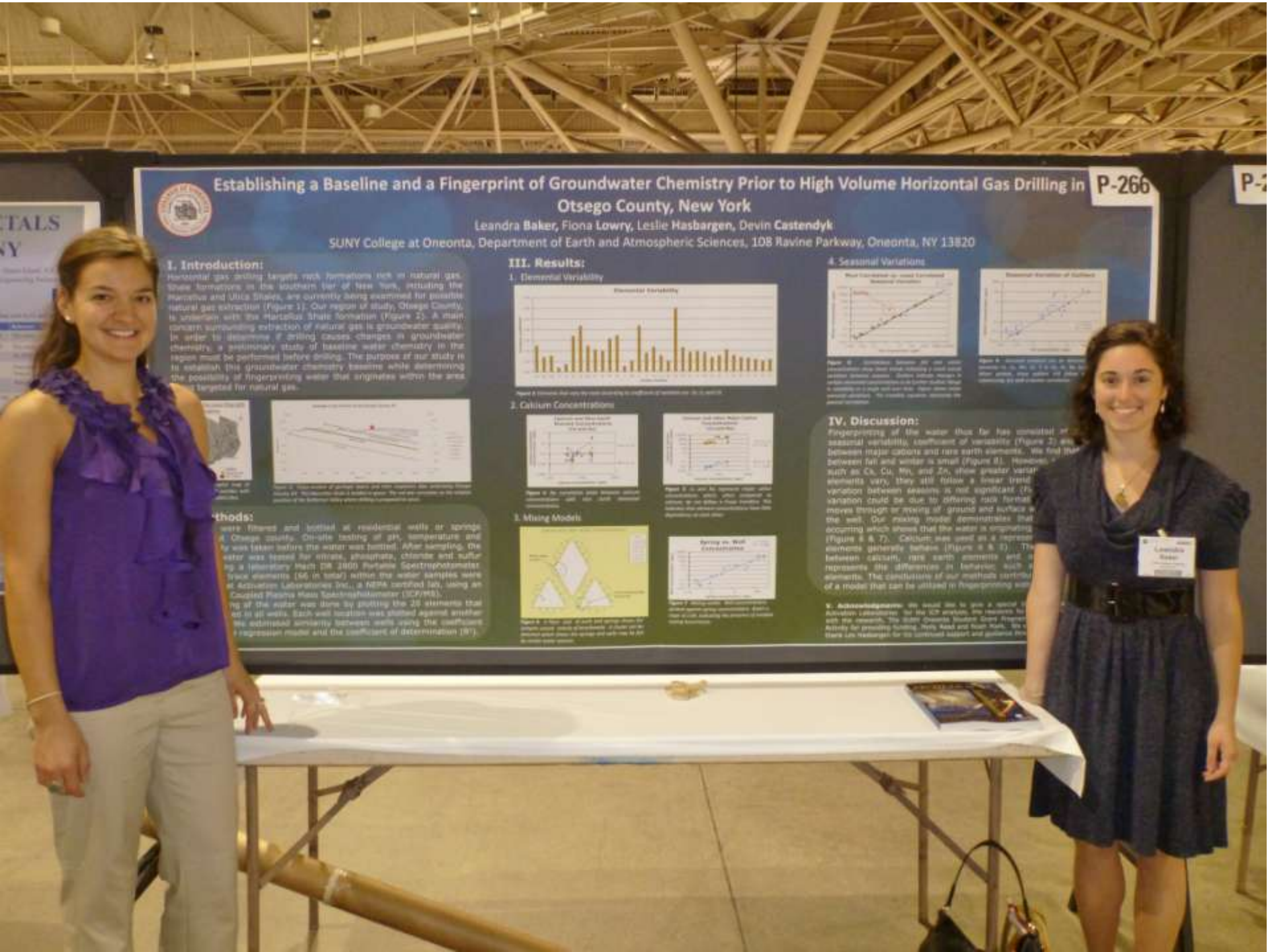
  - Otsego County Conservation Association
  - Research Foundation of State University of New York
  - Vibrant New York program run by Tim Hayes at The Center for Economic & Community Development (**CECD**) at SUNY Oneonta
- Members of the Butternut Valley Alliance and participants in the sampling program
- The loose affiliation of watershed managers who provided the impetus to form Catskill Headwaters Research Institute (USGS, SUNY, Otsego County Soil & Water District, NYS DOH, BFS, GASTEM-USA)
- Most of all: **The Water Sampling Team**!!
  - Leandra Baker, now at Barton & Loguidice
  - Fiona Lowry, soon to be at Public Health, U of MN Graduate School
  - Molly Reed, now at Plumley Engineering, P.C.


Establishing a Baseline and a Fingerprint of Groundwater Chemistry Prior to High Volume Horizontal Gas Drilling in Otsego County, New York
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I. Introduction:
III. Results:
1. Elemental Variability
2. Calcium Concentrations
3. Mixing Models
4. Seasonal Variations
IV. Discussion:

# Why this sampling program?

- BASELINE data on groundwater is very sparse in our county; many of us drink from local private wells.
- We need to understand groundwater flow systems: water chemistry is a product of flow paths and water-rock reactions.
- The public needs this information: knowledge is power.

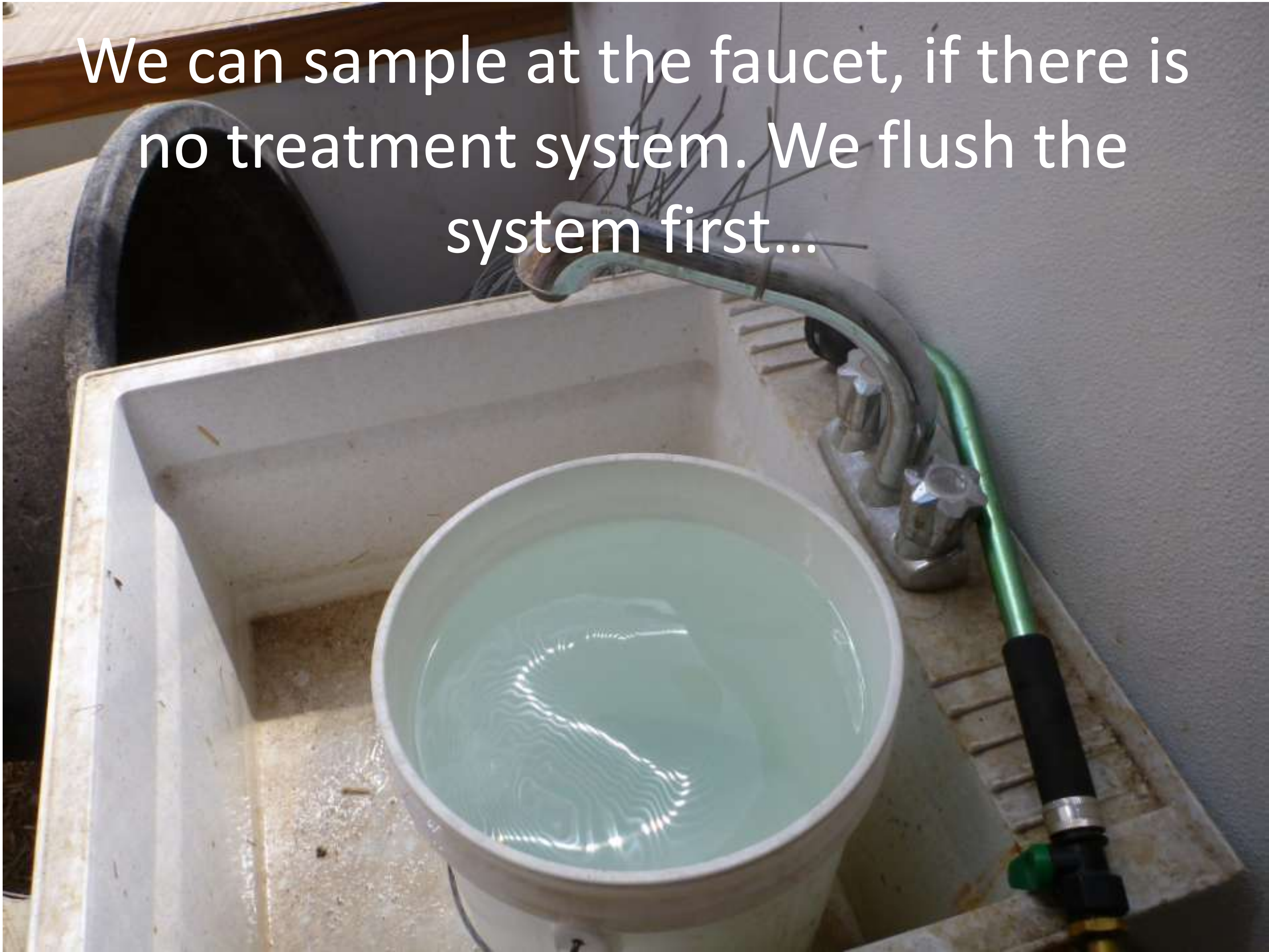
# Sampling Procedure

- **Goal:** Sample across region to get at natural variability
- **Goal**: Capture a representative sample of groundwater
- No chemical treatment
- Minimal time to react with indoor pipes
- Filtered for particulates
- Acid added to sample to keep the metals dissolved
- Bottled, labeled, and sent to Activation Laboratory in Canada to test for **cations**
- Aliquot tested in SUNY Oneonta Hydrology lab for **nutrients, anions, alkalinity** and some metals

# What some well water can look like…

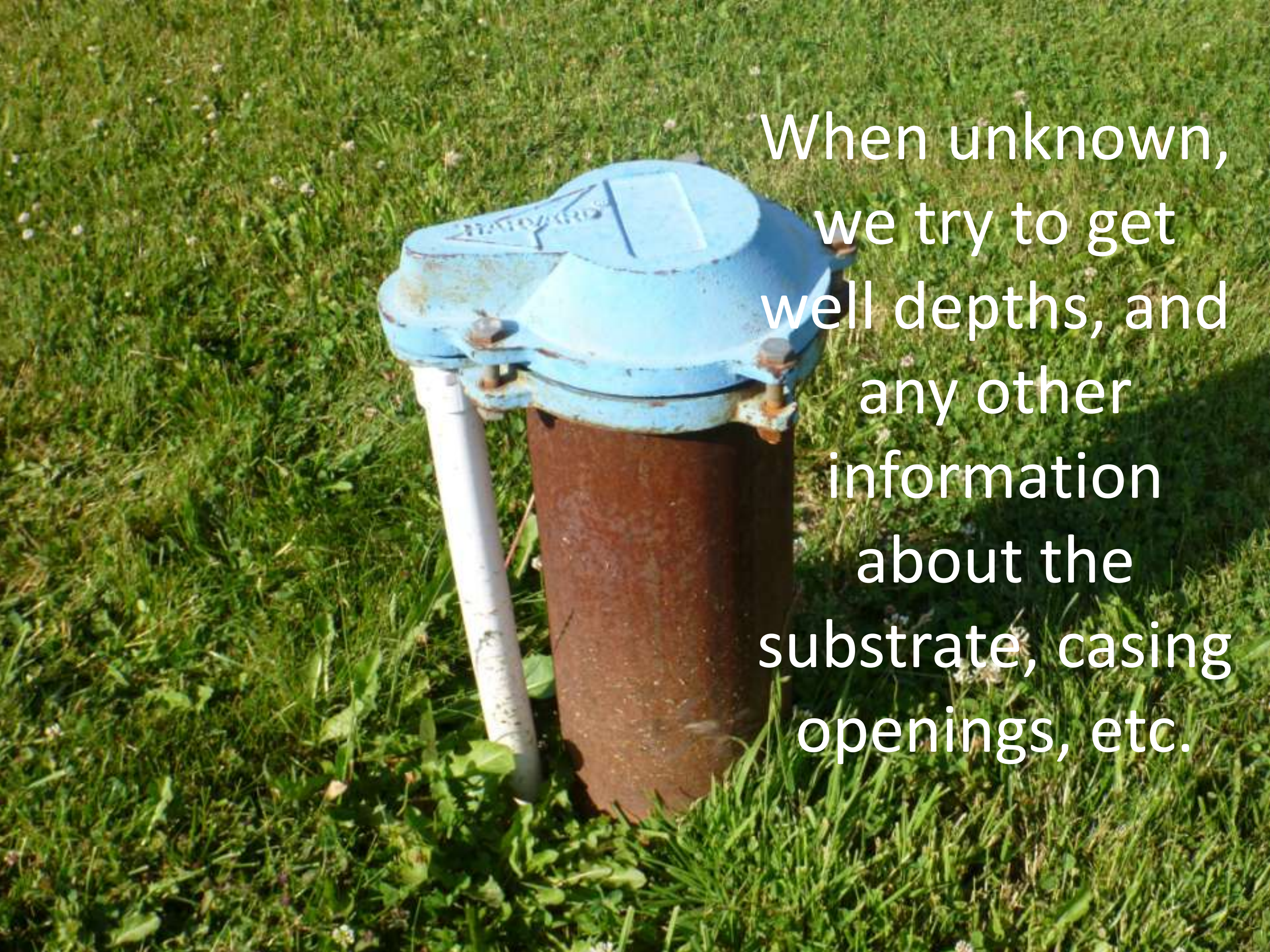
We filter the particulates, and test the dissolved content in the water.

We can sample at the faucet, if there is no treatment system. We flush the system first…




A chemical test in progress for Arsenic


The hose leads to a spigot in the basement, between the well and a treatment system…


When unknown, we try to get well depths, and any other information about the substrate, casing openings, etc.


Testing for water depth in
the well, and well depth

# Pulling a pump

Barney and Sons Drilling

# Sampling a spring…

# Common basement plumbing system

# What did we sample for?

- 66 elements were tested for by ACT Labs with an ICP-MS device
  - Why? This was a VERY affordable way to get a lot of information! $47.50 per sample, plus bottle and mailing costs.
  - More importantly, knowing these concentrations in the water provides IDENTITY, and it provides clues to groundwater flow paths, and water-rock reactions
- We also determined basic water quality measures: nutrients (nitrates and phosphates); chloride; sulfates; temperature, conductivity

# Elements we sampled for…

| Na | Y | Dy | Zr | Ga |
|---|---|---|---|---|
| Ca | Cs | Ge | Tb | Pd |
| K | Br | Mo | Ho | Ag |
| Mg | Cu | Fe | Tl | Be |
| Si | Pb | Ni | Th | Bi |
| Mn | La | Cd | Sc | Hg |
| Zn | Li | Yb | Lu | In |
| Ba | Ce | Sm | Re | Nb |
| Sr | Nd | Er | Cr | Os |
| Rb | Eu | Al | V | Pt |
| Ti | W | Se | Au | Ru |
| U | Co | Sb | Tm | Sn |
| As | I | Pr | Hf | Ta |
| | Gd | | | Te |

See http://www.ptable.com/ for more info on elements

Most common elements are in first column; least common are in far right column. Of these typically 33 are detected in a well (some have more, some less.)

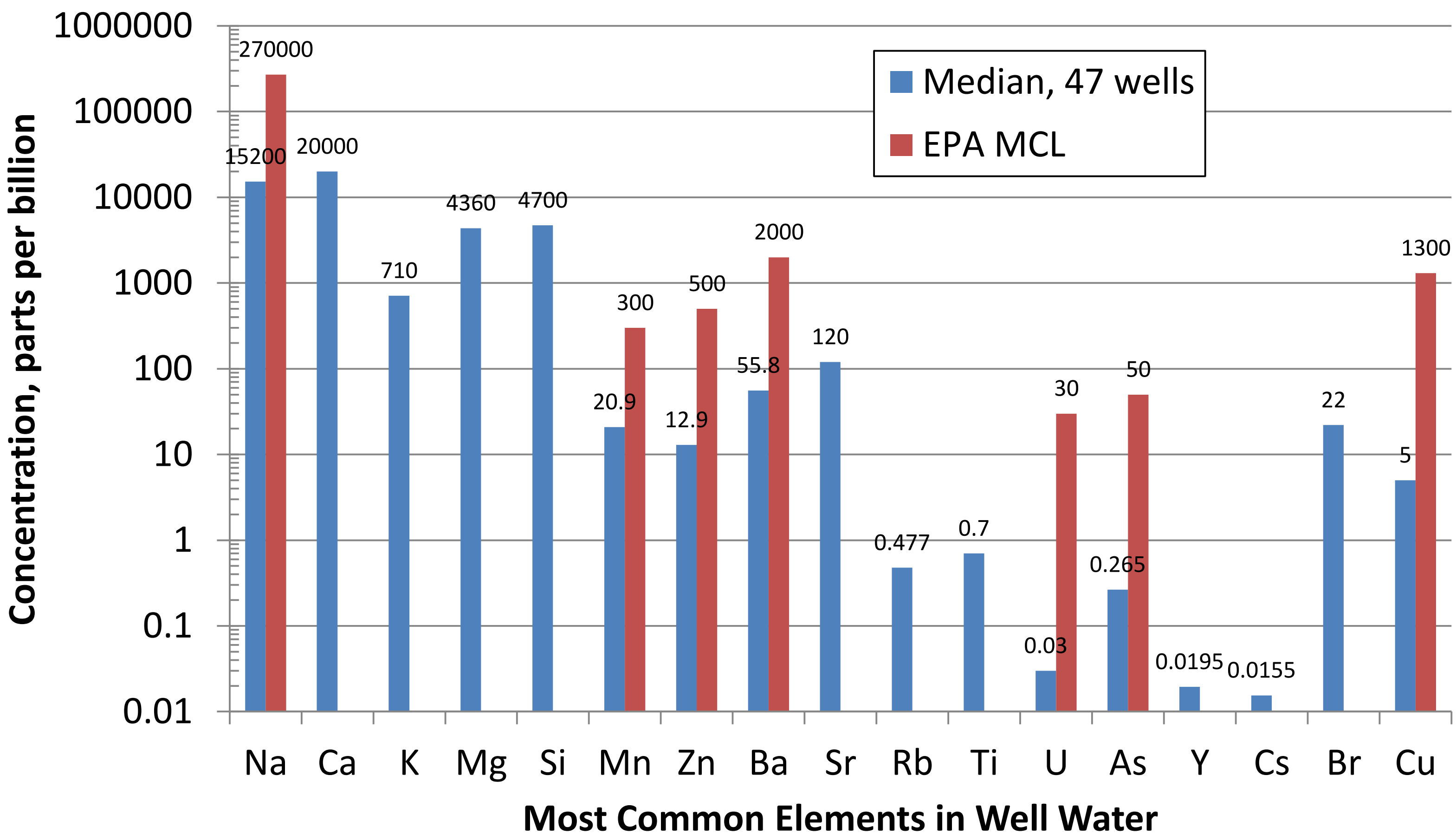
Ag: Silver
Be: Beryllium
Bi: Bismuth
Hg: Mercury
In: Indium
Nb: Niobium
Os: Osmium
Pt: Platinum
Ru: Ruthenium
Sn: Tin
Ta: Tantalum
Te: Tellurium

# These were never detected in wells

# Well Water Concentration (Cations) Statistics…

| Analyte Symbol | Coefficient of Variation (std dev / ave) | Standard Deviation (µg/L) | Min (µg/L) | Max (µg/L) | Median (µg/L) | Average (µg/L) | # Wells with analyte present |
|---|---|---|---|---|---|---|---|
| Na | 0.84 | 15617 | 1100 | 60900 | 15200 | 18689 | 47 |
| Ca | 0.87 | 15459 | 2100 | 89800 | 20000 | 17748 | 47 |
| K | 2.64 | 5702 | 180 | 35500 | 710 | 2157 | 47 |
| Mg | 0.73 | 3719 | 366 | 18100 | 4360 | 5114 | 47 |
| Si | 0.30 | 1445 | 2700 | 8800 | 4700 | 4838 | 47 |
| Mn | 1.40 | 79.90 | 0.3 | 371 | 20.9 | 57.06 | 47 |
| Zn | 1.47 | 38.85 | 1.5 | 228 | 12.9 | 26.34 | 47 |
| Ba | 0.89 | 65.29 | 1.6 | 217 | 55.8 | 73.57 | 47 |
| Sr | 1.38 | 225.93 | 12.8 | 1390 | 120 | 163.50 | 47 |
| Rb | 0.59 | 0.38 | 0.113 | 1.95 | 0.477 | 0.64 | 47 |
| Ti | 0.34 | 0.23 | 0.3 | 1.3 | 0.7 | 0.70 | 47 |
| U | 1.27 | 0.16 | 0.002 | 0.634 | 0.03 | 0.13 | 47 |
| As | 2.16 | 1.71 | 0.06 | 10.3 | 0.265 | 0.79 | 46 |
| Y | 1.49 | 0.06 | 0.004 | 0.37 | 0.0195 | 0.04 | 46 |
| Cs | 1.11 | 0.04 | 0.003 | 0.139 | 0.0155 | 0.03 | 46 |
| Br | 2.52 | 322.95 | 4 | 1800 | 22 | 128.09 | 45 |
| Cu | 1.43 | 65.95 | 0.3 | 200 | 5 | 46.17 | 45 |
| Pb | 1.40 | 0.71 | 0.02 | 3.46 | 0.22 | 0.51 | 43 |

# Most commonly occurring elements (metals) in wells, and EPA MCL



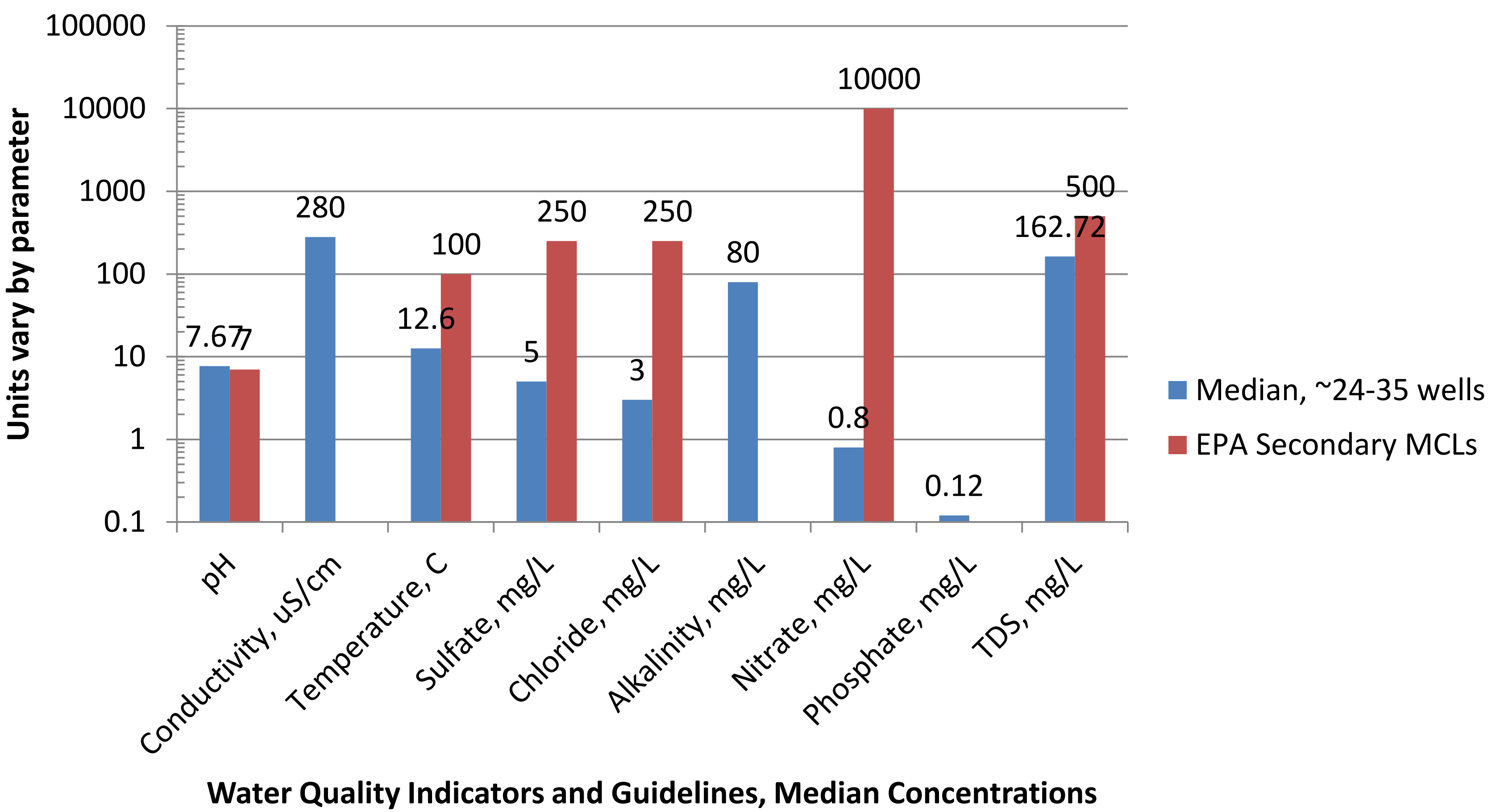

Wells which exceed EPA MCLs:

Cadmium: 1 well exceeds MCL

Iron: 3 wells exceed MCL

Manganese: 1 sample (spring) exceeds MCL

# Water Quality Indicators for 47 wells, with EPA Secondary MCLs

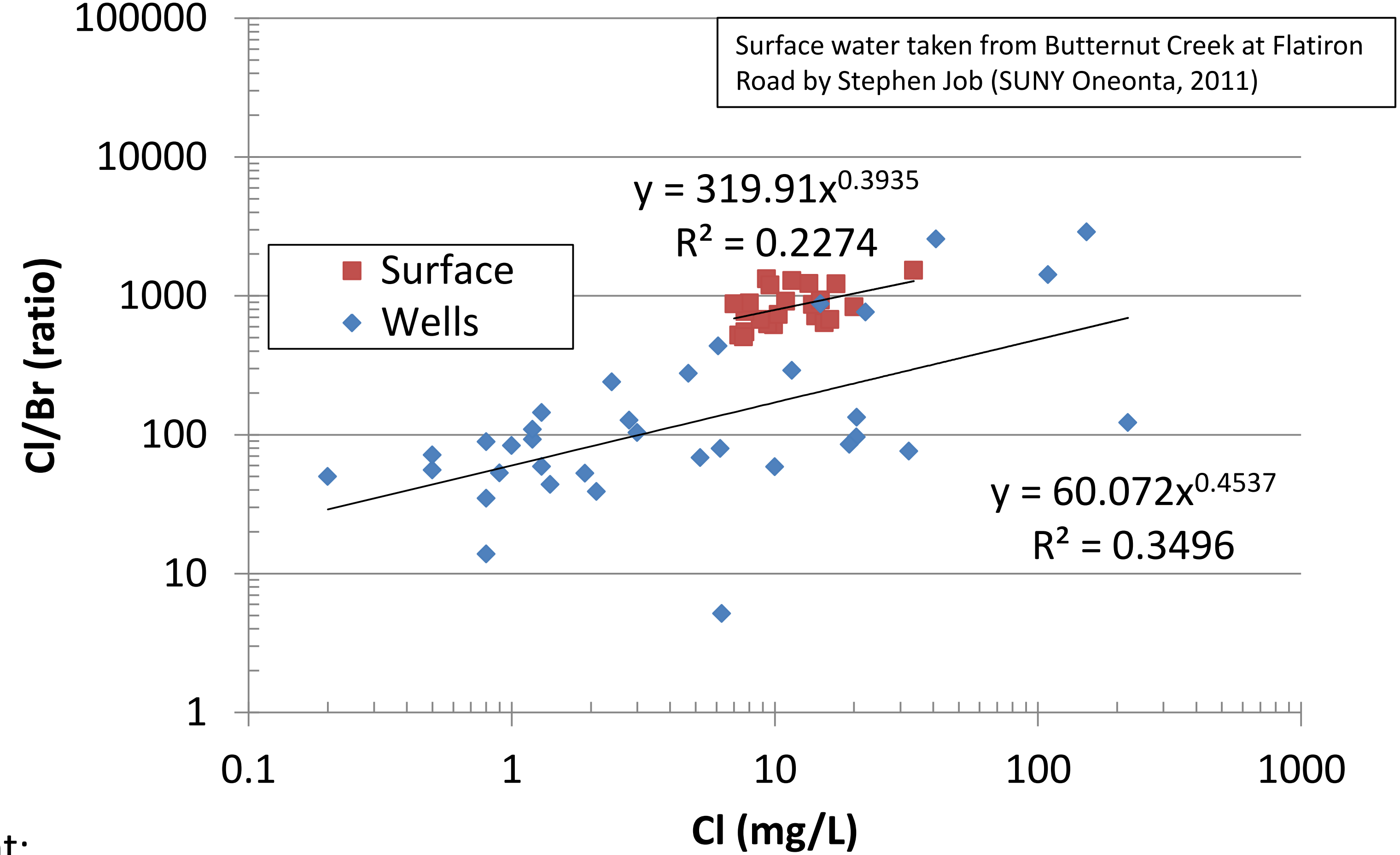


# Well Water Quality Indicators Statistics…

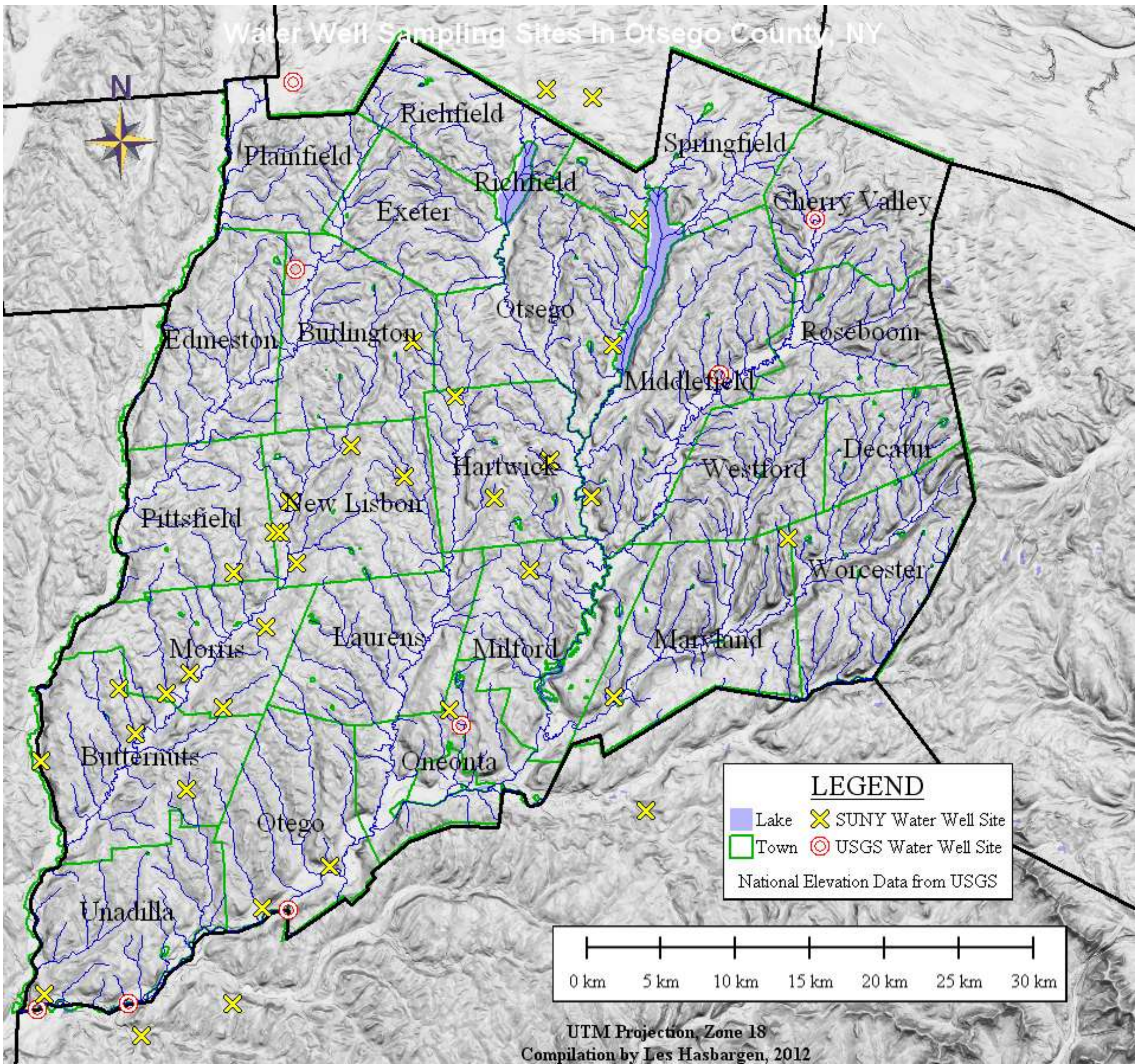
| Analyte Symbol | Coefficient of Variation | Median | Standard Deviation | Average | Min | Max | # Samples |
|---|---|---|---|---|---|---|---|
| **pH** | 0.09 | 7.67 | 0.68 | 7.6 | 6.36 | 9.3 | 35 |
| **Conductivity, µS/cm** | 0.70 | 280 | 218.20 | 310.0 | 50 | 970 | 35 |
| **Temperature, C** | 0.17 | 12.6 | 2.22 | 12.9 | 8.6 | 18.5 | 35 |
| **Sulfate, mg/L** | 1.47 | 5 | 9.48 | 6.5 | 0 | 50 | 31 |
| **Chloride, mg/L** | 2.54 | 2.8 | 28.14 | 11.1 | 0.2 | 152.9 | 31 |
| **Alkalinity, mg/L** | 1.34 | 80 | 207.38 | 154.8 | 0 | 1010.77 | 31 |
| **Nitrate, mg/L** | 1.39 | 0.8 | 1.93 | 1.4 | 0.2 | 7.9 | 25 |
| **Phosphate, mg/L** | 0.79 | 0.12 | 0.13 | 0.2 | 0.03 | 0.47 | 24 |
| **TDS, mg/L** | 0.36 | 162.72 | 71.15 | 200.3 | 155.9 | 282.4 | 3 |

Key Point: Chloride and Sulfate are highly variable; all exhibit moderate variability

# Chloride-Bromide Ratio for Surface and Well Water

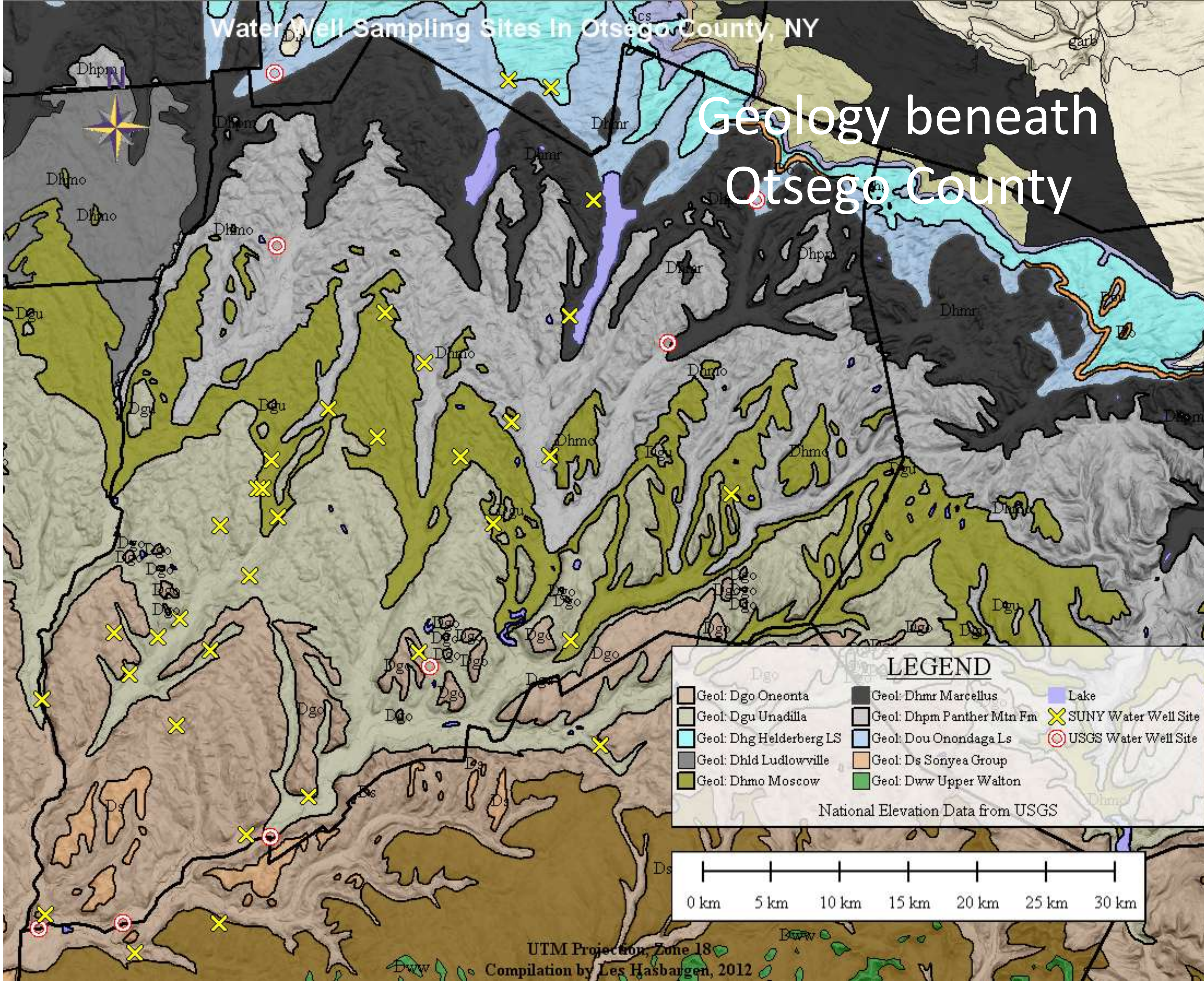



Key Point:
Streams have higher ratios of Chloride to Bromide. While the ranges for stream and well water overlap, significant departures in stream values would be an indication of contamination.




USGS and SUNY Oneonta well sample locations, 2006 through March 2012

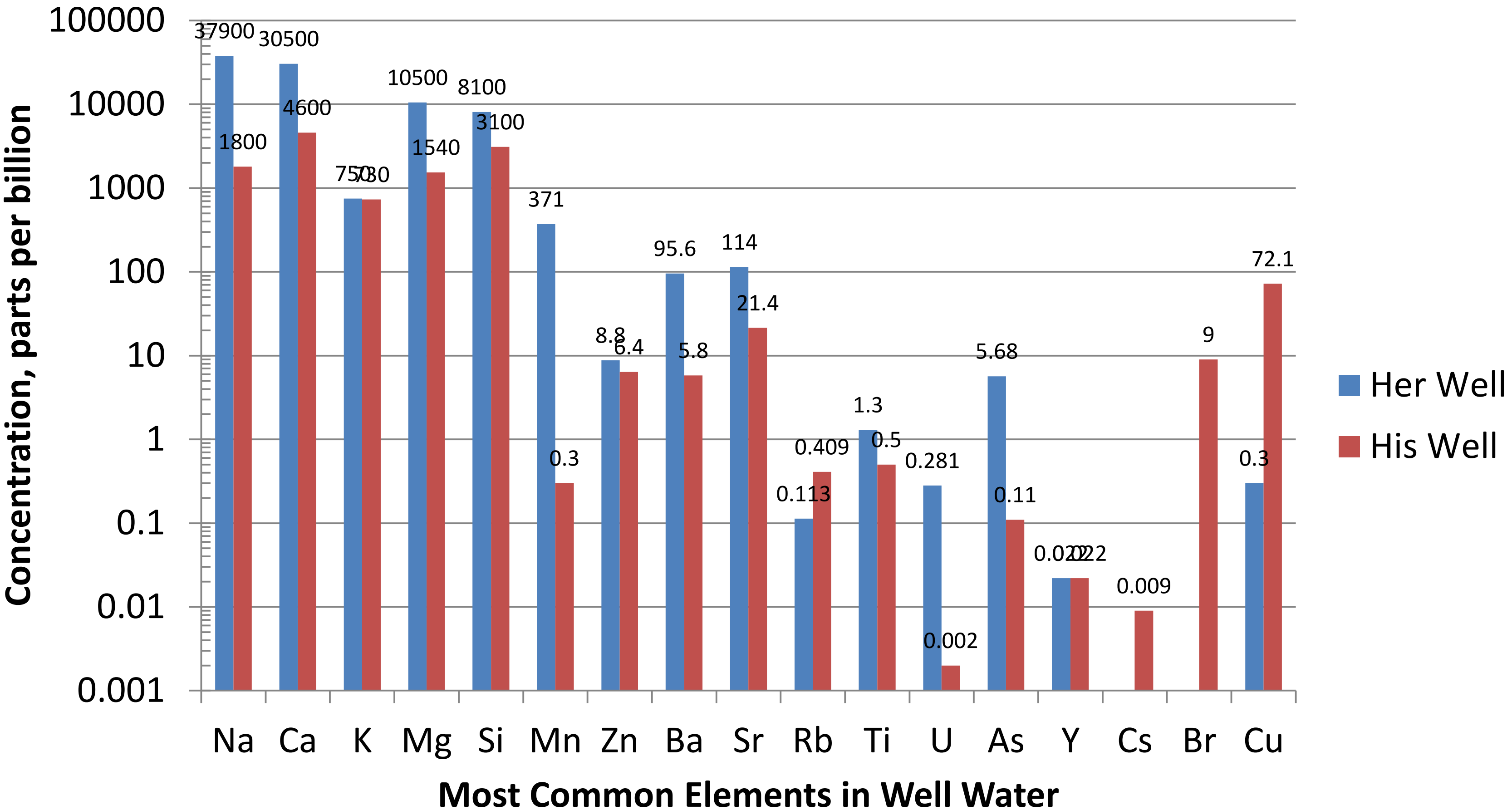
# Geology beneath Otsego County



# Geology and Water Quality

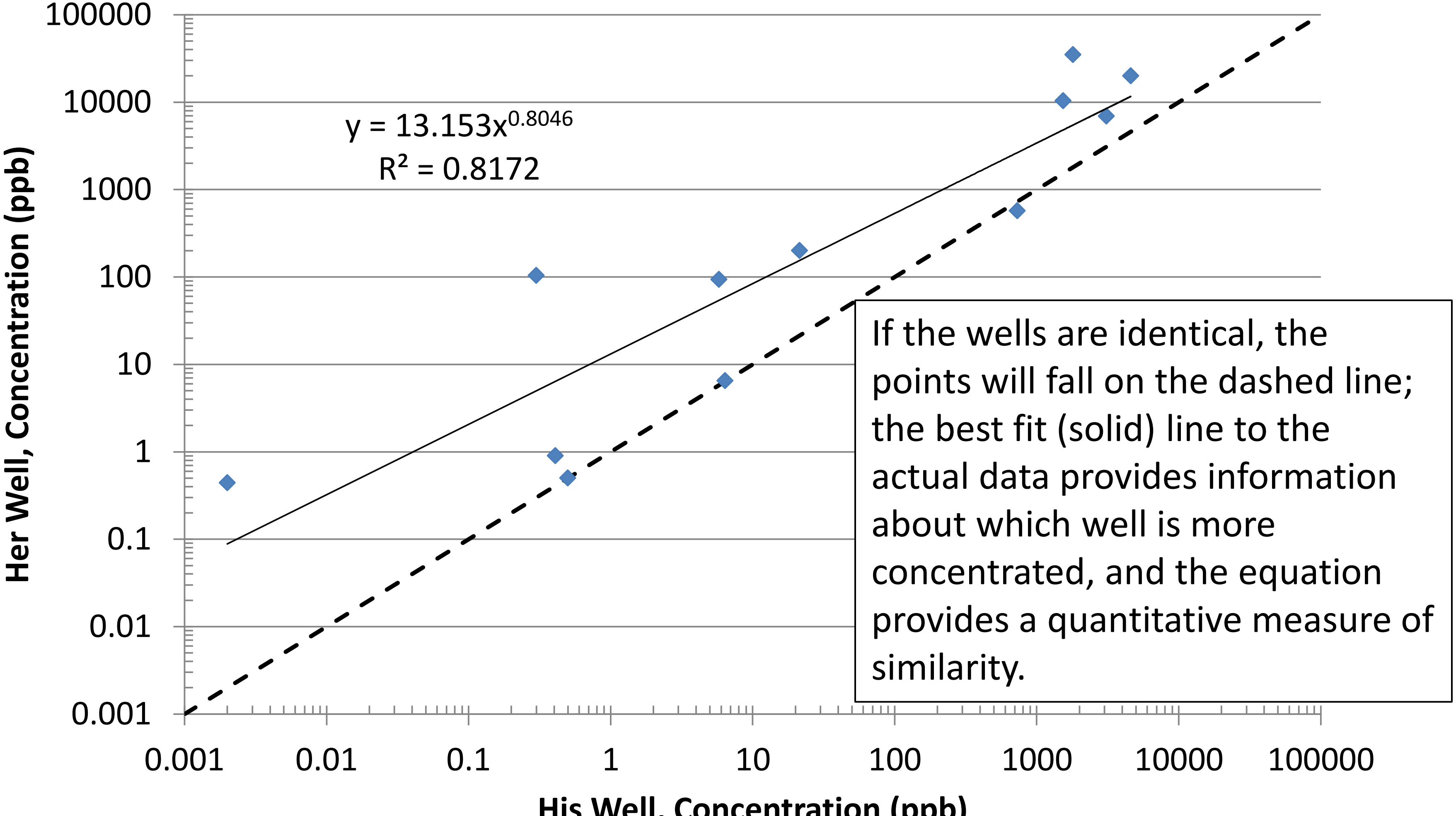
- The previous map is "fresh off the presses"
- A systematic analysis of water and rock relationships has not been conducted yet
- We are hoping to get to this analysis this year, and provide a clearer picture of how these two key pieces of water chemistry are related

# A Comparison Between Wells: A Graphical View



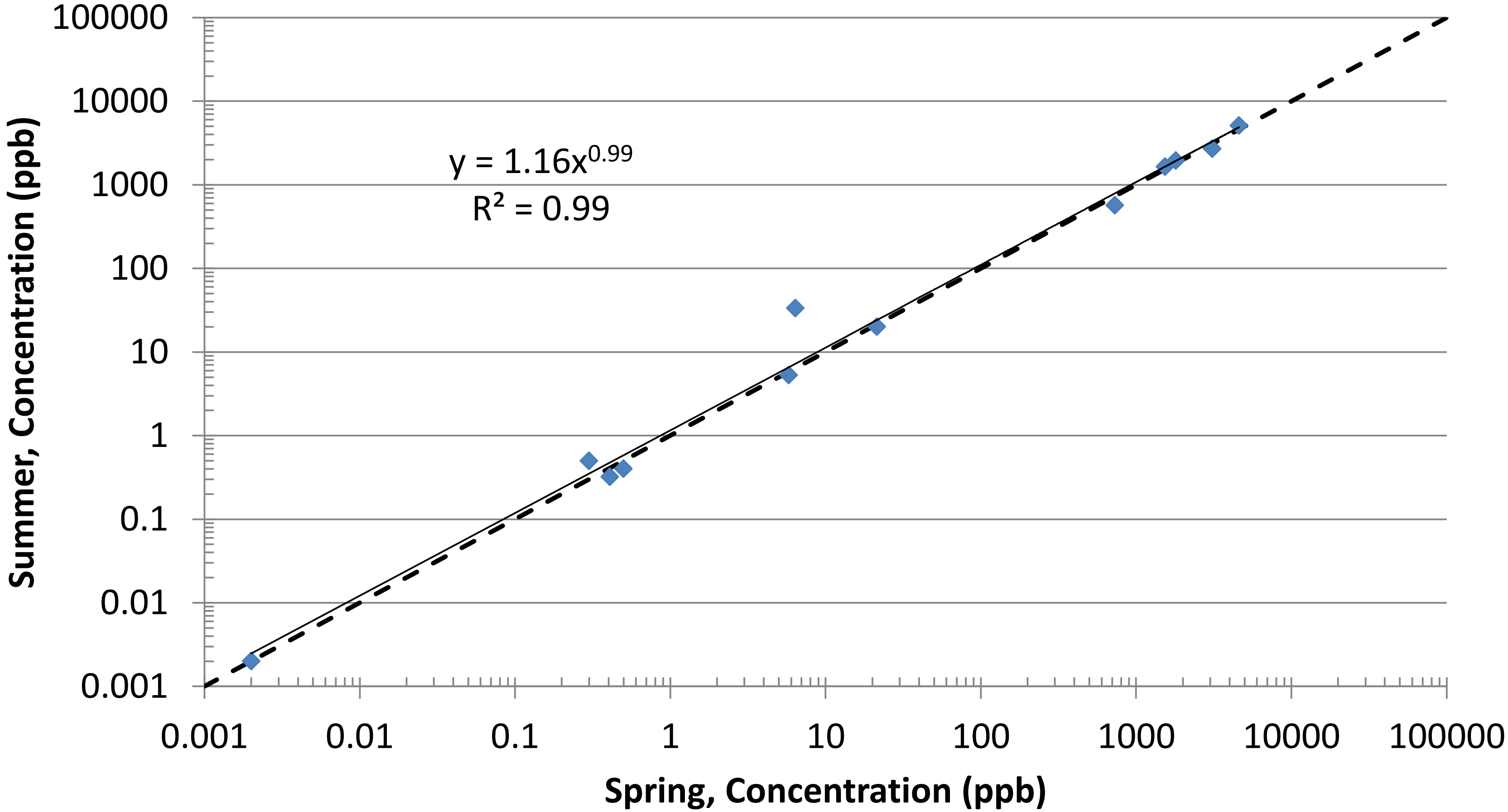

Note: Data are plotted on a logarithmic scale. In the example above, Her Well has much higher concentrations in Na, Ca, Mg, Mn, Ba, Sr, U, and As. His well has more Cs, Br, Cu.

# Comparison Between Wells
# A Quantitative View




If the wells are identical, the points will fall on the dashed line; the best fit (solid) line to the actual data provides information about which well is more concentrated, and the equation provides a quantitative measure of similarity.

# This well was sampled at two different times




Note that the data pretty much fall on the dashed line, with element showing a higher concentration in summer. The relation shows an individual well does vary, but the variability is far less than what we see between wells.

# A note on similarity using a "power law" equation

- A power law equation looks like: $y = a\,x^{b}$
- In our case, if b = 1, then the coefficient "a" tells us how much more (or less) concentrated one well is compared to another. It's a mixing model…
- When "b" is not equal to 1, then complicated mixing and water-rock reactions are in play
- $R^2$ describes how tightly the points fall on a best fit line. Values smaller than 1 mean the data are more distant from the line, which indicates complicated mixing and water-rock reactions are in play

# Interactive mapping of concentrations

- Catskill Headwaters Research Institute is creating a web site where you can map concentrations of the chemicals in groundwater for your area, and the site should be functioning by end of summer, 2012.
- We thank those well owners who participated!!!
- We offer a water sampling service, at cost, for those who would like us to test their water.
  - Contact Dr. Les Hasbargen for more information

    Leslie.Hasbargen@oneonta.edu

    607-436-2741

# We have a lot of work to do!!

- Are shallow wells fresher than deep wells?
- Does geology influence water quality in our area?
- Is there mixing from a deeper saline source?
- Gas migration: we know some wells in our area are gassy. How does this work?

# Surface Water Quality: A VERY important part of local hydrology

- Nutrients
- Ions
- Sediment
- Stream ecology
- Floods
- Erosion
- Management of loads for Chesapeake Bay, concerns over bridges and bank stability, etc.

# Bank stability and Channel History

Thanks for your attention!
Questions!?

# For flyers/announcements

Title: 50 Good Reasons to Enjoy (and Protect!) Your Water

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Researchers at SUNY Oneonta have collected water quality information from numerous local wells for residences across Otsego and parts of Delaware counties in the past 2 years. Overall, chemical analyses show that residents drinking from local wells enjoy good water quality. The sampling program, funded by the Research Foundation and the Vibrant New York Program  of SUNY, and Otsego County Conservation Association, seeks to provide a baseline for water well chemistry for residences without access to municipal water supplies. In addition, the differences in chemistry between wells suggests that fingerprinting of the water in a well is possible, and thus, changes to the well are detectable. Les Hasbargen will give a summary of their results on Sunday, April 15 at 1:30 p.m. at the Butternut Valley Grange in Gilbertsville, NY.