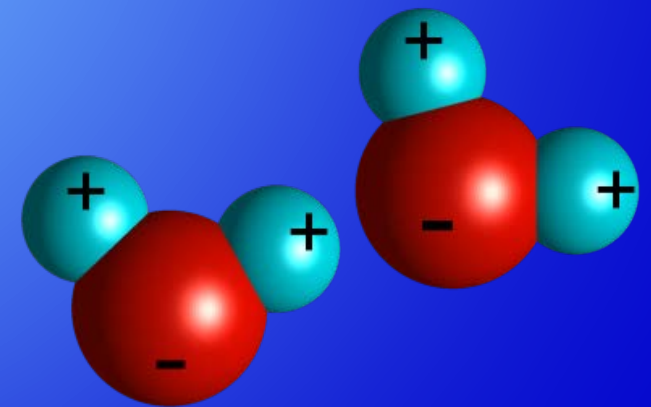
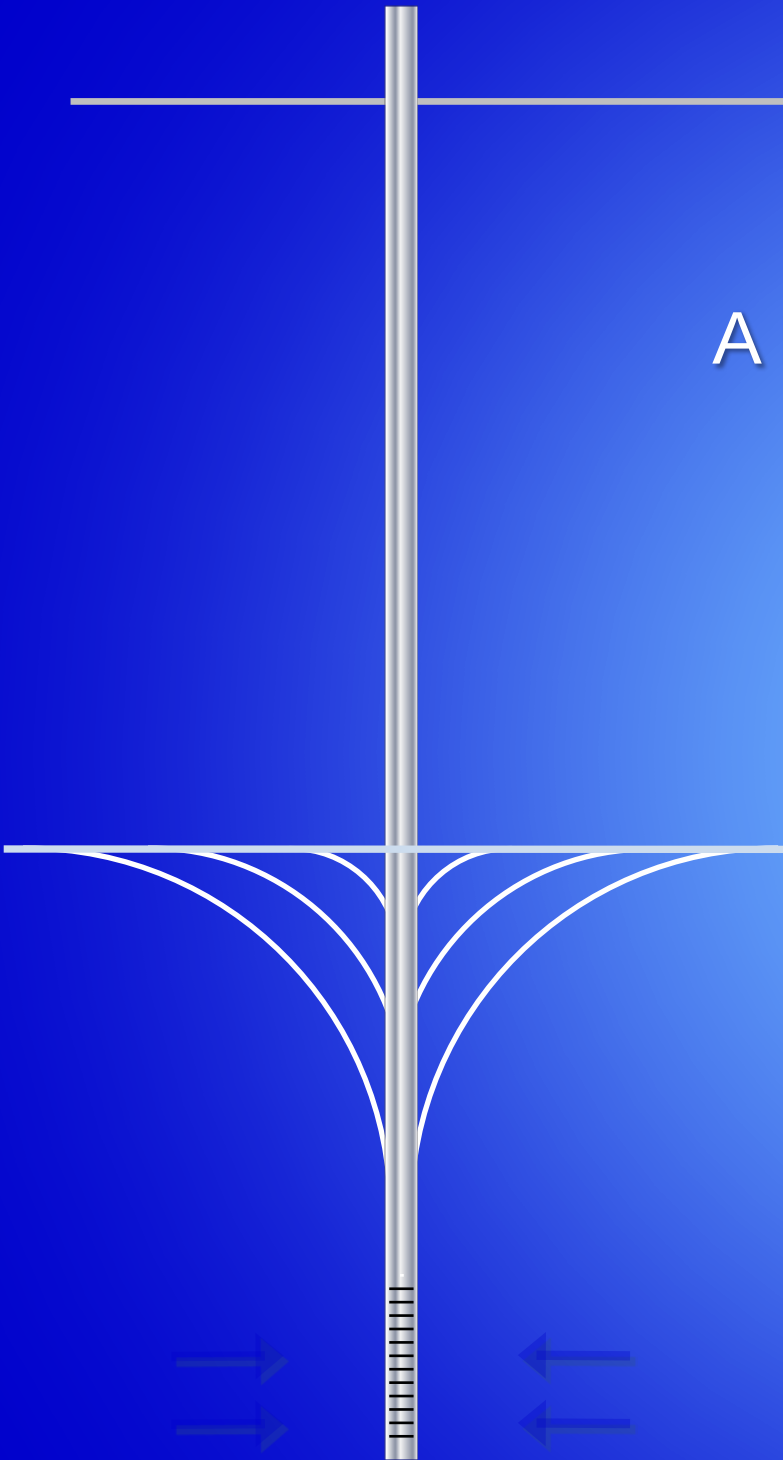


# A Hydrogeochemical Investigation of the Rathdrum Prairie Aquifer Kootenai County, Idaho

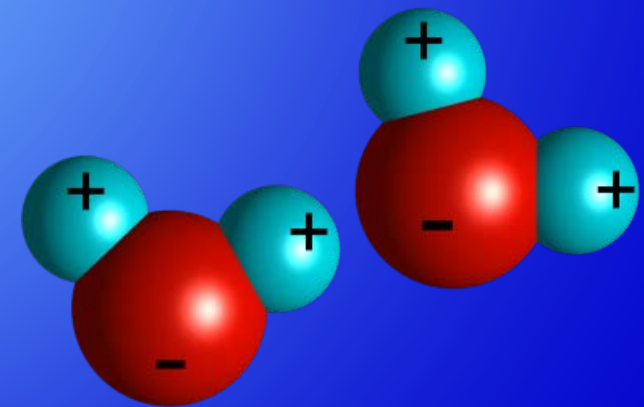
By Gary R. Stevens P.G.  
Idaho Department of Environmental Quality

Rathdrum Prairie CAMP  
Coeur d'Alene, Idaho  
April 22, 2014



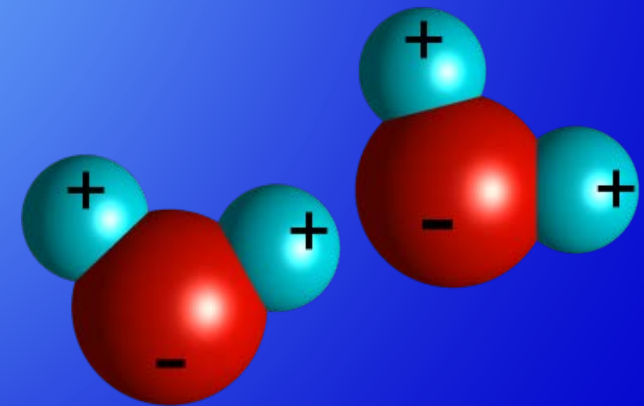
# Hydrogeochemical Investigation of the Rathdrum Prairie Aquifer

- Purpose
- Sample Locations
- Water Quality Parameters
- Analytical Results



# Hydrogeochemical Investigation of the Rathdrum Prairie Aquifer

- **Purpose**
- Sample Locations
- Water Quality Parameters
- Analytical Results



# Purpose

- Improve the geographic distribution of wells



- Identify potential water quality impacts from anthropogenic activities and natural occurring constituents



- Determine age/residence times of ground water

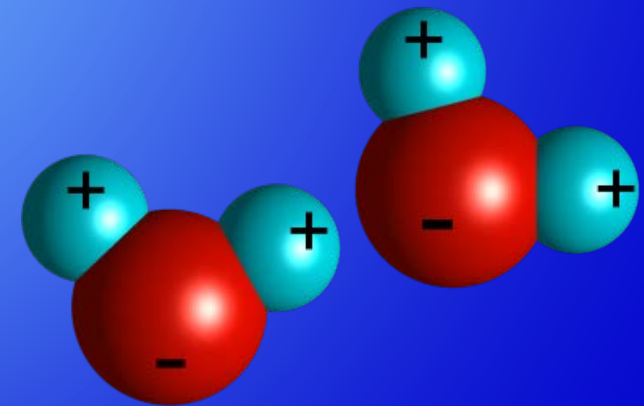


- Define recharge sources

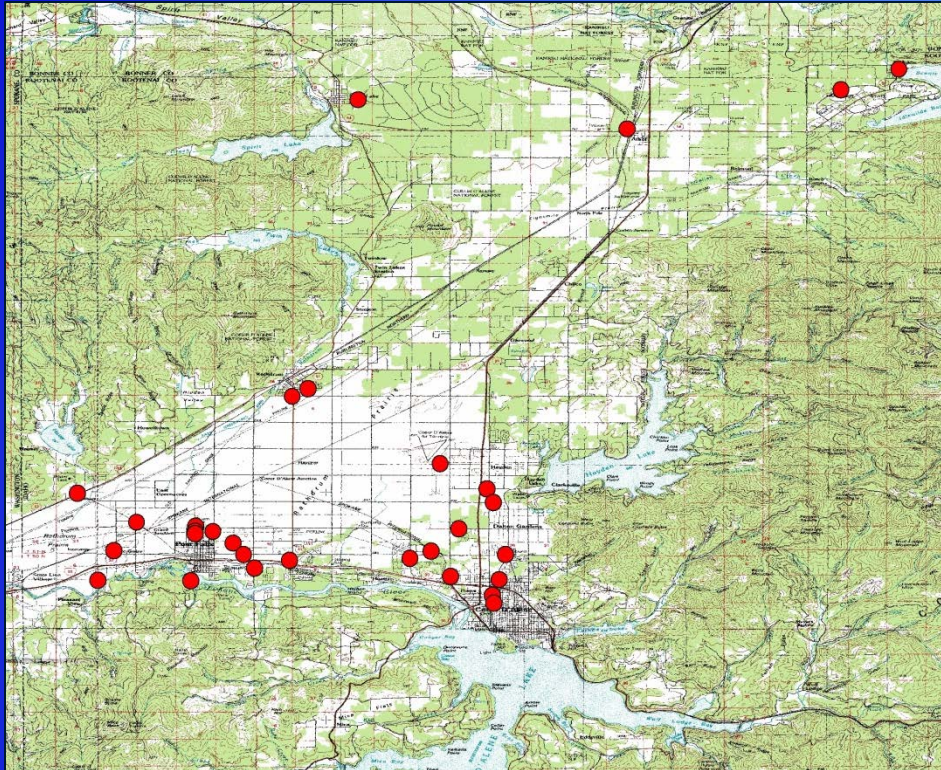


# Hydrogeochemical Investigation of the Rathdrum Prairie Aquifer

- Purpose
- **Sample Locations**
- Water Quality Parameters
- Analytical Results

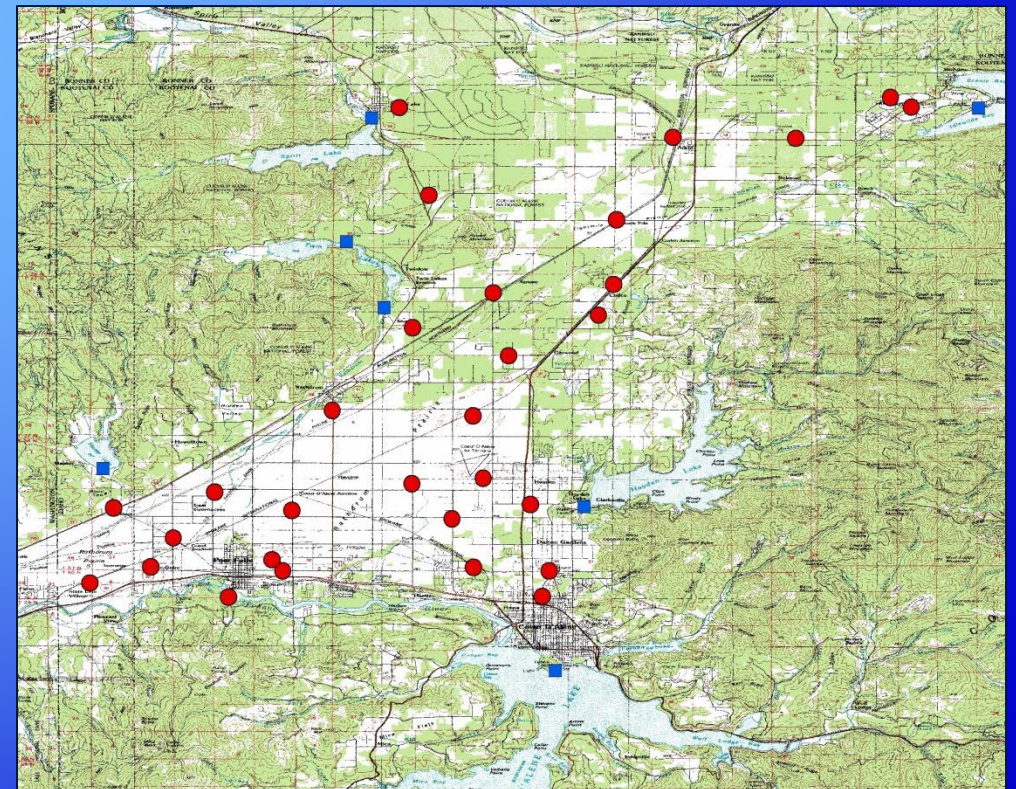


# Sample Locations - Geographic Distribution



Panhandle Health District

## RPA Hydrogeochemistry Investigation



# Sample Locations – Community/Municipal Wells



- Sample Tap
- Proper Construction
- Regularly Pumped/Purged

## Con

- Sampling for drinking water constituents
- If exceedance then would have to take the appropriate regulatory action

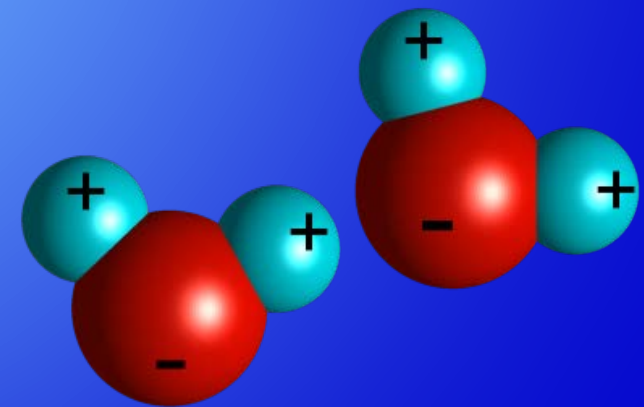
## Pro

- Sampling for drinking water constituents
- Can use analytical results for required regulatory sampling



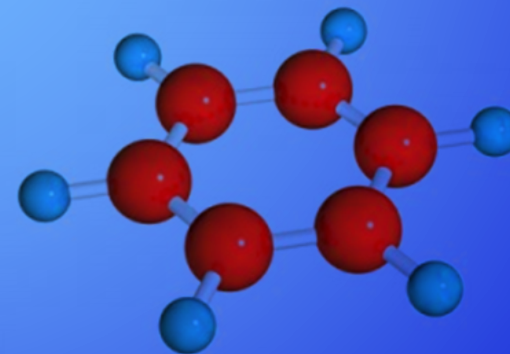
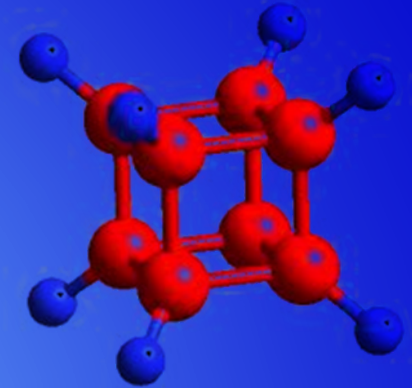
# Hydrogeochemical Investigation of the Rathdrum Prairie Aquifer

- Purpose
- Sample Locations
- **Water Quality Parameters**
- Analytical Results



# Water Quality Parameters

- Major cations and anions
- Inorganic Constituents
  - Arsenic
  - Bromide
  - Nitrate & Nitrate Isotopes
- VOC's & SOC's
- Radionuclides
  - Uranium
  - Radium 226
  - Radium 228
- CFC's & SF6 – Age Dating
- Deuterium & Oxygen -18
- Temperature, pH, conductivity and DO were measured at each sampling location



# Sample Schedule

June, 2012

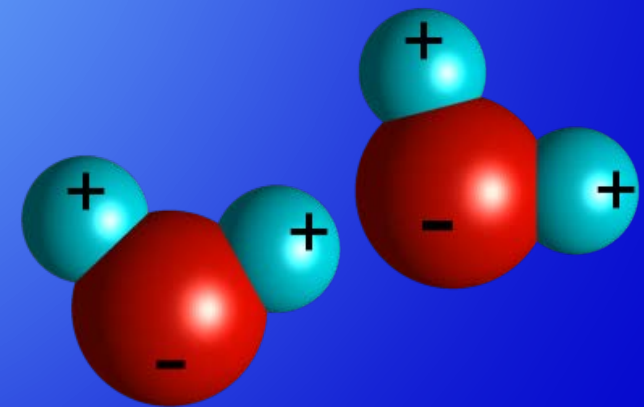
September 2012

January/February 2013

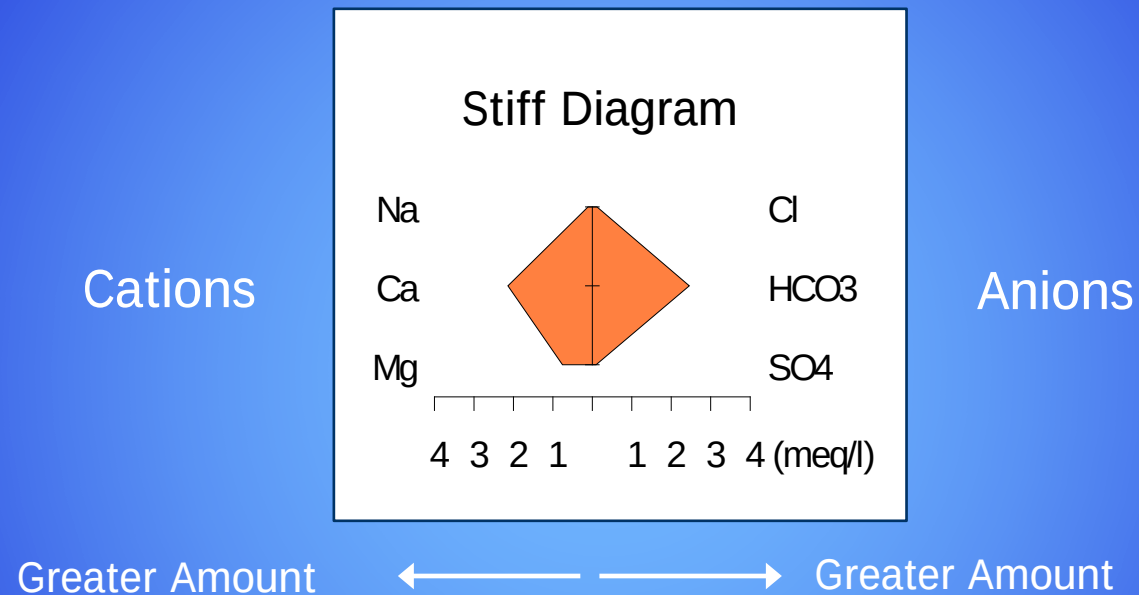
|                                                                                       |                                                |
|---------------------------------------------------------------------------------------|------------------------------------------------|
| Ca<br>Na<br>Mg<br>K<br>HCO <sub>3</sub><br>Cl<br>SO <sub>4</sub>                      | All Wells & Lakes<br>All Three Sampling Events |
| Br<br>TOC<br>As                                                                       | All Wells<br>All Three Sampling Events         |
| VOC - WA List<br>SOC - WA List                                                        | All Wells<br>June Sampling Event               |
| Uranium<br>Radium 226<br>Radium 228                                                   | All Wells<br>June Sampling Event               |
| <sup>2</sup> H<br><sup>18</sup> O                                                     | All Wells & Lakes<br>All Three Sampling Events |
| CFC & SF6                                                                             | Sixteen Wells<br>September Sampling Event      |
| <sup>15</sup> N-NO <sub>3</sub><br><sup>18</sup> O-NO <sub>3</sub><br>NO <sub>3</sub> | All Wells<br>June Sampling Event               |

# Hydrogeochemical Investigation of the Rathdrum Prairie Aquifer

- Purpose
- Sample Locations
- Water Quality Parameters
- **Analytical Results**



# Major Cations & Anions

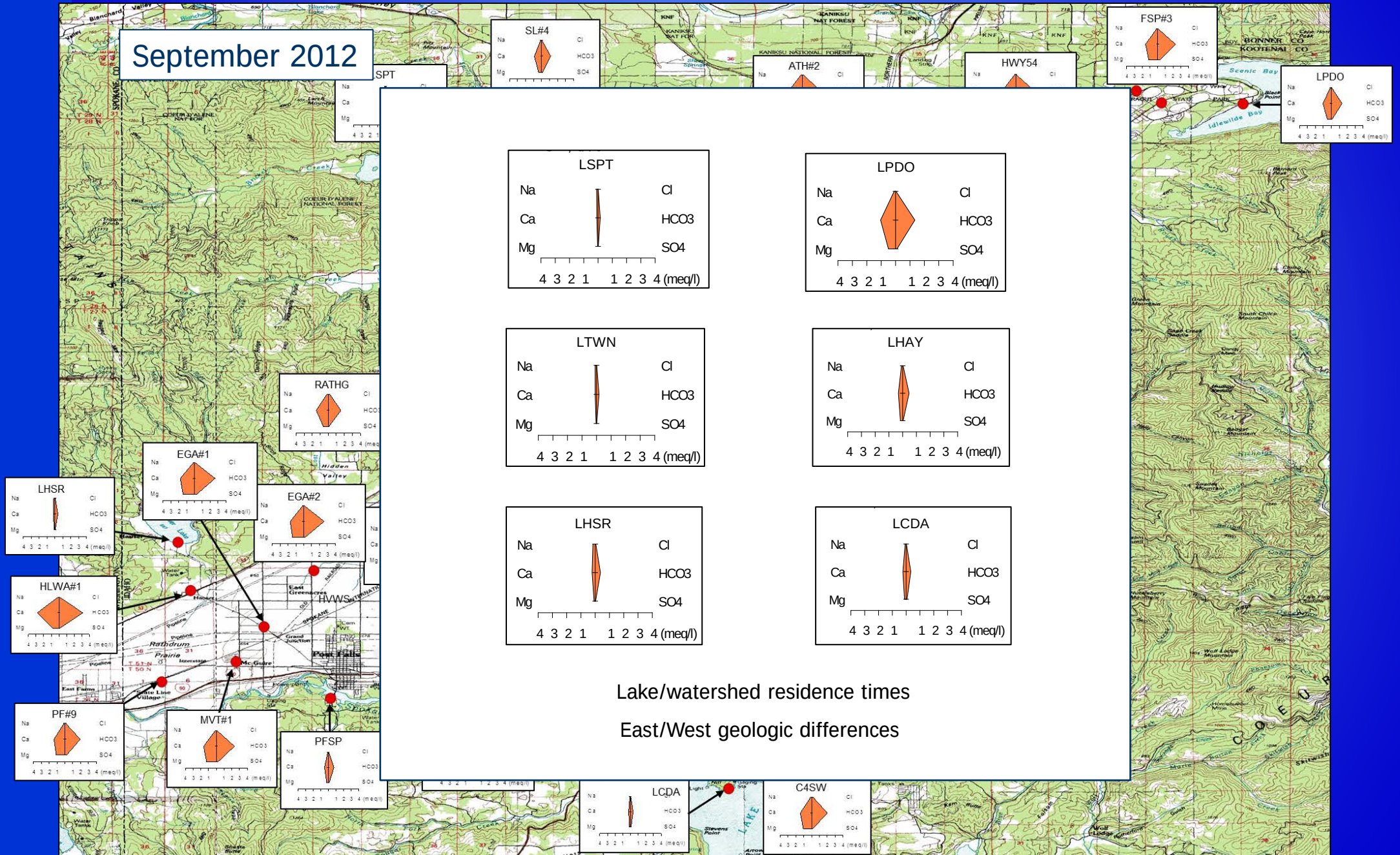


Equivalent = mass of chemical x charge of chemical

Better description of how cations and anions chemically react with each other

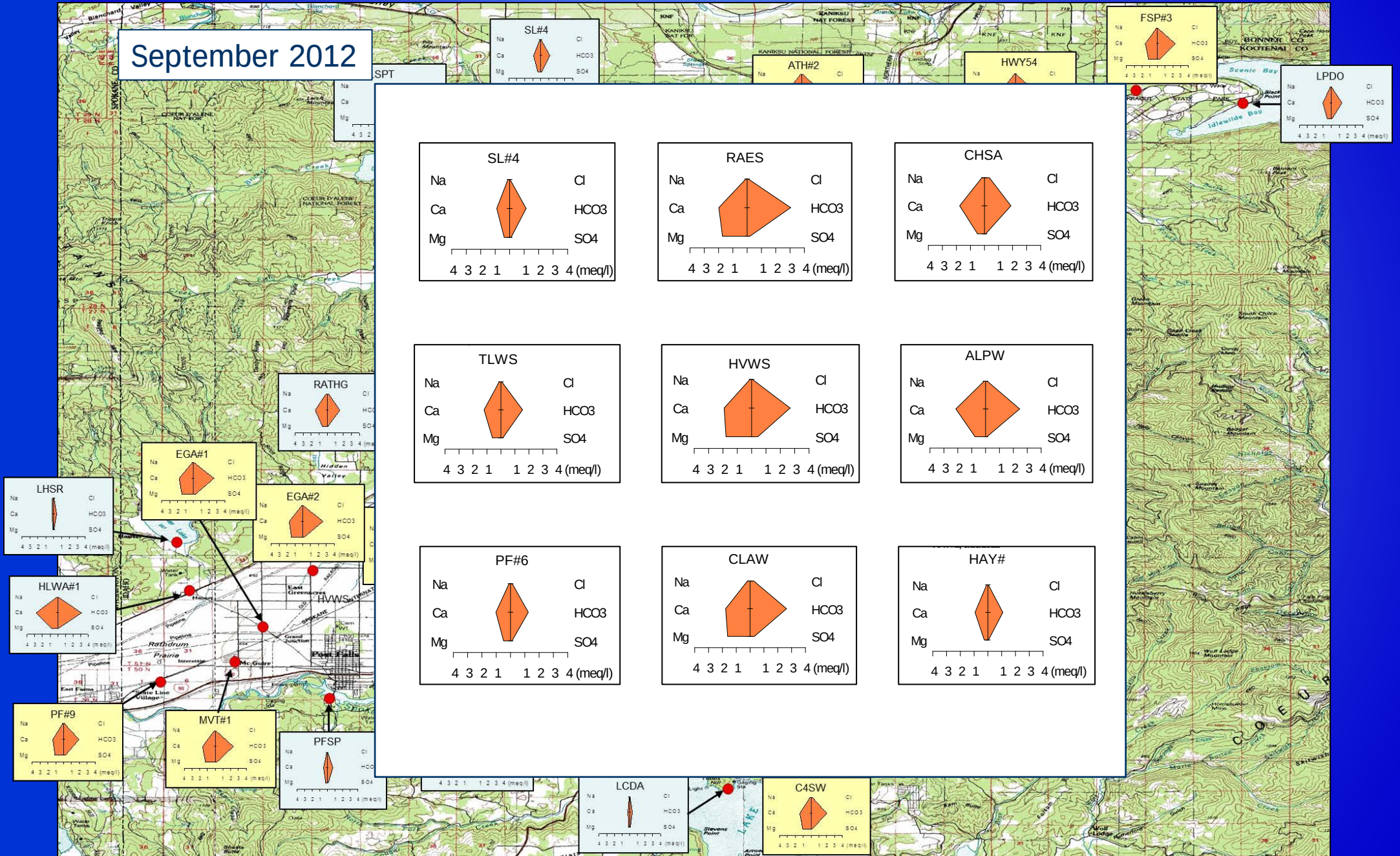
# Major Cations & Anions

September 2012



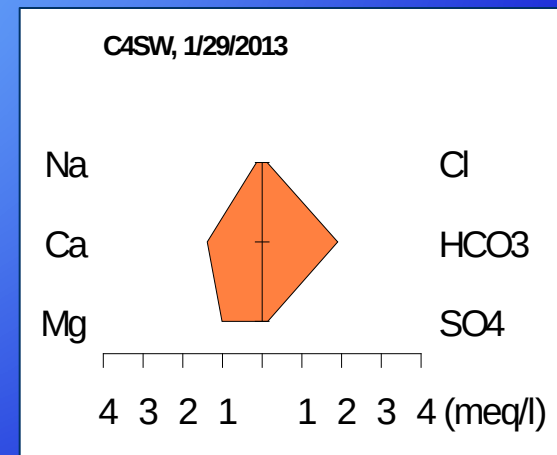
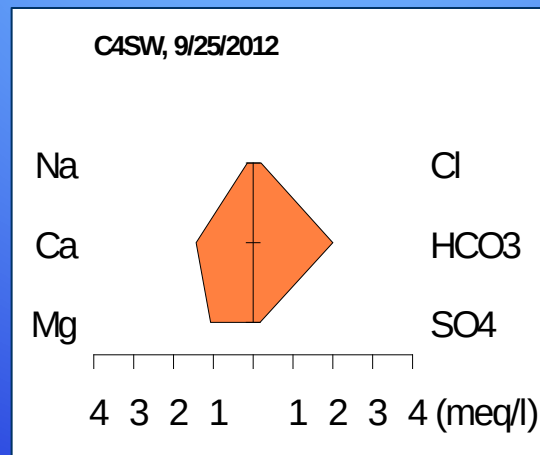
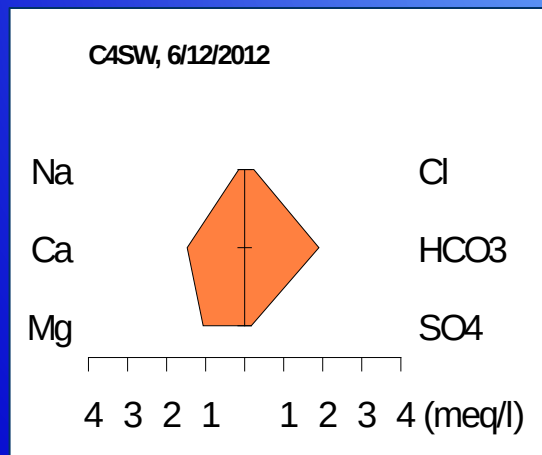
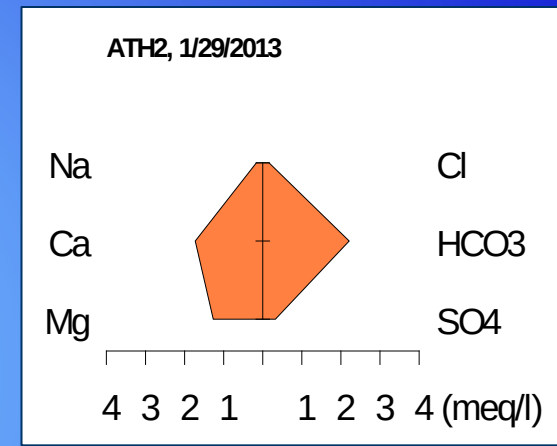
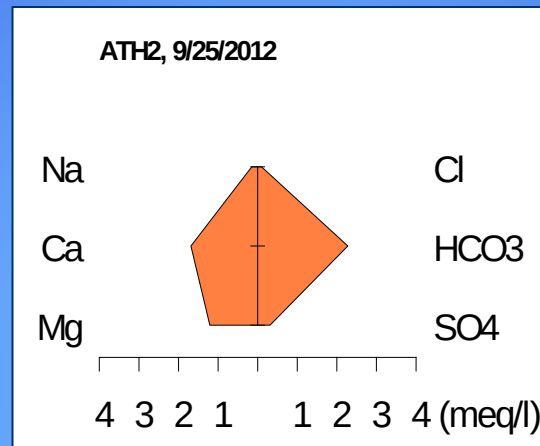
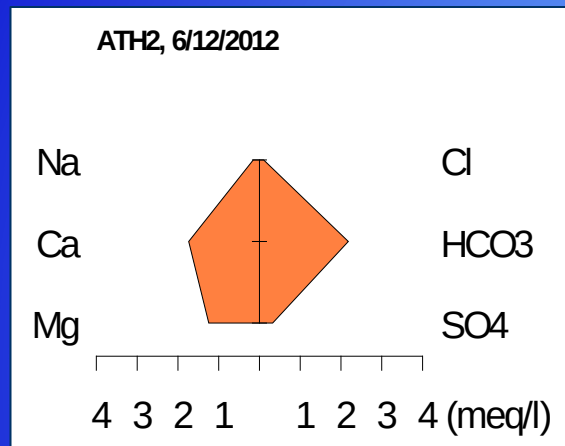
# Major Cations & Anions

September 2012

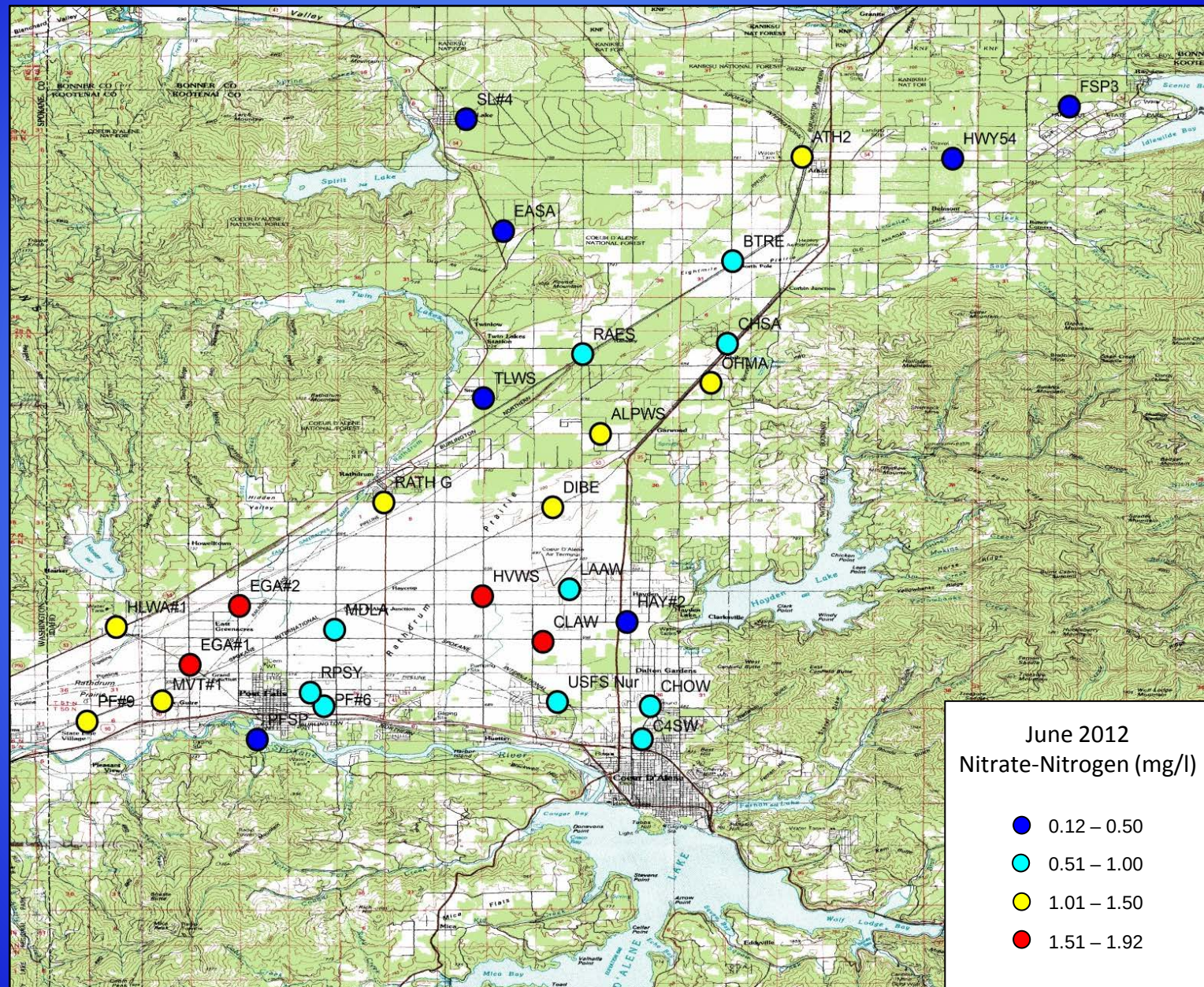


# Major Cations & Anions

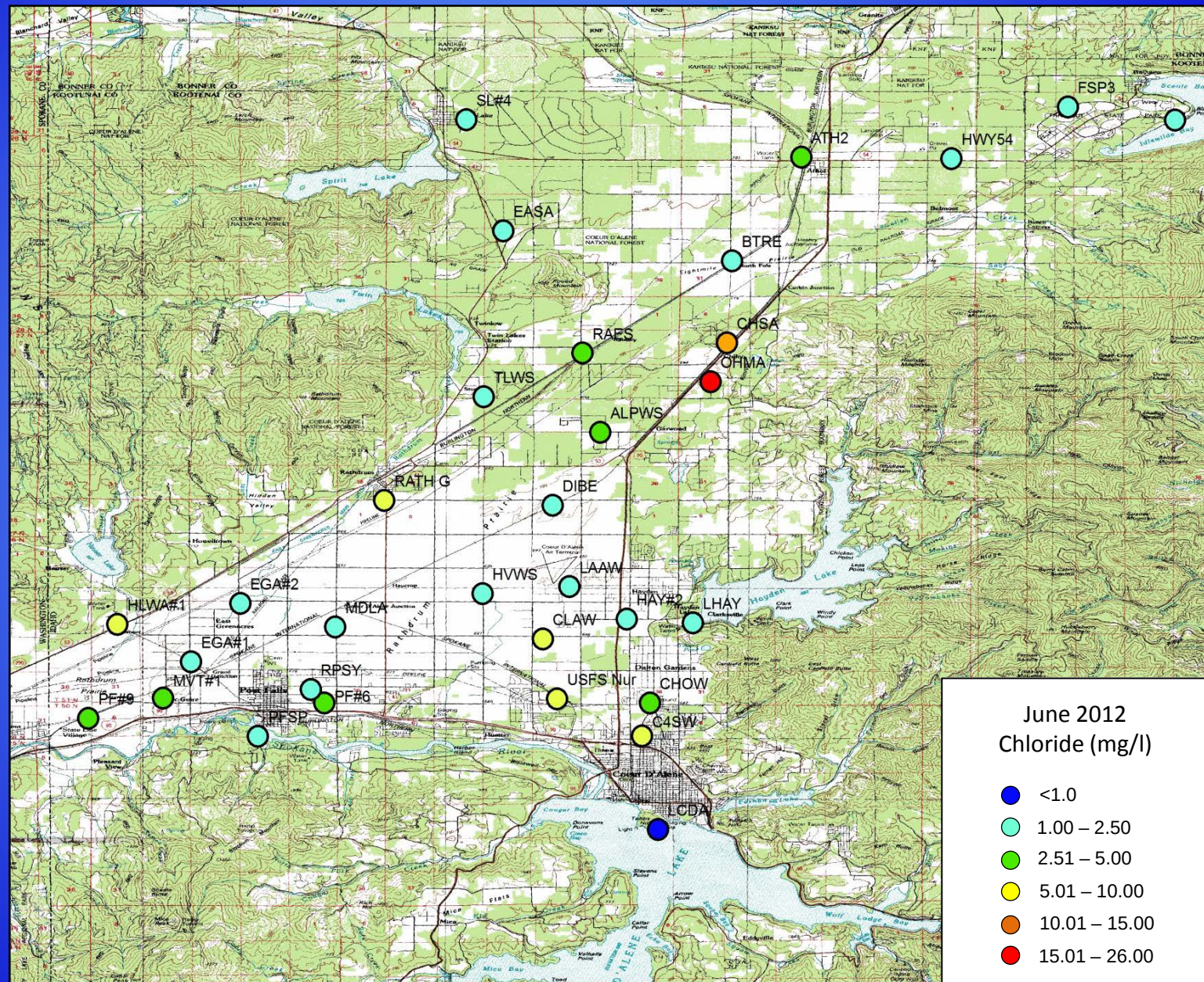
Does not appear to be seasonal variations



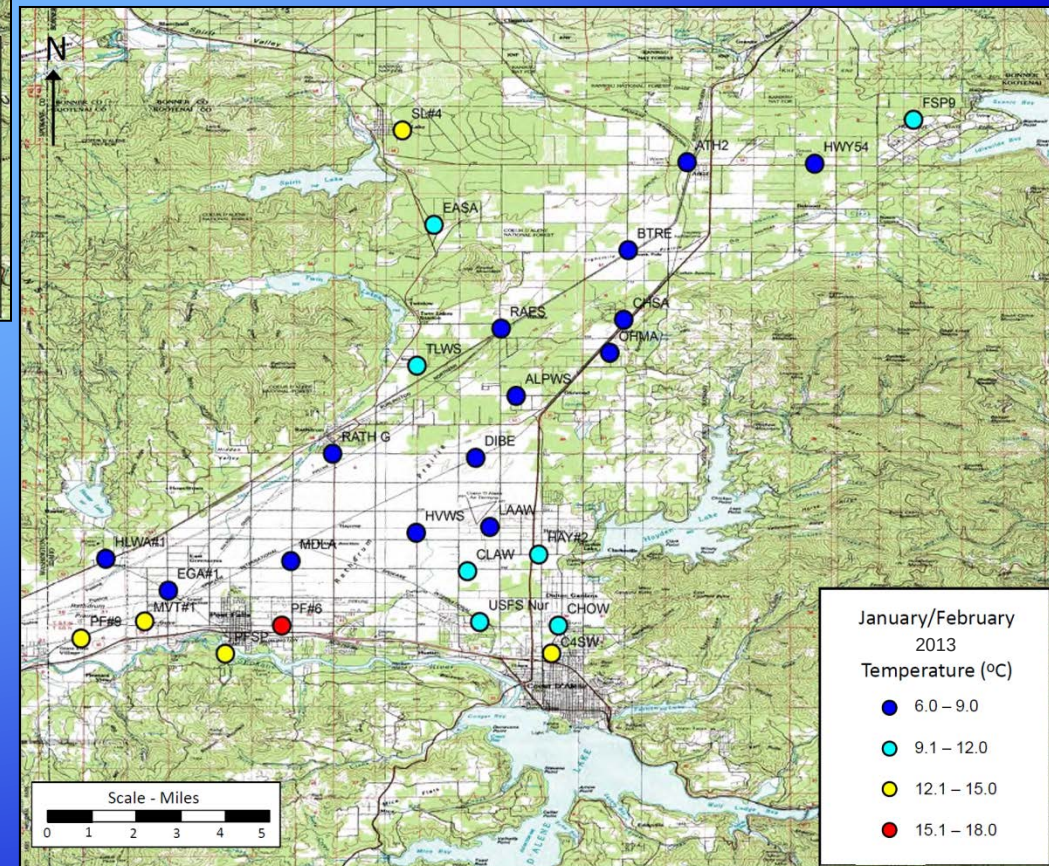
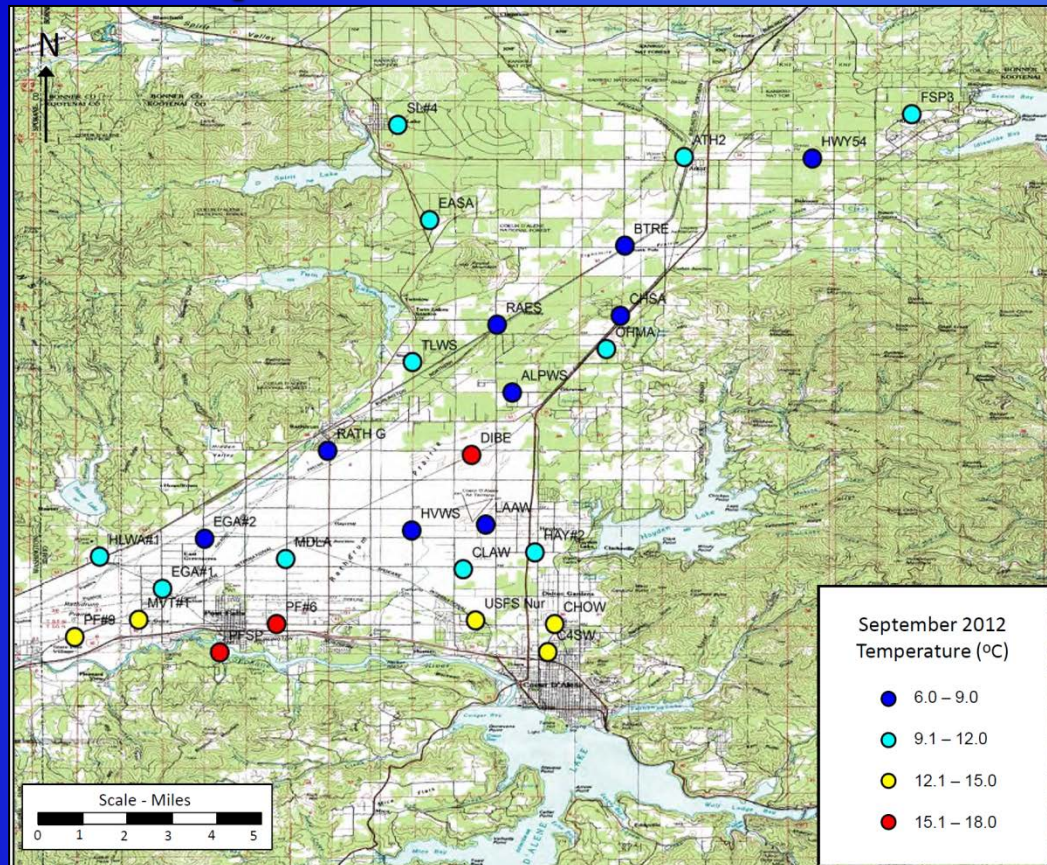
# Nitrate-Nitrogen Drinking Water Standard = 10 mg/l



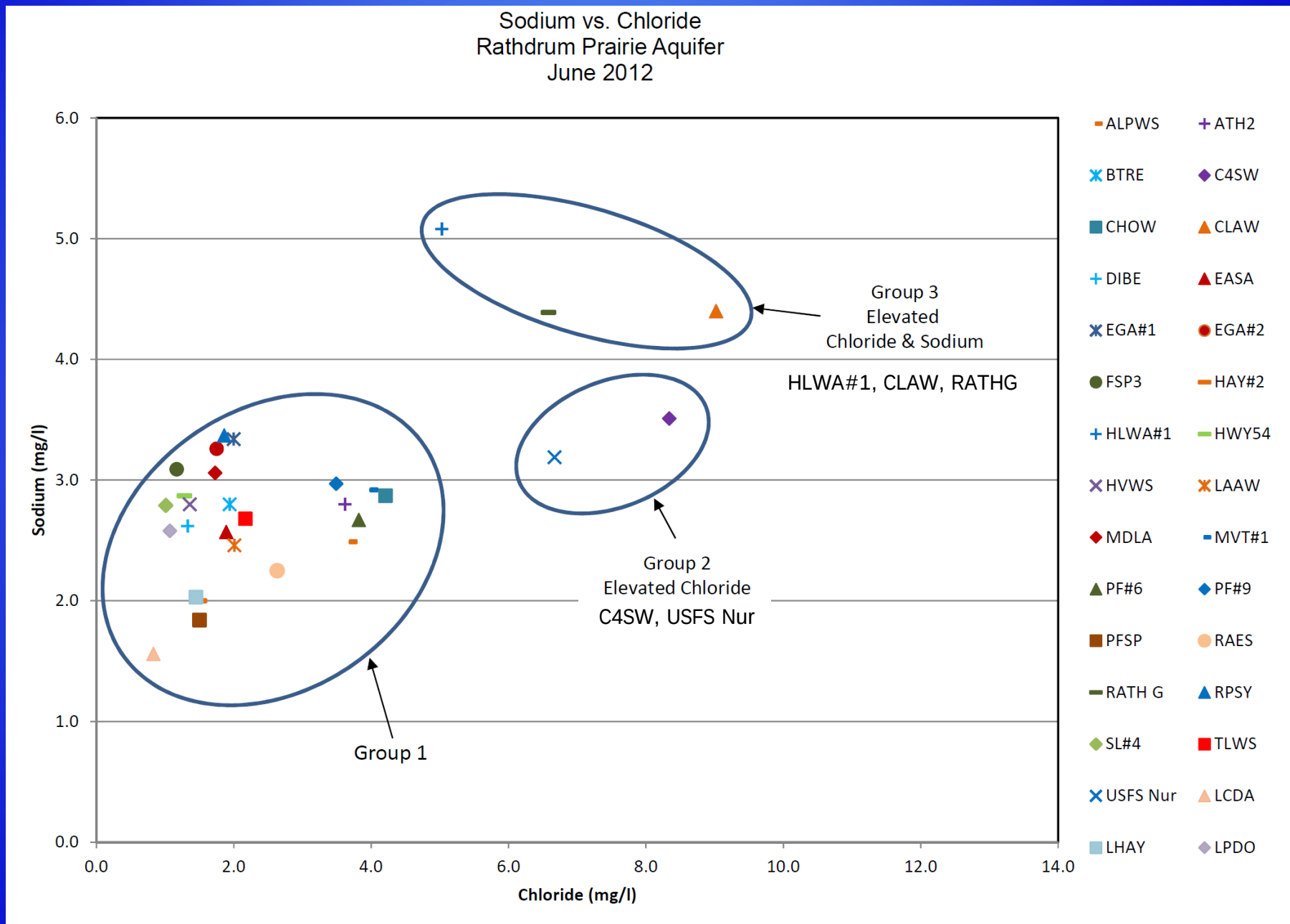
# Chloride - Secondary Drinking Water Standard = 250 mg/l



# Temperature

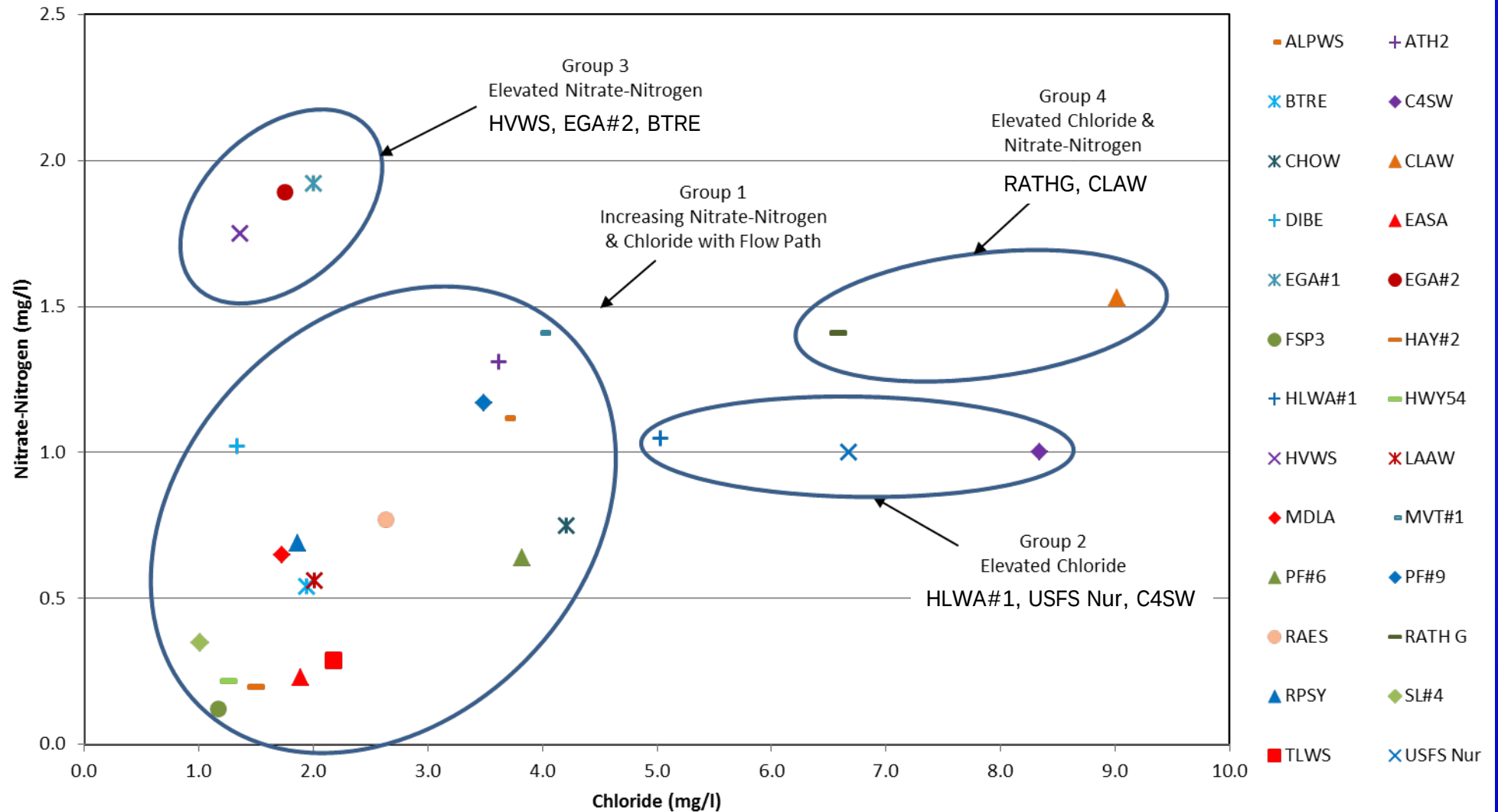


# Sodium vs Chloride



# Nitrate vs Chloride

Nitrate-Nitrogen vs. Chloride  
Rathdrum Prairie Aquifer  
June 2012



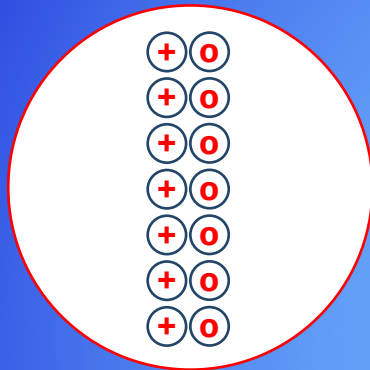
# Nitrate - Isotopes

**$^{14}\text{N}$**

7 Protons

7 Neutrons

Abundance = 99.634%

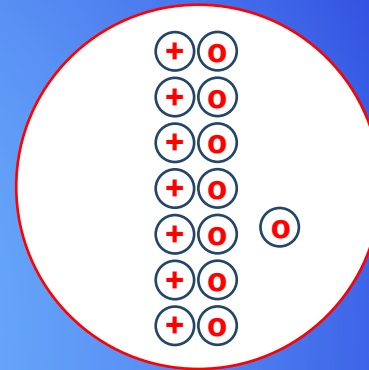


**$^{15}\text{N}$  – Stable Isotope**

7 Protons

8 Neutrons

Abundance = 0.366%

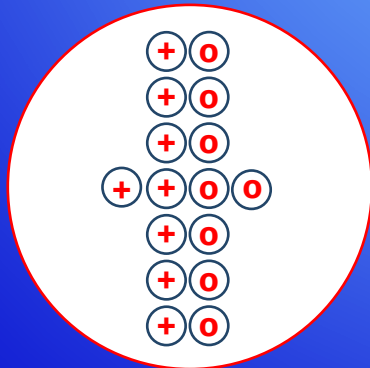


**$^{16}\text{O}$**

8 Protons

8 Neutrons

Abundance = 99.759%

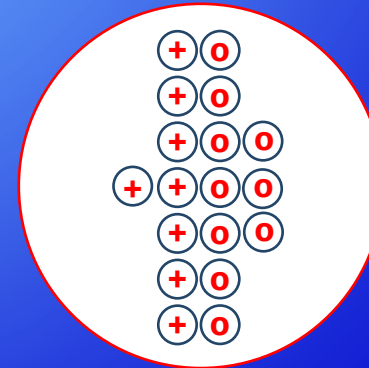


**$^{18}\text{O}$  – Stable isotope**

8 Protons

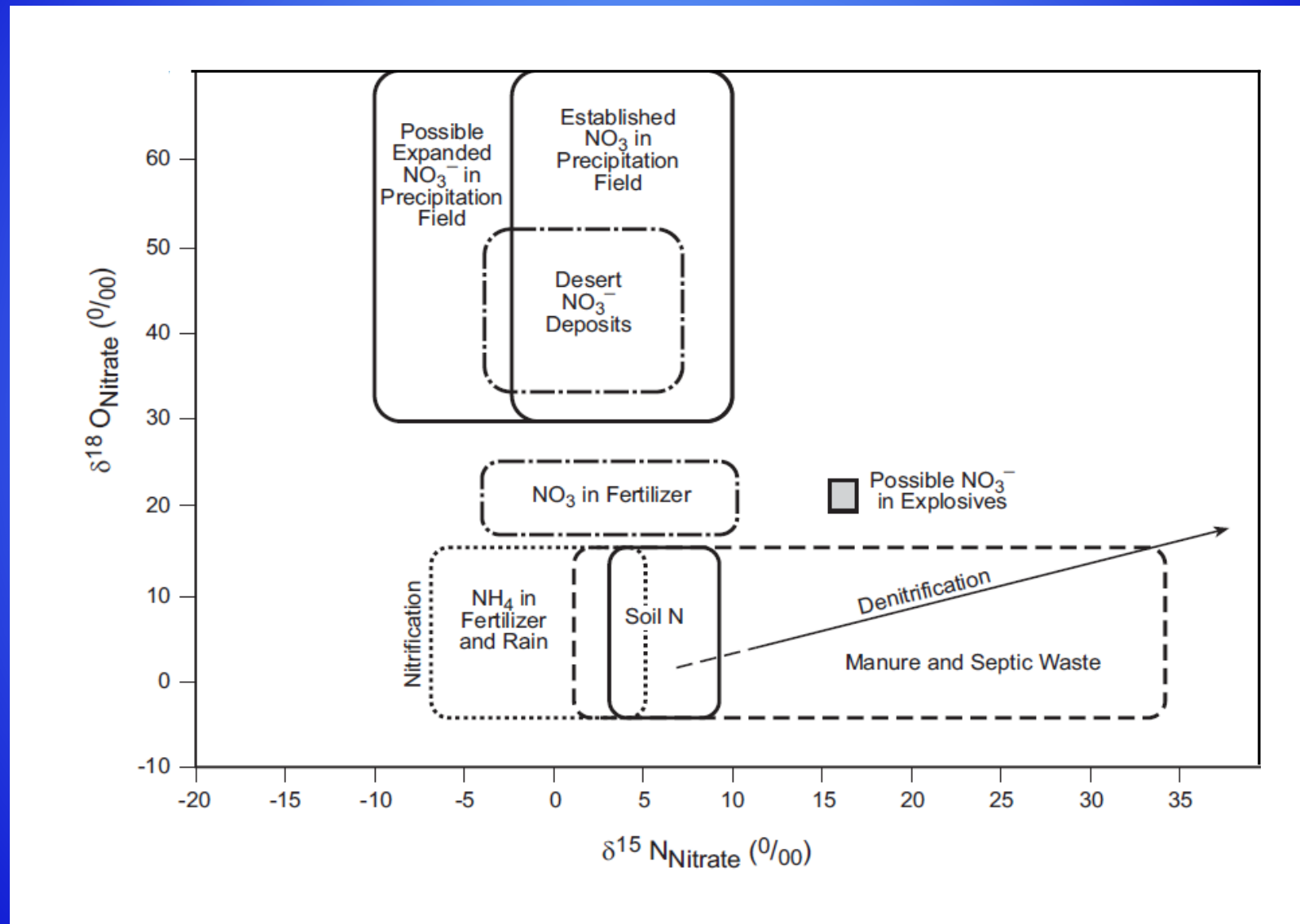
10 Neutrons

Abundance = 0.204%

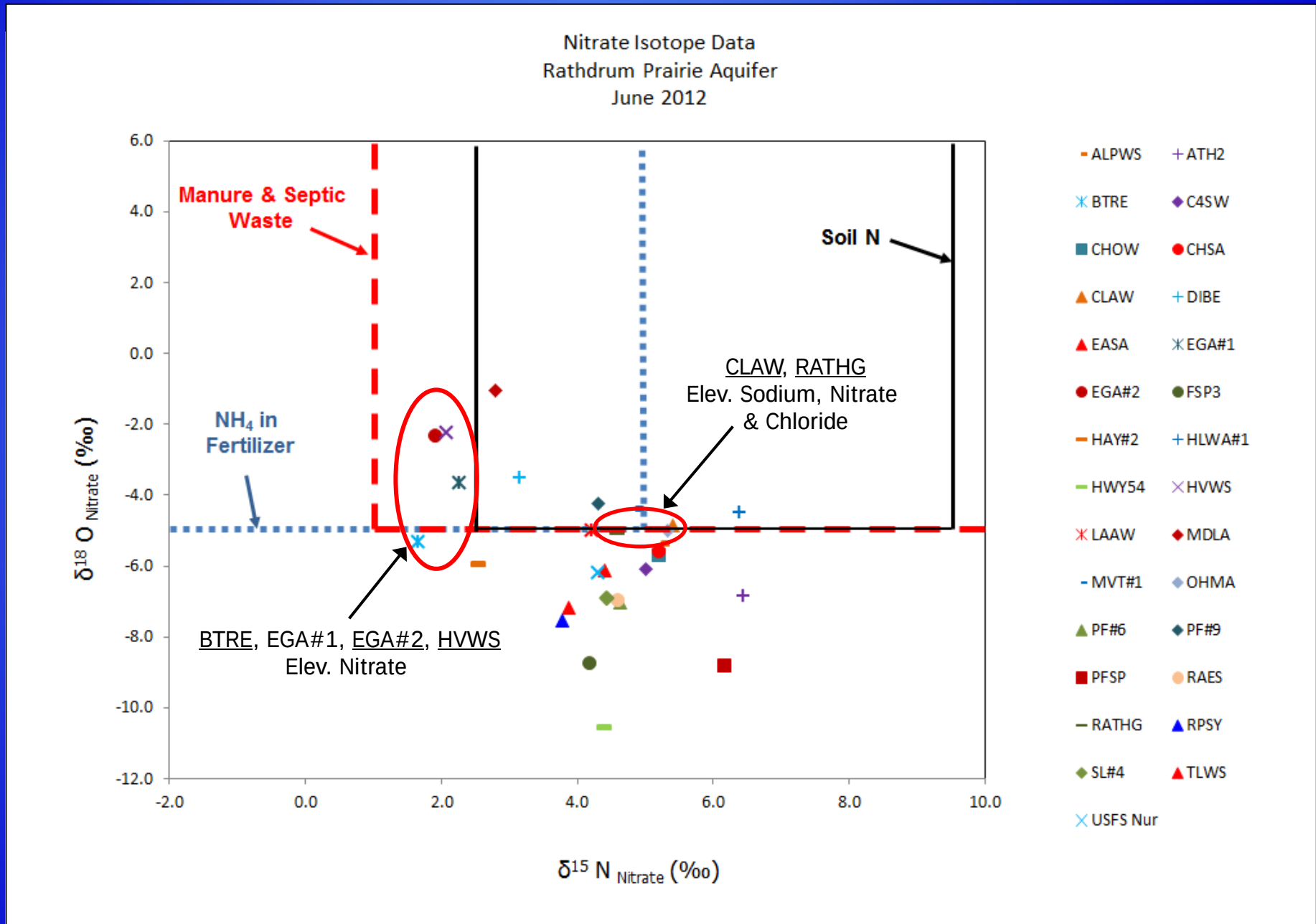


# Nitrate Isotopes

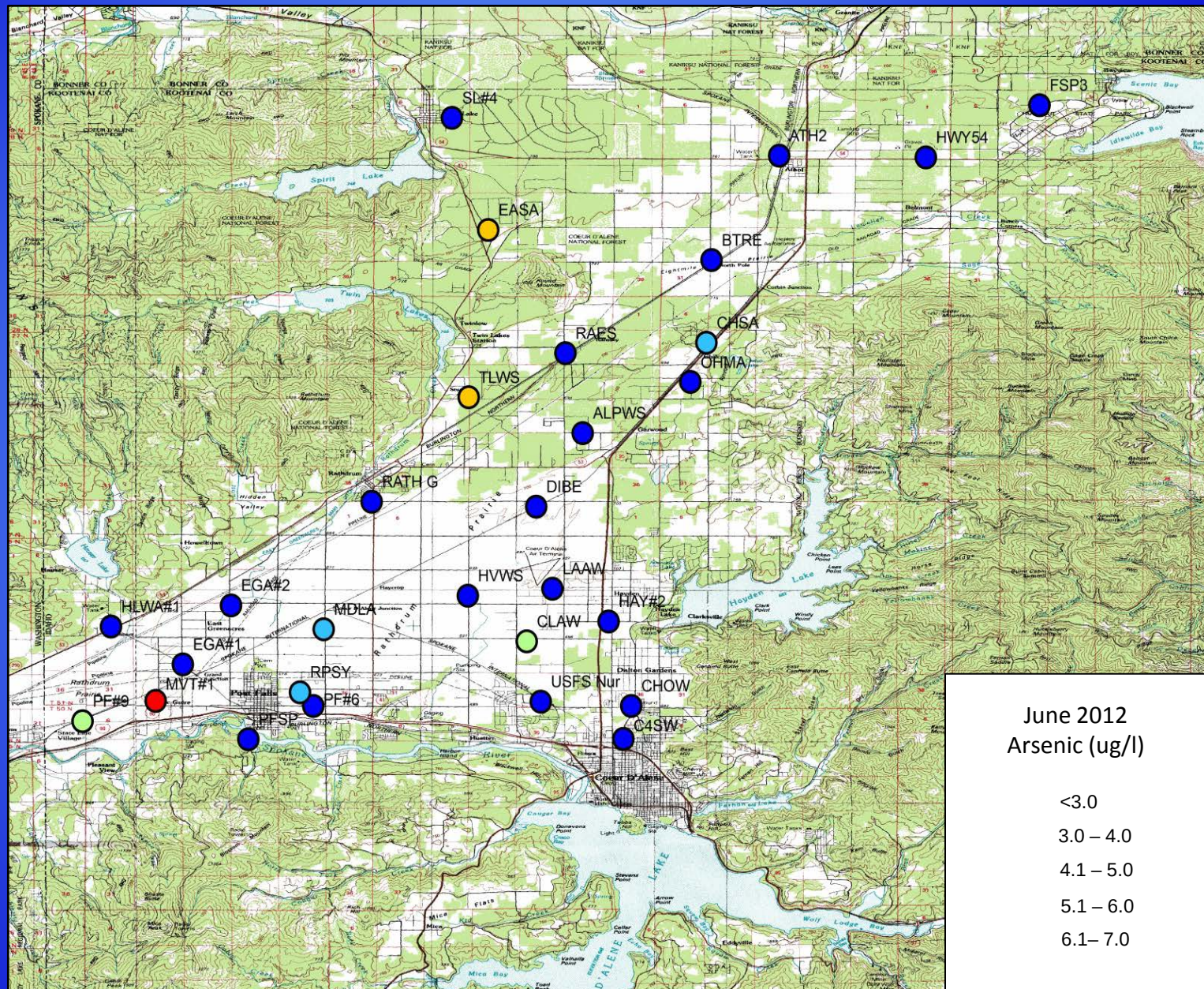
Ranges of  $N^{15}$  and  $O^{18}$  associated with different sources of Nitrogen-Nitrate



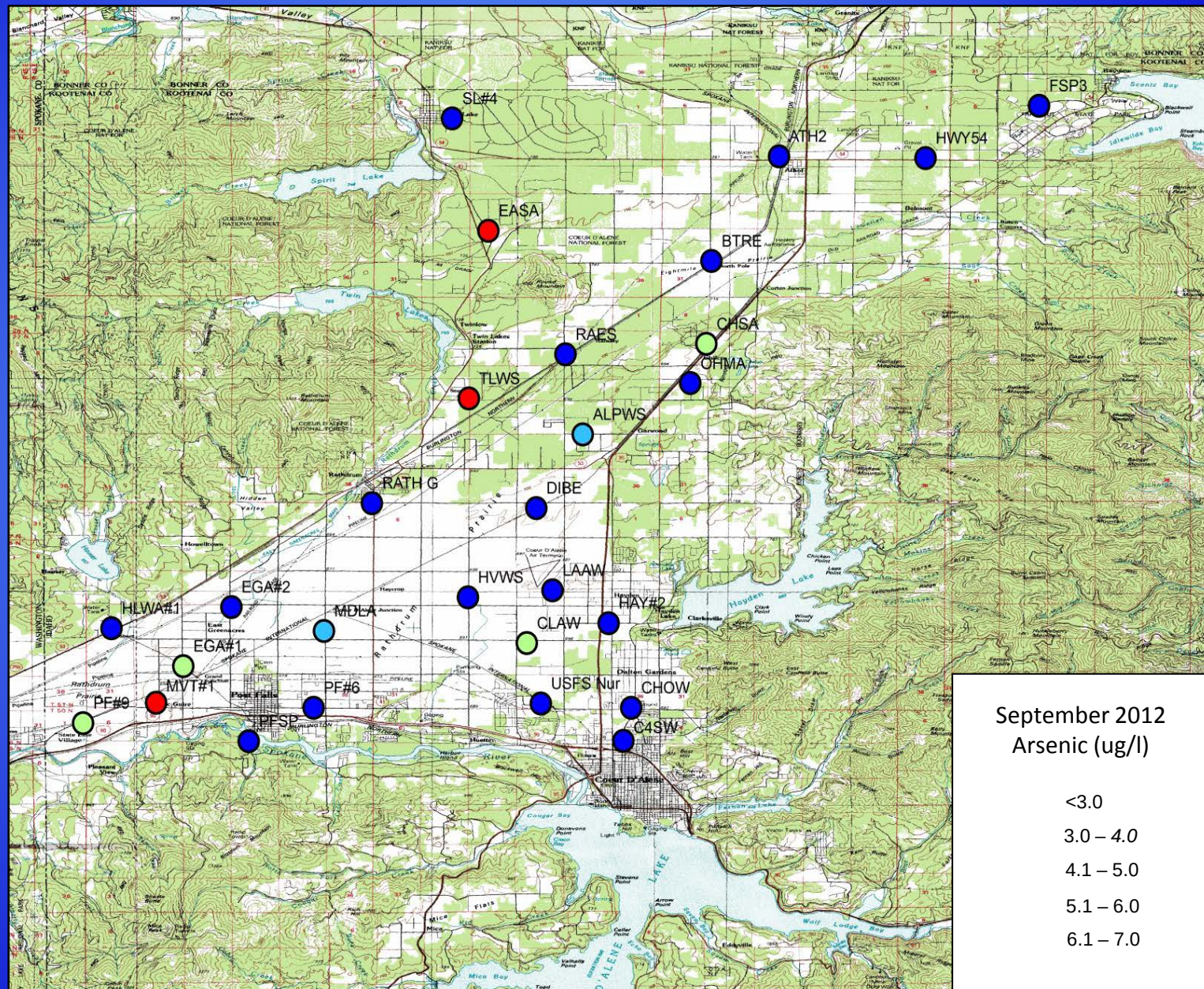
# Nitrogen-Nitrate



# Arsenic Drinking water Standard = 10 ug/l

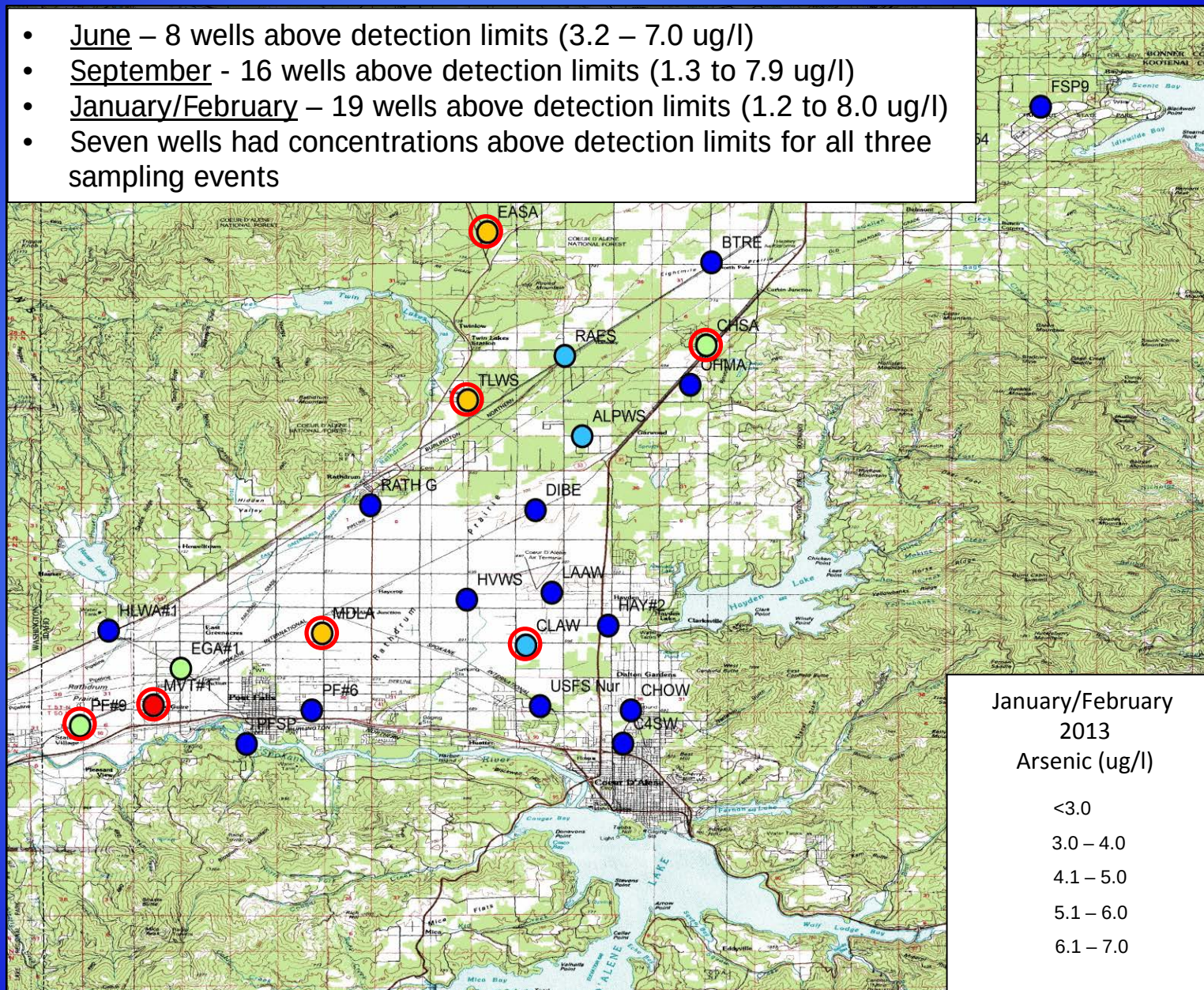


# Arsenic Drinking water Standard = 10 ug/l



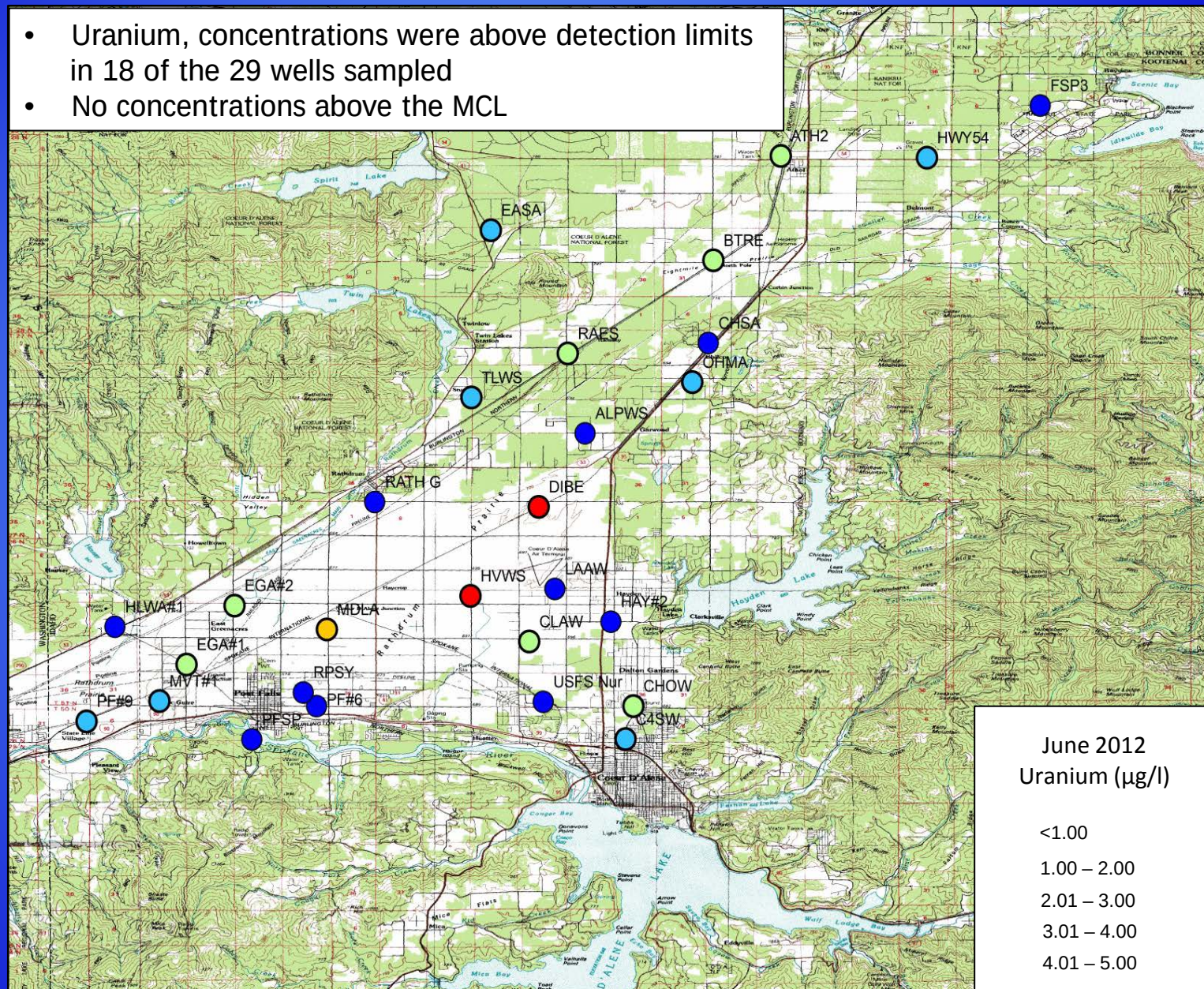
# Arsenic Drinking water Standard = 10 ug/l

- June – 8 wells above detection limits (3.2 – 7.0 ug/l)
- September - 16 wells above detection limits (1.3 to 7.9 ug/l)
- January/February – 19 wells above detection limits (1.2 to 8.0 ug/l)
- Seven wells had concentrations above detection limits for all three sampling events

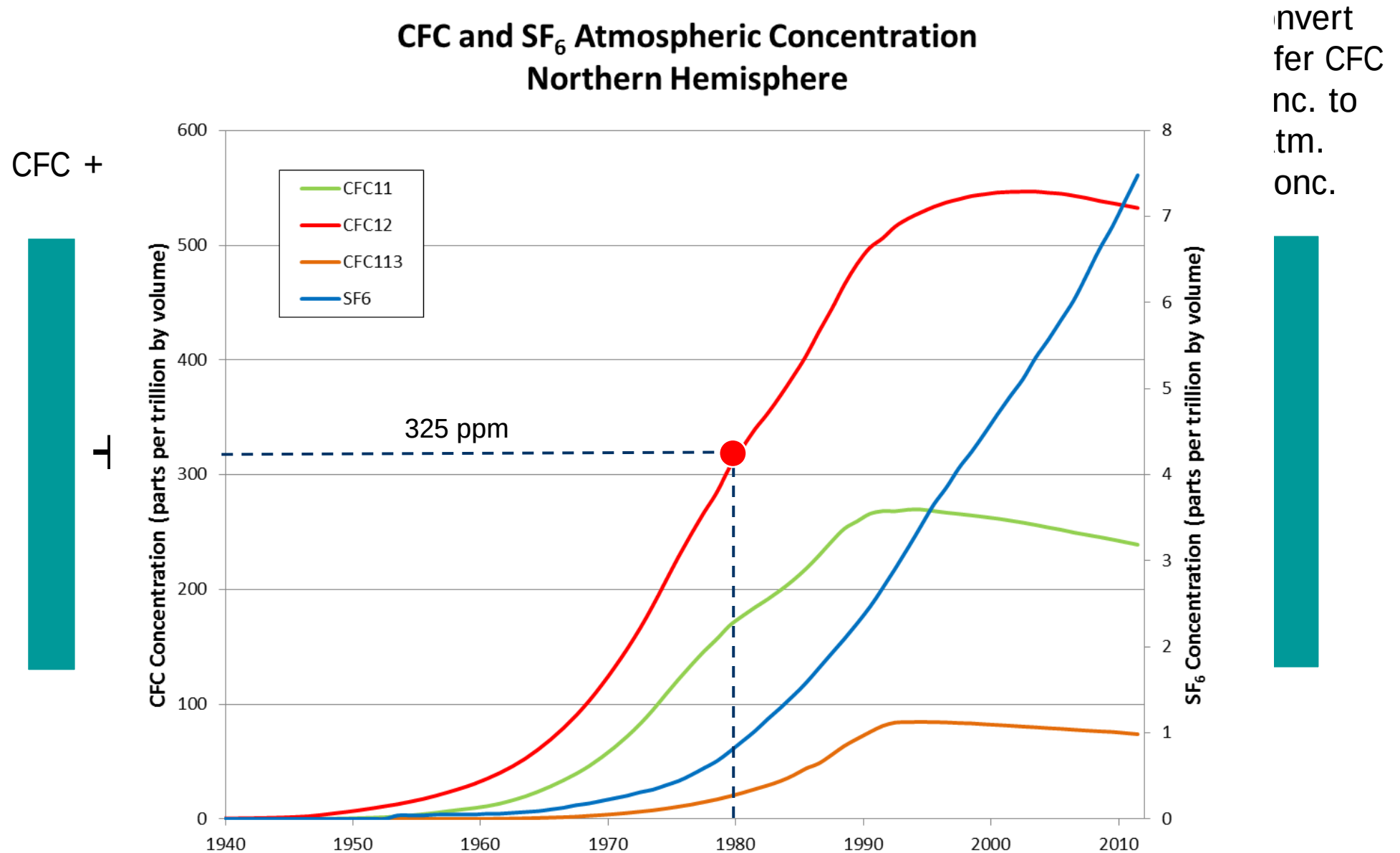


# Uranium - Drinking water Standard = 30 ug/l

- Uranium, concentrations were above detection limits in 18 of the 29 wells sampled
- No concentrations above the MCL



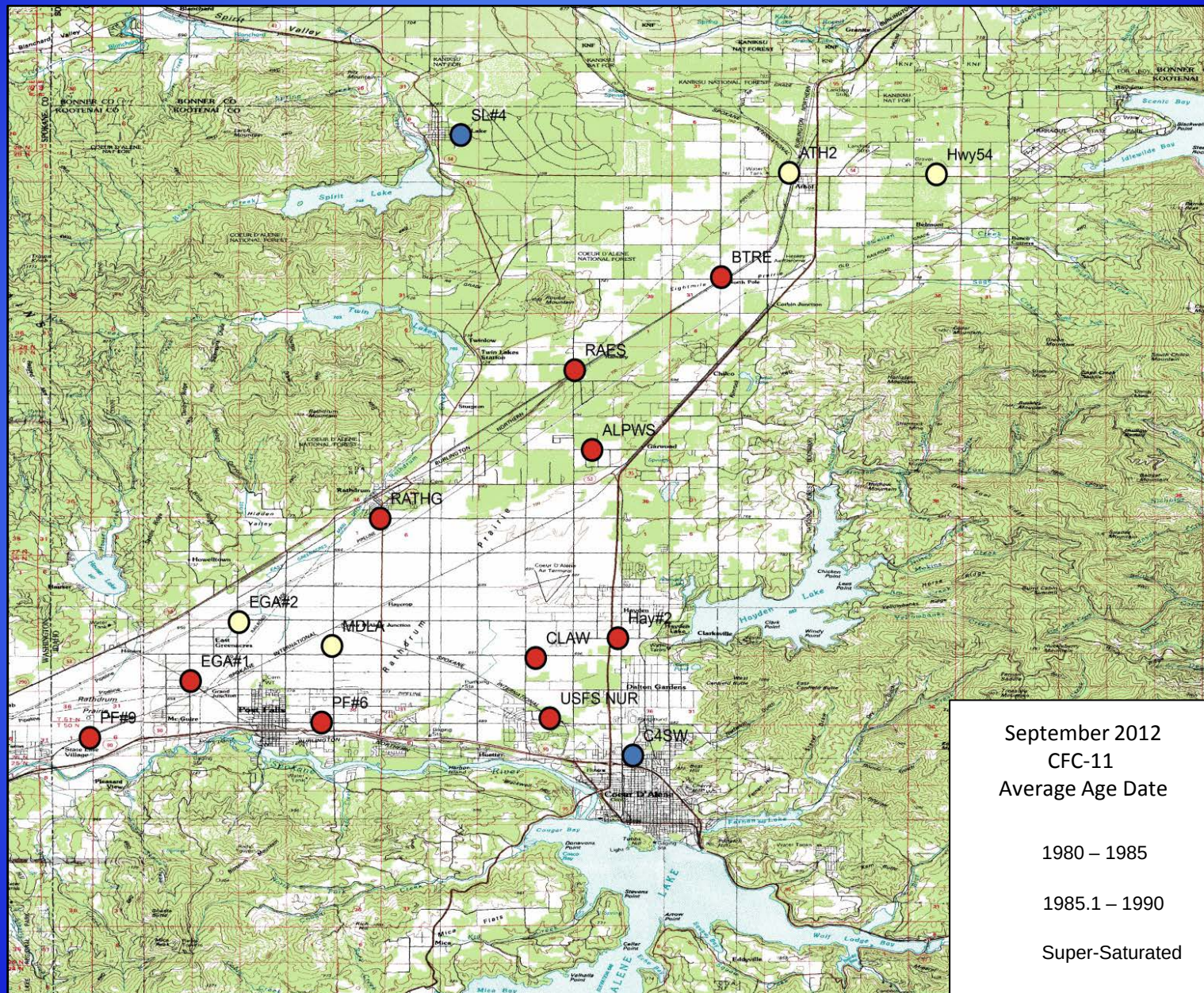
# Age Dating – Chlorofluorocarbons & Sulfur Hexafluoride



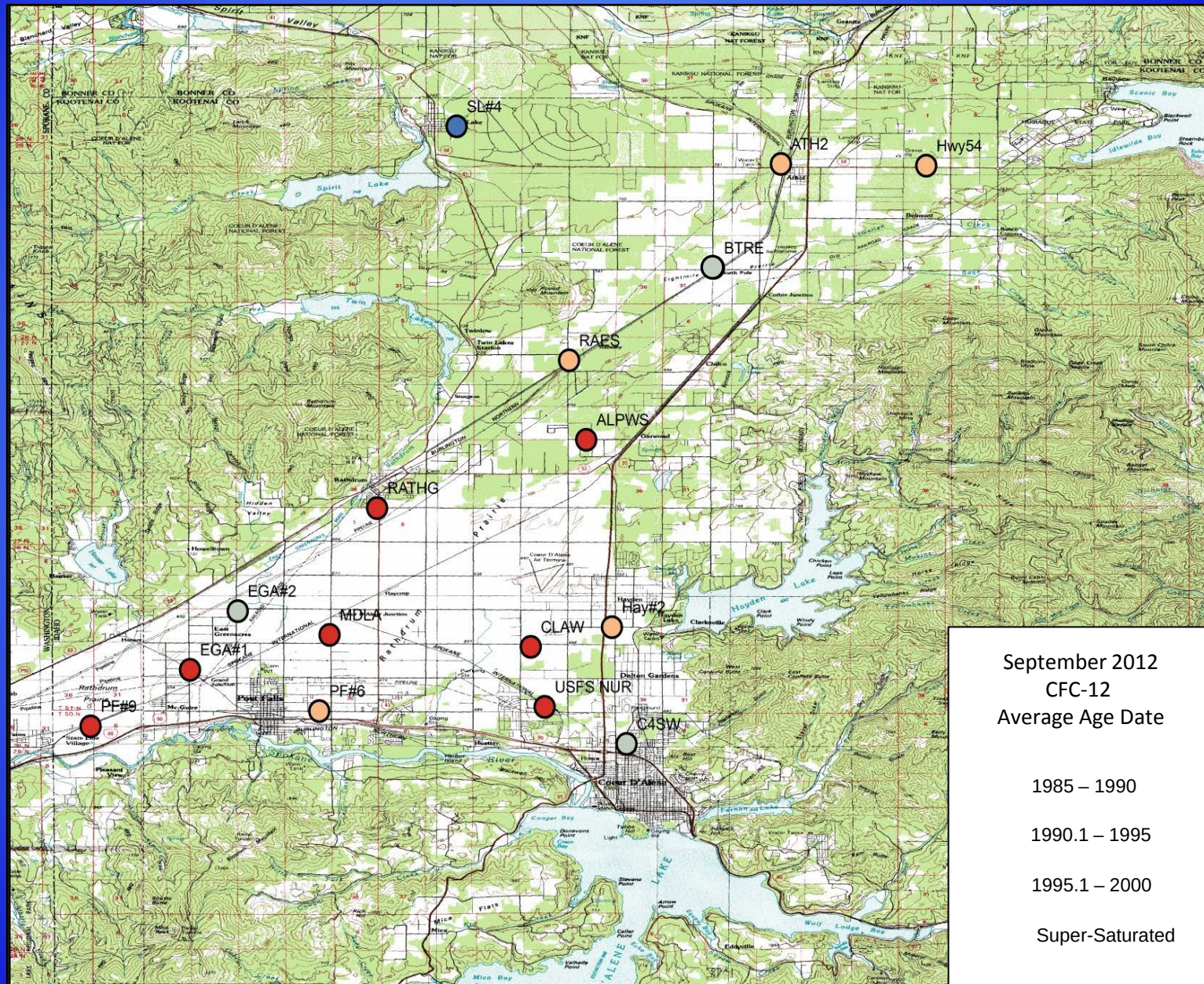
# Age Dating – Chlorofluorocarbons & Sulfur Hexafluoride



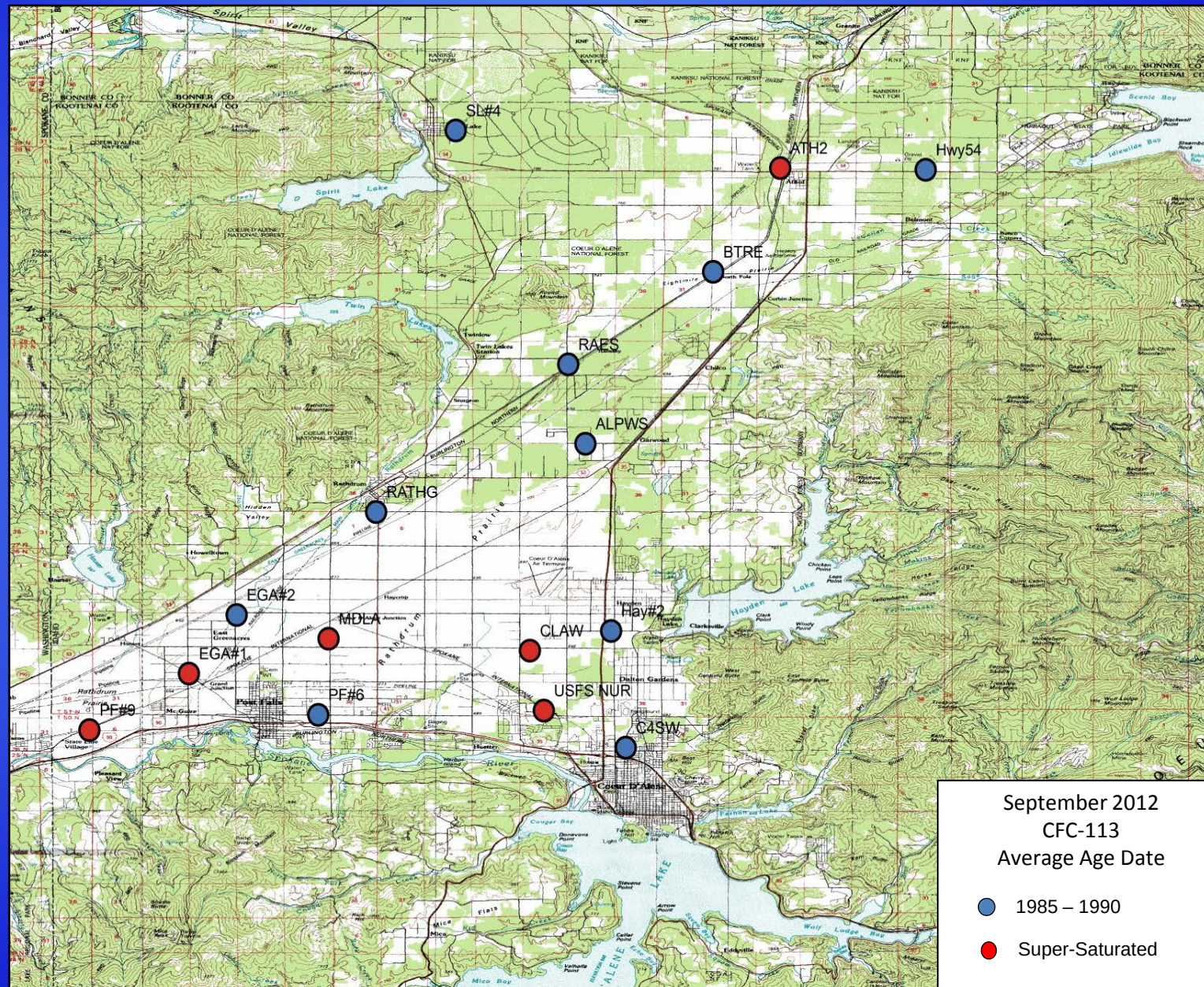
# Age Dating – Chlorofluorocarbons & Sulfur Hexafluoride



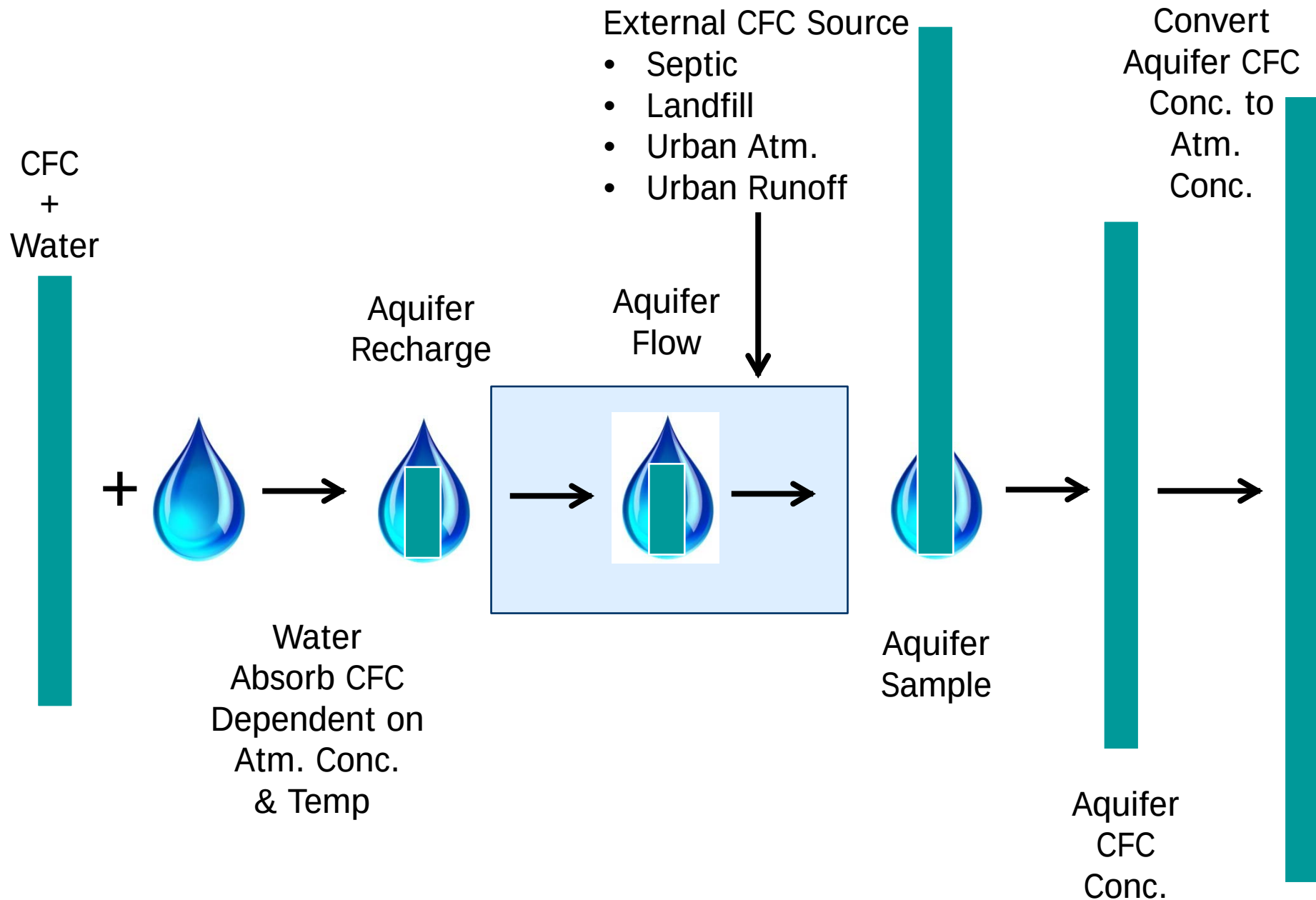
# Age Dating – Chlorofluorocarbons & Sulfur Hexafluoride



# Age Dating – Chlorofluorocarbons & Sulfur Hexafluoride

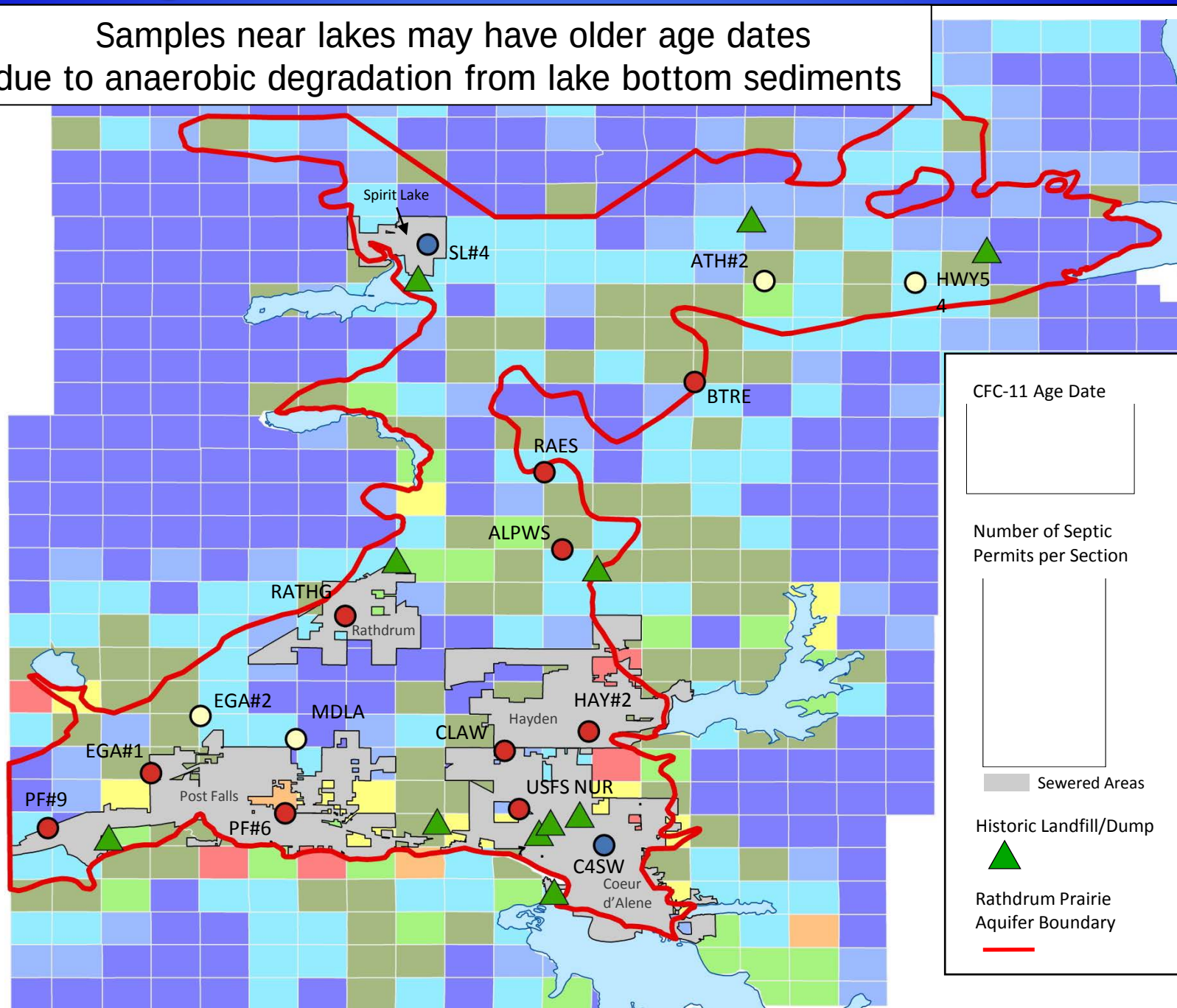


# Age Dating – Chlorofluorocarbons & Sulfur Hexafluoride

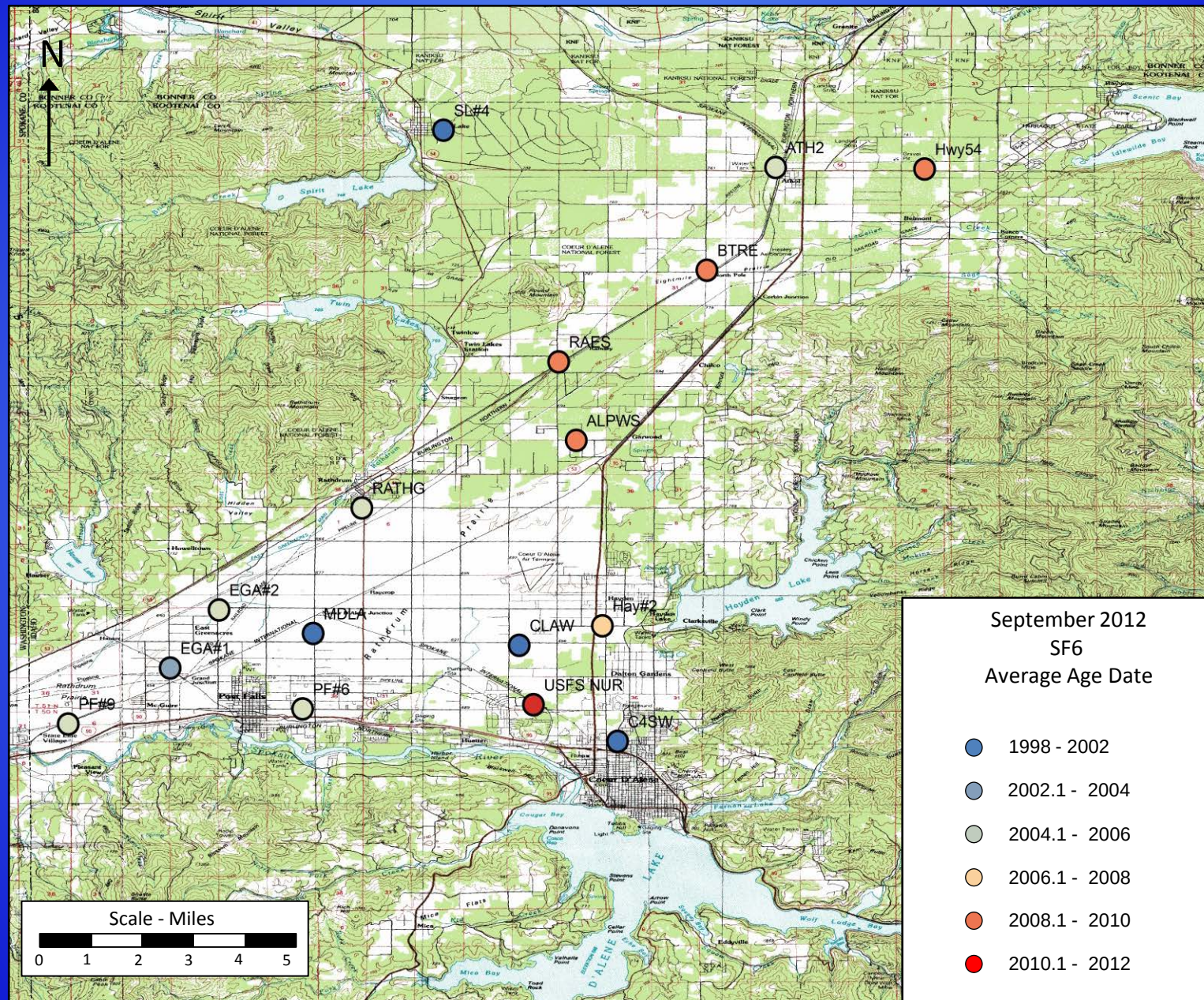


# Age Dating – Chlorofluorocarbons & Sulfur Hexafluoride

Samples near lakes may have older age dates due to anaerobic degradation from lake bottom sediments



# Age Dating – Chlorofluorocarbons & Sulfur Hexafluoride



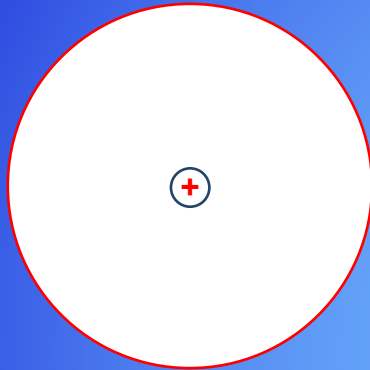
# Deuterium & Oxygen 18

$^1\text{H}$

1 Proton

0 Neutron

Abundance = 99.98%

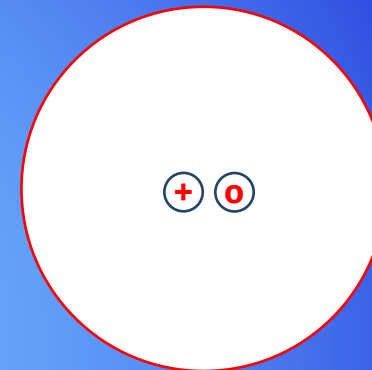


$^2\text{H}$  – Stable Isotope

1 Proton

1 Neutron

Abundance = 0.013%

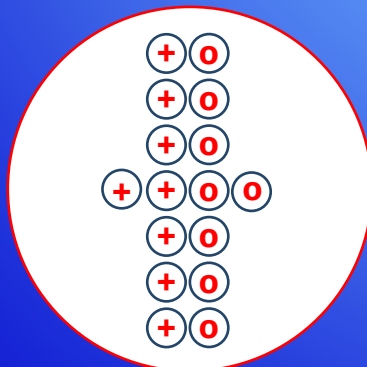


$^{16}\text{O}$

8 Protons

8 Neutrons

Abundance = 99.759%

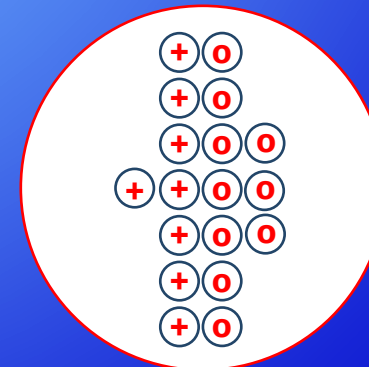


$^{18}\text{O}$  – Stable Isotope

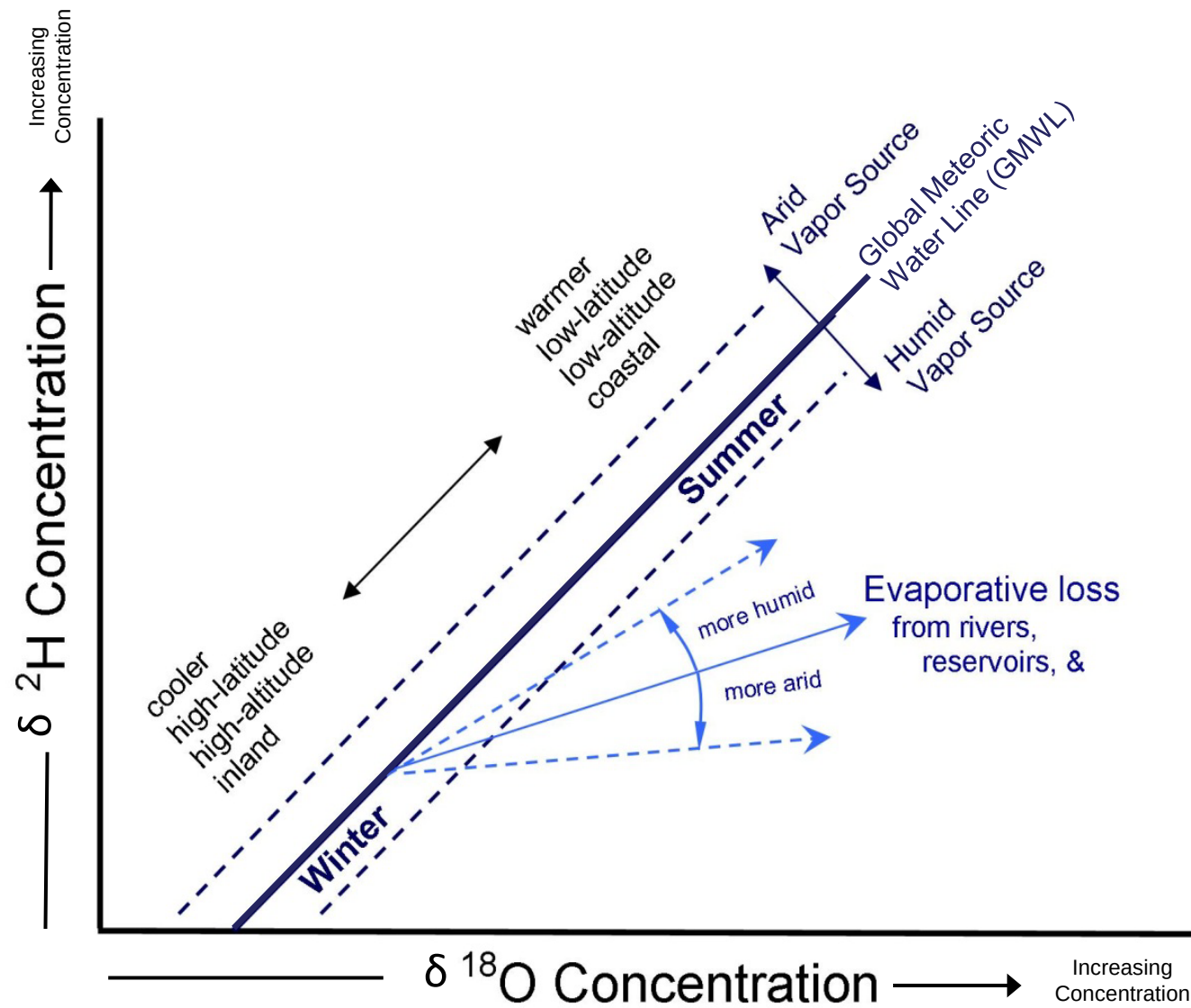
8 Protons

10 Neutrons

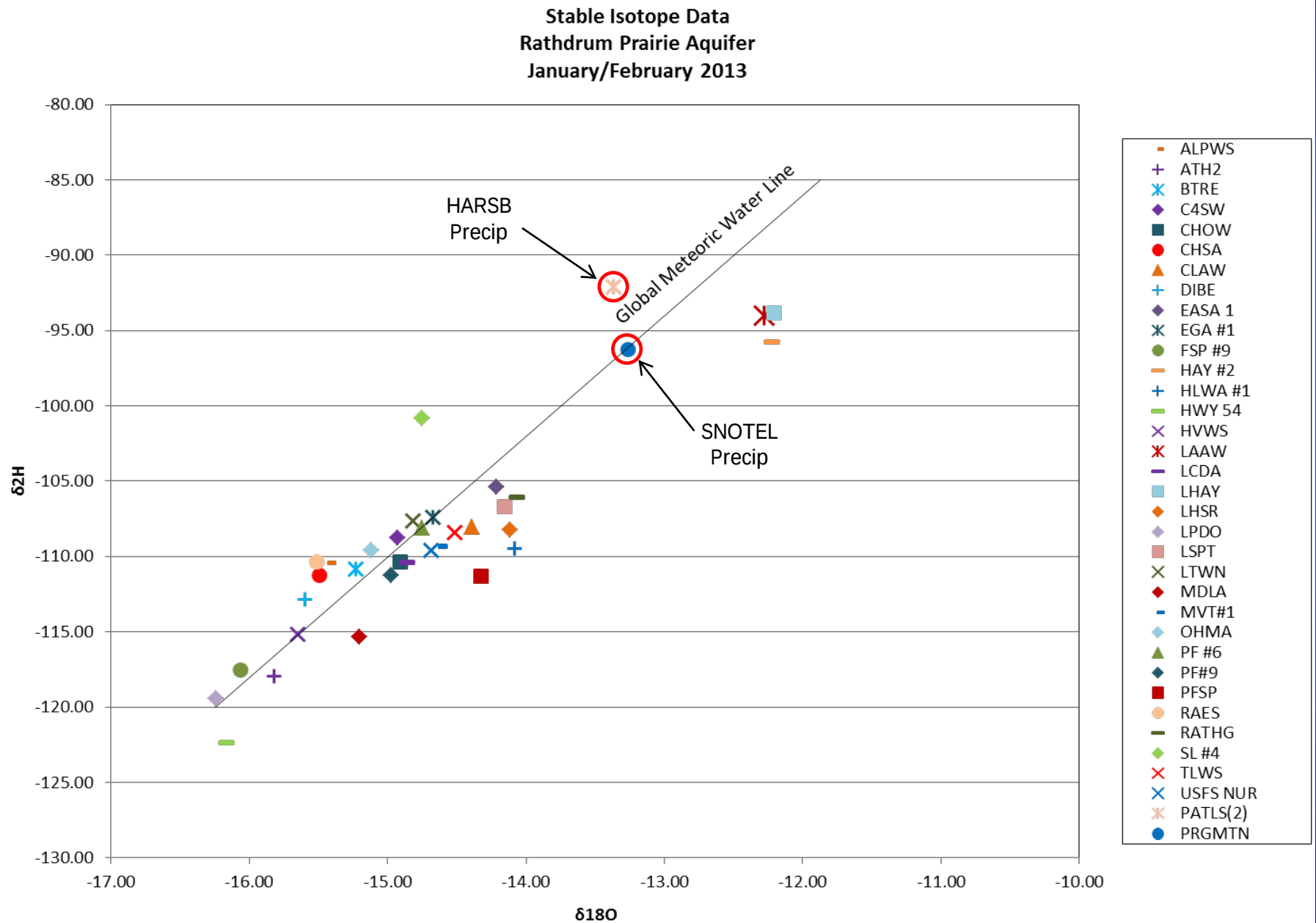
Abundance = 0.204%



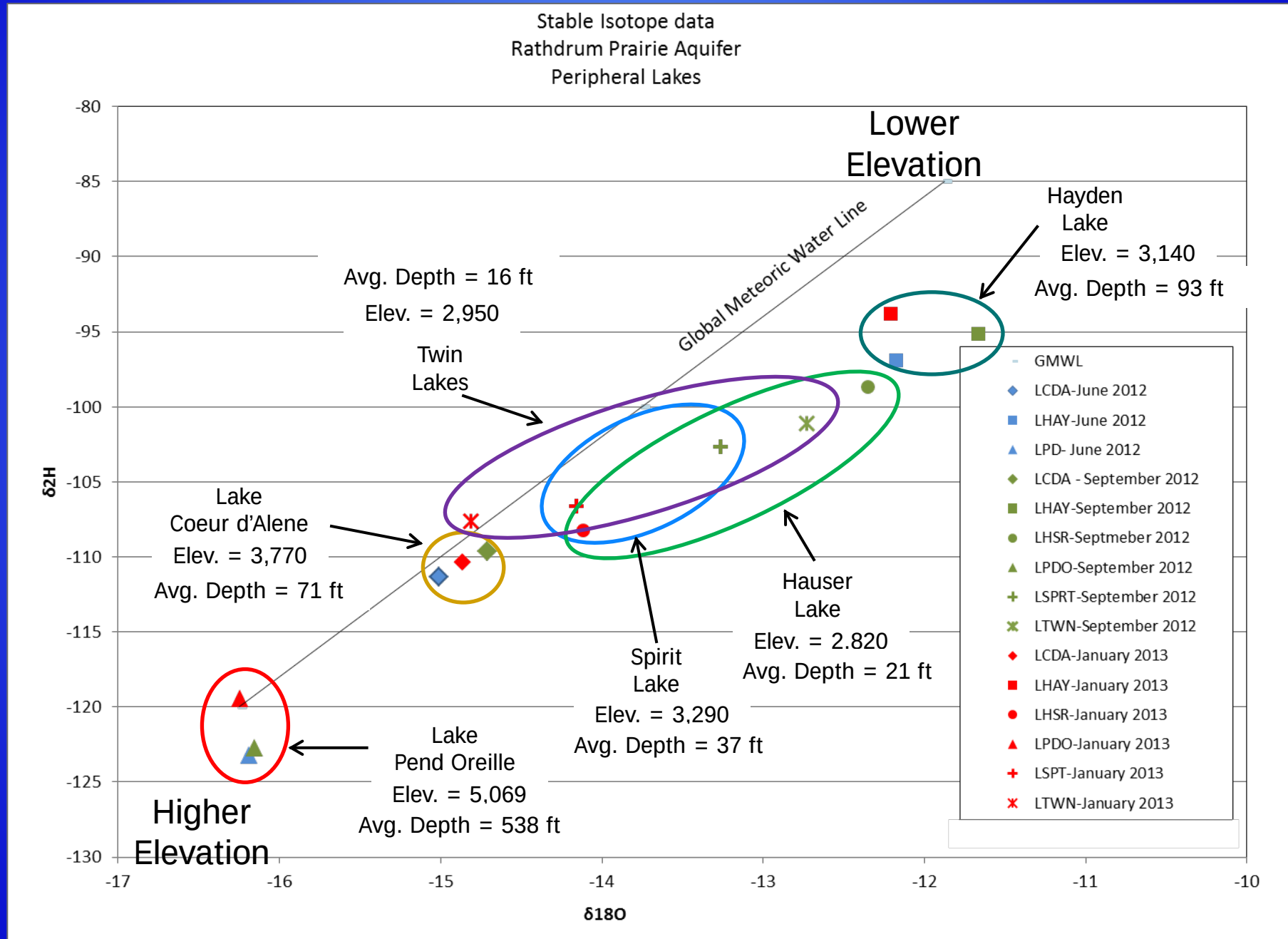
# Deuterium & Oxygen 18



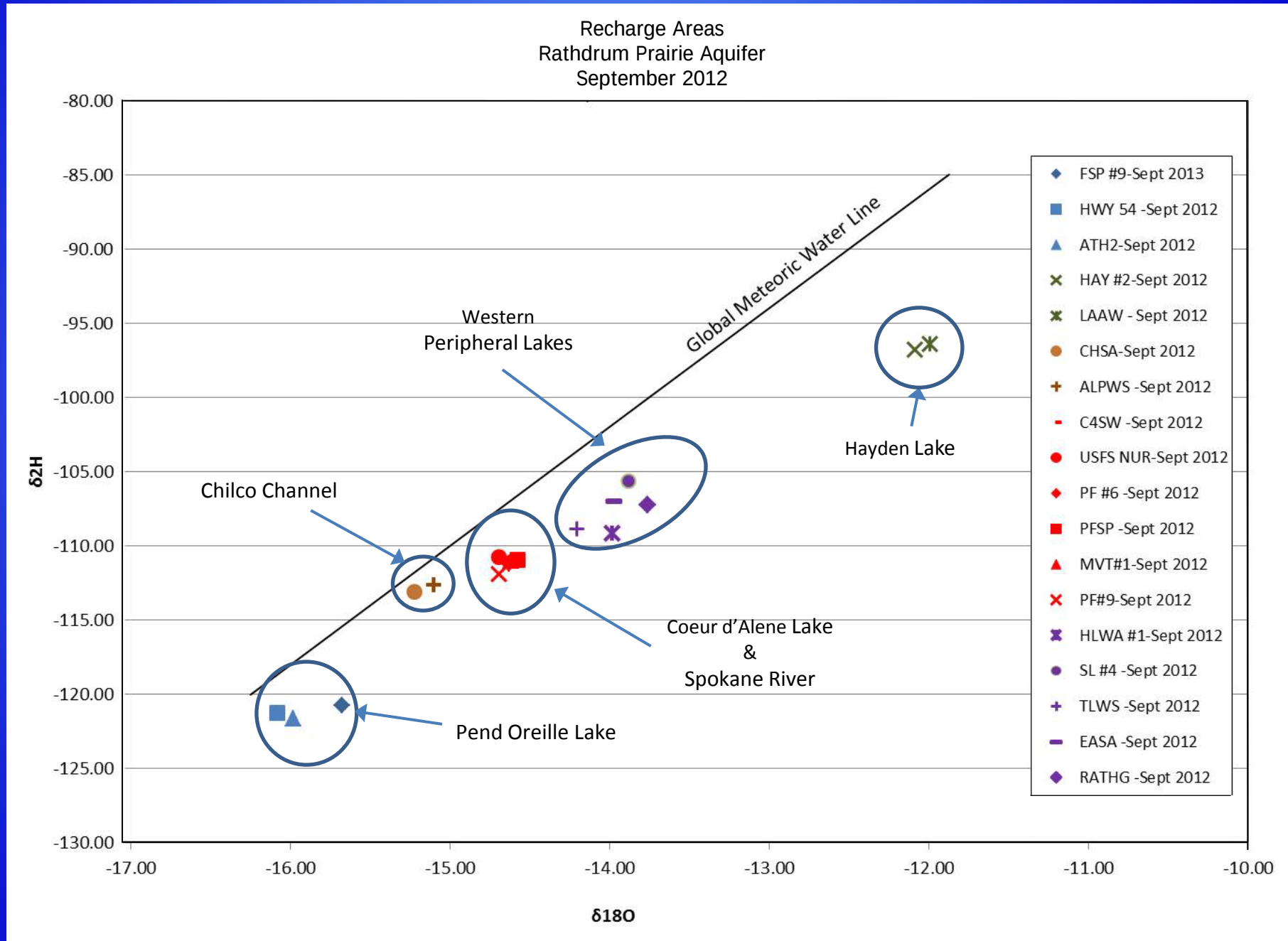
# Deuterium & Oxygen 18



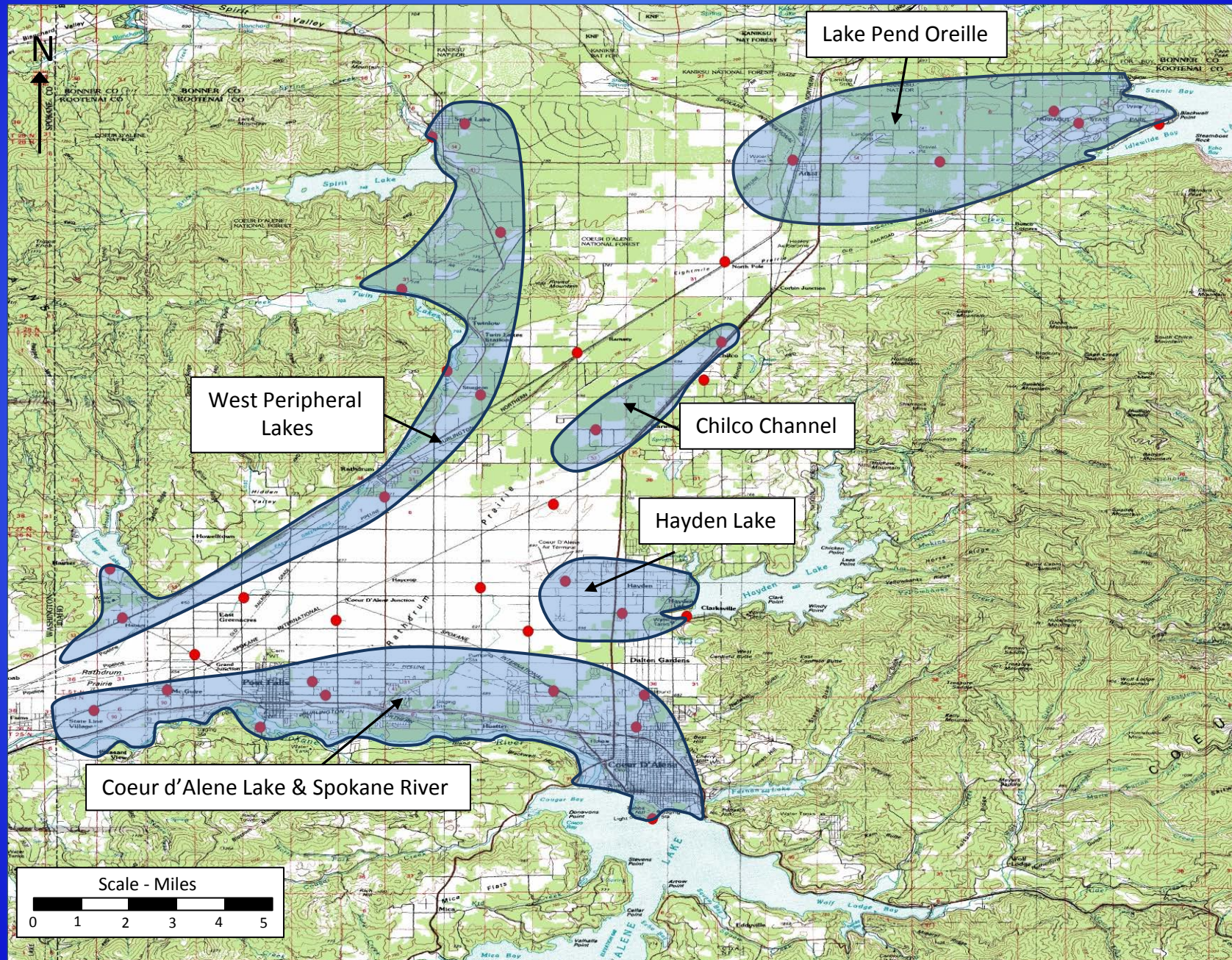
# Deuterium & Oxygen 18



# Deuterium & Oxygen 18

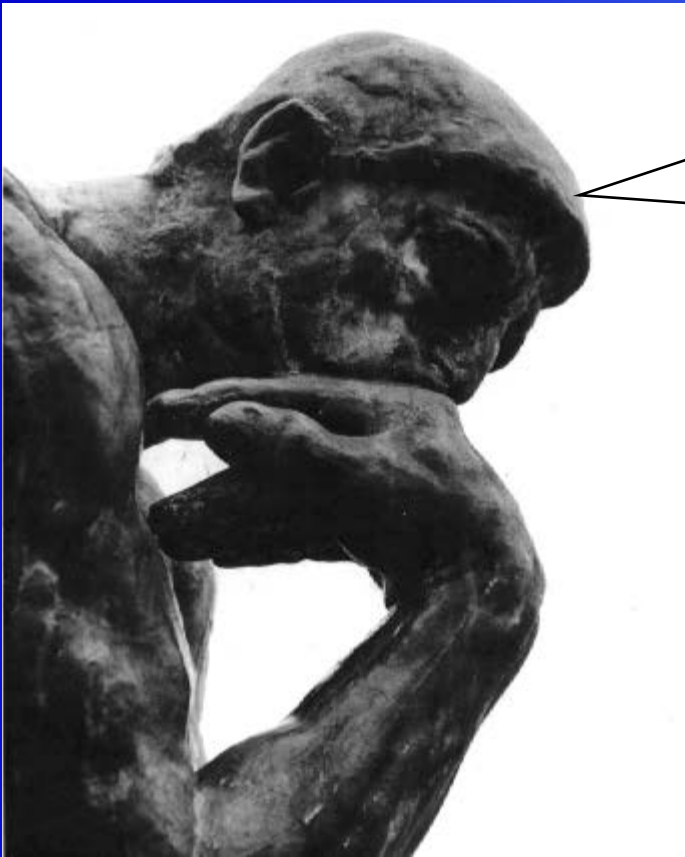


# Deuterium & Oxygen 18



# Conclusions

- Drinking water quality is excellent
- All inorganic constituents were below the drinking water standard
- All VOC and SOC concentrations were below detection limits
- Nitrate concentrations were below 2.0 mg/l , with potentially minor contributions from surface activities
- Uranium and radium-226/radium-228 sampling indicate occurrence in some wells but below the drinking water standard
- Arsenic sampling indicate occurrence in some wells but below the drinking water standard. Multiple sampling indicates that arsenic is consistently present in most wells that had arsenic concentrations above the detection limits
- CFC analytical results show the majority of wells with supersaturated concentrations most likely from anthropogenic sources
- SF6 results indicate ground water with ages less than 15 years
- Deuterium/Oxygen-18 analytical results indicate seasonal recharge and significant contributions from the peripheral lakes
- Deuterium/Oxygen-18 results affected by lake/watershed mechanics



**Your Question Here ?**

**A Hydrogeochemical Investigation of  
the Rathdrum Prairie Aquifer,  
Kootenai County, Idaho**

Ground Water Investigation Report DEQ-CRO-03-13



State of Idaho  
Department of Environmental Quality  
October 2013

Further Information [www.deq.idaho.gov/rpa](http://www.deq.idaho.gov/rpa)

Please call Gary Stevens at (208) 666-4627

