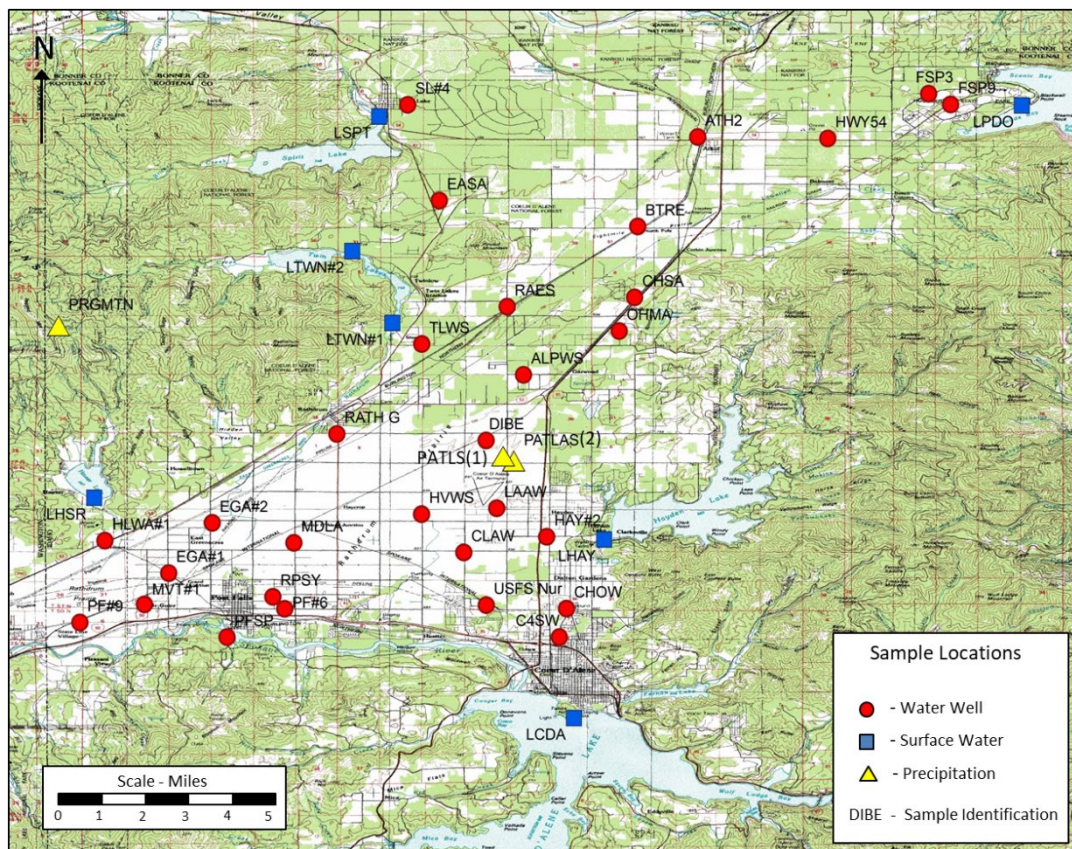




## Rathdrum Prairie Aquifer Water Quality

The population in the area over the Rathdrum Prairie Aquifer is projected to potentially grow to 400,000 by the year 2060 (SPF Water Engineering et al. 2010). The increase in population could result in potential water quality impacts from the changing land use and urbanization. In addition, there has been an improved awareness of the interconnection of surface water and ground water along with water quality and water quantity issues. The result is increasingly complicated regulatory, political, and legal issues that not only involve municipal, county, and state agencies in Idaho but equivalent involvement in Washington state.

To determine the current water quality and evaluate the presence of any contaminants or use as a baseline for future water quality studies, the Idaho Department of Environmental Quality (DEQ) completed a yearlong water quality investigation. The investigation included sampling numerous water wells completed in the Rathdrum Prairie Aquifer along with the peripheral lakes. The sample locations are shown below.

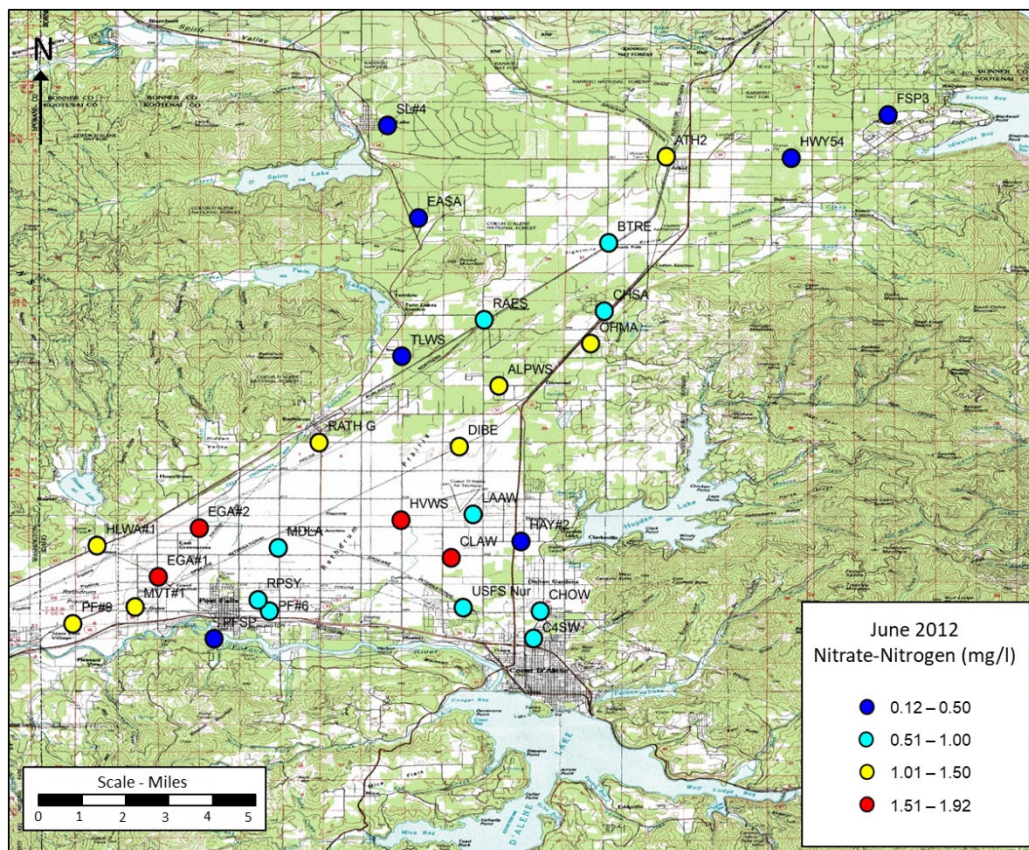


# 1 Water Quality Analytes

A number of different constituents were submitted for analysis that include major cations and anions, nitrate-nitrogen and nitrate isotopes, arsenic, uranium, radionuclides, volatile organic compounds, semivolatile organic compounds, deuterium and oxygen-18 isotopes, along with age dating using chlorofluorocarbons and sulfur hexafluoride. General results of the investigation indicate that the drinking water quality is very good.

## 1.1 Nitrate-Nitrogen

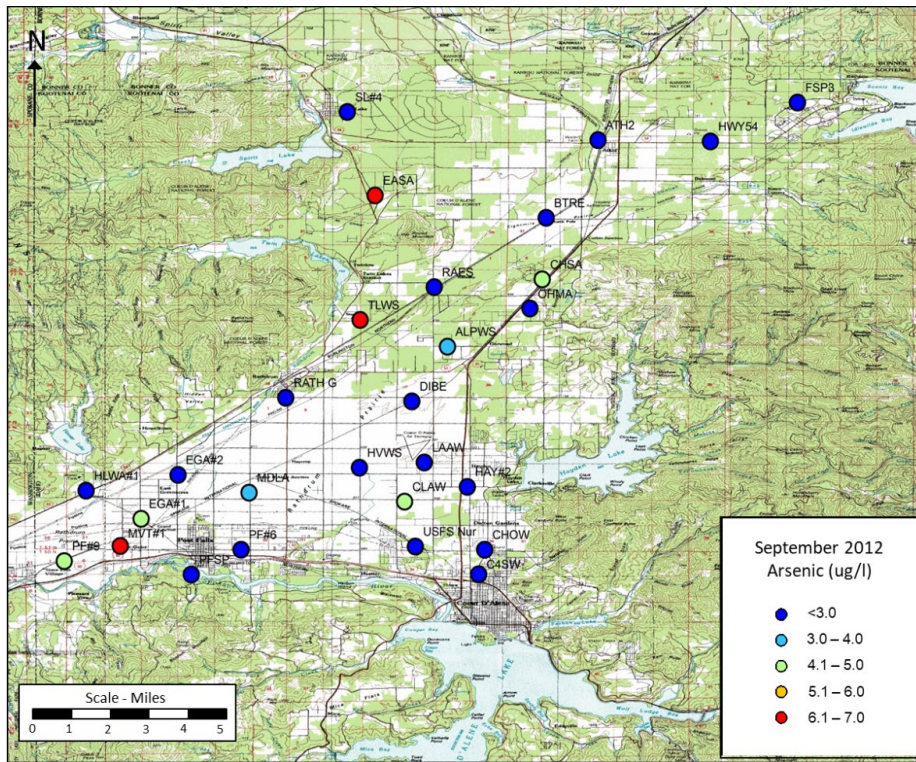
Nitrate-nitrogen is an indicator of water quality impacts from surface activities such as septic effluent and fertilizer application. All the water samples obtained and analyzed had concentrations well below the drinking water standards of 10 milligrams per liter.



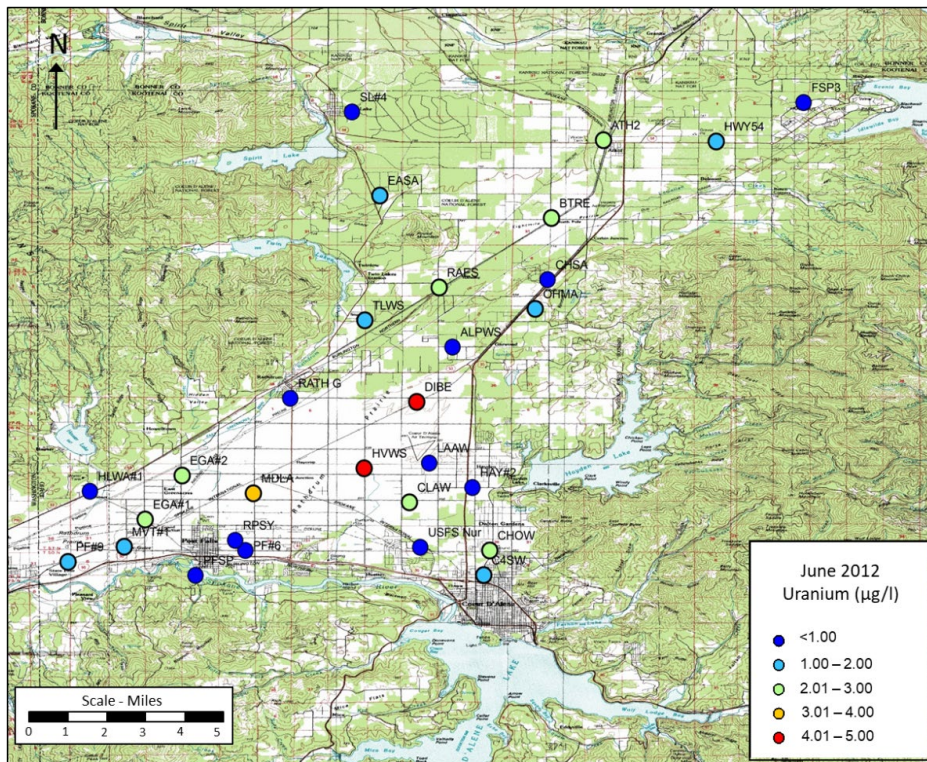
## 1.2 Arsenic and Uranium

Other constituents such as arsenic and uranium are naturally occurring but can have elevated concentrations in the ground water if certain geochemical conditions are created through ground water pumping, injection of water for artificial recharge, or introduction of phosphorus. The arsenic analytical results indicated concentrations were below the allowed maximum contaminant level of 10 micrograms per liter in all wells.





The uranium analytical results also indicated concentrations were below the allowed maximum contaminant level of 30 micrograms per liter in all wells.



### 1.3 Chlorofluorocarbons and Sulfur Hexafluoride

During the past 50–60 years, different chemicals related to manufacturing processes and products have been released worldwide to the atmosphere such as isotopes of chlorofluorocarbons (CFCs) and sulfur hexafluoride (SF<sub>6</sub>). The average atmospheric concentrations in the northern hemisphere is shown in the figure below. Each of the isotopes has specific time periods in which they were introduced in industrial applications and subsequent introduction into the atmosphere. CFCs are stable compounds developed in the 1930s and have been widely used in industrial applications as refrigerants, blowing agents, and solvents. The three relevant isotopes of CFCs used in this study are CCl<sub>3</sub>F (CFC-11), CCl<sub>2</sub>F<sub>2</sub> (CFC-12), and C<sub>2</sub>Cl<sub>3</sub>F<sub>3</sub> (CFC-113). SF<sub>6</sub> production became significant in early 1950s and was used predominantly in electrical switchgear.

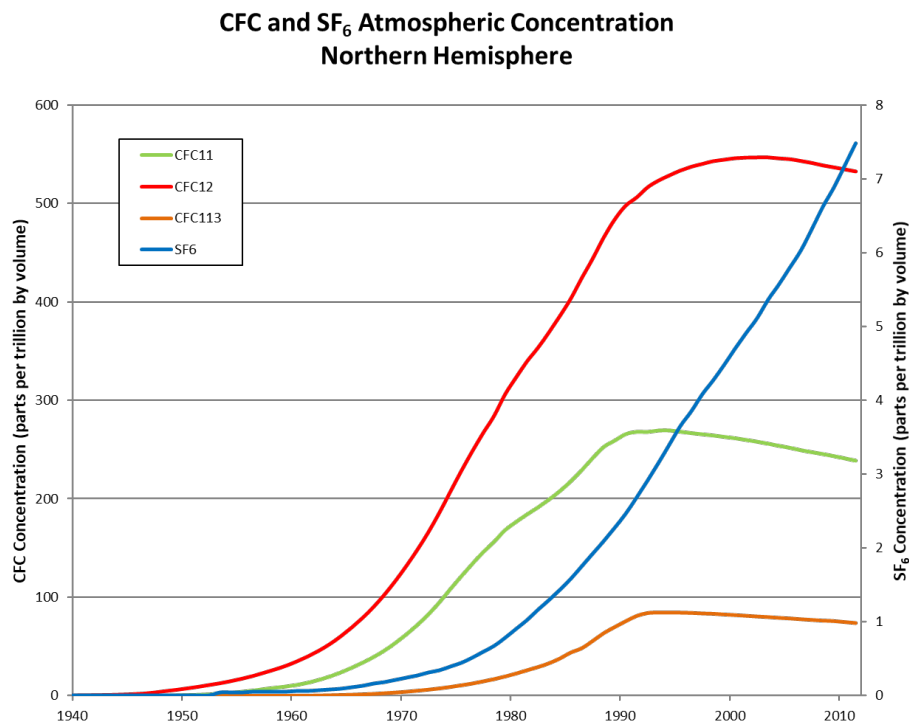


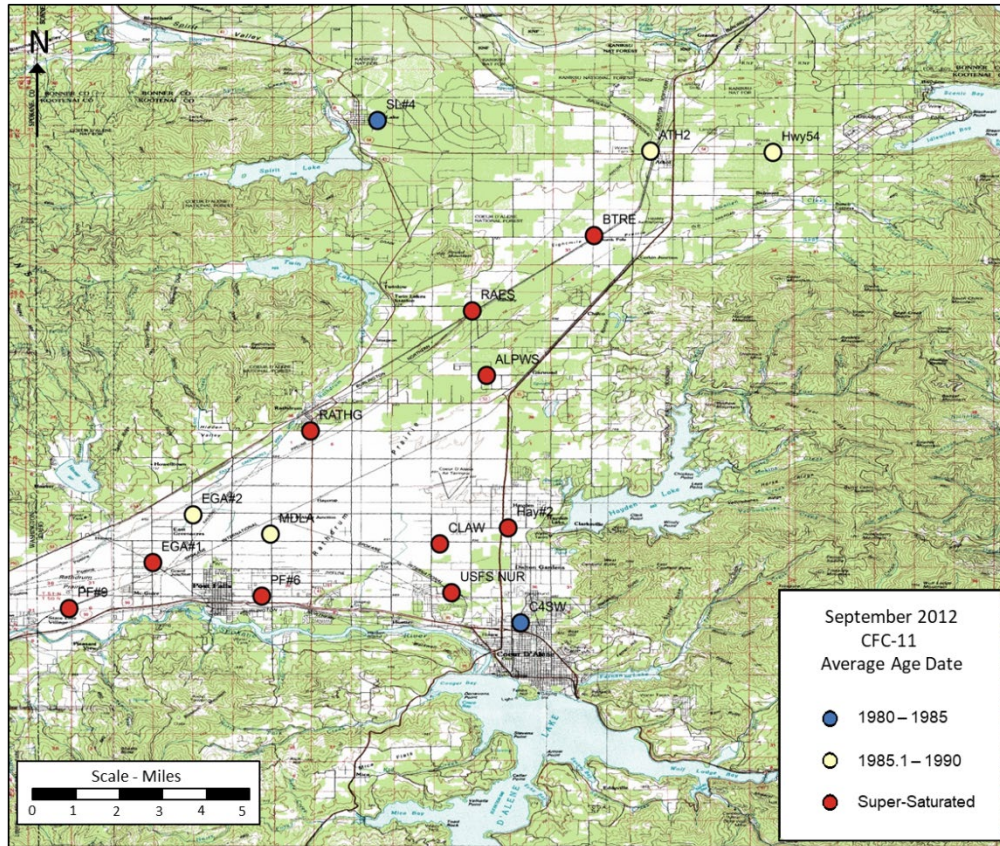
Figure 5. CFCs and SF<sub>6</sub> Historic Northern Hemisphere Atmospheric Concentrations.

Water in contact with the atmosphere such as precipitation or surface water bodies will absorb these chemicals. The concentrations of these chemicals in the atmosphere have generally increased over time and will be reflected in the water concentration. When the water from precipitation or seepage from lakes and rivers recharges the aquifer and is no longer in contact with the atmosphere, the concentrations of CFCs and SF<sub>6</sub> in ground water will no longer change and reflect the time of recharge. Both the CFCs and SF<sub>6</sub> can be used for dating relatively young water generally less than 50 years.

Age dating of the Rathdrum Prairie Aquifer ground water using CFCs (CFC-11, CFC-12, CFC-113) along with SF<sub>6</sub> showed mixed results. The CFCs indicated either very high concentrations

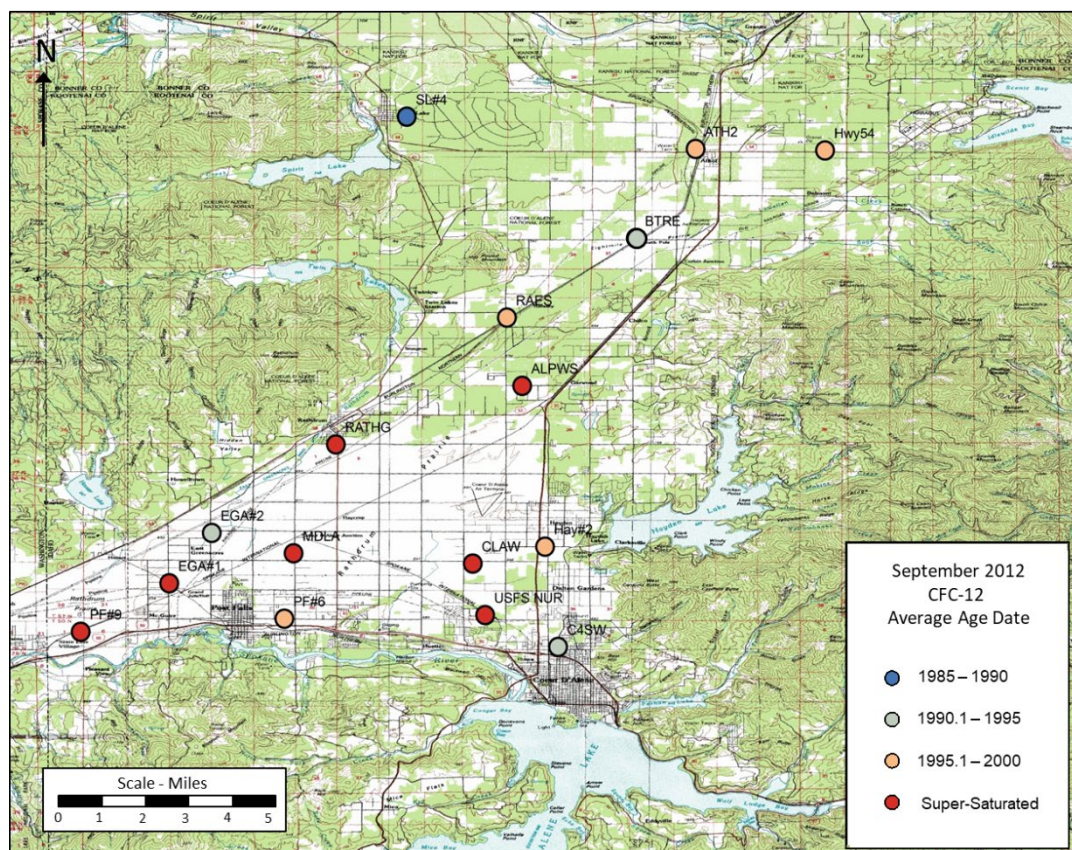


from an external source (other than the atmosphere) or very low concentrations most likely reflecting chemical changes that take place when water is recharged through the thick unsaturated zone or from the peripheral lakes.



A number of external sources could cause the elevated CFCs in the aquifer. The three most likely sources for the Rathdrum Prairie Aquifer would be subsurface sewage disposal, landfills/dumps, and urban runoff.

The SF6 results are generally not affected by the same issues as the CFCs and indicate water with ages less than 15 years old.



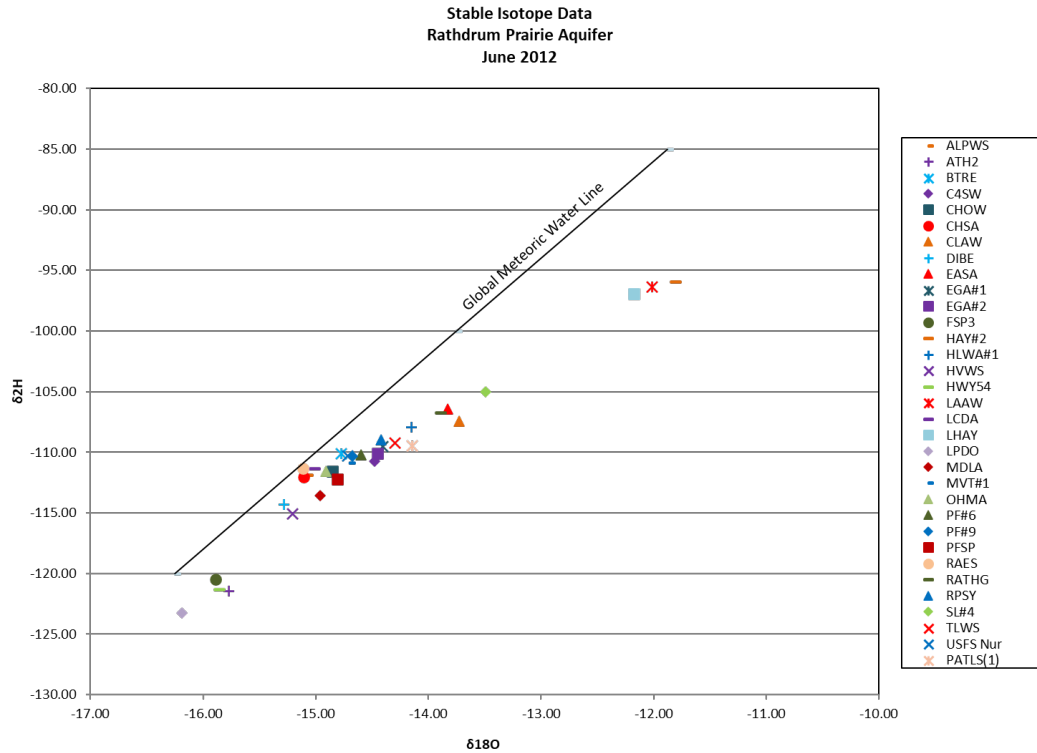
## 1.4 Deuterium and Oxygen-18

Water has the chemical composition of  $H_2O$  with the hydrogen component primarily composed of  $^1H$  (one-proton) and the oxygen component primarily composed of  $^{16}O$  (8-protons and 8-neutrons). A small fraction of water molecules will have either hydrogen composed of the  $^2H$  isotope (one proton and one-neutron) or oxygen composed of the  $^{18}O$  (8-protons and 10-neutrons) isotope. These isotopes do not decay and are considered stable.

The ratio of  $^2H$  and  $^{18}O$  in a water sample depends on a number of conditions relating to the history and source of the water. Generally, precipitation and ground water will have  $^2H/^{18}O$  concentration ratios that will plot on a single line called the global meteoric water line (GMWL). The plotted location of the ratios will change position on the line depending on various factors such as the seasons and distance from the ocean.

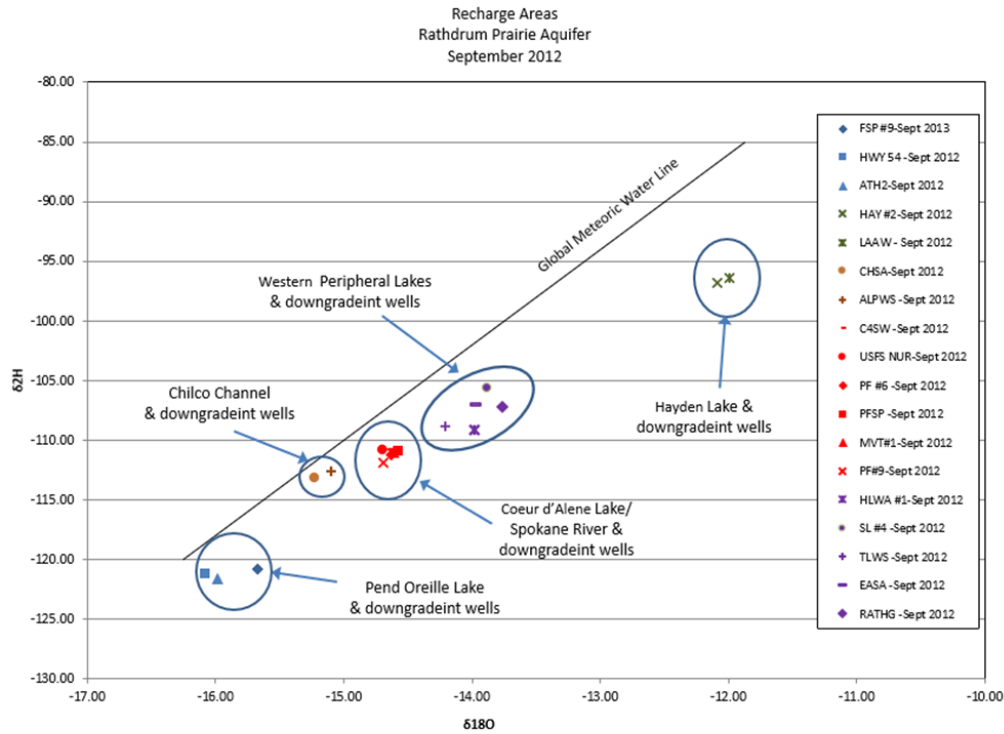
The ground water samples obtained from the Rathdrum Prairie Aquifer indicated the source or sources had undergone some evaporation. The  $^2H$  and  $^{18}O$  concentrations in the January ground water samples indicate that the source or sources had undergone less evaporation.



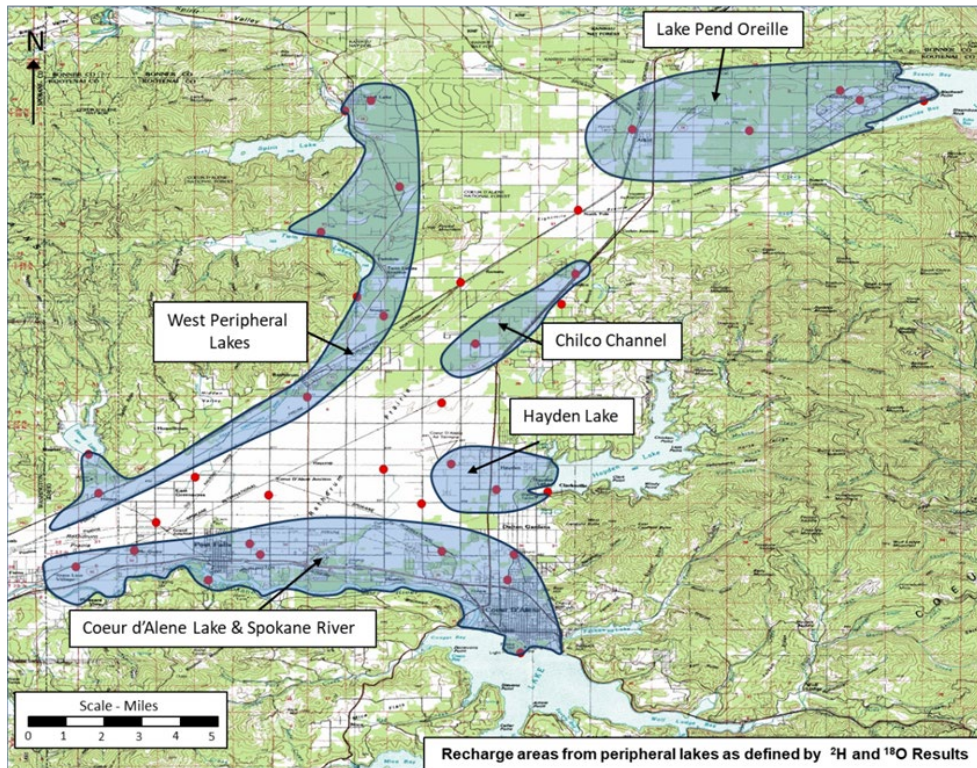


Water that has been subject to significant evaporation, such as lakes and lagoons, will show depletion in the  $^2\text{H}$  isotope and enrichment in the  $^{18}\text{O}$  isotope due to their molecular weight. The lighter  $^2\text{H}$  isotope will evaporate at a greater rate than the heavier  $^{18}\text{O}$  isotope. Waters derived from lakes and lagoons will plot on a line that deviates from the GMWL, reflecting the ratios caused by evaporation. Surface water bodies such as lakes, ponds, and lagoons will have ratios of these isotopes that are characteristic and may be seen in ground water that receives significant recharge from these sources. Stable isotopes of  $^2\text{H}$  and  $^{18}\text{O}$  can be used to determine recharge sources, water budgets, and infiltration rates particularly with surface water bodies.

The  $^2\text{H}$  and  $^{18}\text{O}$  analytical results from many of the ground water wells reflect ratios of the two isotopes that are very similar to the upgradient surface water bodies indicating significant recharge from the lake. The ground water wells have been grouped according to the surface water body that is providing recharge to the wells.



The wells that have significant recharge from the upgradient lakes are shown below.





For more information on the hydrogeochemical study, see the *Hydrogeochemical Investigation of the Rathdrum Prairie Aquifer* report at [Rathdrum Prairie Aquifer Reports and Publications](#).

The Panhandle Health District (PHD) has been collecting water quality information from a number of wells completed in the Rathdrum Prairie Aquifer since 1975. The water quality data consist of a variety of inorganic and organic constituents that represent general aquifer ground water quality, along with some that may indicate contamination from the surface. The emphasis of the PHD sampling program has been to detect potential water quality impacts from septic systems located over the aquifer. The PHD Water Quality Database includes 33 wells distributed across the Rathdrum Prairie Aquifer. Water samples are taken from selected wells three times a year to evaluate general trends in water quality.