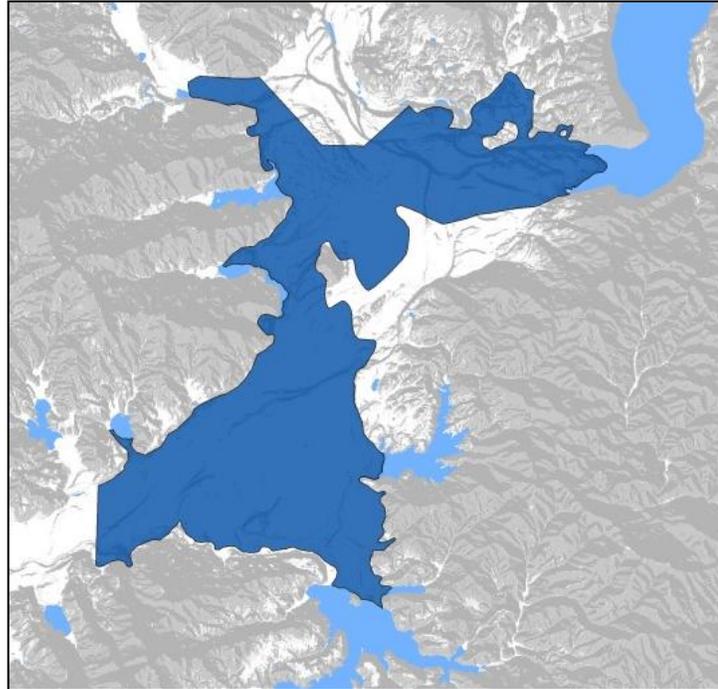




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Characterization of Phosphorus in Ground Water
of the Rathdrum Prairie Aquifer,
Kootenai County, Idaho
2011 and 2012



Gary Stevens P.G.
Idaho Department of Environmental Quality
Coeur d'Alene Regional Office
June 2013

1.0 Introduction

This report describes the sampling and analysis for phosphorus in ground water of the Rathdrum Prairie Aquifer (RPA) during 2011 and 2012. The ground water within the Spokane Valley-Rathdrum Prairie Aquifer is interconnected to the Spokane River (gaining stretches) in Washington State. There is the potential that phosphorus within ground water can contribute and elevate the load in the Spokane River. Municipal, county and industrial facilities treat and discharge wastewater to the Spokane River. There was concern that the excess nutrients, including phosphorus, from wastewater discharge was impacting water quality of the Spokane River and Lake Spokane. Subsequent studies were completed by the Washington State Department of Ecology which culminated with the development of a maximum phosphorus load to the Spokane River from all the dischargers in the form of a Total Maximum Daily Load for dissolved oxygen (DO TMDL). Reduction of phosphorus can occur through advanced treatment of the wastewater prior to discharge or by removal of existing sources contributing to the ground water.

The DO TMDL included a load allocation for groundwater in the analysis of nonpoint sources impacting the Spokane River and Lake Spokane. The contribution of phosphorus from ground water to gaining portions of the Spokane River or directly to Lake Spokane could become significant in relation to potential options in a pollutant trading program. Pollutant trading could provide an alternative methodology of reducing phosphorus loading to the Spokane River from wastewater dischargers in order for the dischargers to meet their permit limits. If an equivalent load can be removed from ground water that reduction can be applied to help meet the phosphorus loads established for wastewater discharge. The sources of phosphorus loading to ground water in Idaho should be recognized and quantified in order to determine the potential for pollutant trading in Idaho. Spokane County has established a ground water monitoring program that includes quarterly sampling and analysis for phosphorus from a number of wells within the Washington extent of the Spokane Valley-Rathdrum Prairie Aquifer. Idaho's ground water monitoring program has primarily been focused on constituents defined in federal and state drinking water standards and has very little data regarding the phosphorus concentrations in ground water. As an initial step in Idaho, quantifying the existing phosphorus concentrations in the ground water of the Rathdrum Prairie Aquifer is necessary to begin to understand the impact on ground water in Washington, and the potential for pollutant trading.

2.0 Site Background

The Rathdrum Prairie Aquifer covers an area of about 211 square miles in Idaho and extends from Lake Pend Oreille southward to Coeur d'Alene and Post Falls and then westward to the Idaho-Washington State line. The water that recharges the aquifer is mainly due to seepage from the Spokane River and adjacent lakes along with precipitation that falls on the Rathdrum Prairie. Ground water from the northern areas of the aquifer starts at a water elevation of about 2,100 feet and at the state line has a water elevation of about 1,970 feet. The gravel, cobbles and boulders that form the Rathdrum Prairie Aquifer were deposited eight to eighteen-thousand years ago by enormous catastrophic floods. The large volume and flow rate of the floods deposited the large

gravel, cobbles and boulders into the Rathdrum Prairie and carried away all the smaller silt and sand leaving behind the very permeable aquifer we enjoy as the source of our drinking water today. The very permeable aquifer allows water to flow with velocities up to 20-50 feet per day. Because of the permeable nature of the aquifer it can be susceptible to contamination from surface spills.

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 constituents that represent general aquifer ground water quality, along with some that may indicate contamination from the surface. The PHD water quality database includes thirty three wells distributed across the Rathdrum Prairie Aquifer. Water samples are taken from selected wells three times a year to evaluate general trends in the water quality. There is very limited data regarding phosphorus concentrations in ground water in Idaho, as the basis of the PHD monitoring program was to target ground water quality, not surface water quality. Obtaining ground water samples for the analysis of phosphorus from the wells currently included in the PHD sampling and analysis program is very important to understand the occurrence and distribution of phosphorus in the RPA.

3.0 Sampling and Analysis

Total phosphorus is a measure of phosphorus in both inorganic and organic forms. Aquatic plants utilize inorganic phosphorus that is largely in the form of orthophosphate. Performing both total phosphorus and orthophosphate analysis on all samples, the fraction of organic versus inorganic forms (available for plant growth) can be determined. An unfiltered ground water sample was obtained from each well using the existing pump for analysis of total phosphorus and orthophosphate during four sampling events. The sampling events occurred during June and September of 2011 and 2012. The same wells were sampled for all the sampling events with the exception of wells that were not available due to either maintenance issues or non-use during low demand portions of the year. Staff from the Idaho Department of Environmental Quality obtained the water quality parameters and water samples for analysis. The location of the sampled wells can be seen in Figure 1.

All water samples were obtained from a sample port located near the wellhead before any treatment. The only exceptions were the Silver Water Association, CHS/Agrilliance and L.A. Aluminum Wells. These water systems do not have any treatment but have sample ports located so that there may be some contributions from pressure/storage tanks. A YSI Model 63 was used to measure the water quality parameters at all sample locations. A three point pH calibration was performed each day prior to sampling using standards with a pH of 4.01, 7.00 and 10.01. The procedure for obtaining a water sample from the wells was to purge until water parameters of temperature, pH and conductivity establish stabilization. Water quality stabilization criteria were as follows:

1. Conductivity +/- 5%;
2. Temperature +/- 5%
3. pH +/- 0.1 unit

The water sample obtained from the Silver Water Association was not purged according to the above criteria due to pressure setting of the pump and flow rate of the well. The well was pumped sufficiently to obtain a water sample before the flow was terminated.

All sample containers and labels were provided by the analytical laboratory just prior to each sampling event. The sample containers for each well were labeled and placed into a new zip-lock style poly bag prior to the sampling event.

Sampling containers and preservatives used are as follows:

Total Phosphorus – Filled 500 milliliter plastic bottle and preserved with H₂SO₄ to a pH less than 2 and cool to 4° Celsius.

Orthophosphate – Filled 500 milliliter plastic bottle and cool to 4° Celsius. No preservative was added.

All samples were labeled with the following information:

1. Alpha-numeric identifier
2. Location
3. Date and Time
4. Samplers initials

After ground water samples were obtained for each well, the containers were placed into the large zip lock style poly bags and then into a cooler with blue ice. The samples were delivered to the analytical laboratory at the end of each day. Standard chain of custody procedures were observed during subsequent transport to the analytical laboratory. The ground water samples were submitted to SVL Analytical in Coeur d'Alene, Idaho and analyzed using the following analytical methods:

Total Phosphorus SM 4500-PE

Orthophosphate SM 4500-PE

4.0 Analytical Results

The analytical results, minimum detection limits (MDL), calculated reporting limits and the stabilized ground water quality parameters for the June and September sampling events of 2011 and 2012 can be seen in Tables 1 through 4. Figures 2 through 9 are plan view maps with well locations and concentration ranges of analytical results indicated with a color code. Figures 10 through 17 are line graphs with analytic concentrations on the y-axis and sampled wells on the x-axis. Copies of the original laboratory reports and chain of custody documents are included in Appendix A.

The MDL as reported by the analytical laboratory for the June and September 2011 sampling events was 0.0010 milligrams per liter (mg/l) for total phosphorus and 0.0015 mg/l for orthophosphate. The method detection limit as reported by the analytical laboratory for the June and September 2012 sampling events was 0.0005 mg/l for total phosphorus and 0.0011 mg/l for orthophosphate. The DEQ did request a reporting limit of 0.0020 mg/l and is shown on the analytical reports. Based on the MDL, the reporting

limits were determined to be approximately three standard deviations from the MDL calculated by multiplying the MDL by 3.18 (Eleuterio et al, 2009, EPA, 2004). The calculated reporting limits for the June and September 2011 sampling events for total phosphorus and orthophosphate are 0.0032mg/l and 0.0048 mg/l respectively. The calculated reporting limits for the June and September 2012 sampling events for total phosphorus and orthophosphate are 0.0016 mg/l and 0.0035 mg/l respectively. The reporting limits presented in the analytical results in Tables 1 through 4 are either the calculated value or requested 0.0020 mg/l, whichever was greatest.

5.0 Analytical Data Evaluation

Quality control procedures were incorporated to ensure that reliable water quality data are obtained. Quality control consists of activities that measure the precision and accuracy of the sampling program and include the use of trip blanks, duplicates and standards in samples submitted from the field and used internal to the laboratory.

A minimum of one duplicate was obtained for every ten samples collected from water wells as a measure of analytical precision. The duplicates were submitted as blind duplicates to the analytical laboratory with no indication as to well identification or location. In addition during the 2012 sampling events a trip blank and standard were also submitted. A trip blank is a water sample provided by the laboratory that has no analyte of concern. The trip blank is carried throughout the sampling event with the other samples and submitted for analysis. The trip blank will provide a measure of the introduction of the analyte into samples during transportation and sampling activities along with laboratory sources. A standard is a sample that is submitted with a known concentration to the laboratory to determine the accuracy of the analytical results. The standards submitted to the analytical laboratory were submitted as blind standards.

The analytical results and evaluation of the field duplicates can be seen in Table 5. Precision was quantified as relative percent difference which is the difference in absolute values between the sample and duplicate divided by their mean and expressed as a percentage. The relative percent difference for all duplicates with concentrations above reporting limits was less than 20% with the exception of September 2012 results for the Rathdrum Pine St. Well. Relative percent differences less than 20% are considered acceptable (EPA, 2010). A comparison of the blind standards with the analytical results can be seen in Table 6. Accuracy was quantified as percent recovery which is the ratio of the measured value divided by the known standard value, multiplied by 100. The percent recovery for the blind standard submitted during the June 2012 sampling event was 32% and outside of the acceptable recovery range of +/- 20% (EPA, 2010). The analytical result for the standard submitted in June 2012 is reported by SVL as an estimate and is below the reporting limit. The percent recovery for the blind standard submitted during the September/October 2012 sampling event is 120.0% and is within the acceptable recovery range. The absolute difference in concentrations between the analytical results and standard values from the June and September/October 2012 sampling events was 0.0016 and 0.0010 mg/l respectively.

A number of the analytical results for orthophosphate had concentrations that were slightly greater than total phosphorus. Given that orthophosphate is a subset of total phosphorus it is expected that orthophosphate would have concentrations that are less than total phosphorus. The analytical results for both have concentrations that are relatively low and are approaching the reporting limit. The relative and absolute differences between the two appear to be within the analytical limits described above.

The relationship of total phosphorus concentrations between the June and September sampling events of 2011 and 2012 were evaluated using the Gehan test. The Gehan test is a nonparametric hypothesis testing procedure that was completed using ProUCL Software (EPA, 2011). The results of the Gehan test indicated that the total phosphorus concentrations from the September 2011 and 2012 sampling events were greater than the total phosphorus concentrations from the June 2011 and 2012 sampling events with a 95% confidence level. The results of the statistical evaluation can be seen in Appendix B.

References

Eleuterion, L., Neethling, J.B., 2009. Low Phosphorus Analytical Measurement Study. WERF Report NUTR1R06F, International Water Association.

EPA, 2004. Revised Assessment of Detection and Quantification Approaches. Engineering and Analysis Division Office of Science and Technology Office of Water, EPA-821-B-04-005.

EPA, 2010. National Functional Guidelines for Inorganic Superfund Data Review, USEPA Contract Laboratory Program. OSWER 9240-1-51/USEPA 540-R-10-011.

EPA, 2011, ver. 4.1.00. ProUCL Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations.

Table 1. June 2011 Analytical Results and Water Quality Parameters

Well	Date Sampled	Analytical Results		Quality Control Results				Blind Duplicate		Physical Parameters			
		Total Phosphorus (mg/l)	Ortho-Phosphate (mg/l)	Total Phosphorus MDL ¹ (mg/l)	Ortho-Phosphate MDL ¹ (mg/l)	Total Phosphorus RL ² (mg/l)	Ortho-Phosphate RL ² (mg/l)	Total Phosphorus (mg/l)	Ortho-Phosphate (mg/l)	pH ³	Temp (°C)	Conductivity (uS)	Specific Conductance (uS @ 25°C)
CHS/Agrilliance	6/6/2011	0.0059	0.0057	0.0010	0.0015	0.0032	0.0048	0.0059	0.0051	8.10	10.9	163.9	224.8
City of Athol #2	6/7/2011	<0.0032	<0.0048	0.0010	0.0015	0.0032	0.0048			7.96	7.8	172.0	256.0
City of Hayden Well #1	6/7/2011	<0.0032	<0.0048	0.0010	0.0015	0.0032	0.0048			8.40	9.9	94.1	131.1
City of Spirit lake #4	6/6/2011	0.0032	<0.0048	0.0010	0.0015	0.0032	0.0048			8.43	12.1	46.5	62.0
Coeur d'Alene 4th St. Well	6/7/2011	0.0034	<0.0048	0.0010	0.0015	0.0032	0.0048			7.85	12.7	183.0	240.8
Coeur d'Alene Honeysuckle Well	6/7/2011	<0.0032	<0.0048	0.0010	0.0015	0.0032	0.0048			7.97	12.0	179.6	239.2
Coeur d'Alene Locust Well	6/7/2011	<0.0032	<0.0048	0.0010	0.0015	0.0032	0.0048			8.04	13.8	140.9	179.9
Dalton Water Assoc.	6/7/2011	0.0133	0.0143	0.0010	0.0015	0.0032	0.0048	0.0122	0.0140	8.23	8.6	109.1	158.9
East Green Acres #1	6/6/2011	0.0055	<0.0048	0.0010	0.0015	0.0032	0.0048			7.78	10.4	177.8	247.7
Farragut State Park Well #3	6/7/2011	<0.0032	<0.0048	0.0010	0.0015	0.0032	0.0048			7.96	10.0	177.0	248.1
Hauser Lake Water Assn Well #1	6/6/2011	<0.0032	<0.0048	0.0010	0.0015	0.0032	0.0048			7.52	9.5	181.9	258.0
L.A. Aluminum Well	6/7/2011	<0.0032	<0.0048	0.0010	0.0015	0.0032	0.0048			8.30	9.7	132.3	186.9
Mountain View Terrace	6/6/2011	0.0076	0.0083	0.0010	0.0015	0.0032	0.0048			8.00	13.7	42.8	54.8
Post Falls #4	6/6/2011	<0.0032	<0.0048	0.0010	0.0015	0.0032	0.0048			8.10	15.4	147.4	181.7
Post Falls #6	6/6/2011	<0.0032	<0.0048	0.0010	0.0015	0.0032	0.0048	<0.0032	<0.0048	8.16	15.4	123.5	151.5
Rathdrum Grange	6/6/2011	<0.0032	<0.0048	0.0010	0.0015	0.0032	0.0048			8.03	8.4	134.9	199.1
Ross Point Hwy 41	6/6/2011	<0.0032	<0.0048	0.0010	0.0015	0.0032	0.0048			7.98	15.6	155.6	189.9
Ross Point Syringa	6/6/2011	<0.0032	<0.0048	0.0010	0.0015	0.0032	0.0048			8.09	15.9	133.4	162.0
Silver Water Assoc.	6/7/2011	<0.0032	<0.0048	0.0010	0.0015	0.0032	0.0048			NA ⁴	NA ⁴	NA ⁴	NA ⁴
South Side Water Assoc.	6/6/2011	0.0086	0.0083	0.0010	0.0015	0.0032	0.0048			6.77	14.6	220.3	274.3
USFS Nursery Well	6/7/2011	<0.0032	<0.0048	0.0010	0.0015	0.0032	0.0048			8.07	11.8	169.5	226.8

¹ MDL = Minimum Detection Limit

² RL = Calculated Reporting Limit

³ pH is temperature compensated

⁴ NA - Not available

Table 2. September 2011 Analytical Results and Water Quality Parameters

Well	Date Sampled	Analytical Results		Quality Control Results				Blind Duplicate		Physical Parameters			
		Total Phosphorus (mg/l)	Ortho-Phosphate (mg/l)	Total Phosphorus MDL ¹ (mg/l)	Ortho-Phosphate MDL ¹ (mg/l)	Total Phosphorus RL ² (mg/l)	Ortho-Phosphate RL ² (mg/l)	Total Phosphorus (mg/l)	Ortho-Phosphate (mg/l)	pH ³	Temp (°C)	Conductivity (uS)	Specific Conductance (uS @ 25°C)
CHS/Agrilliance	9/20/2011	0.0420	<0.0048	0.0010	0.0015	0.0032	0.0048			8.03	12.7	197.0	257.5
City of Athol #2	9/21/2011	0.0047	<0.0048	0.0010	0.0015	0.0032	0.0048			7.77	8.0	161.2	238.0
City of Spirit lake #4	9/20/2011	0.0041	<0.0048	0.0010	0.0015	0.0032	0.0048			8.34	11.7	89.4	119.7
Coeur d'Alene 4th St. Well	9/21/2011	<0.0032	<0.0048	0.0010	0.0015	0.0032	0.0048			7.73	12.6	174.5	228.3
Coeur d'Alene Atlas Well	9/21/2011	<0.0032	<0.0048	0.0010	0.0015	0.0032	0.0048			7.65	13.5	168.5	215.8
Coeur d'Alene Hanley Well	9/21/2011	0.0611	0.0586	0.0010	0.0015	0.0032	0.0048			7.90	12.1	195.5	259.2
Coeur d'Alene Honeysuckle Well	9/21/2011	<0.0032	<0.0048	0.0010	0.0015	0.0032	0.0048			7.79	11.9	181.8	241.9
Coeur d'Alene Locust Well	9/21/2011	<0.0032	<0.0048	0.0010	0.0015	0.0032	0.0048			7.87	13.8	139.6	176.3
Dalton Water Assoc.	9/21/2011	0.0162	0.0163	0.0010	0.0015	0.0032	0.0048	0.0159	0.0160	8.00	7.8	107.1	158.9
East Green Acres #1	9/20/2011	0.0080	0.0081	0.0010	0.0015	0.0032	0.0048	0.0087	0.0088	7.97	12.6	207.3	270.1
Farragut State Park Well #3	9/21/2011	0.0037	<0.0048	0.0010	0.0015	0.0032	0.0048			7.77	10.3	171.8	238.0
Hauser Lake Water Assn Well #1	9/20/2011	0.0041	<0.0048	0.0010	0.0015	0.0032	0.0048			7.59	9.4	213.9	302.6
L.A. Aluminum Well	9/21/2011	0.0041	<0.0048	0.0010	0.0015	0.0032	0.0048			8.07	8.6	138.2	201.8
Mountain View Terrace	9/20/2011	0.0099	0.0093	0.0010	0.0015	0.0032	0.0048			8.02	13.7	202.1	256.3
Post Falls #3	9/20/2011	<0.0032	<0.0048	0.0010	0.0015	0.0032	0.0048			8.00	14.8	180.6	224.2
Post Falls #4	9/20/2011	0.0037	<0.0048	0.0010	0.0015	0.0032	0.0048			7.40	16.3	91.5	109.5
Post Falls #6	9/20/2011	<0.0032	<0.0048	0.0010	0.0015	0.0032	0.0048	<0.0032	<0.0048	8.11	15.2	132.7	164.0
Post Falls #7	9/20/2011	0.0072	<0.0048	0.0010	0.0015	0.0032	0.0048			8.03	13.4	161.7	207.0
Post Falls #9	9/20/2011	0.0061	0.0061	0.0010	0.0015	0.0032	0.0048			7.93	13.8	161.5	204.6
Rathdrum Grange	9/20/2011	<0.0032	<0.0048	0.0010	0.0015	0.0032	0.0048			8.09	8.1	86.8	127.6
Rathdrum Pine Street	9/20/2011	0.0068	0.0061	0.0010	0.0015	0.0032	0.0048			7.85	10.0	192.1	271.2
Ross Point Hwy 41	9/20/2011	<0.0032	<0.0048	0.0010	0.0015	0.0032	0.0048			7.96	15.9	141.1	170.4
Ross Point Syringa	9/20/2011	<0.0032	<0.0048	0.0010	0.0015	0.0032	0.0048			8.10	16.4	141.3	169.2
Silver Water Assoc.	9/21/2011	0.0054	0.0057	0.0010	0.0015	0.0032	0.0048			NA ⁴	NA ⁴	NA ⁴	NA ⁴
USFS Nursery Well	9/21/2011	0.0084	0.0080	0.0010	0.0015	0.0032	0.0048			7.77	12.3	172.2	227.3

¹ MDL = Minimum Detection Limit

² RL = Calculated Reporting Limit

³ pH is temperature compensated

Table 3. June 2012 Analytical Results and Water Quality Parameters

Well	Date Sampled	Analytical Results		Quality Control Results				Blind Duplicate		Physical Parameters			
		Total Phosphorus (mg/l)	Ortho-Phosphate (mg/l)	Total Phosphorus MDL ¹ (mg/l)	Ortho-Phosphate MDL ¹ (mg/l)	Total Phosphorus RL ² (mg/l)	Ortho-Phosphate RL ² (mg/l)	Total Phosphorus (mg/l)	Ortho-Phosphate (mg/l)	pH ³	Temp (°C)	Conductivity (uS)	Specific Conductance (uS @ 25°C)
CHS/Agrilliance	6/11/2012	0.0047	0.0066	0.0005	0.0011	0.0016	0.0035			7.76	12.3	160.3	217.5
City of Athol #2	6/12/2012	<0.0020	<0.0035	0.0005	0.0011	0.0016	0.0035			7.65	7.9	195.5	290.7
City of Hayden Well #2	6/2/2012	<0.0020	<0.0035	0.0005	0.0011	0.0016	0.0035			7.98	10.7	82.5	113.7
City of Spirit Lake #4	6/11/2012	<0.0020	<0.0035	0.0005	0.0011	0.0016	0.0035			7.96	11.2	74.7	101.5
Coeur d'Alene 4th St. Well	6/12/2012	<0.0020	<0.0035	0.0005	0.0011	0.0016	0.0035			7.70	12.8	167.0	218.1
Coeur d'Alene Atlas Well	6/12/2012	<0.0020	<0.0035	0.0005	0.0011	0.0016	0.0035			7.62	13.7	144.7	184.6
Coeur d'Alene Honeysuckle Well	6/12/2012	<0.0020	<0.0035	0.0005	0.0011	0.0016	0.0035			7.68	12.0	163.7	218.0
Coeur d'Alene Locust Well	6/12/2012	<0.0020	<0.0035	0.0005	0.0011	0.0016	0.0035	<0.0020	<0.0035	7.77	14.0	114.7	144.0
Dalton Water Assoc.	6/12/2012	0.0105	0.0112	0.0005	0.0011	0.0016	0.0035			7.76	9.6	161.1	228.2
East Green Acres #1	6/11/2012	0.0027	0.0037	0.0005	0.0011	0.0016	0.0035			7.65	11.7	161.4	215.9
Farragut State Park Well #3	6/12/2012	<0.0020	<0.0035	0.0005	0.0011	0.0016	0.0035			7.69	10.2	188.7	262.1
Hauser Lake Water Assn Well #1	6/11/2012	<0.0020	<0.0035	0.0005	0.0011	0.0016	0.0035			7.50	9.4	189.6	270.1
L.A. Aluminum Well	6/12/2012	<0.0020	<0.0035	0.0005	0.0011	0.0016	0.0035			8.02	8.7	123.4	177.4
Mountain View Terrace	6/13/2012	0.0077	0.0073	0.0005	0.0011	0.0016	0.0035	0.0074	0.0070	7.94	13.8	196.2	249.6
Post Falls #3	6/11/2012	<0.0020	<0.0035	0.0005	0.0011	0.0016	0.0035			7.71	15.0	152.9	189.0
Post Falls #4	6/11/2012	0.0020	<0.0035	0.0005	0.0011	0.0016	0.0035			7.19	16.3	7.6	91.3
Post Falls #5	6/11/2012	0.0025	0.0044	0.0005	0.0011	0.0016	0.0035			7.71	13.7	166.0	210.4
Post Falls #6	6/11/2012	<0.0020	<0.0035	0.0005	0.0011	0.0016	0.0035			7.68	15.5	122.3	150.0
Post Falls #9	6/11/2012	0.0036	0.0048	0.0005	0.0011	0.0016	0.0035	0.0038	0.0049	7.47	13.4	148.9	190.4
Post Falls South Park	6/11/2012	0.0032	<0.0035	0.0005	0.0011	0.0016	0.0035			6.56	12.2	42.1	55.6
Rathdrum Grange	6/11/2012	<0.0020	<0.0035	0.0005	0.0011	0.0016	0.0035			7.78	8.1	113.3	167.2
Rathdrum Pine St.	6/11/2012	0.0047	0.0060	0.0005	0.0011	0.0016	0.0035			7.72	9.6	152.7	215.7
Ross Point Syringa	6/11/2012	0.0021	<0.0035	0.0005	0.0011	0.0016	0.0035			8.03	16.0	111.5	134.9
Silver Water Assoc.	6/12/2012	0.0024	<0.0035	0.0005	0.0011	0.0016	0.0035			NA ⁴	NA ⁴	NA ⁴	NA ⁴
USFS Nursery Well	6/12/2012	0.0039	0.0050	0.0005	0.0011	0.0016	0.0035			7.81	11.7	167.3	224.4
Field Blank	6/11/2012	<0.0020	<0.0035	0.0005	0.0011	0.0016	0.0035						
Standard (STA 1)	6/12/2012	0.0034		0.0005	0.0011	0.0016	0.0035						

¹ MDL = Minimum Detection Limit

² RL = Calculated Reporting Limit

³ pH is temperature compensated

⁴ NA - Not available

Note: Reporting limit for total phosphorus is shown as 0.0020 mg/l which is greater than the calculated 0.0016 mg/l

Table 4. September 2012 Analytical Results and Water Quality Parameters

Well	Date Sampled	Analytical Results		Quality Control Results				Blind Duplicate		Physical Parameters			
		Total Phosphorus (mg/l)	Ortho-Phosphate (mg/l)	Total Phosphorus MDL ¹ (mg/l)	Ortho-Phosphate MDL ¹ (mg/l)	Total Phosphorus RL ² (mg/l)	Ortho-Phosphate RL ² (mg/l)	Total Phosphorus (mg/l)	Ortho-Phosphate (mg/l)	pH ³	Temp (°C)	Conductivity (uS)	Specific Conductance (uS @ 25°C)
CHS/Agrilliance	9/24/2012	0.0058	0.0063	0.0005	0.0011	0.0016	0.0035			7.82	10.6	171.3	232.2
City of Athol #2	9/25/2012	<0.0020	<0.0035	0.0005	0.0011	0.0016	0.0035			7.81	10.8	173.9	239.4
City of Hayden #2	9/26/2012	<0.0020	<0.0035	0.0005	0.0011	0.0016	0.0035			8.23	10.0	73.0	102.7
City of Spirit lake #4	9/24/2012	<0.0020	<0.0035	0.0005	0.0011	0.0016	0.0035			8.24	11.1	42.4	57.8
Coeur d'Alene 4th St. Well	9/25/2012	<0.0020	<0.0035	0.0005	0.0011	0.0016	0.0035			7.74	13.0	159.9	206.3
Coeur d'Alene Atlas Well	9/25/2012	0.0201	<0.0035	0.0005	0.0011	0.0016	0.0035			7.67	13.7	165.3	210.7
Coeur d'Alene Hanley Well	9/25/2012	0.0524	0.0534	0.0005	0.0011	0.0016	0.0035			7.76	13.3	193.6	249.6
Coeur d'Alene Honeysuckle Well	9/25/2012	<0.0020	<0.0035	0.0005	0.0011	0.0016	0.0035			7.75	12.1	163.0	216.4
Coeur d'Alene Locust Well	9/25/2012	<0.0020	<0.0035	0.0005	0.0011	0.0016	0.0035			7.75	14.1	135.5	171.9
Dalton Water Assoc.	9/25/2012	0.0120	<0.0035	0.0005	0.0011	0.0016	0.0035			8.02	9.3	113.7	160.2
East Green Acres #1	9/24/2012	0.0046	0.0058	0.0005	0.0011	0.0016	0.0035			7.71	12.0	199.5	266.7
Farragut State Park Well #3	9/25/2012	<0.0020	<0.0035	0.0005	0.0011	0.0016	0.0035			7.87	10.1	154.0	215.7
Hauser Lake Water Assn Well #1	9/24/2012	<0.0020	<0.0035	0.0005	0.0011	0.0016	0.0035			7.44	9.6	119.2	168.8
L.A. Aluminum Well	9/25/2012	<0.0020	<0.0035	0.0005	0.0011	0.0016	0.0035			8.00	8.5	127.8	187.3
Mountain View Terrace	9/26/2012	0.0074	0.0065	0.0005	0.0011	0.0016	0.0035	0.0071	0.0072	7.74	13.8	174.6	222.3
Post Falls #3	9/24/2012	<0.0020	<0.0035	0.0005	0.0011	0.0016	0.0035	<0.0020	<0.0035	7.82	15.2	160.8	198.5
Post Falls #4	9/24/2012	0.0035	<0.0035	0.0005	0.0011	0.0016	0.0035			6.89	16.9	79.9	94.6
Post Falls #5	9/24/2012	0.0029	0.0035	0.0005	0.0011	0.0016	0.0035			7.83	13.5	169.9	217.7
Post Falls #6	9/24/2012	<0.0020	<0.0035	0.0005	0.0011	0.0016	0.0035			7.90	15.7	117.4	141.1
Post Falls #9	9/24/2012	0.0052	0.0044	0.0005	0.0011	0.0016	0.0035			7.88	13.7	137.3	174.5
Post Falls South Park	9/24/2012	0.0069	0.0044	0.0005	0.0011	0.0016	0.0035			6.61	16.2	67.4	81.3
Rathdrum Grange	10/2/2012	<0.0020	<0.0035	0.0005	0.0011	0.0016	0.0035			7.88	8.2	121.5	178.1
Rathdrum Pine Street	10/2/2012	0.0062	0.0055	0.0005	0.0011	0.0016	0.0035	0.0082	0.0055	7.75	10.1	176.4	246.7
Ross Point Syringa	9/24/2012	<0.0020	<0.0035	0.0005	0.0011	0.0016	0.0035			7.99	16.5	140.0	166.9
Silver Water Assoc.	9/25/2012	<0.0020	<0.0035	0.0005	0.0011	0.0016	0.0035			8.00	10.01	296.8	419.40
USFS Nursery Well	9/25/2012	0.0032	<0.0035	0.0005	0.0011	0.0016	0.0035			7.86	12.5	146.5	192.8
Field Blank	9/24/2012	<0.0020	<0.0035	0.0005	0.0011	0.0016	0.0035						
Standard (STA 1)	10/2/2012	0.0060		0.0005	0.0011	0.0016	0.0035						

¹ MDL = Minimum Detection Limit

² RL = Calculated Reporting Limit

³ pH is temperature compensated

⁴ NA - Not available

Note: Reporting limit for total phosphorus is shown as 0.0020 mg/l which is greater than the calculated 0.0016 mg/l

Table 5 Analytical Results and Duplicate Analysis

June 2011

Well	Date Sampled	Analytical Results		Blind Duplicate Results		Reporting Limit		Relative Percent Difference	
		Total Phosphorus (mg/l)	Ortho-Phosphate (mg/l)	Total Phosphorus (mg/l)	Ortho-Phosphate (mg/l)	Total Phosphorus (mg/l)	Ortho-Phosphate (mg/l)	Total Phosphorus %	Ortho-Phosphate %
Dalton Water Assoc.	6/7/2011	0.0133	0.0143	0.0122	0.0140	0.0032	0.0048	8.27	2.10
Post Falls #6	6/6/2011	<0.0032	<0.0048	<0.0032	<0.0048	0.0032	0.0048	No Data	No Data
CHS/Agrilliance	6/6/2011	0.0059	0.0057	0.0059	0.0051	0.0032	0.0048	0.00	10.53

September 2011

Well	Date Sampled	Analytical Results		Blind Duplicate Results		Reporting Limit		Relative Percent Difference	
		Total Phosphorus (mg/l)	Ortho-Phosphate (mg/l)	Total Phosphorus (mg/l)	Ortho-Phosphate (mg/l)	Total Phosphorus (mg/l)	Ortho-Phosphate (mg/l)	Total Phosphorus %	Ortho-Phosphate %
Dalton Water Assoc.	9/21/2011	0.0162	0.0163	0.0159	0.0160	0.0032	0.0048	1.86	1.86
Post Falls #6	9/20/2011	<0.0032	<0.0048	<0.0032	<0.0048	0.0032	0.0048	No Data	No Data
East Green Acres #1	9/20/2011	0.0080	0.0081	0.0087	0.0088	0.0032	0.0048	8.33	8.28

June 2012

Well	Date Sampled	Analytical Results		Blind Duplicate Results		Reporting Limit		Relative Percent Difference	
		Total Phosphorus (mg/l)	Ortho-Phosphate (mg/l)	Total Phosphorus (mg/l)	Ortho-Phosphate (mg/l)	Total Phosphorus (mg/l)	Ortho-Phosphate (mg/l)	Total Phosphorus %	Ortho-Phosphate %
Coeur d'Alene Locust Well	6/12/2012	<0.0016	<0.0035	<0.0016	<0.0035	0.0016	0.0035	No Data	No Data
Mountain View Terrace	6/6/2011	0.0077	0.0073	0.0074	0.0070	0.0016	0.0035	4.08	4.20
Post Falls #9	6/11/2012	0.0036	0.0048	0.0038	0.0049	0.0016	0.0035	4.71	2.06

September 2012

Well	Date Sampled	Analytical Results		Blind Duplicate Results		Reporting Limit		Relative Percent Difference	
		Total Phosphorus (mg/l)	Ortho-Phosphate (mg/l)	Total Phosphorus (mg/l)	Ortho-Phosphate (mg/l)	Total Phosphorus (mg/l)	Ortho-Phosphate (mg/l)	Total Phosphorus %	Ortho-Phosphate %
Rathdrum Pine Street	10/2/2012	0.0062	0.0055	0.0082	0.0055	0.0016	0.0035	34.19	0.00
Post Falls #3	9/24/2012	<0.0016	<0.0035	<0.0016	<0.0035	0.0016	0.0035	No Data	No Data
Mountain View Terrace	9/26/2012	0.0074	0.0065	0.0071	0.0072	0.0016	0.0035	4.11	10.22

Relative Percent Difference = $\frac{|S-D|}{0.5(S+D)} \times 100$

S = Sample concentration

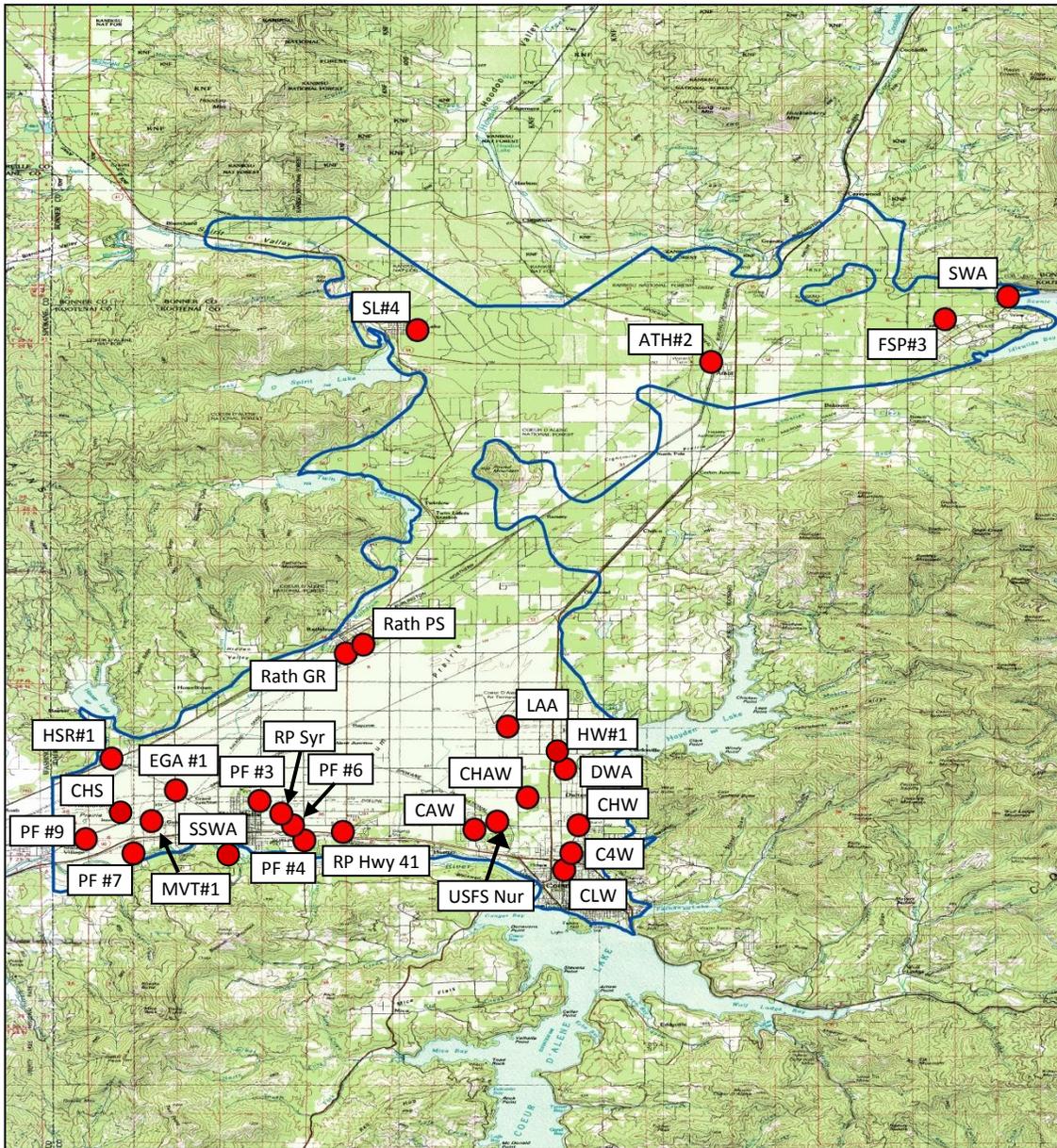
D = Duplicate concentration

Acceptable Relative Percent Difference is less than 20%

Table 6 Analytical and Standard Results

Well	Date Sampled	Analytical Results	Standard Results	Percent Difference ¹
		Total Phosphorus (mg/l)	Total Phosphorus (mg/l)	Total Phosphorus %
STA#1	6/11/2012	0.0034	0.005	68.0
STA#1	10/2/2012	0.0060	0.005	120.0

¹ Acceptable standard result +/- 20%



- | | |
|--|---|
| ATH#2 – City of Athol Well #2 | PF#3 – City of Post Falls Well #3 |
| C4W – City of Coeur d’Alene Well #4 | PF#4 – City of Post Falls Well #4 |
| CAW – City of Coeur d’Alene Atlas Well | PF#6 – City of Post Falls Well #6 |
| CHAW – City of Coeur d’Alene Hanley Well | PF#7 – City of Post Falls Well #7 |
| CLW – City of Coeur d’Alene Locust Well | PF#9 – City of Post Falls Well #9 |
| CHW – City of Coeur d’Alene Honeysuckle Well | Rath GR – City of Rathdrum Grange Well |
| CHS – CHS/Agrilliance Well | Rath PS – City of Rathdrum Pine St. Well |
| DWA – Dalton Water Association | RP Hwy 41 – Ross Point Highway 41 Well |
| EGA#1 – East Greenacres Well #1 | RP Syr – Ross Point Syringa Well |
| FSP#3 – Farragut State Park Well #3 | SL#4 – City of Spirit lake Well #4 |
| HSR #1 – City of Hauser Well #1 | SSWA – South Side Water Association |
| HW#1 – City of Hayden Well #1 | SWA – Silver Water Association |
| LAA – L.A. Aluminum Well | USFS Nur – U.S. Forest Service Nursery Well |
| MVT#1 – Mountain View Terrace Well #1 | |

Figure 1. Water well location and identification.

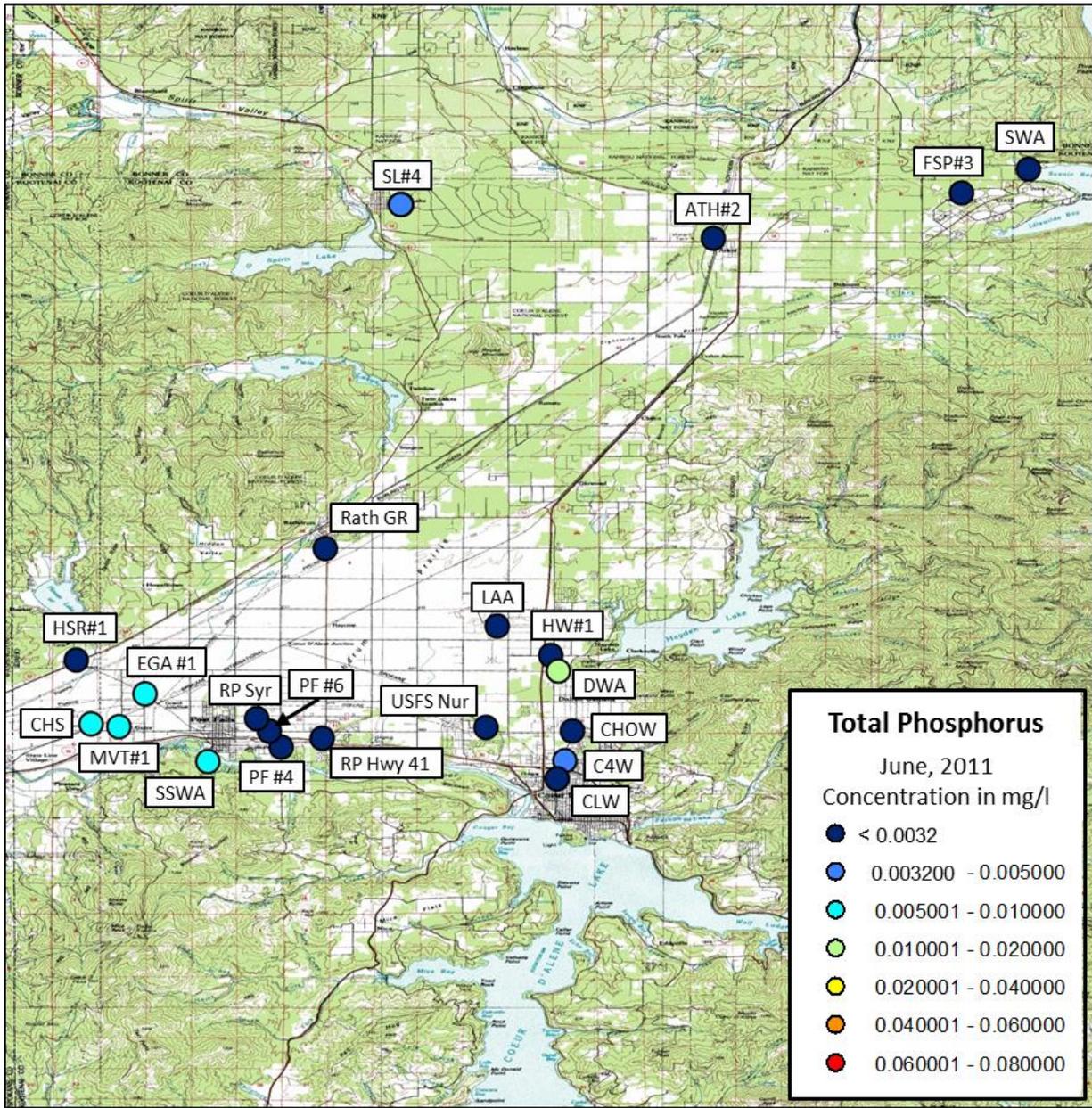


Figure 2. June 2011 - Ground water wells sampled and total phosphorus concentration results.

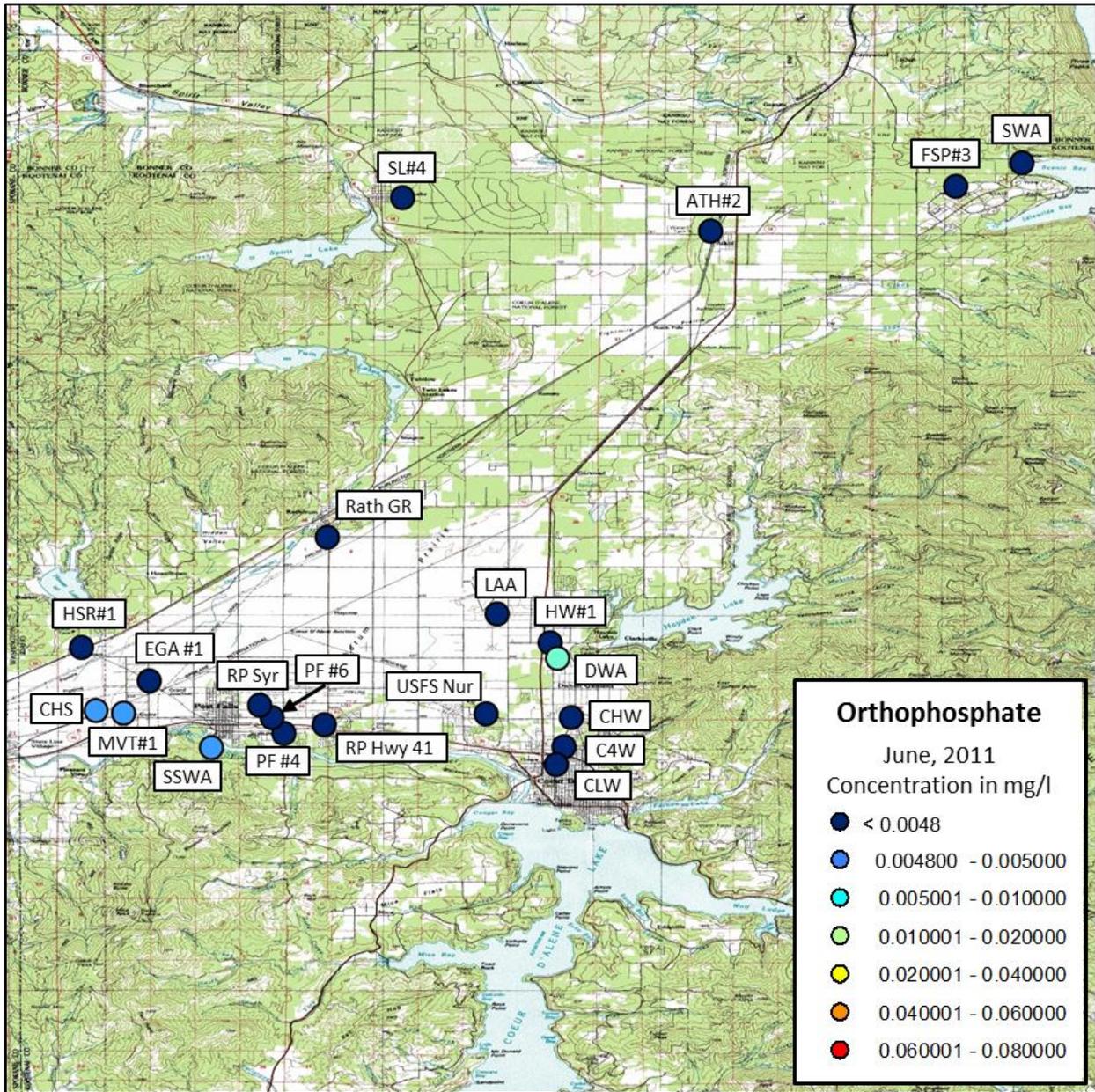


Figure 3. June 2011 - Ground water wells sampled and orthophosphate concentration results.

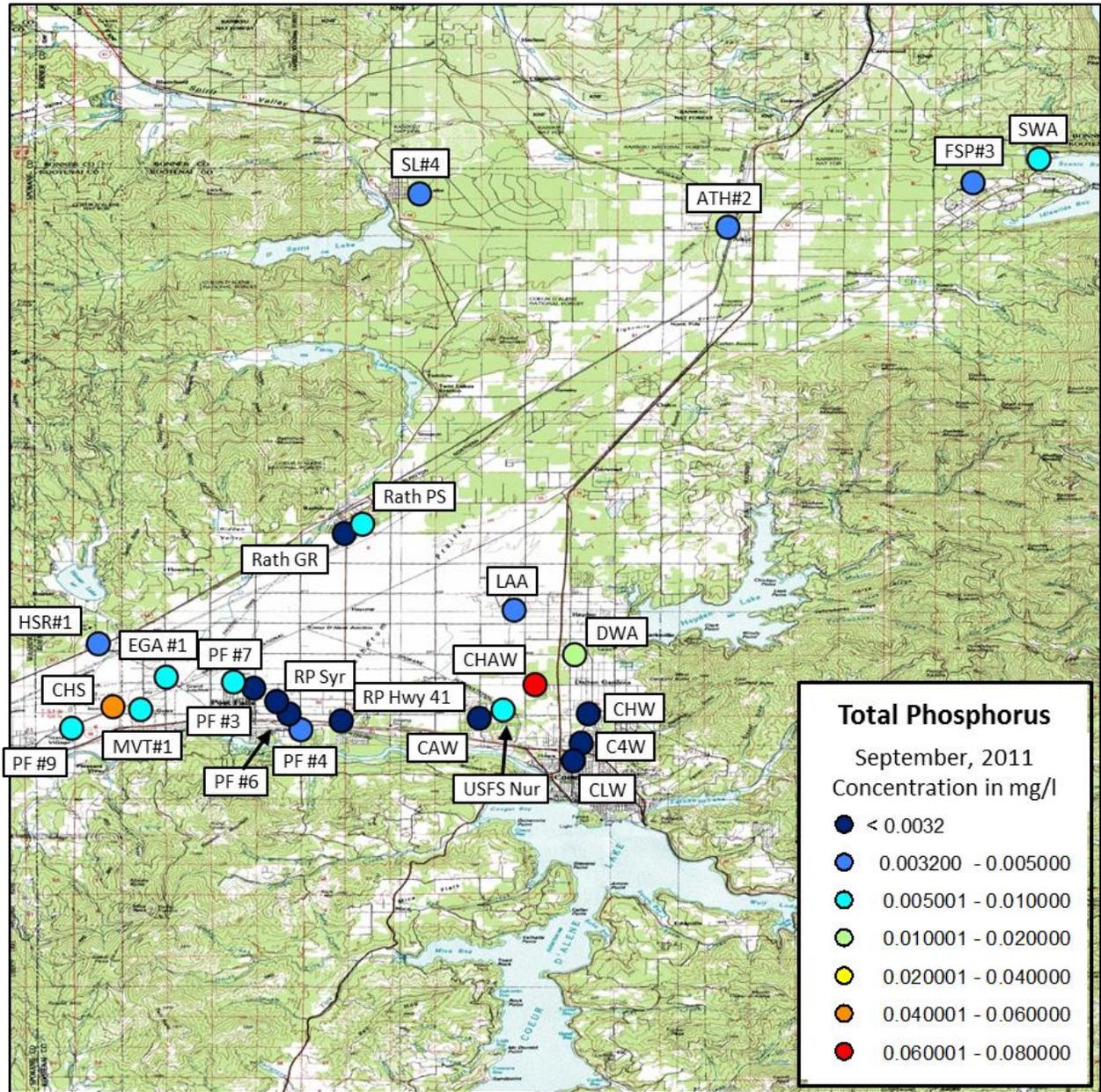


Figure 4. September 2011 - Ground water wells sampled and total phosphorus concentration results.

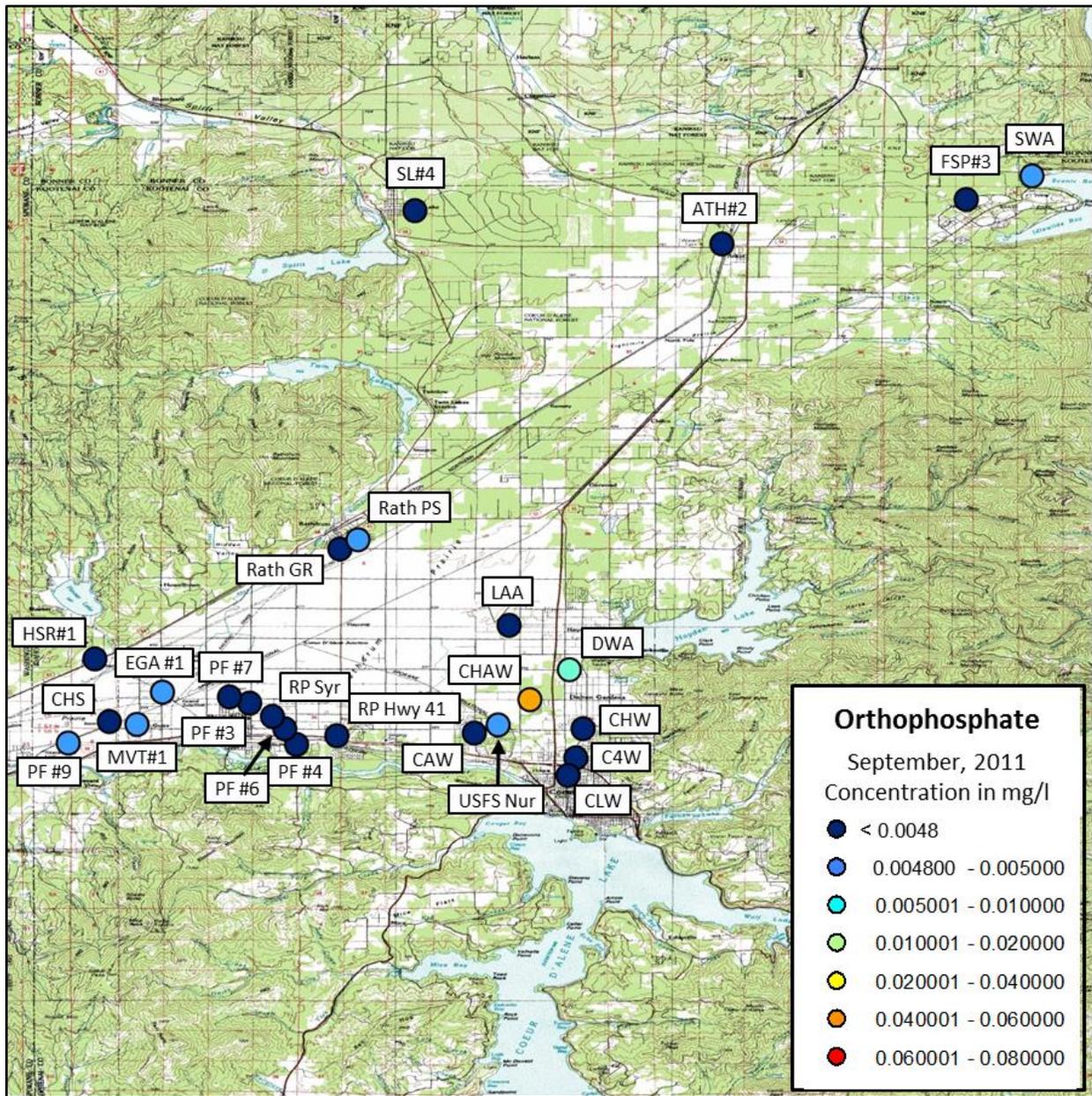


Figure 5. September 2011 - Ground water wells sampled and orthophosphate concentration results.

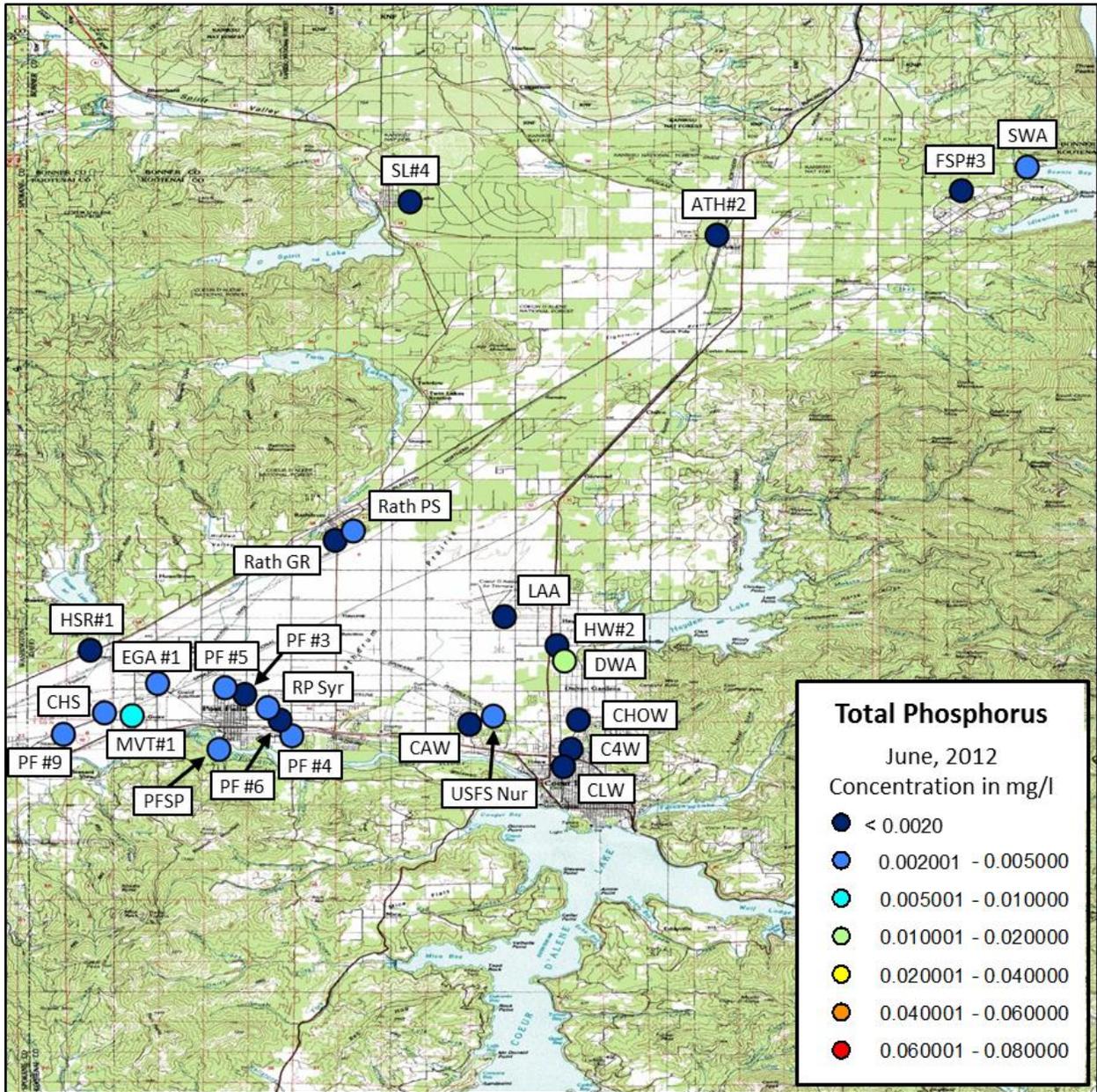


Figure 6. June 2012 - Ground water wells sampled and total phosphorus concentration results.

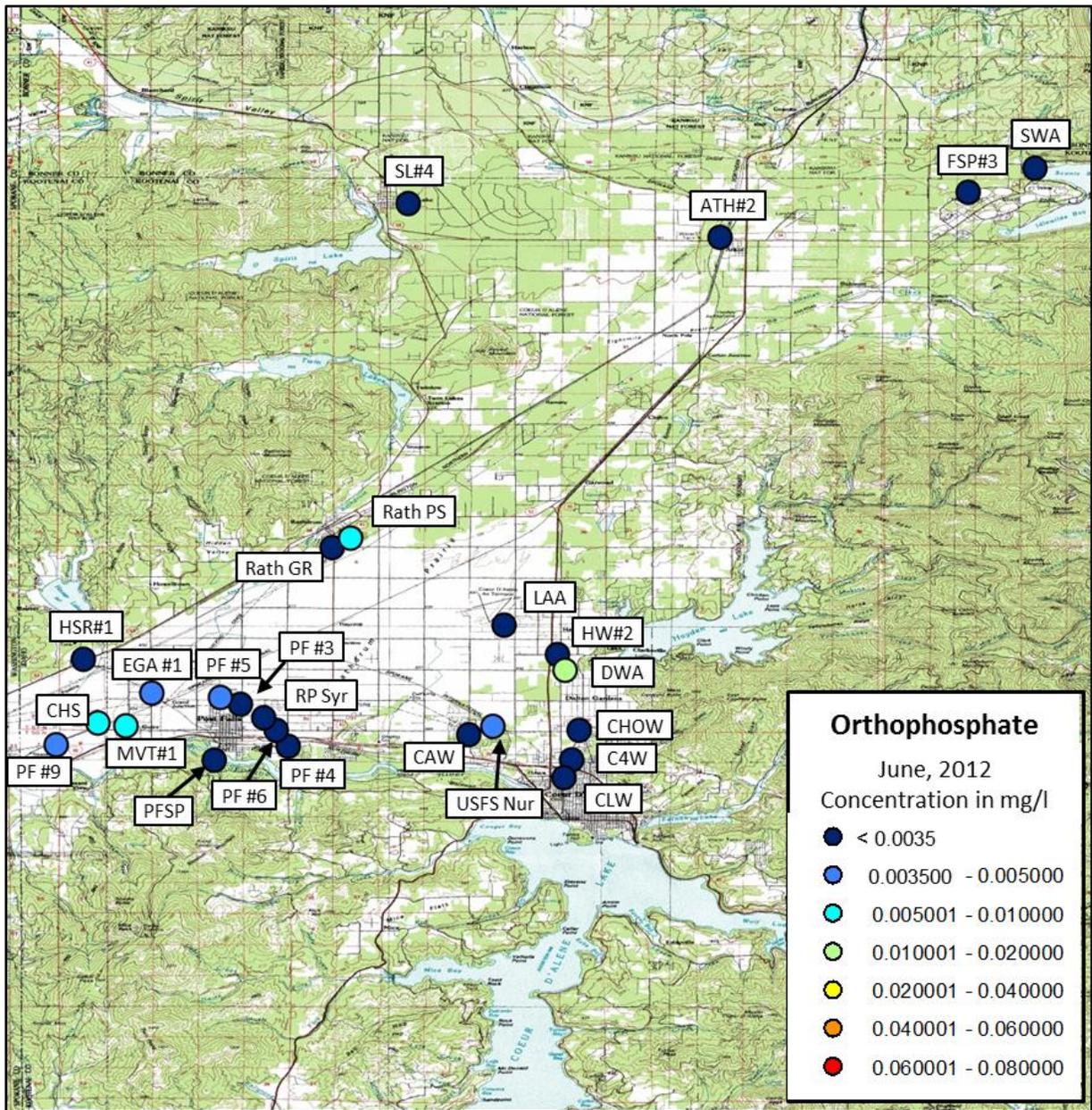


Figure 7. June 2012 - Ground water wells sampled and orthophosphate concentration results.

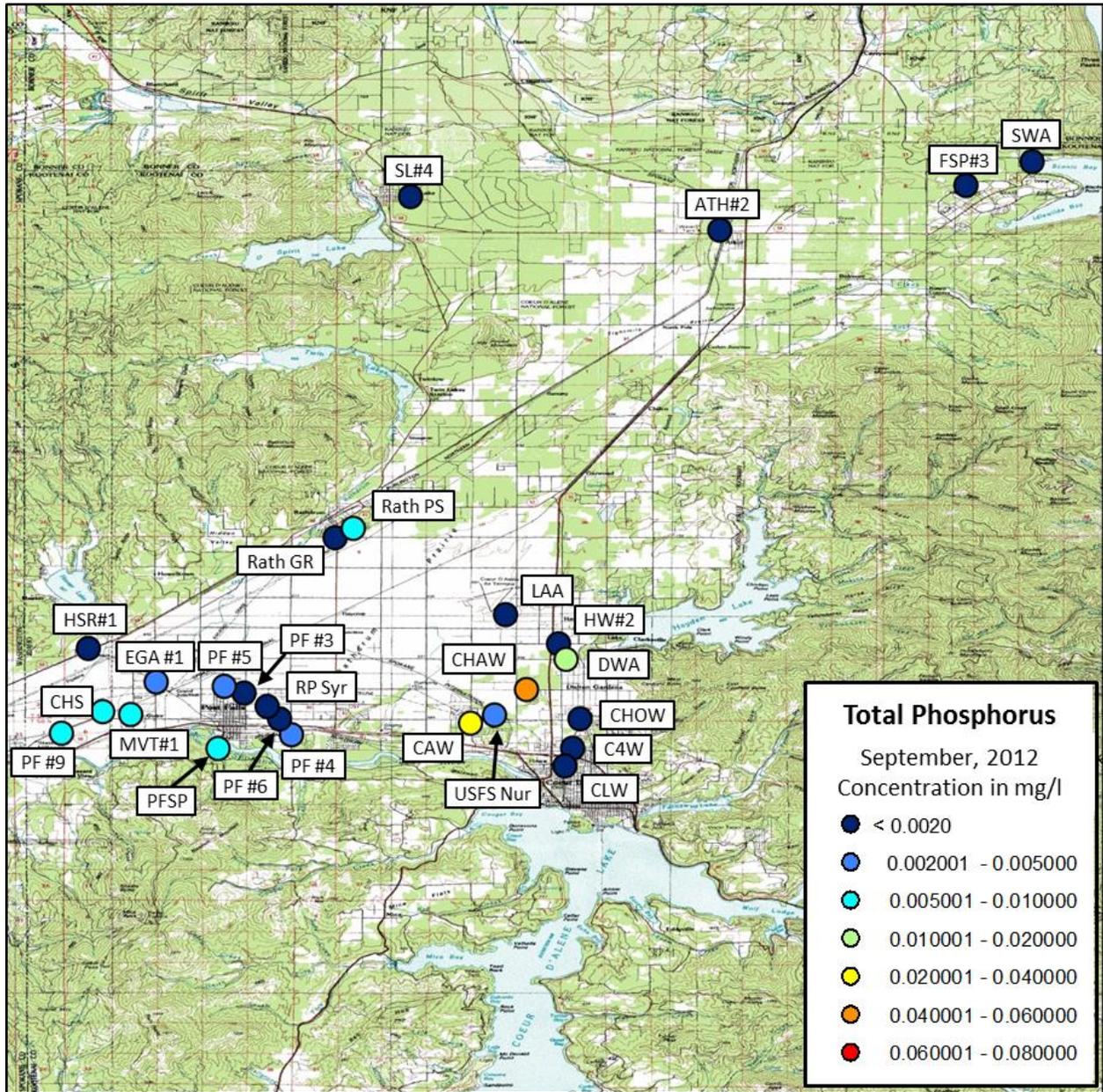


Figure 8. September 2012 - Ground water wells sampled and total phosphorus concentration results.

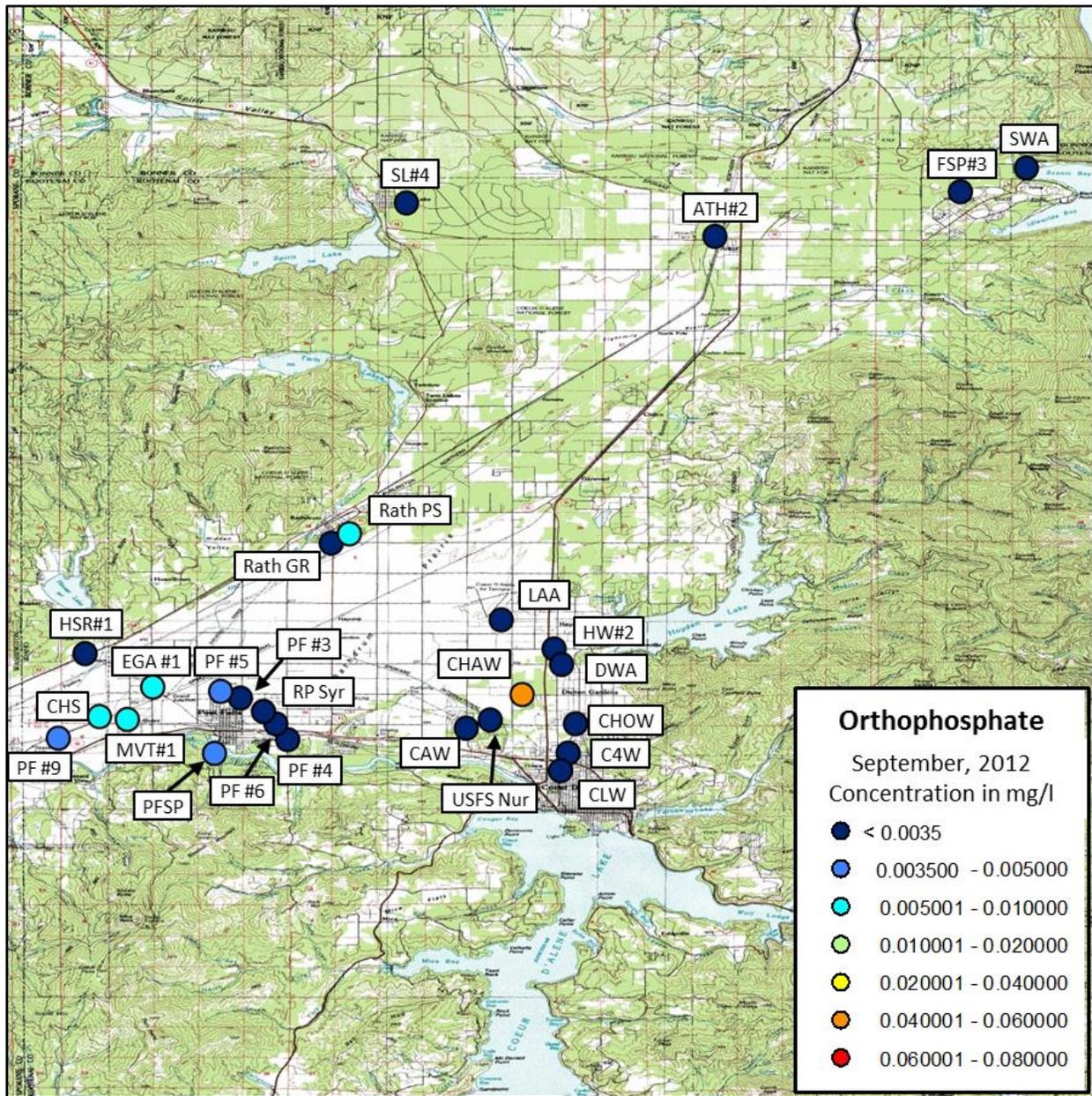


Figure 9. September 2012 - Ground water wells sampled and orthophosphate concentration results.

**Rathdrum Prairie Aquifer
Total Phosphorus
June 2011**

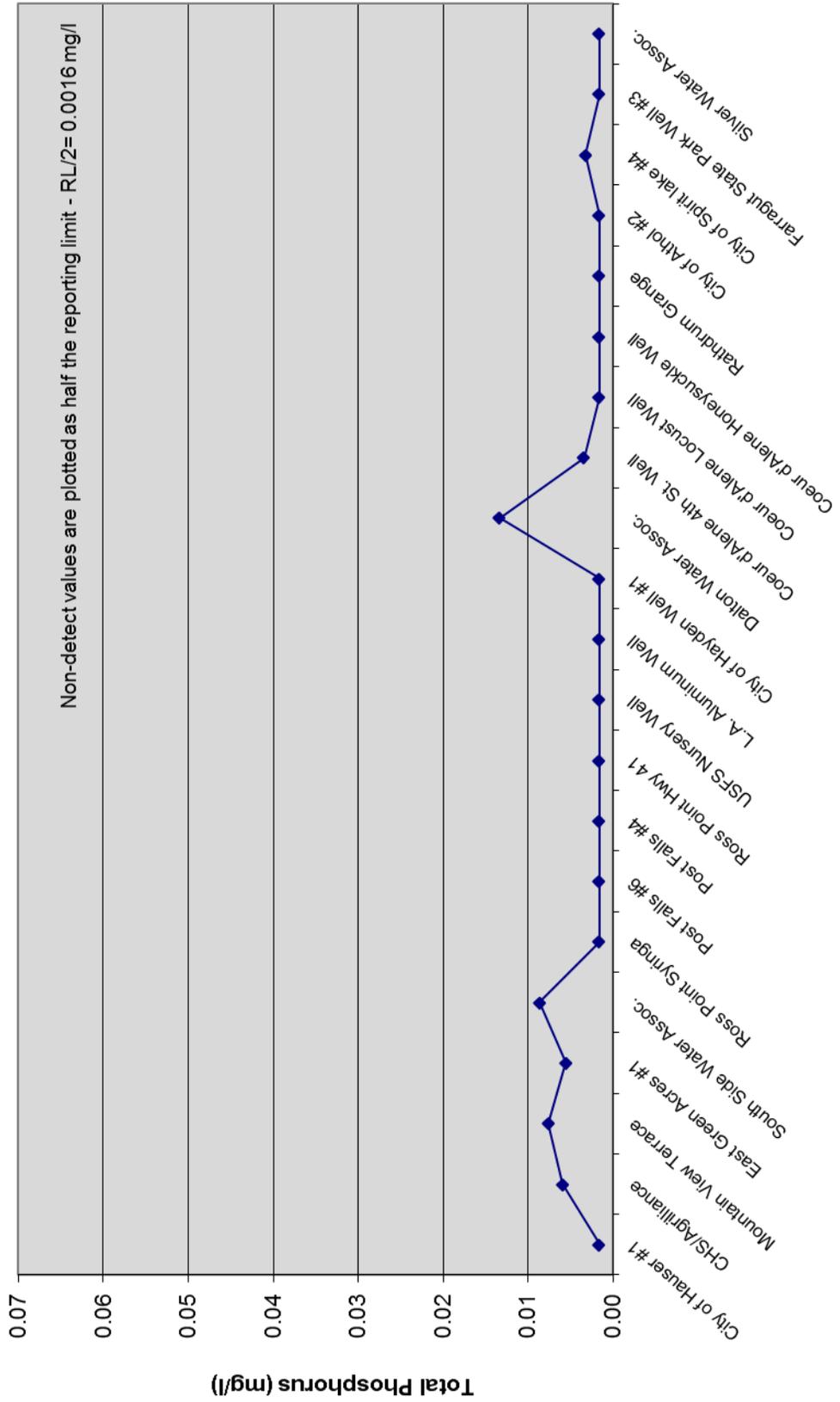


Figure 10. June 2011 - Total phosphorus concentrations and wells sampled.

**Rathdrum Prairie Aquifer
Orthophosphate
June 2011**

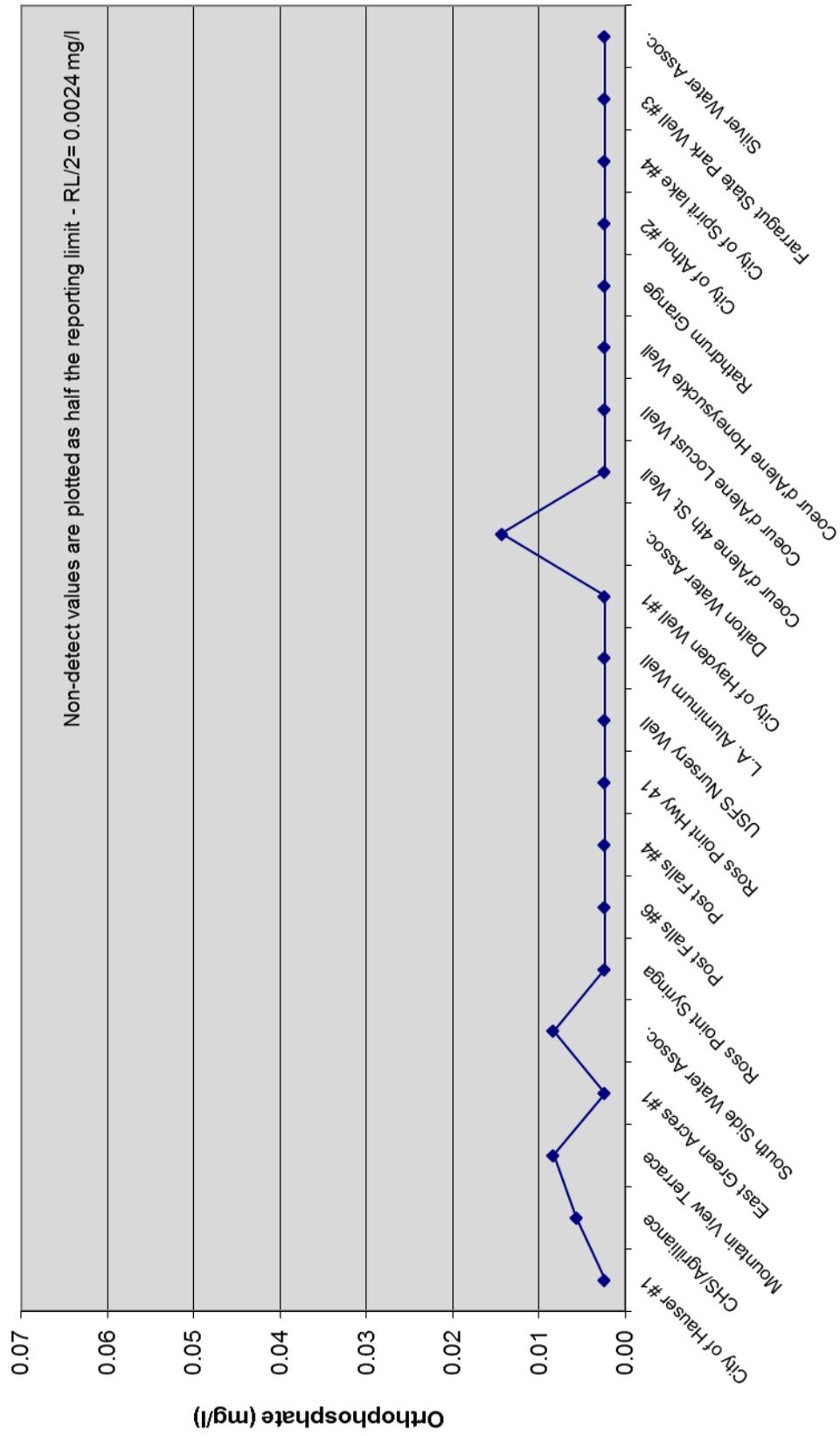


Figure 11. June 2011 - Orthophosphate concentrations and wells sampled.

**Rathdrum Prairie Aquifer
Orthophosphate
September 2011**

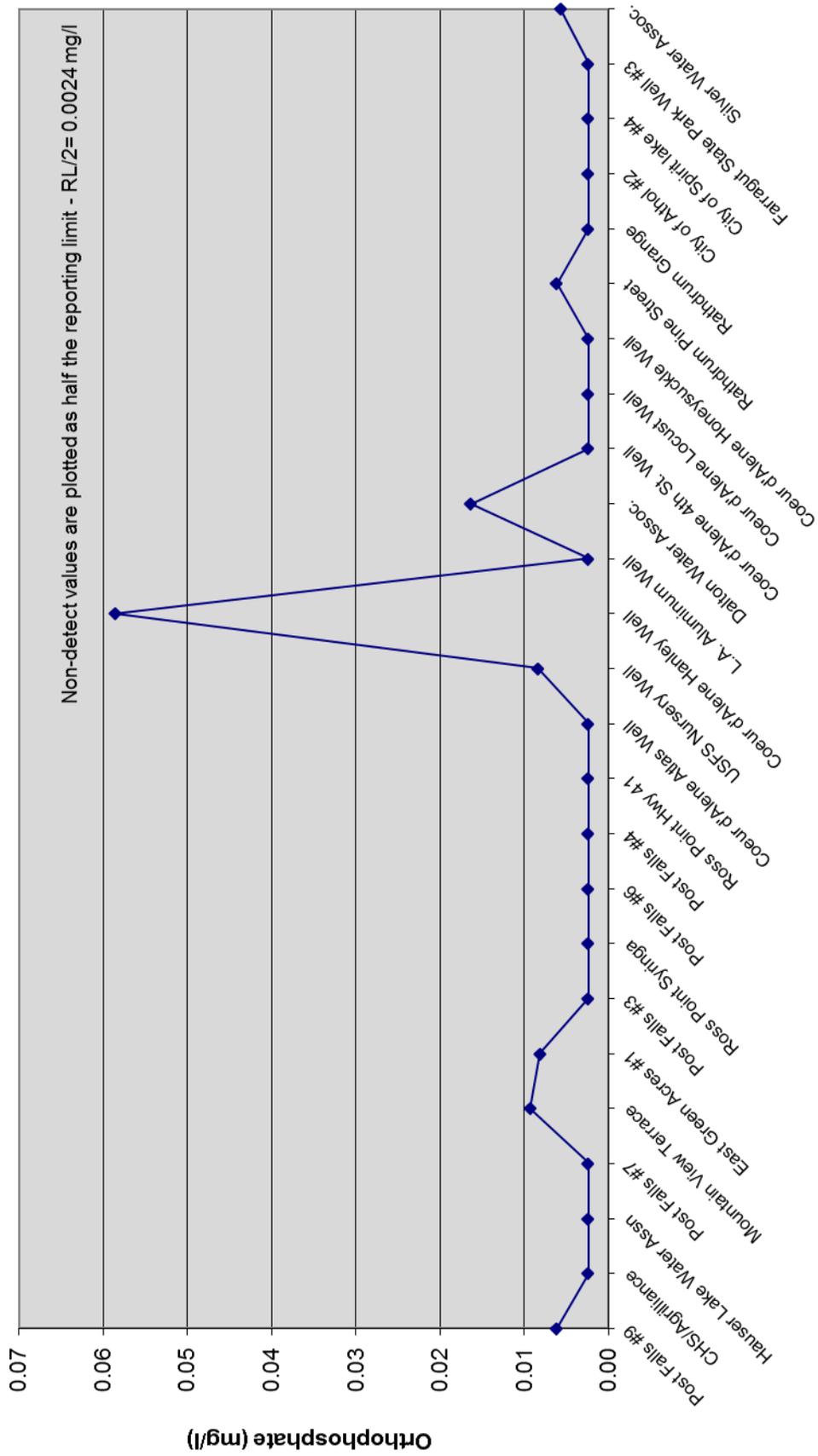


Figure 13. September 2011 - Orthophosphate concentrations and wells sampled.

**Rathdrum Prairie Aquifer
Total Phosphorus
June 2012**

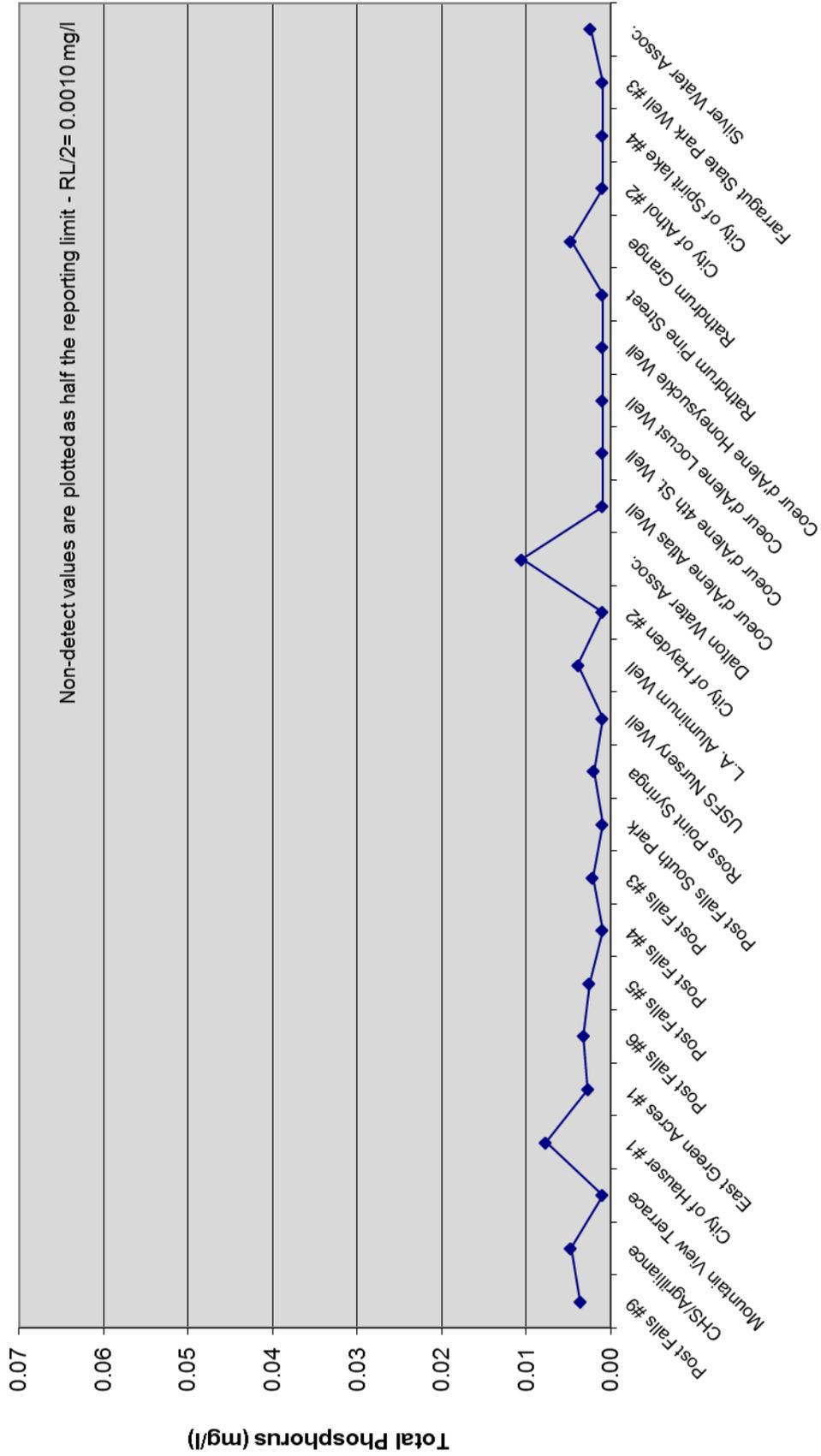


Figure 14. June 2012 - Total phosphorus concentrations and wells sampled.

**Rathdrum Prairie Aquifer
Orthophosphate
June 2012**

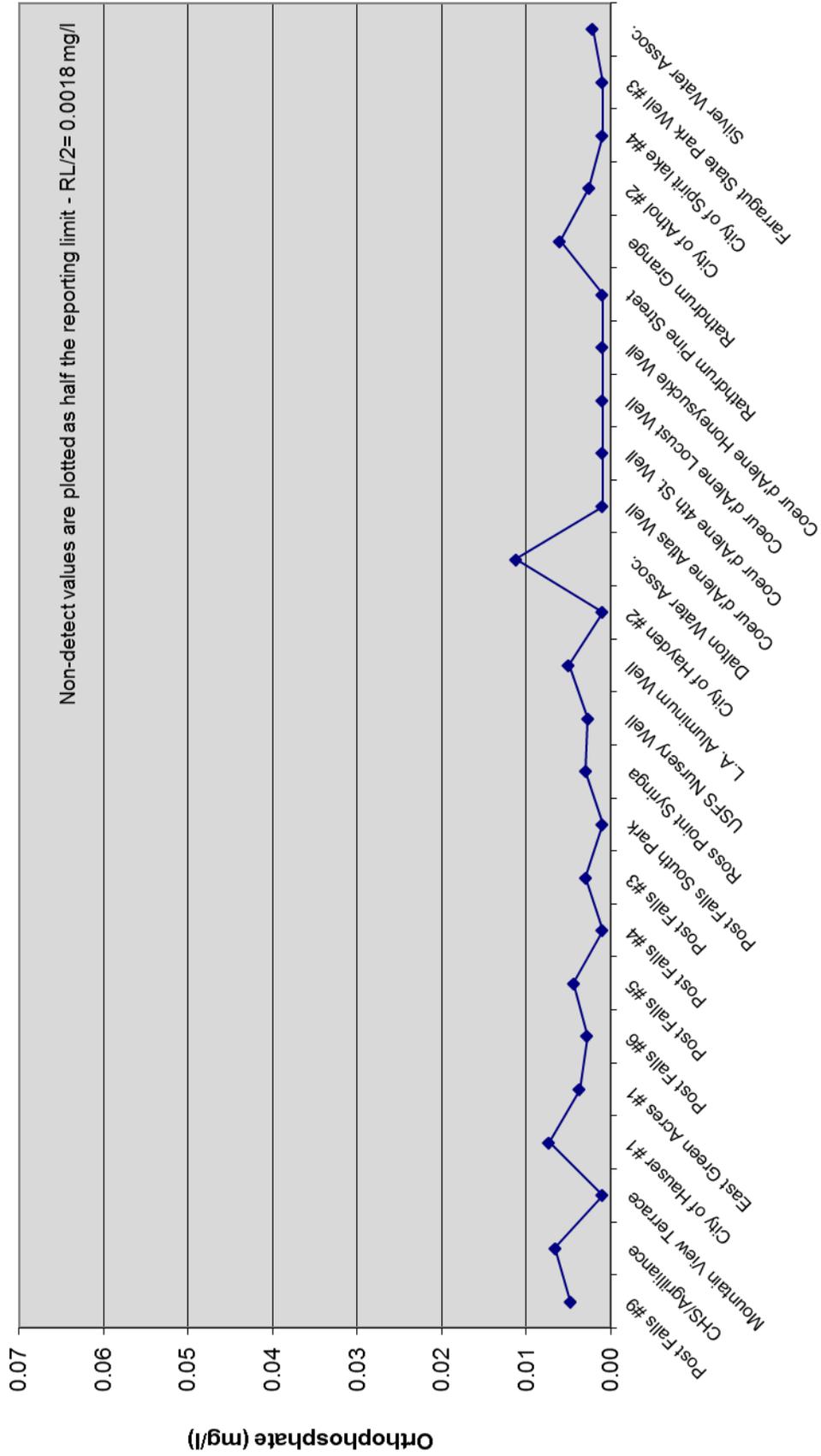


Figure 15. June 2012 - Orthophosphate concentrations and wells sampled.

**Rathdrum Prairie Aquifer
Total Phosphorus
September 2012**

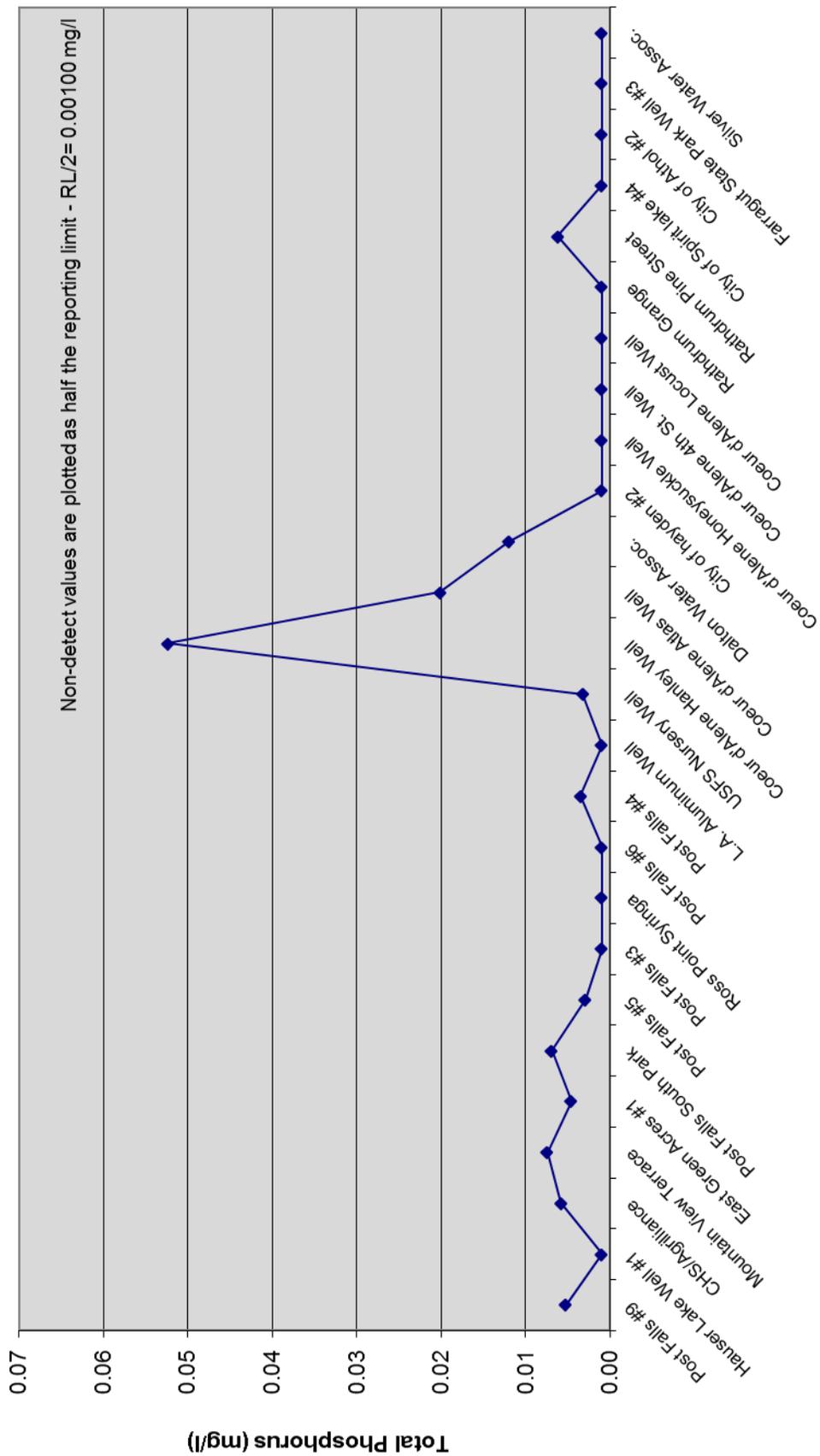


Figure 16. September 2012 - Total phosphorus concentrations and wells sampled.

**Rathdrum Prairie Aquifer
Orthophosphate
September 2012**

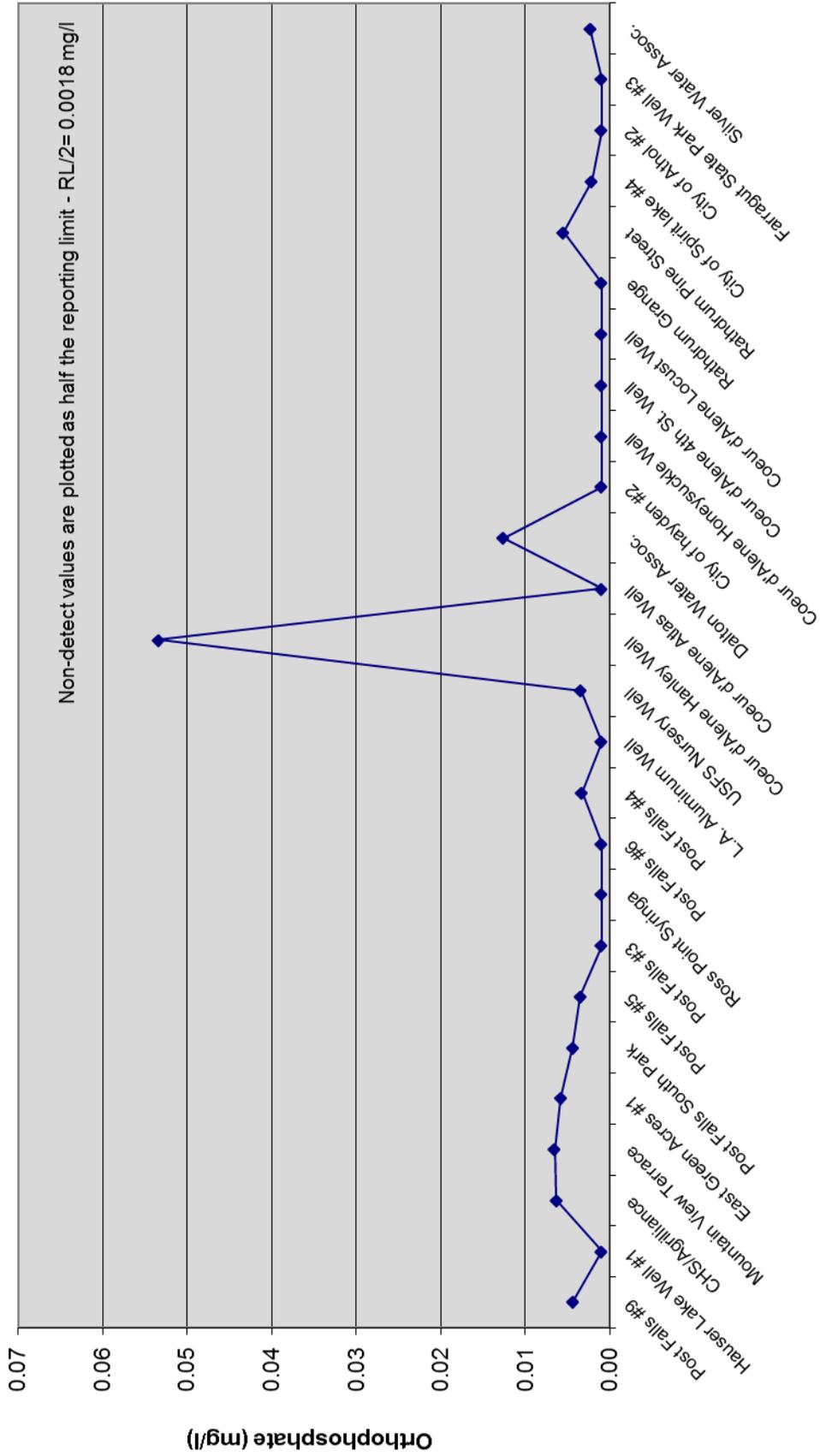


Figure 17. June 2012 - Orthophosphate concentrations and wells sampled.