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APPLYING GEOCHEMISTRY TO INVESTIGATE THE OCCURRENCE OF RIVERBANK INDUCEMENT INTO A SHALLOW AQUIFER IN SOUTHEASTERN WISCONSIN

by

Anna M. Thorp

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ABSTRACT

APPLYING GEOCHEMISTRY TO INVESTIGATE THE OCCURRENCE OF RIVERBANK INDUCEMENT INTO A SHALLOW AQUIFER IN SOUTHEASTERN WISCONSIN

by

Anna M. Thorp

The University of Wisconsin-Milwaukee, 2013
Under the Supervision of Professor Timothy J. Grundl

Increased urbanization in southeastern Wisconsin has led to significant drawdown in both the shallow and deep aquifer. In Waukesha County combined radium activity levels exceeding the limit set forth by the USEPA have been detected within the deep aquifer. This has prompted the community to consider alternative, long term, drinking water supply solutions.

One possible solution is riverbank inducement (RBI), in which river water is induced into the adjacent aquifer as recharge. This would make the shallow aquifer an effective addendum to growing water supply demands, and reduce the effects of excessive pumping. Using basic geochemical analyses, this study examines the interaction between surface water and shallow groundwater along a segment of the Fox River in Waukesha County, with consideration given to mixing, chemical evolution and travel time.

In 2007 a network of sampling sites was established to monitor the chemistry of treated waste-water effluent, river water and municipal wells located in close proximity to the river. Increases in groundwater chloride concentrations over time suggest that the shallow aquifer is susceptible to sodium chloride inputs from three upstream waste water treatment plants, road salt application and water softeners.

Multiple lines of evidence are used to determine the occurrence of RBI, including major ion chemistry, trace elements and stable isotope signatures. Modeling, using the aqueous geochemical program PHREEQC, is used to determine the processes occurring under a RBI scenario and to explain the chemical evolution observed in groundwater. Trace element analysis is performed to discriminate between waste water effluent and road salt as the main source of sodium chloride.

PHREEQC results indicate that 35% to 40% of groundwater is induced from the river. In addition, the travel time between the river and the wells is estimated to take approximately 2 years, furthering our understanding of groundwater pathways. These results are supported by previous numeric flow modeling, using MODFLOW, and electromagnetic surveys. Trace element analysis suggests that waste water effluent is the primary source of contamination. The results from preliminary stable isotope analyses are also included to show the isotopic signatures of the different waters and the effects of mixing.

Dedicated to

my extremely patient and understanding husband,

my daughter who trained me to function without sleep,

my mother who has always supported my endeavors,

my advisor Tim Grundl who has led the way,

and everyone involved with the Geoscience

department, thanks for all the inspiration,

motivation and good times.

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Chapter 1: Introduction

Population growth in southeastern Wisconsin has compelled the search for alternative long term drinking water sources. Communities such as Waukesha County, which straddle the boarder of the Great Lakes drainage basin, rely on groundwater as their primary source of drinking water. Significant drawdown has been observed in the deep and shallow aquifers due to excessive use. Within the last one-hundred years the region has seen over a 500ft drop in water level within the deep aquifer, experiencing annual declines of as much as 5 to 9ft per year (SEWRPC, 2002). Water quality issues surrounding the deep aquifer have arisen, due to elevated radium and arsenic levels. As a potential solution, Waukesha has proposed a Lake Michigan diversion. However, concerns surrounding the ecological impacts and resource management practices make the proposal highly controversial.

Consideration of alternative management strategies may provide a better solution. One possibility includes riverbank inducement (RBI), where water is recycled back into the shallow aquifer through induced recharge. The purpose of this study is to examine the occurrence and extent of RBI along a particular segment of the Fox River and to understand the interaction between surface water and shallow groundwater using geochemical analysis.

Recycling of water into aquifers has proven to be a successful management option in water limited environments in other area of the world (Massman et al., 2008; Reitveld et al., 2011; Tresse et al., 2009). In the Waukesha area there is an underlying concern that RBI has made the shallow aquifer susceptible to contamination from three upstream waste water treatment plants (WWTPs), road salt application, and water softeners. Since

2007, a significant increase in groundwater chloride concentrations have been observed in two high capacity wells located within close proximity to the Fox River.

Road salt is a potential source of elevated groundwater chloride concentrations. Increased use of road salt nationwide has been documented since the 1940's, with the average annual salt sales for deicing purposes escalating from 0.28 to 16.0 million metric tons per year from 1940 to 2000 (Corsi et al., 2010). Areas with dense highway networks such as Waukesha County are susceptible to surface and groundwater contamination through road salting as well as salt storage, and snow dumping (Field et al., 1973). The Wisconsin Department of Transportation reports an average of 22.9 tons per lane mile over a ten year period from 2001 to 2011 for Waukesha County (WisDOT, 2001-2012).

Another major source of groundwater contamination is treated waste water effluent. The facilities upstream of the study area include the Sussex, Brookfield, and Waukesha WWTPs. The Sussex treatment facility discharges into the Sussex Creek, a tributary of the Fox River, while both the Brookfield and Waukesha treatment facilities discharge directly into the Fox River. Outfall from the Waukesha WWTP constitutes a significant portion of the river's discharge especially during the low flow months of summer and fall, comprising more than one-quarter of the flow 50 percent of the time between July through September (SEWRPC, 2011).

The use of water softeners, common in southeastern Wisconsin, is a third potential source of NaCl contamination in groundwater. The contribution of dissolved halite from water softening has been estimated by to be between 660 to 990 kilograms per year for a family of four, based on the typical manufacturer's recommended operational amount of 1.8 to 2.7 kilograms per day of NaCl (Panno et al. 2006). One study in the Chicago metropolitan area (totaling 3,700 square miles) estimates that up to 127,000 metric tons of halite has the potential to enter groundwater, based on the US Census bureau's 1993 figure of the number of homes with private septic systems (Kelly, 2008).

In order to determine the occurrence and extent of RBI, several lines of chemical analysis are performed. Major ion analysis has identified the two end-member waters. These include native groundwater not influenced by RBI, and WWTP effluent. Other waters pertinent to this study include the Fox River, which has a high proportion of WWTP effluent, and groundwater extracted from wells located near the river in the riparian zone. The evolution of groundwater in riparian wells been observed and is significant in the determination of RBI.

The aqueous geochemical program PHREEQC is used to model the observed groundwater evolution. Through modeling, relevant geochemical processes are identified and the travel times of breakthrough curves are determined. These travel time are compared with independently obtained numerical modeling and geophysical results. Trace element analysis is applied as a means of source discrimination between waste water effluent and road salt. Preliminary stable isotope results are included to support the occurrence of RBI.

Chapter 2: Setting

Study Area and Site Physiography

The Fox River watershed has a total area of 2,658 square miles which spans northeastern Illinois and southeastern Wisconsin. The Upper Fox River watershed, located in southeastern Wisconsin, is approximately 938 square miles and contains the northern stretch of the Fox River. The drainage area of the Fox River at Waukesha is approximately 126 square miles. Pewaukee Lake, covering an area of 3.8 square miles, contributes significant discharge into the Fox River through the Pewaukee River.

The topography and physiography of the Fox River basin is developed on glacial till and glacial outwash deposited during the end of the Wisconsin Glaciation approximately 11,000 years ago and is characterized by moraines, drumlins, kames, outwash plains, and lake basin deposits, illustrated in Figure 1. These features produce a gently rolling landscape with moderate land slopes and an average channel slope for the Fox River of 4 feet per mile. In Waukesha County, elevation ranges from 700 to 900 feet above mean sea level.

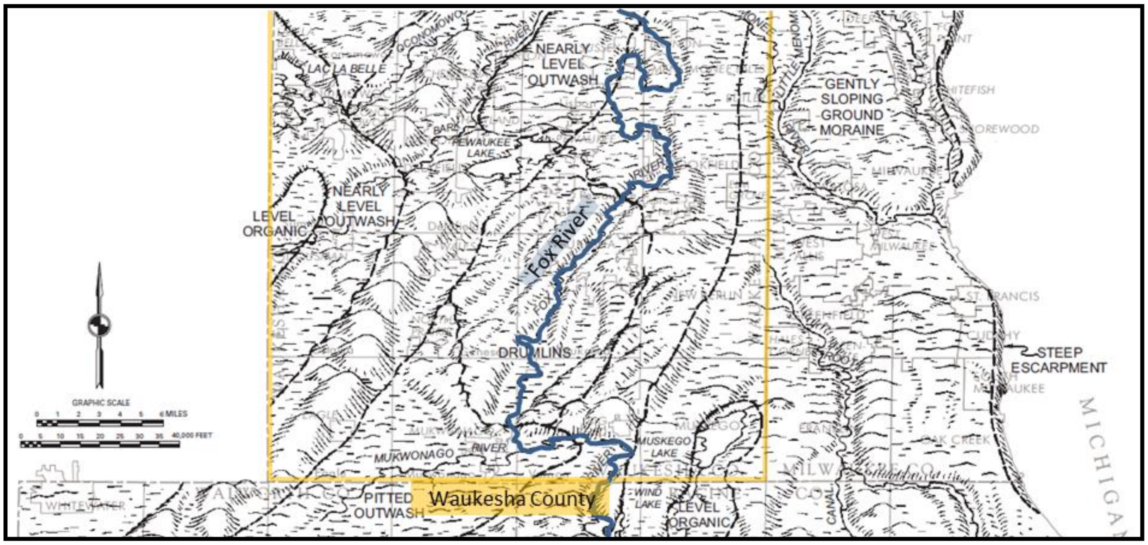


Figure 1. Physiography of the Fox River basin in Waukesha County and parts of surrounding counties. Modified from SEWRPC, 2002.

Climate and Precipitation

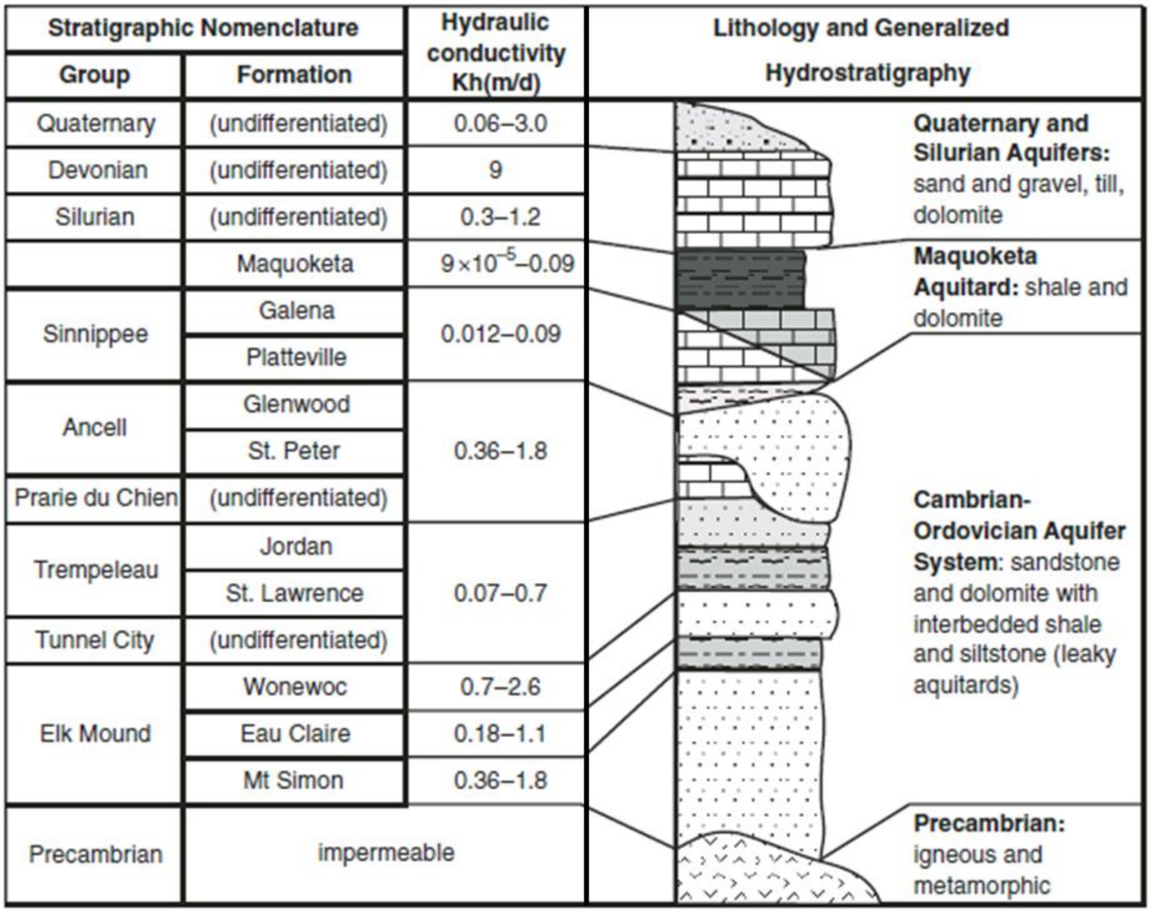
Climate and precipitation data (for Waukesha WI Station USC00478937 (http://www.ncdc.noaa.gov/cdoweb/datasets/ANNUAL/stations/COOP:478937/detail)) obtained from the National Oceanic and Atmospheric Administration's National Climatic Data Center between 2002 and 2012 reports an average annual temperature of 47.6° Fahrenheit. The reported average annual precipitation is 32.7 inches with the majority of precipitation occurring in June and July and the least precipitation occurring in January and February.

Precipitation data indicates that Lake Michigan has a much more pronounced effect on temperature than it does on precipitation within the region; its influence as a moisture source is primarily reflected by slightly higher seasonal snowfalls compared to areas lying west of the region (Knapp et al., 1991).

Regional Geology

Waukesha County lies east of the Wisconsin Arch within the Michigan Basin. The Precambrian bedrock consists of primarily granite and quartzite. Its surface undulates from 100m above sea level in the northwestern portion to 600m below sea level in the southeastern portion as it slopes into the Michigan Basin (Thwaites, 1957). Above the bedrock lie Paleozoic and Quaternary deposits.

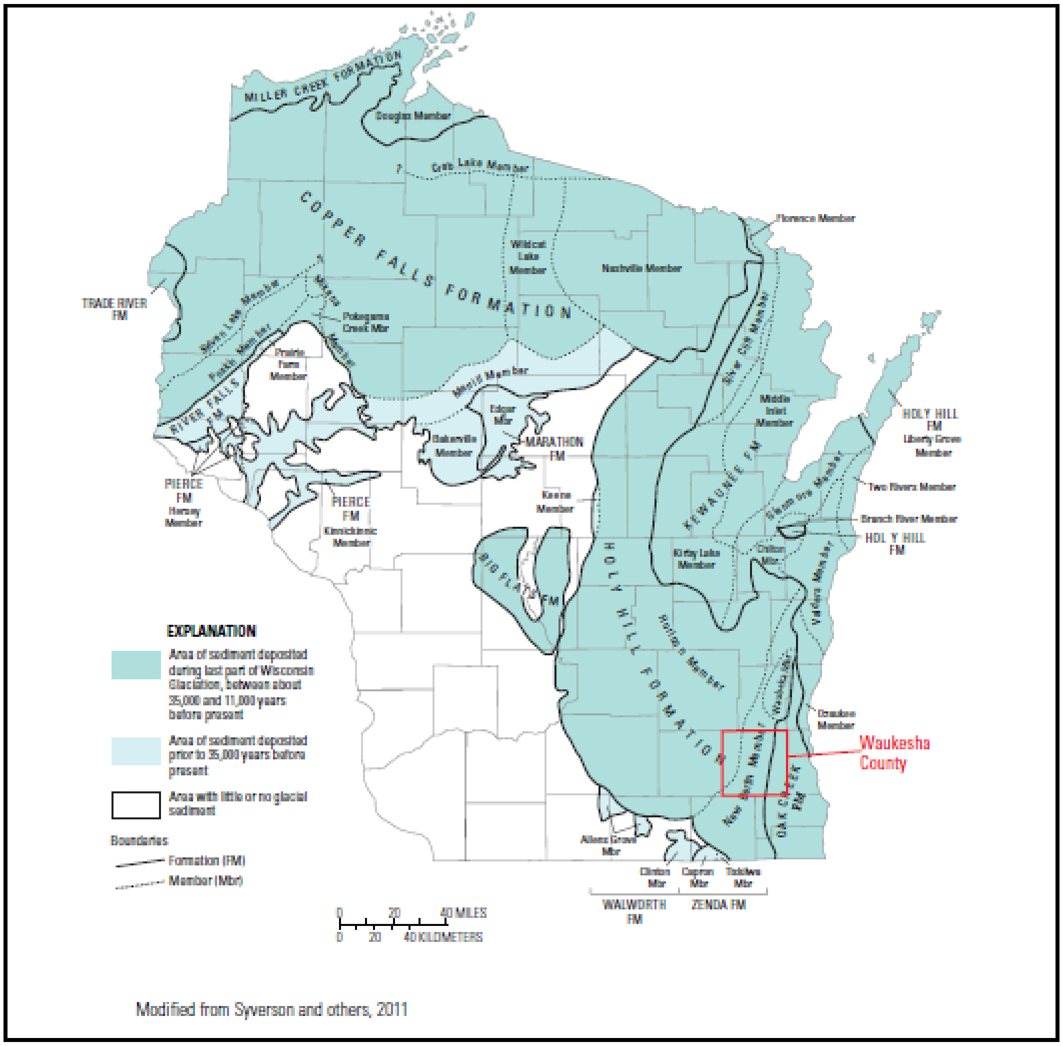
The oldest of the Paleozoic deposits include Cambrian rocks consisting of sandstone with some shale and dolomite. Above this are Ordovician deposits which include the sandstones of the Saint Peter Formation and the Maquoketa Formation, which is comprised of dolomitic shale up to 60m thick and acts as an impermeable barrier from the Silurian dolomite above (Clayton, 2001; SWERPC 2002). The Silurian dolomite ranges from 0-100m thick and is overlain in much of the area by Pleistocene sediments of the Quaternary Group (Clayton 2001). Figure 2 shows the lithology and generalized hydrostratigraphy of the study area.



Stratigraphic Nomenclature		Hydraulic conductivity Kh(m/d)	Lithology and Generalized Hydrostratigraphy
Group	**Formation**		
Quaternary	(undifferentiated)	0.06–3.0	**Quaternary and Silurian Aquifers:** sand and gravel, till, dolomite
Devonian	(undifferentiated)	9	
Silurian	(undifferentiated)	0.3–1.2	
	Maquoketa	9×10^{-5}–0.09	**Maquoketa Aquitard:** shale and dolomite
Sinnippee	Galena	0.012–0.09	
	Platteville		
Ancell	Glenwood	0.36–1.8	**Cambrian-Ordovician Aquifer System:** sandstone and dolomite with interbedded shale and siltstone (leaky aquitards)
	St. Peter		
Prarie du Chien	(undifferentiated)		
Trempeleau	Jordan	0.07–0.7	
	St. Lawrence		
Tunnel City	(undifferentiated)		
Elk Mound	Wonewoc	0.7–2.6	
	Eau Claire	0.18–1.1	
	Mt Simon	0.36–1.8	
Precambrian	impermeable		**Precambrian:** igneous and metamorphic

Figure 2. General hydrostratigraphic column showing the associated hydraulic conductivity of each geologic unit in the study area, vertical exaggeration 100x (Klump et al., 2008).

The Pleistocence glacial deposits, consist of a complex interfingering of tills and glaciofluvial sediments. The location of Waukesha County in relation to these lithostratigraphic units is shown in Figure 3, with much of the study area characterized by the deposits of the New Berlin Member. The moraines, drumlins, kames, outwash plains, and lake basins of the New Berlin Member consist of varied compositions of sand, gravel, and clays. This level of heterogeneity is typically associated with glacial sediments.



Modified from Syverson and others, 2011

Figure 3. Location of Waukesha County in relation to Pleistocene lithostratigraphic units in Wisconsin, the study area denoted by the red box. Modified from Syverson et al., 2011.

Hydrostratigraphy

There are several significant hydrostratigraphic units which influence the physical flow and chemical characteristics of groundwater in southeastern Wisconsin. The most recently deposited Pleistocene glacial and alluvial materials form the upper part of the shallow aquifer. Reworking of the glacial deposits during advances and retreats of the ice sheets has resulted in complex heterogeneous stratigraphic units, both vertically and horizontally in extent, with highly varying thickness.

The New Berlin Member, deposited during the last part of the Wisconsin Glaciation, characterizes most of the Pleistocene lithology in the study area. It is composed of two facies, the lower sand and gravel unit, interpreted as a proglacial outwash unit, and the upper till unit, originating from basal till. The formation's thickness can reach 22 meters, with the lower unit being up to 12m thick. The composition of the upper basal till unit typically averages 58% sand, 29% silt, and 13% clay (Wisconsin Geological and Natural History Survey, 2011). Large quantities of crushed dolomite make the till strongly calcareous resulting in a pH of about 8. Clay mineral analyses indicate the clays are composed of 66% illite, 17% expandable clay and 17% kaolinite plus chlorite (WGNHS, 2011). This is significant when considering cation exchange, since cation exchange is a direct function of the structure and composition of the clay.

The lower part of the shallow aquifer consists of Silurian dolomite. Beneath this lies the deep aquifer consisting of Ordovician dolomite and Cambrian sandstone. The shallow and deep aquifers are separated by the Maquoketa shale, an impermeable unit, which pinches out in the westward direction approximately 10 miles west of the city of Waukesha. The low conductivity of this unit plays a significant role in limiting groundwater recharge into the deep aquifer. Figure 2 shows the associated hydraulic conductivities of each unit.

Although the deep sandstone is the most productive unit in the area, capable of producing large quantities of water, naturally occurring contamination by radium and arsenic have called for the discontinuation of its use. The shallow aquifer consists of both the upper sand and gravel unit and the lower Silurian dolomite, which is hydraulically connected but produces much less water. Combined they can sustain a withdrawal of approximately 6.3 million gallons per day, based on numerical modeling (Feinstein, 2012).

The local chemistry of both the shallow and deep groundwater is classified as the calcium-magnesium-bicarbonate type, influenced by the dissolution of both calcite ($CaCO_3$) and dolomite ($CaMg(CO_3)_2$). Major ion chemistry in both the shallow and deep aquifer is similar, with the exception of the deep aquifer showing higher concentrations of sulfate. Total dissolved solids range from 300-500 ppm in the aquifers, with the maximum concentration occurring in the Silurian dolomite.

Vulnerability to contamination is relatively high in the region within the shallow aquifer. Glacial deposits such as those in the Fox River Valley, which consist of sandier sediments, shallow groundwater table depth and high to moderate soil percolation increase vulnerability. The complex heterogeneity also provides unpredictable passageways for contaminant transport through clay lenses which may otherwise act to obstruct flow and retard harmful constituents through adsorption.

Chapter 3: Previous Studies

The success of RBI flow to augment drinking water supplies is dependent on the quality of the infiltrating water and its subsequent chemical and biological alteration. The USEPA, under the Surface Water Treatment Rule (USEPA, 1989), has proposed bank filtration as an alternative treatment strategy for certain biological contaminants including *Giardia* and *Cryptosporidium*. Elimination and attenuation of these bacteria as well as parasites, viruses, biodegradable compounds, suspended solids and adsorbable compounds has been observed (Andelman, 1994: Hiscock and Grischek, 2002;, Leschik et al., 2009; Massmann et al., 2008).

An aquifer recharged through RBI is susceptible to any contaminant discharged into a stream. Discharges of treated waste water effluent host a wide range of undesirable constituents. Degradation of groundwater due to NaCl from treated effluent has been well documented (Barber et al., 2006; Gros et al., 2007; Leshik et al., 2009; Massmann et al., 2008; Vengosh and Keren, 1996). The trace element boron, used as a bleaching agent in detergents, is also found in higher concentrations in waste water effluent. Elevated sodium chloride and boron concentrations have proven to be reliable indicators of waste water effluent interacting with groundwater systems (Panno et al., 2006; Vengosh and Keren 1996). Chloride has been shown to behave conservatively in groundwater (Barber et al., 2006; Barrett et al.,1999; Leschik et al., 2009; Panno et al., 2006) while sodium is subject to cation exchange reactions (Norrstrom and Bergstedt, 2000; Ramakrishna and Viraraghavan, 2005; Stotler et al., 2011; Vengosh et al., 1994).

Vengosh and Keren (1996) used NaCl and B to characterize the movement of effluent through the Coastal Plain aquifer in Israel. Their study of the Dan Region

Sewage Reclamation Project recorded NaCl and B concentrations in effluent and observation wells between 1977 and 1993. Breakthrough curves revealed that Cl^- transport took only 6 months, however Na^+ and B transport took 2 years, suggesting cation exchange of Na^+ and sorption of $B(OH)_3$ onto clay minerals within the aquifer. Over time, the chemical composition of groundwater became increasingly similar to recharge water. This demonstrates the finite nature of soil sorption capacity, which is limited by the exchangeable sodium percentage of clay minerals in the aquifer. In addition, the concentrations of Cl^- (200-350 mg/L) and B (0.3-0.6 mg/L) found in the effluent decreased with increasing distance from the recharge basins. This indicates advective and dispersive flow occurs within the aquifer resulting in mixing with background groundwater.

The use of road salt, composed primarily of halite, has been shown to result in widespread groundwater contamination (Bester et al., 2006; Kelly, 2008; Meriano et al., 2009; Norrstrom, 2001; Perrera et al., 2010; Ramakrishna and Viraraghavan, 2005). The impacts of road salt runoff into streams, within the greater Milwaukee area, were documented using specific conductance values to estimate chloride concentrations (Corsi et al., 2010). Of 11 urban stream sites 8 exhibited elevated chloride concentrations greater than 860 mg/L, which exceeds the USEPA’s acute water-quality criteria, while the remaining 3 exceeded the chronic level of 250 mg/L. A direct correlation was made between land use and elevated chloride concentrations. Increases in impervious surfaces increased chloride concentrations as high as 7150mg/L during the winter months as a result of direct runoff.

The fate of road salt in the environment is determined by its distribution as either runoff or infiltration. Howard and Haynes (1993) investigated road salt partitioning within the Highland Creek Watershed in the Greater Toronto area. They developed a chloride mass balance, which considered road salt application rates, aquifer storage and the observed annual concentrations in streams. The results suggested an estimated 44% was removed through overland flow, while 55% entered the shallow groundwater and contributed to stream baseflow in late summer and early fall. In addition, they observed the effects of chloride retention over time, predicting an increase in aquifer Cl^- concentrations of 10mg/L per year.

Refinement of the mass balance on the Highland Creek Watershed, during 2004-2008 by Perera et al. (2013), estimates that approximately 40% of applied road salt enters the subsurface. Over the last 20 years Cl^- concentrations increased slightly less than originally predicted by Howard and Haynes, and were calculated to be 6 mg/L per year. Both studies indicate that a significant amount of chloride is introduced into aquifers through infiltration and is retained. Under a RBI scenario additional chloride input into the aquifer is also expected from direct runoff contributions into stream flow.

Major ion and trace element analysis has proven useful not only in determining the introduction of contaminated waters into an aquifer, but also in source discrimination (Panno et al., 2006; Vengosh and Keren, 1996; Venugopal et al., 2007). Using mixing curves and end-member waters contaminant sources can be linked to their affected waters. Panno et al. (2006) utilized an average seawater composition (Krauskopf, 1979), of 10,770 mg/L of Na^+ and 18,800 mg/L of Cl^- for natural source discrimination. Increases in B/Cl ratio from the reported value of 8×10^{-4} in seawater (Vengosh et al.,

1991) have been used to distinguish anthropogenic from natural sources (Barber et al., 2006).

Vengosh and Keren (1996) demonstrated, in their extensive monitoring of the Coastal Plain aquifer, that boron and its isotopes are useful for monitoring the accumulation of organic pollutants in groundwater. The isotopically distinct low $\delta^{11}B$ signature of anthropogenic boron makes it useful in contaminant source identification, as does its resistivity to removal and fractionation during the treatment of waste water effluent (Vengosh et al, 1994). Although once considered a relatively conservative tracer (Quast et al., 2006) boron’s adsorption onto clay minerals has been demonstrated through several studies (Kloppmann et al., 2009; Parks and Edwards, 1994; Vengosh et al., 1994). Although it is considered a reliable tracer in determining the origin and movement of effluent in groundwater; its potential to react with the aquifer, however, has further implications for understanding geochemical processes within the aquifer.

The use of stable isotopes of hydrogen (δD), and oxygen ($\delta^{18}O$) has also proven to be reliable in source discrimination (Panno et al., 2006). The isotopic composition of a known water makes it applicable as a tracer. The Global Meteoric Water Line (GMWL) describes the distribution of δD and $\delta^{18}O$ by the linear equation $\delta D = 8\delta^{18}O + 10$ (Craig, 1961). The relative position of a sample to the GMWL can reveal its history.

Deviations from the GMWL shed light on physical equilibrium and kinetic isotopic effects, which provide information about the origin of water, any subsequent mixing, and its cycling through the environment (Bhatia et al., 2011; Gat, 1996; Merlivat and Jouzel, 1979). Non equilibrium processes, such as evaporation, result in a deviation from the slope of 8 of the GMWL to a slope of less than 8 (Dansgaard, 1964). Local evaporation lines (LEL) tend to have a slope near 5, as increased evaporation results in the remaining residual being more enriched in D than ^{18}O.

Another deviation from the GMWL is the additive parameter "deuterium excess" (d) defined by the equation $d = \delta D - 8\delta^{18}O$ (Dansgaard, 1964). Conditions of relative humidity and temperature at the evaporation site result in a Local Meteoric Water Line (LMWL) that parallels the GMWL but falls either above or below depending on the addition or loss of deuterium. Environments such as the Great Lakes Region see enhanced water recycling. This produces positive d-excess values, a result of surface waters becoming more and more isotopically light (Froehlich, 2002). Gat et al. (1994) has examined the effect of enhanced continental water recycling on d-excess values in the Great Lakes Region, and reports values being on average 3.5‰ higher in precipitation than values recorded at upwind sites.

The isotopic signatures of glacial waters have been extensively studied through the Greenland Ice Core Project. The extreme temperature decrease during glacial periods has a pronounced effect on isotope fractionation. This results in low δD and $\delta^{18}O$ values and lower d-excess values in polar snow, which can be used to distinguish waters originating during the Last Glacial Maximum (LGM) (Corcho Alvarado et al., 2006; Jouzel et al., 2007; Masson-Delmotte, 2005).

Chapter 4: Relevance and Research Objectives

The effects of increased use of the shallow aquifer in southeastern Wisconsin, due to population growth and water quality issues, have prompted consideration of alternative resource management strategies. However, an understanding of the shallow aquifer's susceptibility to contamination needs further consideration before determining the safety of using induced flow as a water source. Examination of the physical and geochemical processes at work within the aquifer will identify the potential for the natural filtration of recharging water. Determining the extent of contamination is the first step in preventing further degradation to the aquifer and implementing practices to preserve water resources for future use.

The objectives of this research project include:

1) Investigating the occurrence of RBI using geochemical analysis of major ions and trace elements of groundwater, Fox River water, and WWTP effluent.
2) Quantifying the extent of anthropogenic influence on the aquifer using geochemical modeling. Results will help identify the chemical and physical processes responsible for the observed evolution of groundwater. Physical processes will also help determine travel times and potential flow pathways of contaminants within the aquifer.
3) Discriminating between sources of contamination using trace element and stable isotope analysis.

Chapter 5: Methods

Monitoring Network

The study area is located in Southeastern Wisconsin and consists of sampling locations within the Root and Menomonee Watersheds located in Milwaukee County and the northern portion of the Upper Fox Watershed located in Waukesha County. An established monitoring network, developed from previous research (Holzbauer 2010; Wilberding, 2007), provides the sampling locations. The 18 sampling sites include 7 high capacity wells, 7 river locations, 1 artesian spring and treated effluent from the Sussex, Brookfield, and Waukesha WWTPs. Locations are shown Figure 4. Coordinates and water utility contact information is included in Appendix A.

Additional surface water and groundwater samples have been collected to maintain the background sample record for possible future use, but are not used directly in this study. Additional surface water samples include Hygeia Spring, an artesian well located near Fox 3, and Sussex Creek, located just below the outfall from the Sussex WWTP; both sites are within the Upper Fox Watershed. Two other sites within the Menomonee and Root Watersheds are also sampled; these include Underwood Creek and the Root River. Background well water samples include 3 municipal wells maintained by the city of Brookfield, IZ385, IZ36 and EM275, which are all screened in the Silurian dolomite. The final well included in the study SV631 is located in the city of Franklin and its water supply is utilized by a private school, it is screened within the shallow sand and gravel aquifer.

The primary area of interest for the current study is located within the Upper Fox Watershed in Waukesha County. The occurrence of RBI is examined by sampling spatially significant locations in and along the Fox River. River locations include Fox 0 which is located upstream of all WWTPs, Fox 1 located below the outfall of the Sussex and Brookfield WWTPs, Fox 2 located downstream of all 3 treatment facilities and just below the outfall of the Waukesha WWTP. The final river location is Fox 3 located much further south and is subject to a significant increase in volume from the input of tributaries and groundwater flow.

Groundwater locations of interest along the Fox River include 3 high capacity wells that are maintained by the Waukesha Water Utility. These are RL255, RL256, and WK947, which are all screened in the shallow sand and gravel aquifer. RL255 is drilled to a depth of 127ft, RL256 is drilled to a depth of 144ft, and the total depth of WK947 is 105ft (WDNR, 2012). Well construction reports and well logs are included in Appendix A. RL255 and RL256 are located in close proximity to the Fox River, at 225ft and 83ft from the riverbank respectively. WK947 is located in the same general area, but at a distance of approximately 1500ft from the river. To date its water chemistry has shown no signs of influence from the river. Although WK947 is the shallowest of the three wells, it rests just above the Silurian dolomite. The influence of its position is evident in the major ion chemistry of water sourced from this well.

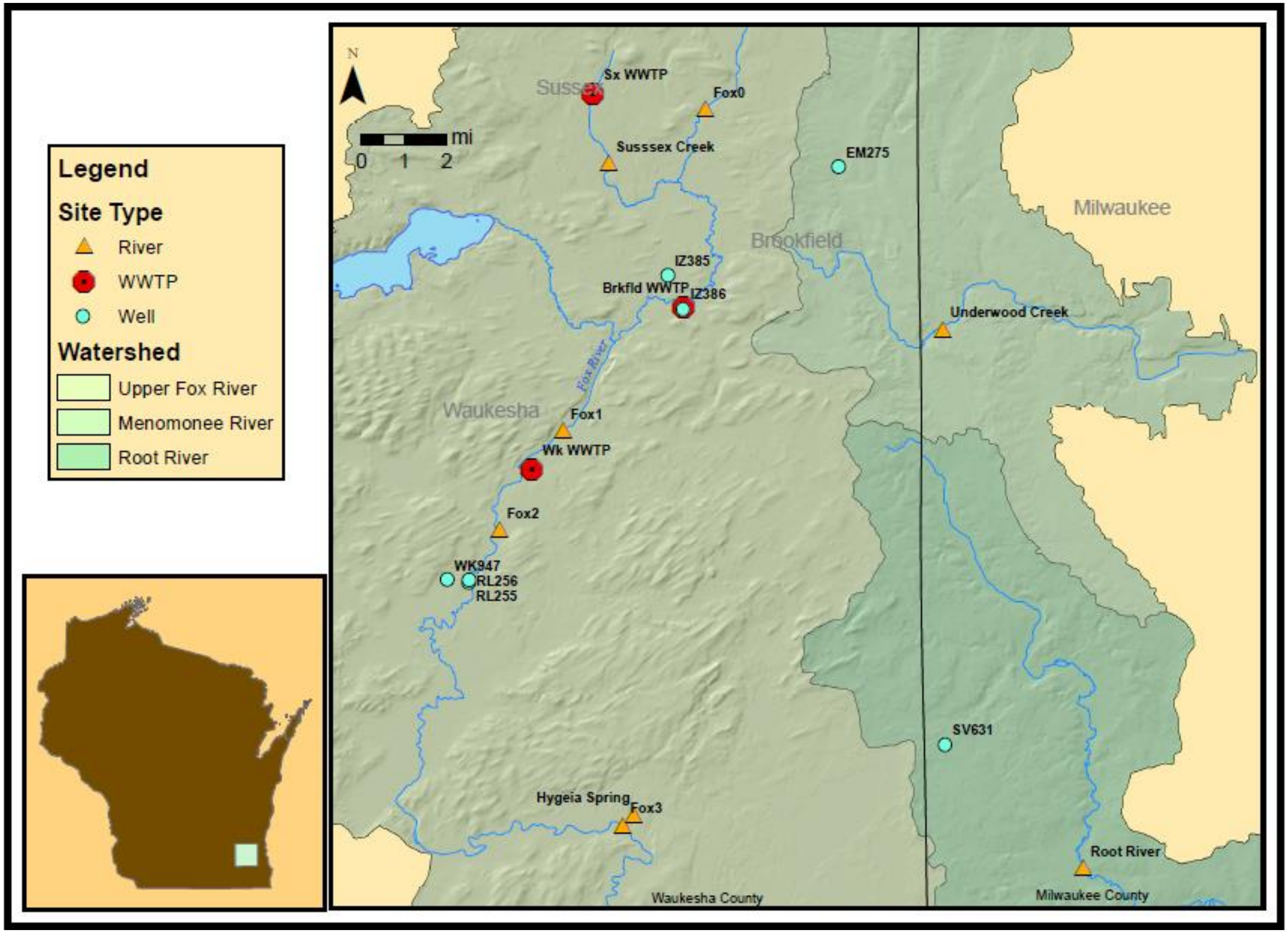


Figure 4. Monitoring network with sampling locations (Holzbauer 2010; Wilberding, 2007).

Field Methods and Equipment

All sites shared the same sampling schedule. Samples were collected at time intervals pertinent to groundwater. These seasonally significant times included the spring recharge, the late summer which captured annual baseflow conditions, and the late fall which captured significant recharge conditions. In addition, sampling was performed once during the winter in February of 2012. The treatment and storage of samples was the same for all sites. Site type dictated collection techniques and field measurements for selected physical and chemical properties.

Surface water collection was performed at low flow conditions as determined by the USGS gage station 05543830 Fox River at Waukesha, located approximately 0.7 miles downstream of the Fox 1 site (measured from GIS mapping, Figure 4). Collection was done by Teflon bailer at 5 to 10 intervals across the river. Individual samples were composited to ensure that a representative stream sample was obtained. Well water collection was conducted at well houses using a YSI 3550 flow-through chamber with tubing connecting the raw water tap with the chamber input and the outflow hose emptying into a 1L collection bottle. Well pumps ran for a minimum of 10 minutes prior to collection to ensure a representative groundwater sample. Waste water effluent was obtained from the treatment facilities as a 24hour composite sample; the refrigerated 1L was filled as high as possible to reduce exposure to oxygen.

Physical parameters of dissolved oxygen, electrical conductivity and temperature were performed for all river and well sites. Dissolved oxygen was measured using a YSI Model 52 dissolved oxygen meter calibrated to barometric pressure reported from a handheld barometer. Dissolved oxygen was also measured using CHEMetrics colorimetric ampoule kits K-7512 and K-7501. Electrical conductivity and temperature were measured using a YSI 3500 water quality meter. At river locations the meters were situated on the bank of the river with the probes positioned as far into the river as possible to ensure the best possible representative measurement. At well locations the oxygen probe was positioned in the 1L collection bottle at the chamber outflow while the YSI 3500 water quality meter was attached to the chamber's designated inflow ports. Three readings were taken for each parameter at intervals of at least 10 minutes to determine an average.

Several chemical parameters, which are subject to rapid change, were also tested for at river and well water sites; these include pH, alkalinity, ferrous or total iron, and sulfide. Field measurements of pH was performed using an Accumet 1002 pH meter by Fischer Scientific, calibrated to pH of 4.0 and 7.0. A filtered 50mL sample was then titrated to a pH of 4.5 using dilute 0.02N hydrochloric acid to determined bicarbonate alkalinity. The total acid amount added was determined through the mass difference between the original mass of 50mL sample and the mass of the sample after titration to the 4.5 endpoint using an Ohaus SP402 portable scale. Alkalinity for WWTP effluent was calculated according to charge balance requirements of 10%. CHEMetrics colorimetric ampoule kits were used to measure ferrous or total iron (kit K-6210) and sulfide (kit K-9510).

All river, well and WWTP effluent samples were passed through a 0.2 µm sterile, regenerated, cellulose filter attached to a plastic syringe and hand filtered in preparation for chemical analysis. At each site two 125mL HDPE Nalgene bottles were filled with samples for major anion and cation analysis. The cation sample received1mL of 4N trace metal grade nitric acid for preservation. An additional 50mL were collected in polypropylene conical tubes for trace element analysis of boron, lithium, bromine, and iodine. For select sites, including the Waukesha wells, Fox River locations and WWTPs a 15mL sample was collected in polypropylene conical tubes to be analyzed for isotopic composition. All bottles and tubes were sealed with Parafilm and refrigerated at 4°C for long term storage.

Laboratory Analysis

Major ion analysis was performed at the Great Lakes WATER Institute. Anion analysis was conducted using ion chromatography on a DIONEX ICS-1000 IC System, with Chromeleon version 6.80 SR7 workstation software. Analytes include Cl^-, SO_4^{2-}, NO_3^- and PO_4^{3-}. Cation analysis was conducted using atomic absorbance spectrometry on an ICE 300 Series AA Spectrometer, with SOLAAR version 11.02 workstation software. Analytes include Ca^{2+}, Mg^{2+}, Na^+, and K^+. Anion and cation standards were prepared from commercial 100 mg/L stock solutions. Calibrations were performed at the start of every analytical run with a single standard included every 12-15 samples to check for machine drift. In addition, the entire set of standards was run at the end of AA analysis. Ion concentrations were calculated independently of the reported software results using calibration curves constructed from standard absorbances.

Trace element analysis was conducted through the University of Wisconsin-Madison Soil Testing Lab. Inductively coupled plasma mass spectrometry was performed on VG PlasmaQuad PQ2 Turbo Plus ICP-MS instrumentation. Analytes included boron, lithium, bromine, and iodine. Samples were acidified to 2% using optima grade nitric acid prior to analysis.

Stable isotope analysis was performed at the Great Lakes WATER Institute. Analysis of D and ^{18}O was done using a Finnigan MAT Delta-S Isotope Ratio Mass Spectrometer after first being passed through the Carlo Erba NA1500 NCS elemental analyzer connected to a Finnigan MAT Conflo-II interface. The data acquisition software Isodat V7.2 was used for analysis and reporting.

Chapter 6: Previous Fox River Studies

Numerical Modeling

Previous numerical modeling of the study site (Feinstein et al., 2012) was done to gain an understanding of groundwater conditions and the interactions between surface water and groundwater in the shallow aquifer. The main purpose behind the study was to evaluate riverbank inducement as an alternative water supply for communities in the surrounding area. Analysis required quantifying the heterogeneity of the subsurface, interactions between groundwater and surface water, and stresses on the aquifer system either as sources or sinks, i.e. pumping wells.

The finite difference program MODFLOW was used to construct a domain of horizontal and vertical cells which were discretized according to several parameters including hydraulic conductivity. Over 7000 well logs obtained from the Wisconsin Department of Natural Resources, the University of Wisconsin-Milwaukee, USGS records, the Wisconsin Geological and Natural History Survey (WGNHS), and consulting reports were used to interpolate the hydrostratigraphy. Figure 5 shows a cross section of the stratigraphy along row 421 in the model, its location relative to the wells is shown in Figure 6. The cells were constructed with a grid spacing of 125ft, a distance fine enough to capture the heterogeneity of the unconsolidated deposits in the study area.

The glacial sediments are characterized by a large degree of heterogeneity. Most of the modeled area is covered by the mixed clays, silts, sands, and gravels of the New Berlin Member of the Lake Michigan Lobe (see Figure 3). Mapping of the unconsolidated sediments was accomplished by classifying the depth interval at a log location by one of five possible facies. Facies 1 and 2 represent the less hydraulically conductive silts and clays. Facies 3, 4, and 5 represent more hydraulically conductive sands and gravels. Vertical and horizontal hydraulic conductivity for each facies unit was determined from sampling done by WGNHS. Figure 5 shows the modeled distribution of the different facies directly adjacent to wells RL255 and RL256. The surface sediments at this location shows fine grained facies composed of primarily silts and clays. This, in combination with the original artesian conditions encountered in these wells suggests that RBI is not originating from the stretch of river directly adjacent to the wells.

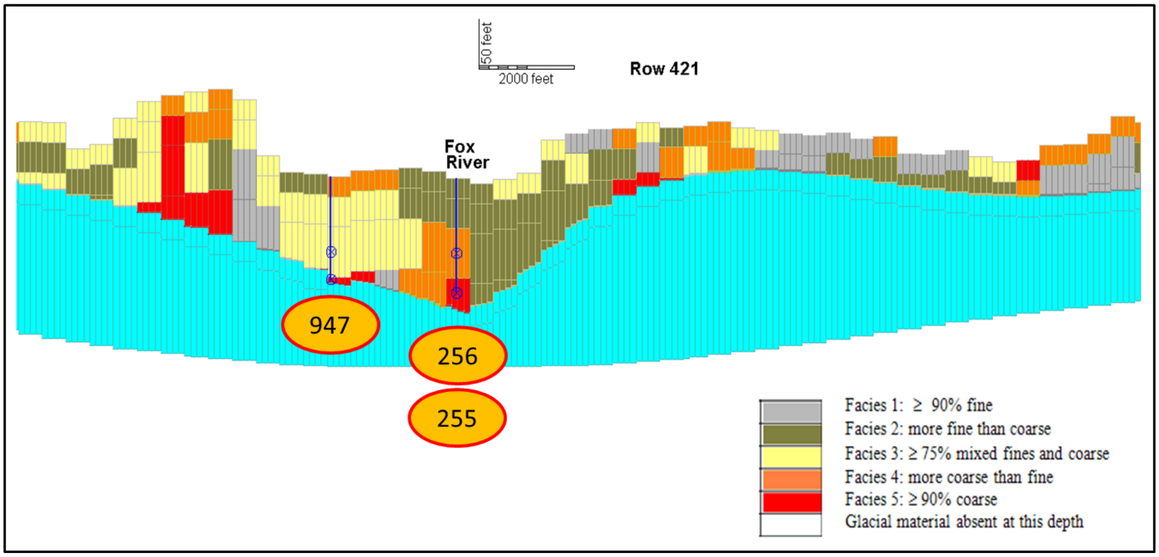


Figure 5. Interpolated stratigraphy from MODFLOW along the east west transect of row 421, identifying the fine facies material of the riverbed directly adjacent to wells RL255 and RL256. Modified from Feinstein et al., 2012.

In order to determine the range of uncertainty associated with the study area's complex heterogeneity two models were developed. Continuity of flow was determined by preferentially connecting either the fine grained deposits or the coarse grained deposits, coined the fine-favored or coarse-favored model respectively. Inducement of river water into wells RL255 and RL256 is estimated at 31% for the fine-favored model and 41% for the coarse-favored model.

MODPATH (Pollock, 1994) forward particle tracking was used to determine flow systems near the river. Water originating in river cells near the well field was tracked to determine its path from river to well. MOPATH shows that pumped water does not originate from cells immediately adjacent to the wells but rather from the south (Figure 6). Flow paths indicate distances of up to 1,000ft for RL255 and 2,000ft for RL256. These extended flow paths require long travel times. Modeled results estimate travel times of 0.7 to 1.9 years for RL255 and 1.0 to 2.5 years for RL256. The results for WK947 did not show a connection to river cells, indicating that it does not pump any water from the river.

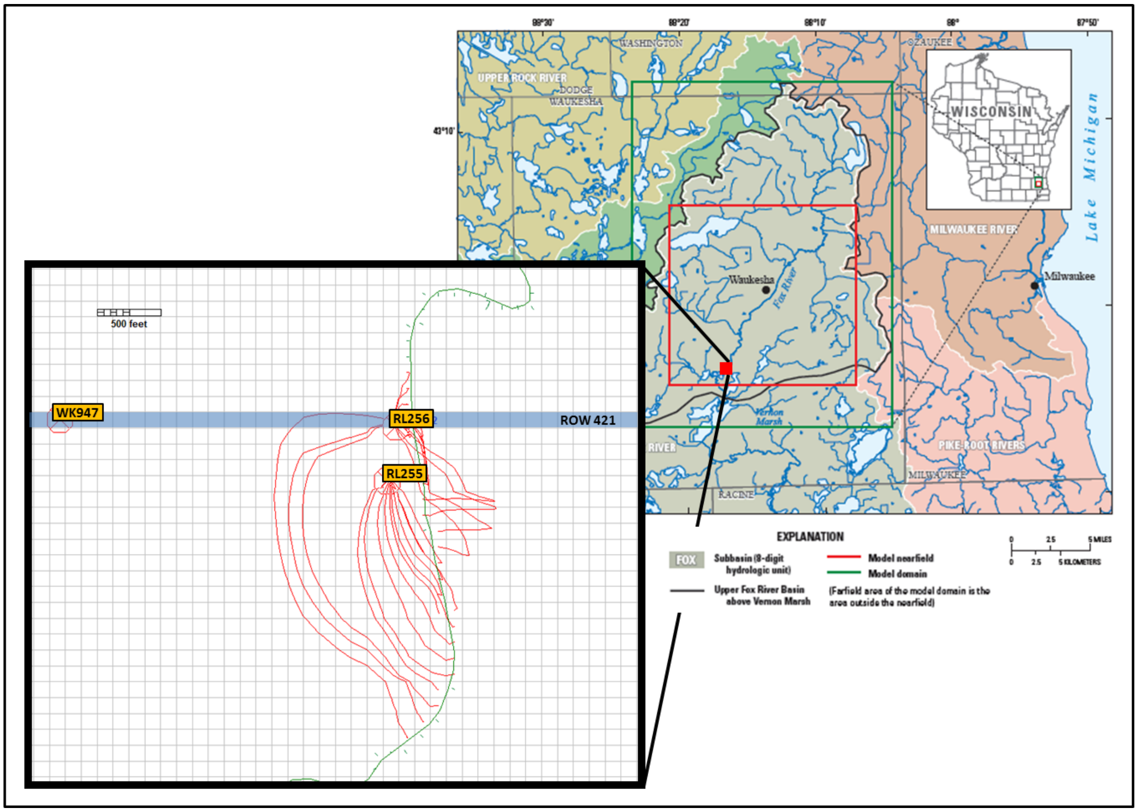


Figure 6. Location of the model within the Upper Fox River Basin and model grid showing the stratigraphy transect across row 421 and the extended flow pathways from MODPATH forward particle tracking. Modified from Feinstein et al., 2012.

Geophysical Surveys

Geophysical surveys of the study site (Baierlipp, 2012) corroborate the stratigraphic interpolation contained in the numerical modeling. Electromagnetic (EM) techniques were used to measure the subsurface materials' response to electromagnetic radiation, both electrical conductivity and inductance. EM surveys of the upper 6m, shown in Figure 7, report the electrical conductivity values in microsiemens per meter of subsurface materials.

Those areas reporting high electrical conductivity measurements are composed of hydraulically impermeable materials such as silts and clays. The elevated electrical conductivity in these materials is due to their ability to retain water. Low electrical conductivity is associated with hydraulically conductive materials such as sands and gravels. The survey results indicate much finer sediments in the riverbed directly adjacent to wells RL255 and RL256, while the area to the south shows much coarser grained material. This supports the stratigraphic results found in MODFLOW, as well as particle tracking results from MODPATH which show preferred flow pathways originating from the south.

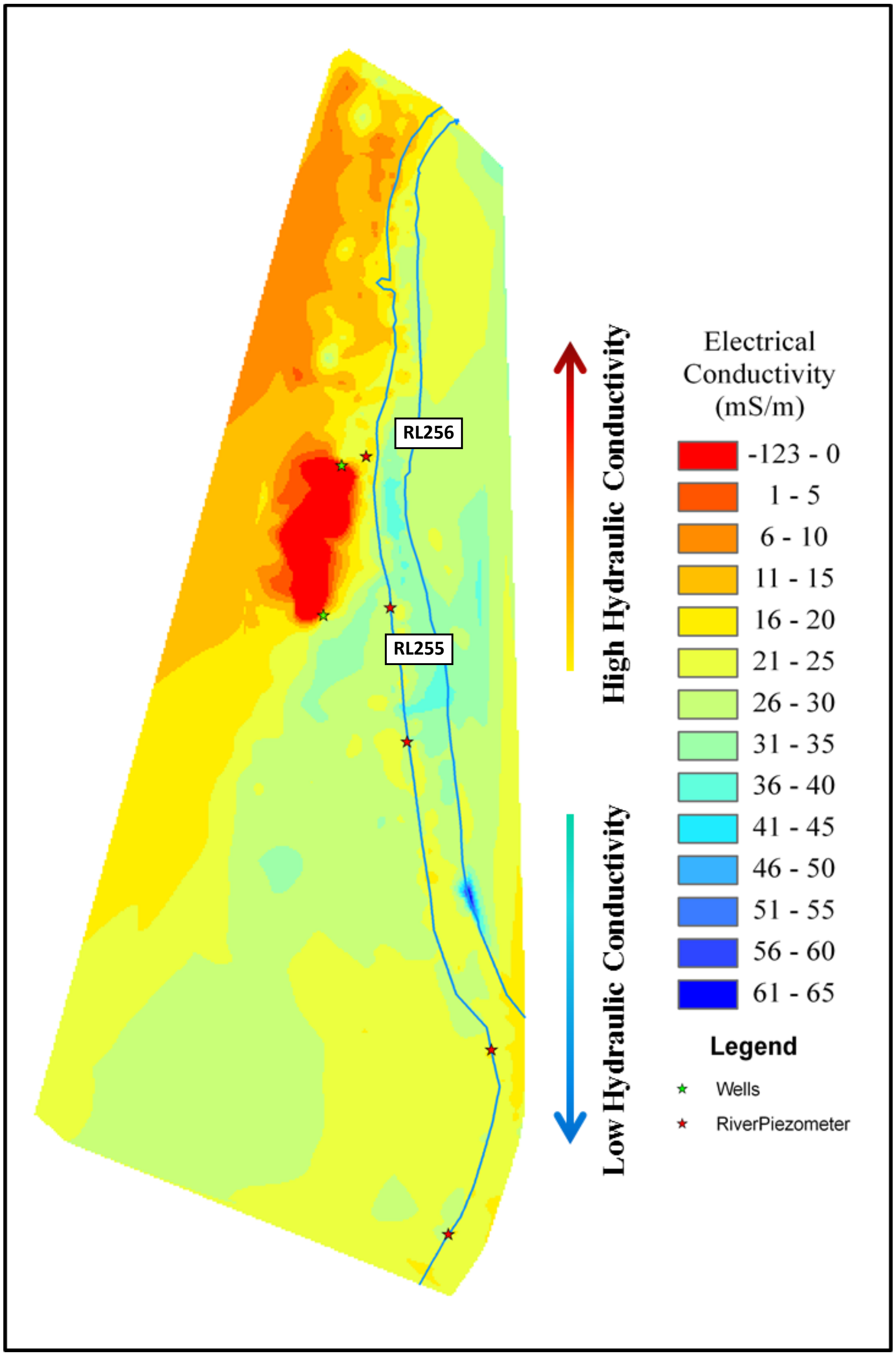


Figure 7. Electromagnetic survey results showing less hydraulically conductive material adjacent to wells RL255 and RL256 and more hydraulically conductive material to the south. Modified from Baierlipp, 2012.

Chapter 7: Interpretation and Modeling of Results

Major Ions: Fox River

The locations of the Fox River sampling sites are spatially significant relative to the outfall from the Sussex, Brookfield, and Waukesha WWTPs, see Figure 4. Results for the major ion concentrations are shown in Figure 8. Averages have been calculated from samples collected between 2007 and 2012 and are reported in Table 1, along with the relative standard deviation.

The contribution of WWTP effluent to river flow was calculated for various stages of river flow (Holzbauer, 2010). Using known effluent flow rates and Fox River flow rates, the downstream progression of effluent contributions to flow was calculated. Estimation of flow contributions were done for stretches of the river above each sampling location. At annual low flow conditions (recorded at USGS gage #05543830) Fox 0 has 0% contribution from effluent, as expected due to its location upstream of all treatment facilities. Fox 1, downstream of both the Sussex and Brookfield treatment facilities shows an effluent contribution of approximately 28%. Fox 2, downstream of all 3 facilities and just below the outfall of the Waukesha WWTP, shows the highest effluent contribution of approximately 40%. Fox 3 is much further downstream and experiences the effects of dilution from groundwater and tributary inputs has 23% of effluent contributing to flow.

These estimates are consistent with the values of Na^+ and Cl^- observed for each site in the Piper diagram, Figure 8. Fox 0 has the lowest concentrations, with Fox 3 showing a slight increase. The highest concentrations are found in Fox 2, consistent with the highest percentage of effluent contributions. Concentrations in Fox 1 are just below those of Fox 2, also consistent with estimated effluent contributions. The location of wells RL255 and

RL256 just below the Fox 2 sampling site is ideal to use effluent as an indicator for riverbank inducement because effluent percentages in the Fox River are a maximum.

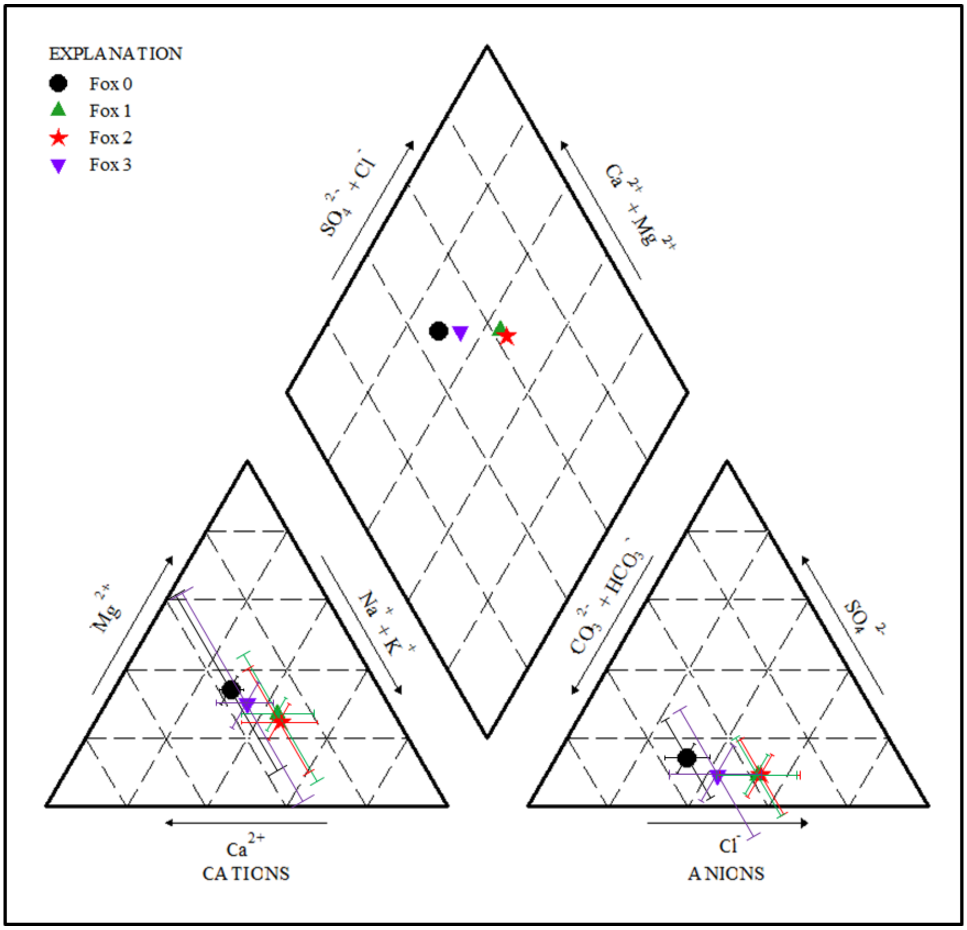


Figure 8. Piper diagram of Fox River sampling sites, with relative standard deviations.

Sampling	Concentration mg/L							
Site	Calcium	RSD%	Magnesium	RSD%	Sodium	RSD%	Potassium	RSD%
Fox 0	81.14	6.41	44.73	8.49	72.05	25.68	2.33	27.79
Fox 1	77.96	18.76	44.13	9.90	135.66	17.34	4.55	22.31
Fox 2	82.96	10.02	42.24	10.86	148.73	12.75	5.13	19.38
Fox 3	72.53	14.60	37.93	14.11	80.81	27.34	3.38	36.85

	Alkalinity	RSD%	Chloride	RSD%	Sulfate	RSD%
Fox 0	356.92	9.03	127.22	12.33	73.32	24.42
Fox 1	323.71	11.96	259.98	21.01	63.28	23.80
Fox 2	323.78	12.71	273.00	21.46	61.93	22.75
Fox 3	313.87	17.09	163.30	23.83	47.63	39.00

Table 1. Ion averages and relative standard deviations for the Fox River sites.

Major Ions: Wells, WWTP effluent, Fox 2

Changes in groundwater chemistry, since pumping began in June 2008, near the Fox River show the influences of anthropogenic contaminants, including increasing concentrations in Na^+ and Cl^-. This increase has been documented in wells RL255 and RL256, both of which are in close proximity to the Fox River.

Appendix B includes all analytical results for major ions, as well as results of measured field parameters, and calculated relative standard deviations. The major ion results also include charge balances; only those samples that balance to better than 10% were used in interpretation and modeling with nearly all samples passing. The waters most relevant to understanding the occurrence of RBI include: Fox 2, WWTP effluent, and groundwater from wells, RL255, RL256, and WK947.

Relative standard deviations for all major ions were calculated for Fox 2 and WWTP effluent over the entire sampling period from 2007 to 2012, the sampling period for WK947 starts in 2010 when pumping began. For RL255 and RL256 relative standard deviations were calculated for individual sampling dates starting in May 2011. Replicate analysis of major cations was performed for the last five sampling dates to determine analytical error. Samples collected prior to May 2011 are averages between two separate analyses where possible.

The Piper diagram, shown in Figure 9, characterizes the composition of waters used to determine the occurrence of RBI. The average ion values for WK947 are inclusive of all the samples from this site but exclude the initial sample collected in November 2007 by the Wisconsin Department of Natural Resources. This sample has been excluded since numerical modeling of pre-pumpage conditions indicate that it initially contained water primarily drawn from the Silurian dolomite (Feinstein, 2012).

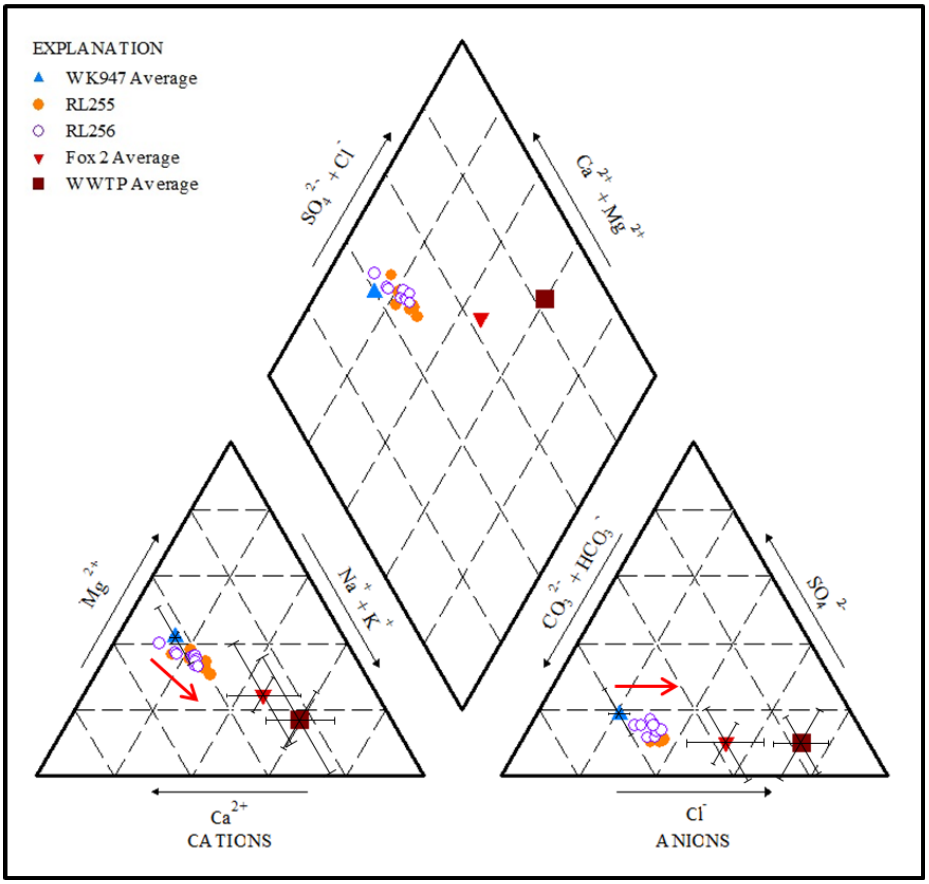


Figure 9. Piper diagram of waters significant to RBI. Error bars for average values are relative standard deviations obtained during the course of all sampling. Individual samples are shown for RL255 and RL256.

WK947 represents groundwater unaffected by RBI, as determined through forward particle tracking in MODFLOW. The other end-member is treated waste water effluent, represented as a combined average from all three facilities for each sampling date since 2007. Treated effluent shows the highest concentrations of Na^+ and Cl^-. Between these two end-members falls the average value of Fox 2, a mix of river water and effluent; its position near the WWTP effluent indicates the high contribution of effluent to river flow at this location (Holzbauer, 2010). Individual RL255 and RL256 samples fall between the WK947 end-member and Fox 2. This is consistent with the expected concentrations of Na^+ and Cl^- under a RBI scenario. In addition, both wells show an increasing trend in major ion chemistry toward Fox River water since pumping began, indicated by the red arrows.

Increasing concentrations of Na^+ and Cl^- over time in wells RL255 and RL256 are more clearly depicted in figures 10 and 11. The initial data points are ion concentrations obtained from WDNR pumping tests in 2005. Standard deviations were calculated for Ca^{2+}, Mg^{2+} and Na^+ from replicate analysis of samples collected from May 2011 to present.

Results for RL255 show an increase in Na^+ concentrations from the initial 2005 WDNR sample of 1.35 mmol/L to 4.11 mmol/L in October 2012. Cl^- concentrations have also increased over time from 3.38 mmol/L to 5.08 mmol/L. Results for RL256 show a similar trend. The initial WDNR sample from 2005 had a Na^+ concentration of 0.87 mmol/L and increased to 3.16 mmol/L in October 2012. Cl^- concentrations increased from the initial value of 2.51 mmol/L to 4.14 mmol/L.

In both RL255 and RL256 the change in major ion chemistry over time is apparent since the beginning of pumping in June 2006. For the purpose of modeling, initial concentrations of Na^+ and Cl^- reported by the WDNR are assumed to be constant until pumping starts in June 2006. The molar mismatch between sodium and chloride observed in all wells indicates that some portion of recharge water, that which originates from natural infiltration as opposed to induced river water, is subject to cation exchange processes as it infiltrates across the clay-rich upper basal till unit. As time progresses Na^+ and Cl^- concentrations in both wells approach those found in average Fox 2 water (6.47

mmol/L of Na^+ and 7.69 mmol/L of Cl^-). This suggests the induction of river water into the shallow aquifer.

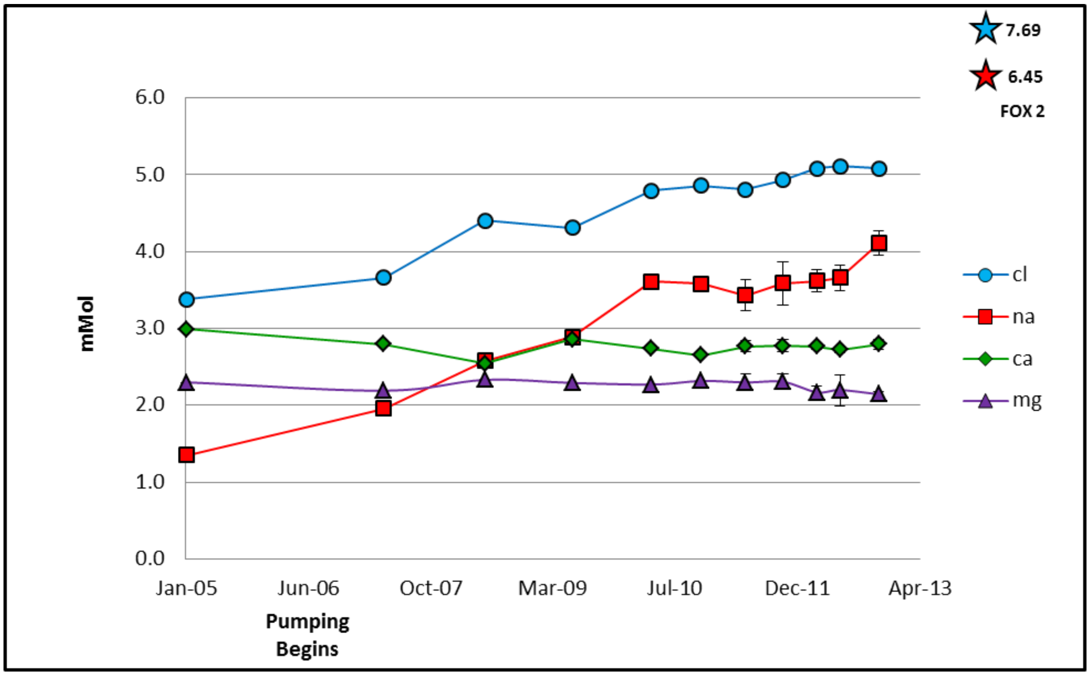


Figure 10. Plot of major ion concentrations for RL255. Standard deviation bars are included for the last five cation data points beginning in May 2011, those not visible are within the marker. Average Na^+ and Cl^- concentrations observed at Fox 2 are shown in the upper right corner.

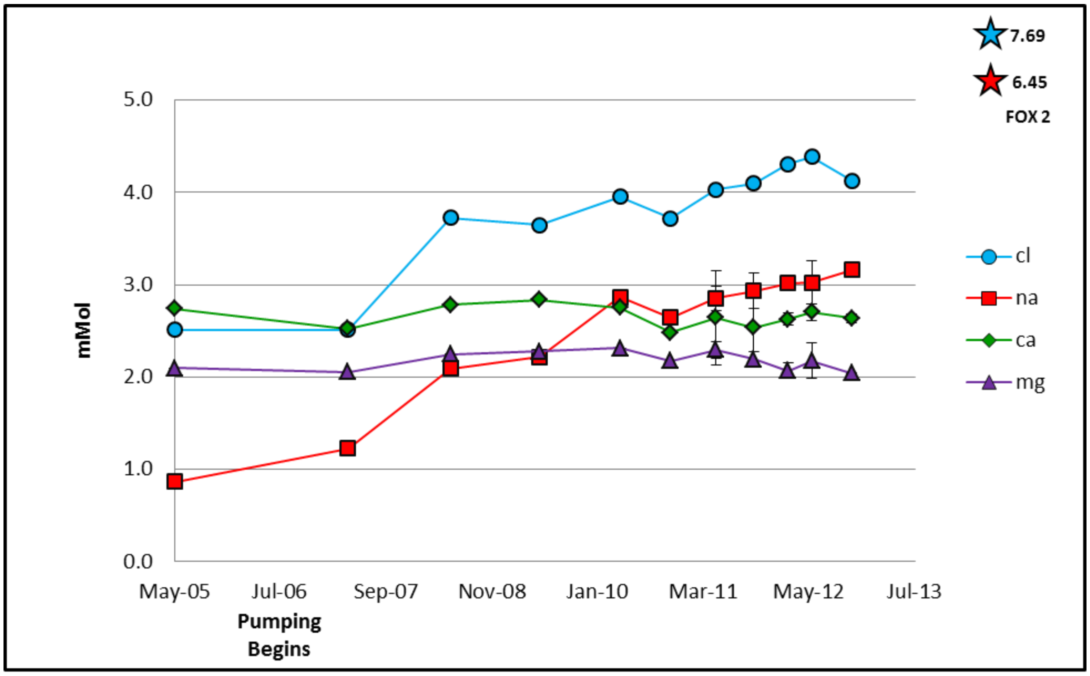


Figure 11. Plot of major ion concentrations for RL256. Standard deviation bars are included for the last five cation data points beginning in May 2011, those not visible are within the marker. Average Na^+ and Cl^- concentrations observed at Fox 2 are shown in the upper right corner.

Modeling of Major Ions

PHREEQC version 2.18 (Parkhurst and Appelo, 2005) was used to simulate the movement and the observed chemical evolution of groundwater over time. A 1-D transport model was constructed which included a transport algorithm to account for both advection and dispersion as well as specified geochemical reactions. Quantification of geochemical reactions included in the simulation was obtained by first performing inverse modeling. Input and output files are included in Appendix C.

Inverse modeling is used to quantify the amounts of end-member mixing, mineral and gas phase precipitation or dissolution and cation exchange reactions responsible for the observed changes in water chemistry. Simulations for RL255 and RL256 were performed to determine the extent of assigned geochemical reactions between uncontaminated groundwater and Fox River water that is needed to produce the most recently extracted well water. For both simulations the initial well water from the WDNR pumping test was allowed to interact with the average Fox 2 water to produce the ion concentrations observed in recent well water, averaged from the last three sampling events.

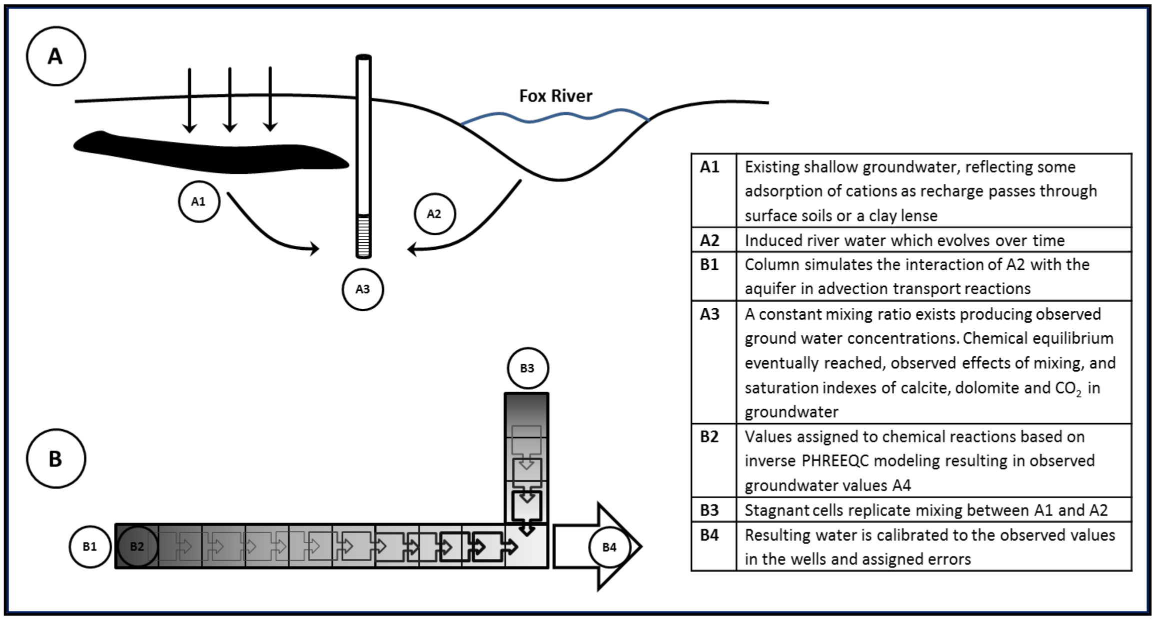
By designating the solid and gas phases involved, along with cation exchange capacity, the amount of mole transfers and mixing ratios required to produce the observed ion concentrations in recent groundwater is determined by PHREEQC. The program was allowed to consider the dissolution or precipitation of calcite and dolomite, cation exchange, and an increase or decrease in CO_2 partial pressure. Selection of these parameters was based on knowledge of the hydrologic setting. Uncertainty limits were assigned to constrain the possible number of outcomes. Each solution was assigned an uncertainty of 10% for the general water chemistry, the maximum error seen in major ion analysis. In the absence of analytical error data for chloride, an uncertainty of 3% was assigned to achieve better calibration with observed data. Potassium uncertainty in the late well water was increased to 20% in both simulations and sulfate was increased to 20% in the RL256 simulation.

This increase in error to 20% was necessary since inverse modeling accounts for changes in molar concentration through the dissolution or precipitation of minerals. Due to the low concentrations of potassium and sulfate, mineral phases which include these minor elements were not designated in the model. During the course of the modeling it became clear that mixing ratios were being controlled by potassium and sulfate and it was necessary to adjust the error to 20% to overcome this problem. The model, no longer constrained by these two elements, was free to solve for the major elements undergoing significant changes in molar concentrations and more relevant to the geochemical processes being examined.

For each well a number of possible models was generated, which specified mixing ratios with minimum and maximum values, and quantified the input parameters. Selection of the best model was based on agreement of mixing ratios with previous numerical modeling, and was in agreement with reactions likely to have occurred. For RL255 four possible models were generated, the one selected for advection transport modeling suggested a mixing ratio of 40% Fox River water with early groundwater. Errors of approximately -5% and +7% were calculated based on the minimum value of 35% and the maximum value of 47%. The selected model also included the dissolution of calcite and dolomite, and an increase in CO_2 pressure, indicating that the system is open to the atmosphere. Cation exchange was initially considered, but the amount was negligible and did not produce any significant changes in ion concentrations and was thus excluded in the final inverse model.

The results for RL256 generated 8 possible models. The selected model was based using the same criteria as for RL255. The suggested mixing ratio of Fox River water was 35% with a minimum value of 34% and a maximum value of 39%, giving the associated errors of -1% and +4%. The model suggested the precipitation of calcite and an increase in CO_2 pressure. As in the RL255 model, cation exchange was also excluded due to its negligible effects.

A transport advection model was then constructed from the inverse modeling results. The main reactions included the mixing ratios between Fox River water and early groundwater, and the dissolution of calcite and dolomite and the addition of CO_2. Other data required to construct the model included flow length, determined by the number of and length of cells, and aquifer dispersivity. This is required for calibration of the model with the Cl^- breakthrough curve observed in the wells.



A1	Existing shallow groundwater, reflecting some adsorption of cations as recharge passes through surface soils or a clay lense
A2	Induced river water which evolves over time
B1	Column simulates the interaction of A2 with the aquifer in advection transport reactions
A3	A constant mixing ratio exists producing observed ground water concentrations. Chemical equilibrium eventually reached, observed effects of mixing, and saturation indexes of calcite, dolomite and CO_2 in groundwater
B2	Values assigned to chemical reactions based on inverse PHREEQC modeling resulting in observed groundwater values A4
B3	Stagnant cells replicate mixing between A1 and A2
B4	Resulting water is calibrated to the observed values in the wells and assigned errors

Figure 12. Explanation of the conceptual model as it relates to the PHREEQC transport model

Figure 12 illustrates interactions within the aquifer (A) as they relate to the PHREEQC model (B) which simulates a 1-D laboratory column experiment. Initially the column is filled with early “unaffected” water found in the well before pumping began. At point B1 Fox River water is introduced into the column, simulating induced flow of the river water into the aquifer, along A2. B2 is where geochemical reactions from inverse modeling are defined. As the river water moves through the column it undergoes advective/dispersive transport and chemical reactions, just as it does within the aquifer along A2. The constant mixing ratio between existing shallow groundwater (A1), and Fox River water (A2), is denoted by point A3 (extracted well water). B3 represents the mixing between these waters and is added at the last cell of the advective/dispersive transport simulation. This is an exact analog to mixing in the well of existing groundwater (A1) with modified Fox River water (A2). The resulting final water (B4) has been calibrated to the observed groundwater concentrations. B4 is a produced from the mixing ratio estimated in A3, the cation exchange reactions in existing groundwater (A1) and the advective/dispersive transport processes which occurred along A2.

The results of the advective/dispersive transport model are shown in Figure 13. In RL255 approximately 40% of the water is induced from the Fox River; this is consistent with the coarse-favored numerical model value of 41%. In accordance with inverse modeling, calcite and dolomite were kept undersaturated with saturation indexes set to -0.2 for calcite, -0.6 for dolomite. In addition, CO_2 was added by setting the pCO_2 at $10^{-1.4}$. Defining the saturation indexes, in cell one, for calcite and dolomite resulted in their dissolution and increased Ca^{2+} and Mg^{2+} concentrations in the water. CO_2 was also injected into cell one; conceptually this is where recharge is entering the aquifer and were CO_2 would. An increase in the partial pressure of pCO_2, suggests an open system and also contributes to the solubility of these carbonate minerals. Adjusting the saturation indexes minimized the reduction of Ca^{2+} and Mg^{2+} concentrations that would be expected if only mixing between groundwater and Fox River water was occurring.

The advective/dispersive transport model for RL255 used a cell length of 7.62 meters for each of the 40 cells, equating a flow path length of 1000ft. This is consistent with flow path lengths determined in forward particle tracking. Cell dispersivity was adjusted to 2 meters per cell to calibrate the slope of the model’s breakthrough curve with the rise in the observed data.

The model was run to a total of four pore volumes. The pore volumes for the observed results were calculated based on the midway point of the chloride breakthrough curve. This occurred in July of 2008, approximately 2 years after the beginning of pumping (June 2006). The travel time is in agreement with numerical modeling values for RL255 of 0.7 to 1.9 years. These long travel times support the idea that flow is not induced from the riverbed directly adjacent to the wells but rather from further away. This was also confirmed by geophysical survey results.

In RL256 it was determined that approximately 35% of the water is induced from the Fox River; this is in agreement with the numerical modeling results of 41% for coarse-favored flow and 31% for fine-favored flow. Reactions determined from inverse modeling were identical to those seen in RL255. Saturation indexes were set to -0.2 for calcite, -0.6 for dolomite, and pCO_2 was set to $10^{-1.4}$. The decrease in saturation indexes for calcite and dolomite, in cell one, increased Ca^{2+} and Mg^{2+} concentrations in the water. CO_2 was also injected into cell one, simulating its addition during recharge and the aquifer’s open interaction with the atmosphere.

The advective/dispersive transport model for RL256 used a cell length of 15.25 meters for each of the 40 cells equating flow path length of 2000ft, consistent with flow path lengths determined through forward particle tracking. Cell dispersivity was adjusted to 5 meters per cell to obtain a match with the observed breakthrough curve. This increase in dispersivity is a result of the increased flow path, compared to that of RL255.

The model was also run to a total of four pore volumes and determination of the observed pore volumes was accomplished in the same manner as for RL255. The estimated arrival time for RL256 was also in July of 2008, approximately 2 years after the start of pumping. This is in agreement with numerical modeling values for RL256 of 1.0 to 2.5 years. This has the same implications for extended flow pathways as seen in RL255 and is also supported by geophysical survey results.

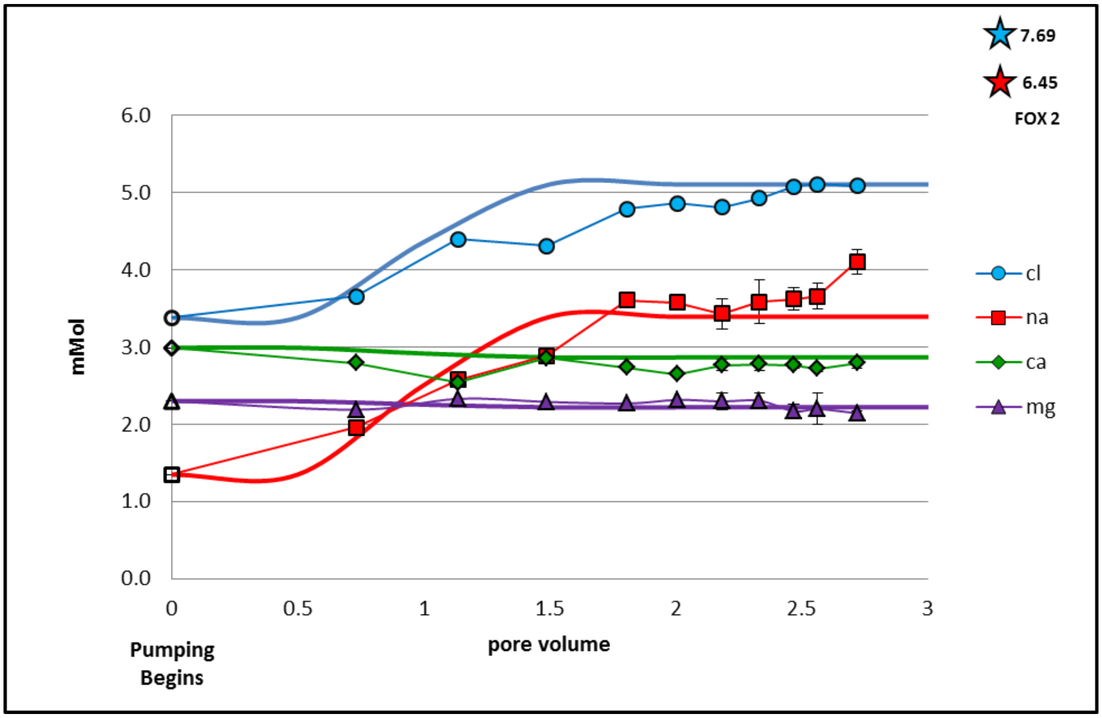


Figure 13. PHREEQC advective transport modeling results for well RL255 (smooth lines) compared to observed concentrations, denoted by data markers. Error bars are included for the last five cation data points, those not visible are within the marker. Average Na^+ and Cl^- concentrations observed at Fox 2 are shown in the upper right corner.

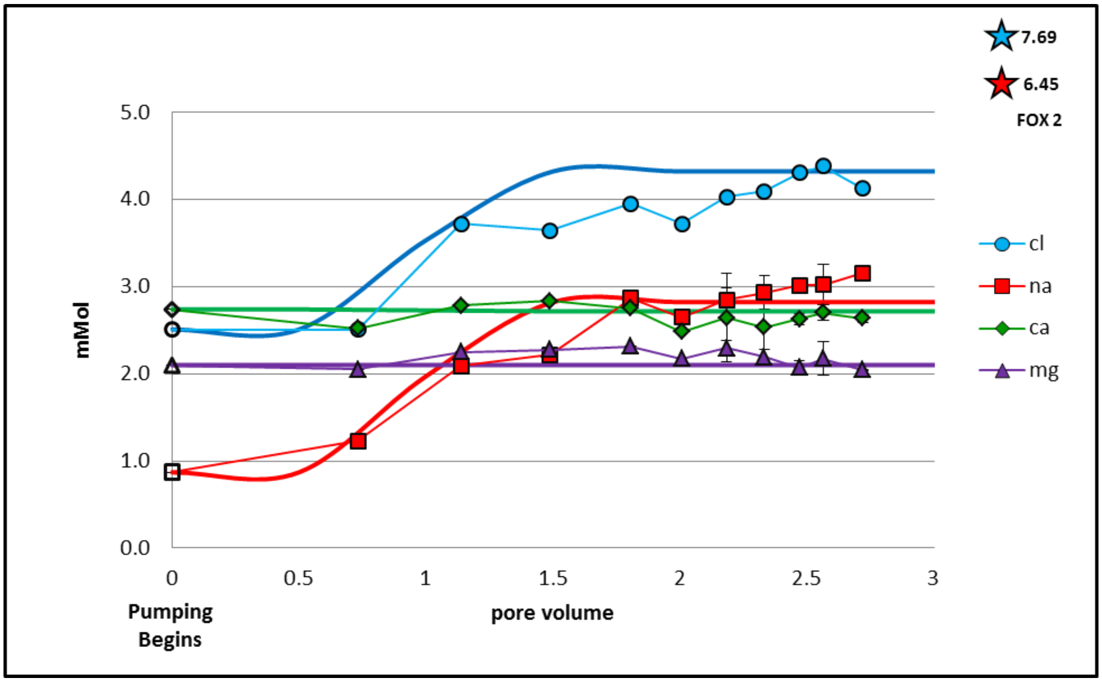


Figure 14. PHREEQC advective transport modeling results for well RL256 (smooth lines) compared to observed concentrations, denoted by data markers. Error bars are included for the last five cation data points, those not visible are within the marker. Average Na^+ and Cl^- concentrations observed at Fox 2 are shown in the upper right corner.

Trace elements

Trace element analysis was performed in order to determine the source of NaCl contamination in groundwater. Boron, lithium and iodine were analyzed in an attempt to discriminate waste water effluent from road salt. Results for boron, lithium, and iodine are reported in Appendix B.

Source discrimination between WWTP effluent and road salt, using B/Cl^- ratios is shown in Figure 15. Road salt, comprised primarily of halite, is represented by seawater composition, (Krauskopf, 1979). WWTP effluent shows most elevated concentrations of B and Cl^-, and is significantly enriched in B, with respect to seawater. Unaffected groundwater (WK947) shows the lowest concentrations of B and Cl^-. Along the mixing line between these two end-members are Fox River sites 0, 2, and 3 and RL255 and RL256.

The concentration of B in WK947 is higher than expected, in seeming contradiction with other data which indicate that the well does not have a direct connection with river water. This is indicative of slightly elevated natural background levels in local groundwater. The average of WK947 analyses is 42 ppb. Previous trace element analysis by Holzbauer (2010) reports an average value of 35 ppb for an artesian spring located within the study area.

Fox 2 shows the highest concentration of B and Cl^- of the river sites. It’s location along the mixing line closest to WWTP is consistent with major ion chemistry results and estimations of effluent to flow contributions done by Holzbauer (2010). Fox 0 shows the lowest ratio of B and Cl^-, falling slightly below the effluent mixing line, which is consistent with its upstream location to the outfall of all WWTPs. Fox 3 falls between the other two river sites, a result of dilution and location which reduces the overcall contribution of effluent to flow.

Discrimination between the sources of NaCl found in groundwater is significant in determining the occurrence of RBI. Both RL255 and RL256 fall closer to the effluent mixing line than to the road salt composition (sea water). Data points lie at approximately 20% to 40% between WK947 and Fox 2. These results indicate that effluent is the primary source of the NaCl signature and further support the mixing amounts determined in PHREEQC and numerical modeling.

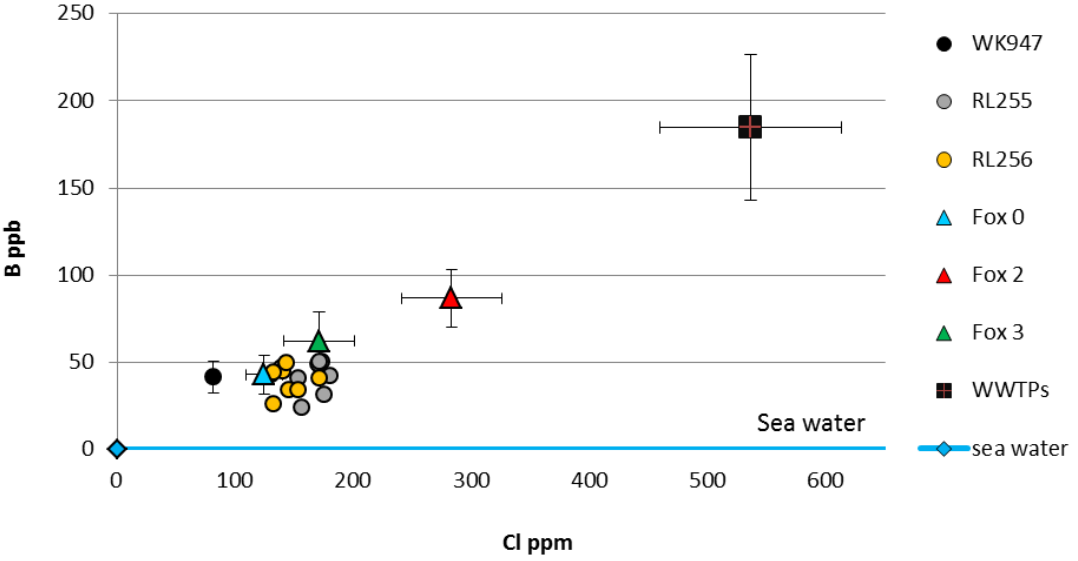


Figure 15. Source discrimination between road salt (sea water) and WWTP effluent based on B/Cl ratios along the mixing line between end-member waters WK947 and WWTP effluent. Error bars for average values of WK947, WWTPs, and Fox River sites are relative standard deviations obtained during the course of all sampling. Individual samples are shown for RL255 and RL256.

Stable Isotopes

Analysis of D and ^{18}O also supports the occurrence of RBI and provides a better understanding of local effects on isotopic composition. Stable isotope results are included in Appendix B. Figure 16 shows each water's isotopic signatures and the effects of mixing and evaporation on isotopic composition. Results for end-members WK947 and WWTP effluent is an average of the analyzed samples, while RL255, RL256 and Fox 2 are plotted individually to demonstrate changes over time.

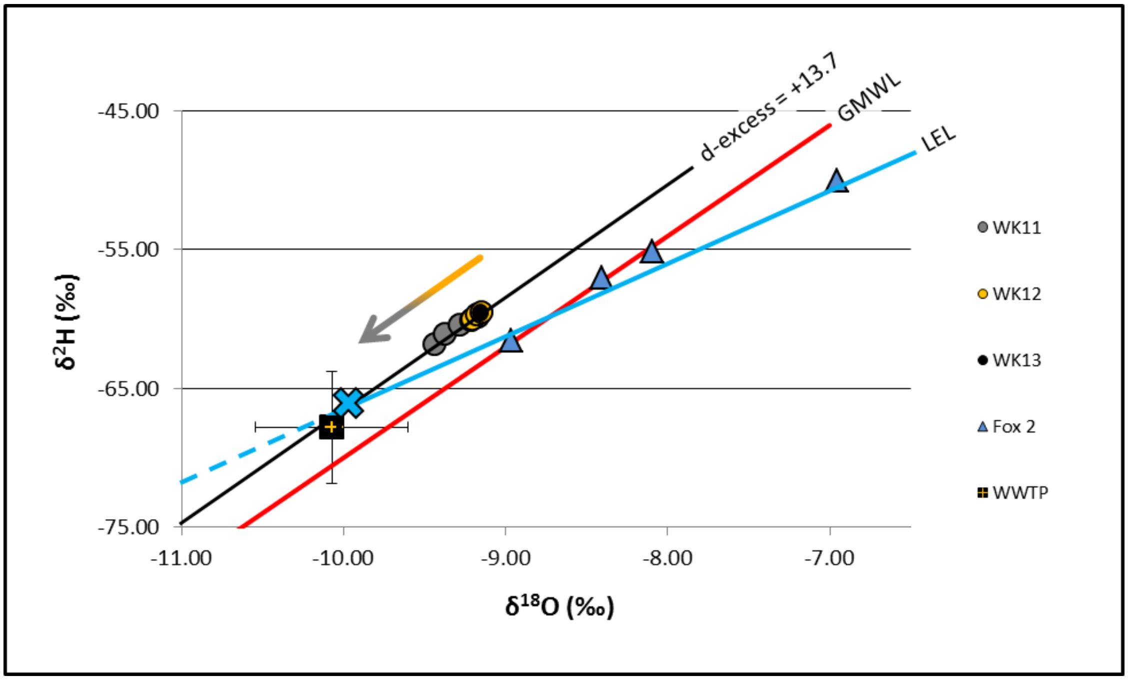


Figure 16. Results of stable isotope analysis, showing the mixing line between end-member waters WK947 and WWTP effluent. Error bars for the average value of WWTP effluent are relative standard deviations obtained during the course of all sampling. The trend of RL255 and RL256 toward WWTP effluent concentrations is indicated by the arrow. X denotes the expected location of river water along the mixing line if sampling was performed on unbiased time scales.

The global meteoric water line (GMWL) represents the average distribution of δD and δ^{18}O in precipitation by the linear equation $\delta D = 8\delta^{18}O + 10$ (Craig, 1961). During the evaporation and condensation processes of the water cycle, isotopic fractionation results in water vapor depleted in D and ^{18}O while precipitation becomes enriched. In the

Great Lakes region, where there is enhanced continental recycling, the return of equilibrated water vapor produces precipitation having an excess of deuterium and results in reservoir waters becoming more and more isotopically light. This addition of deuterium is accounted for by the local meteoric water line (LMWL), which parallels the GMWL (whose d-excess is 10‰) but has a higher d-excess value of 13.7‰.

The local evaporation line (LEL) is a function of the environment of a particular surface water. Surface water, subject to the effects of evaporation, falls along the LEL. The slope of a LEL is generally around 5, a result of the residual waters becoming more enriched in D than in ^{18}O. Fox 2 samples fall along a LEL with a slope of 5.6. Because the main objectives of the study are groundwater related, the river has been sampled only at low flow conditions. This explains why all points show significant enrichment in both D and ^{18}O. It is expected that if sampling was performed on a time scale relevant to river dynamics the samples would fall along the mixing line at the location denoted by the X, the intercept of the current samples' regression line. It is also possible that Fox 2 samples could fall on the other side of the intercept, where during high flow there would be enrichment in light isotopes compared to the LMWL.

The mixing line shows end-member WWTP effluent in the lower left corner indicating isotopically light water; this is consistent with the glacial origin of the deep aquifer water used by the treatment facilities. The end-member WK947 plots furthest away from the effluent water, consistent with the lack of induced recharge. Wells RL255 and RL256 plot between WK947 and the river water intercept on the mixing line, showing a trend over time toward isotopically lighter water (denoted by the arrow). The biased sampling of the Fox 2 river site requires the plotting of a regression line to predict the isotopic composition of average river water. The X intercept indicates the isotopic composition of the recharge water under a RBI scenario.

Chapter 8: Conclusions

This study used geochemical analysis to determine the occurrence of RBI into the shallow sand and gravel aquifer along a portion of the Fox River in Waukesha County. Water samples relevant to this investigation include end-members WK947 and WWTP effluent, surface water collected at spatially significant locations along the Fox River, and ground water from wells RL255 and RL256. The observed evolution in groundwater was characterized by the chemical and physical processes taking place between surface water and groundwater.

Since sampling began in 2007, an increase in the concentration of sodium and chloride has been observed in wells RL255 and RL256. The proximity of the wells to the Fox River suggests that WWTP effluent discharged into the river may be the source of contamination. Other possible sources include road salt and private use water softeners. Through chemical analysis and modeling the occurrence and extent of RBI was determined. In addition, trace element analysis was used in contaminant source discrimination and stable isotopes were examined as another line of evidence supporting RBI.

Major ion analysis of river water shows that the Fox 2 sampling location has the highest concentrations of Na^+ and Cl^-, a result of being downstream from all three WWTPs included in the study. A significant portion of flow is comprised of effluent from the Waukesha treatment facility, as the outfall is less than 2 miles upstream. RL255 and RL256 are located approximately 1.5 miles downstream from the Fox 2 site which makes the wells' location ideal for using effluent as a tracer in determining the occurrence RBI.

Major ion analysis also shows the trending of groundwater over time toward ion concentrations seen in Fox 2. Early RL255 and RL256 water shows the lowest concentrations of Na^+ and Cl^-. However, after pumping begins in June of 2006 a consistent increase is observed. Although the increase seems to occur at the same rate in both wells the absolute concentration is approximately 1mmol less, for both Na^+ and Cl^-, in RL256.

Modeling was performed in PHREEQC to determine which geochemical processes were responsible for these observed changes. Results determined that mixing plays a significant role and that Rl255 and RL256 are inducing 40% and 35% Fox River water, respectively. The effect of dispersion on a field scale was also significant, affecting the calibration of the modeled breakthrough curve with the observed data. The undersaturation of calcite and dolomite was required in order to better calibrate Ca^{2+} and Mg^{2+} concentrations. PHREEQC also suggested an increase in CO_2 partial pressure, which is consistent with what may be expected in an unconfined aquifer open to the atmosphere. However, cation exchange processes did not show a significant influence on results, and as such, the observed molar mismatch between Na^+ and Cl^- can only be explained through the occurrence of these processes somewhere else in the aquifer.

PHREEQC modeling also revealed information about travel time from the river to the wells. In matching the model's breakthrough curve to the observed data, the calculated travel time is approximately two years. This long travel time is consistent with evidence obtained through numerical modeling and geophysical surveys.

Both numerical modeling and geophysical surveys indicate that the riverbed adjacent to the wells has low hydraulic conductivity, precluding any direct flow.

Furthermore, forward particle tracking indicates flow pathways from the river to the wells originating from much further south. This is consistent with the inferred hydraulic conductivities of subsurface materials obtained through electromagnetic surveys. These extended flow pathways of up to 1000ft for RL255 and 2000ft for RL256 explain the long travel time of two years.

The trace element boron was used to determine the source of contamination as either effluent or road salt. RL255 and RL256 fall near the effluent mixing line between end-member WK947 and Fox 2 water, which confirms that effluent is contributing the majority of NaCl and supports RBI. The unexpectedly high concentration of B in end-member WK947 is explained by slightly elevated natural background levels of B. B and Cl^- ratios in RL255 and RL256 did not show obvious increasing patterns over time, this may be in part due to subtle changes being masked by the elevated background levels. There is also evidence that B does not behave as conservatively as previously expected, and may be subject to adsorption. As a solution, isotopic analysis of ^{10}B and ^{11}B would provide more conclusive evidence for contaminant source identification, since anthropogenic boron shows a distinctly low $\delta^{11}B$ signature and is not subject to fractionation processes or removed during the treatment of effluent.

Stable isotopes ratios of δD and $\delta^{18}O$ were used to construct a LMWL which served as a mixing line between end-members WK947 and WWTP effluent. RL255 and RL256 fall on the mixing line between WK947 and Fox 2 water, supporting RBI. A significant finding is the trend of groundwater over time toward the isotopic signature found in effluent and river water. The biased sampling of river water (at low flow conditions) required using a regression line through the Fox 2 data to determine the location of average river water along the mixing line. This intersection falls near the treated effluent, and represents the recharge water in RBI. This analysis indicates that further sampling, on time scales relevant to river dynamics, is necessary to obtain more conclusive results.

Using multiple lines of chemical analysis and geochemical modeling the interaction between surface water and groundwater supports a RBI scenario. In addition, independent numerical modeling and geophysical results identified extended flow pathways between the river and wells RL255 and RL256. These pathways are consistent with the long travel times calculated in both numerical and PHREEQC modeling. In water stressed environments RBI can be a viable alternative in supplementing water supplies and reducing drawdown in the aquifer, however the contamination potential of infiltrating water must be addressed to prevent the degradation of groundwater resources.

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Appendix A:

Sample Collection Information

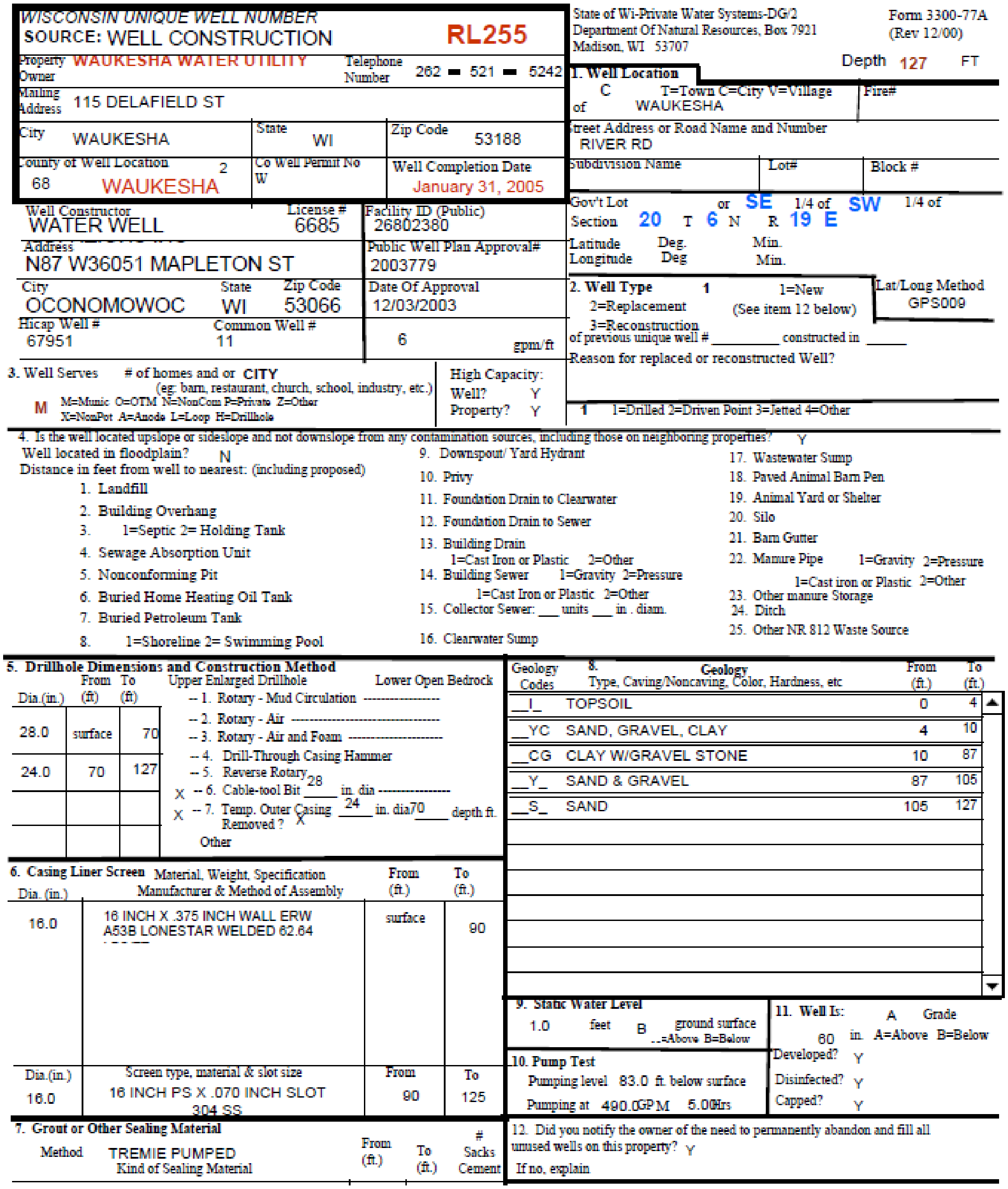
Table 2. Locations well, river and WWTP sampling sites in decimal degrees (Holzbauer, 2010).

Sampling Site	Latitude	Longitude
RL255	42.959938	-88.279256
RL256	42.961012	-88.279063
WK947	42.961236	-88.289167
Fox 0	43.120068	-88.164715
Fox 1	43.011395	-88.234244
Fox 2	42.977690	-88.264797
Fox 3	42.876283	-88.210559
Brookfield WWTP	43.052745	-88.177110
Sussex WWTP	43.126171	-88.216985
Waukesha WWTP	42.998190	-88.249151
Hygeia Spring	42.879817	-88.205125
Susssex Creek	43.102008	-88.210367
Root River	42.858027	-87.997586
Underwood Creek	43.042935	-88.056498
EM275	43.099327	-88.103161
IZ385	43.063351	-88.183740
IZ386	43.051841	-88.176827
SV631	42.901237	-88.059776

Table 3. Water Utility Contact Information

Municipality	Contact Person	Contact Number			
Waukesha Wells	Jeff Detro	262-521-5272 Ext. 532	RL255, #11	RL256, #12	WK947, #13
Brookfield Wells	Mark Simon Mike Terry	262-796-6717	IZ385, #7 Camelot 2	IZ386, #19 Industrial	EM275, #28 Pilgrim Road
St. Martins	Tom Breedom	414-333-4700			
Waukesha WWTP	Randy Thater	Office: 262-524-3631 Cell: 414-507-1139	600 Sentry Drive Waukesha		
Brookfield WWTP	Rick Wenzel	262-787-3809 For Gate 262-782-0199	21225 Enterprise Avenue Brookfield		
Sussex WWTP	Gerry Spengler	262-246-5184	N59 W23551 Clover Drive Sussex, Wi		

Well Construction Report RL255



WISCONSIN UNIQUE WELL NUMBER
SOURCE: WELL CONSTRUCTION **RL255**

State of Wi-Private Water Systems-DG/2
Department Of Natural Resources, Box 7921
Madison, WI 53707

Form 3300-77A
(Rev 12/00)

Depth 127 FT

Property Owner WAUKESHA WATER UTILITY
Telephone Number 262 ‒ 521 ‒ 5242
Mailing Address 115 DELAFIELD ST
City WAUKESHA State WI Zip Code 53188
County of Well Location 2 68 WAUKESHA
Co Well Permit No W
Well Completion Date January 31, 2005
Well Constructor WATER WELL License # 6685
Facility ID (Public) 26802380
Address N87 W36051 MAPLETON ST
Public Well Plan Approval# 2003779
City OCONOMOWOC State WI Zip Code 53066
Date Of Approval 12/03/2003
Hicap Well # 67951
Common Well # 11
6 gpm/ft

1. Well Location
C T=Town C=City V=Village
of WAUKESHA
Fire#
Street Address or Road Name and Number
RIVER RD
Subdivision Name
Lot#
Block #
Gov't Lot or SE 1/4 of SW 1/4 of
Section 20 T 6 N R 19 E
Latitude Deg. Min.
Longitude Deg Min.

2. Well Type 1 1=New
2=Replacement (See item 12 below)
3=Reconstruction
of previous unique well # __________ constructed in ______
Reason for replaced or reconstructed Well?
Lat/Long Method GPS009

3. Well Serves # of homes and or CITY
(eg: barn, restaurant, church, school, industry, etc.)
M M=Munic O=OTM N=NonCom P=Private Z=Other
X=NonPot A=Anode L=Loop H=Drillhole

High Capacity:
Well? Y
Property? Y

1 1=Drilled 2=Driven Point 3=Jetted 4=Other

4. Is the well located upslope or sideslope and not downslope from any contamination sources, including those on neighboring properties? Y
Well located in floodplain? N
Distance in feet from well to nearest: (including proposed)

1. Landfill
2. Building Overhang
3. 1=Septic 2= Holding Tank
4. Sewage Absorption Unit
5. Nonconforming Pit
6. Buried Home Heating Oil Tank
7. Buried Petroleum Tank
8. 1=Shoreline 2= Swimming Pool
9. Downspout/ Yard Hydrant
10. Privy
11. Foundation Drain to Clearwater
12. Foundation Drain to Sewer
13. Building Drain
    1=Cast Iron or Plastic 2=Other
14. Building Sewer 1=Gravity 2=Pressure
    1=Cast Iron or Plastic 2=Other
15. Collector Sewer: ___ units ___ in . diam.
16. Clearwater Sump
17. Wastewater Sump
18. Paved Animal Barn Pen
19. Animal Yard or Shelter
20. Silo
21. Barn Gutter
22. Manure Pipe 1=Gravity 2=Pressure
    1=Cast iron or Plastic 2=Other
23. Other manure Storage
24. Ditch
25. Other NR 812 Waste Source

5. Drillhole Dimensions and Construction Method

Dia.(in.)	From (ft)	To (ft)
28.0	surface	70
24.0	70	127

Upper Enlarged Drillhole Lower Open Bedrock
-- 1. Rotary - Mud Circulation ----------------
-- 2. Rotary - Air -------------------------------
-- 3. Rotary - Air and Foam ------------------
-- 4. Drill-Through Casing Hammer
-- 5. Reverse Rotary
X -- 6. Cable-tool Bit 28 in. dia ----------------
X -- 7. Temp. Outer Casing 24 in. dia 70 depth ft.
Removed ? X
Other

6. Casing Liner Screen

Dia. (in.)	Material, Weight, Specification Manufacturer & Method of Assembly	From (ft.)	To (ft.)
16.0	16 INCH X .375 INCH WALL ERW A53B LONESTAR WELDED 62.64	surface	90

Dia.(in.)	Screen type, material & slot size	From	To
16.0	16 INCH PS X .070 INCH SLOT 304 SS	90	125

7. Grout or Other Sealing Material

Method	Kind of Sealing Material	From (ft.)	To (ft.)	# Sacks Cement
	TREMIE PUMPED			

8.

Geology Codes	Geology Type, Caving/Noncaving, Color, Hardness, etc	From (ft.)	To (ft.)
__I_	TOPSOIL	0	4
__YC	SAND, GRAVEL, CLAY	4	10
__CG	CLAY W/GRAVEL STONE	10	87
__Y_	SAND & GRAVEL	87	105
__S_	SAND	105	127

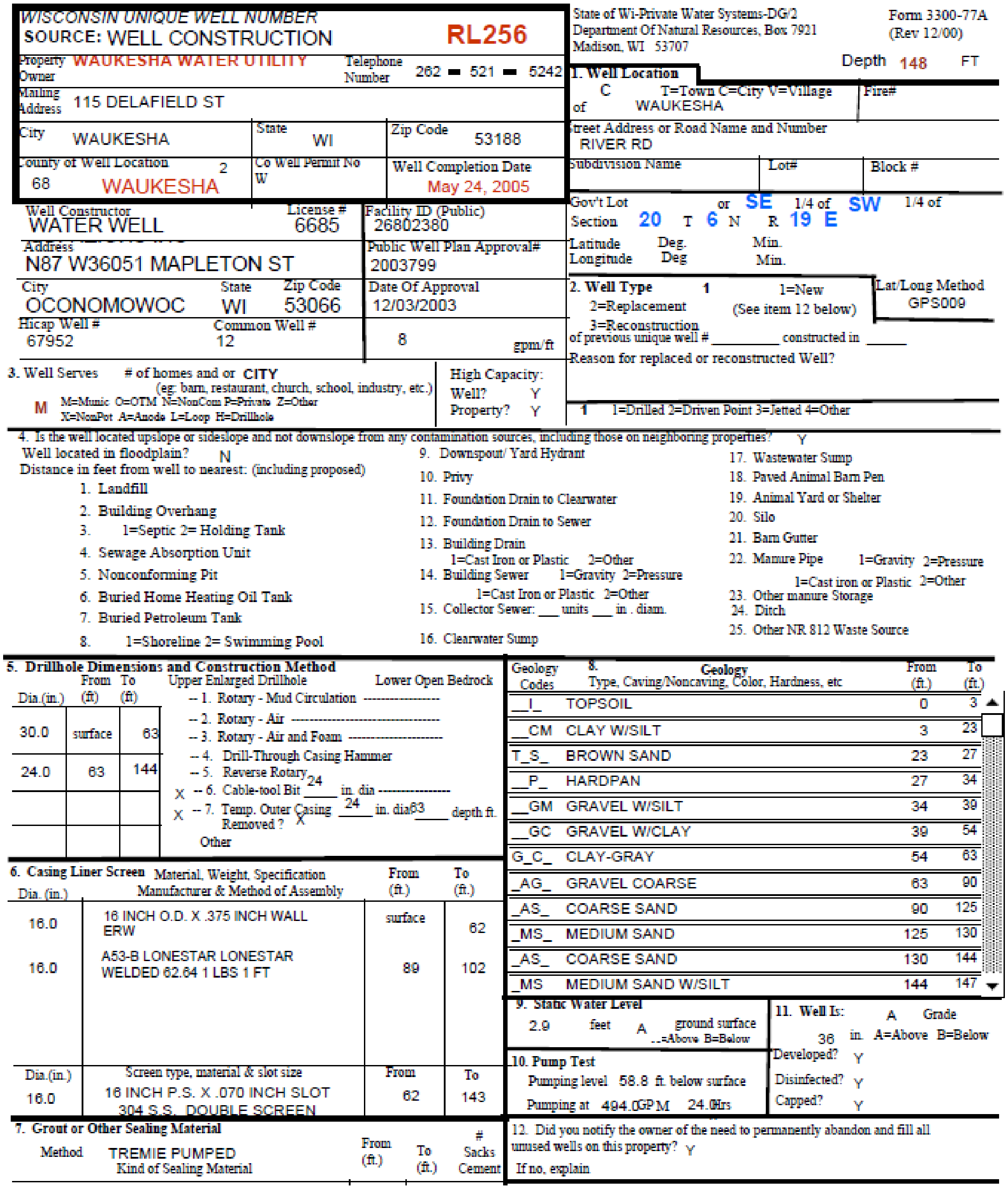
9. Static Water Level
1.0 feet B ground surface
A=Above B=Below

10. Pump Test
Pumping level 83.0 ft. below surface
Pumping at 490.0 GPM 5.0 Hrs

11. Well Is: A Grade
60 in. A=Above B=Below
Developed? Y
Disinfected? Y
Capped? Y

12. Did you notify the owner of the need to permanently abandon and fill all unused wells on this property? Y
If no, explain

Well Construction Report RL256



WISCONSIN UNIQUE WELL NUMBER
SOURCE: WELL CONSTRUCTION RL256

State of Wi-Private Water Systems-DG/2
Department Of Natural Resources, Box 7921
Madison, WI 53707

Form 3300-77A
(Rev 12/00)

Depth 148 FT

Property Owner WAUKESHA WATER UTILITY
Telephone Number 262 - 521 - 5242
Mailing Address 115 DELAFIELD ST
City WAUKESHA State WI Zip Code 53188
County of Well Location 68 WAUKESHA 2
Co Well Permit No W
Well Completion Date May 24, 2005

Well Constructor WATER WELL License # 6685
Facility ID (Public) 26802380
Address N87 W36051 MAPLETON ST
Public Well Plan Approval# 2003799
City OCONOMOWOC State WI Zip Code 53066
Date Of Approval 12/03/2003
Hicap Well # 67952 Common Well # 12
8 gpm/ft

1. Well Location
C T=Town C=City V=Village
of WAUKESHA
Fire#
Street Address or Road Name and Number
RIVER RD
Subdivision Name
Lot#
Block #
Gov't Lot or SE 1/4 of SW 1/4 of
Section 20 T 6 N R 19 E
Latitude Deg. Min.
Longitude Deg Min.
Lat/Long Method GPS009

2. Well Type 1 1=New
2=Replacement (See item 12 below)
3=Reconstruction
of previous unique well # __________ constructed in ______
Reason for replaced or reconstructed Well?
1 1=Drilled 2=Driven Point 3=Jetted 4=Other

3. Well Serves # of homes and or CITY
(eg: barn, restaurant, church, school, industry, etc.)
M M=Munic O=OTM N=NonCom P=Private Z=Other
X=NonPot A=Anode L=Loop H=Drillhole
High Capacity:
Well? Y
Property? Y

4. Is the well located upslope or sideslope and not downslope from any contamination sources, including those on neighboring properties? Y
Well located in floodplain? N
Distance in feet from well to nearest: (including proposed)

1. Landfill
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5. Nonconforming Pit
6. Buried Home Heating Oil Tank
7. Buried Petroleum Tank
8. 1=Shoreline 2= Swimming Pool
9. Downspout/ Yard Hydrant
10. Privy
11. Foundation Drain to Clearwater
12. Foundation Drain to Sewer
13. Building Drain
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14. Building Sewer 1=Gravity 2=Pressure
1=Cast Iron or Plastic 2=Other
15. Collector Sewer: ___ units ___ in . diam.
16. Clearwater Sump
17. Wastewater Sump
18. Paved Animal Barn Pen
19. Animal Yard or Shelter
20. Silo
21. Barn Gutter
22. Manure Pipe 1=Gravity 2=Pressure
1=Cast iron or Plastic 2=Other
23. Other manure Storage
24. Ditch
25. Other NR 812 Waste Source

5. Drillhole Dimensions and Construction Method

Dia.(in.)	From (ft)	To (ft)
30.0	surface	63
24.0	63	144

Upper Enlarged Drillhole Lower Open Bedrock
-- 1. Rotary - Mud Circulation ----------------
-- 2. Rotary - Air ------------------------------
-- 3. Rotary - Air and Foam -----------------
-- 4. Drill-Through Casing Hammer
-- 5. Reverse Rotary
X -- 6. Cable-tool Bit 24 in. dia ----------------
X -- 7. Temp. Outer Casing 24 in. dia 63 depth ft.
Removed ? X
Other

6. Casing Liner Screen

Dia. (in.)	Material, Weight, Specification Manufacturer & Method of Assembly	From (ft.)	To (ft.)
16.0	16 INCH O.D. X .375 INCH WALL ERW	surface	62
16.0	A53-B LONESTAR LONESTAR WELDED 62.64 1 LBS 1 FT	89	102

Dia.(in.)	Screen type, material & slot size	From	To
16.0	16 INCH P.S. X .070 INCH SLOT 304 S.S. DOUBLE SCREEN	62	143

7. Grout or Other Sealing Material

Method	Kind of Sealing Material	From (ft.)	To (ft.)	# Sacks Cement
	TREMIE PUMPED			

8.

Geology Codes	Geology Type, Caving/Noncaving, Color, Hardness, etc	From (ft.)	To (ft.)
__I_	TOPSOIL	0	3
__CM	CLAY W/SILT	3	23
T_S_	BROWN SAND	23	27
__P_	HARDPAN	27	34
__GM	GRAVEL W/SILT	34	39
__GC	GRAVEL W/CLAY	39	54
G_C_	CLAY-GRAY	54	63
_AG_	GRAVEL COARSE	63	90
_AS_	COARSE SAND	90	125
_MS_	MEDIUM SAND	125	130
_AS_	COARSE SAND	130	144
_MS	MEDIUM SAND W/SILT	144	147

9. Static Water Level
2.9 feet A ground surface
A=Above B=Below

10. Pump Test
Pumping level 58.8 ft. below surface
Pumping at 494.0 GPM 24.0 Hrs

11. Well Is: A Grade
36 in. A=Above B=Below
Developed? Y
Disinfected? Y
Capped? Y

12. Did you notify the owner of the need to permanently abandon and fill all unused wells on this property? Y
If no, explain

Appendix B:

Field and Analytical Results

Table 4. Field Parameters
x-measurement not taken, xx-equipment malfunction,
* alkalinity calculated with correction factor due to incorrectly calibrated scale

Sample Site	Date	pH	Specific Conductivity (mmhos/cm)	Temperature (°C)	DO (mg/L) meter	DO (mg/L) colorimetric	S2- (mg/L) colorimetric	Fe2+ (mg/L) colorimetric	Calculated HCO_3
Waukesha 11 S									
RL 255	4/18/2007	x	x	x	x	x	x	x	307.27*
RL 255	9/28/2007	x	x	x	x	x	x	x	309.40*
RL 255	6/3/2008	7.23	1.24	10.1	0.145	0.05	0	x	348.88*
RL 255	5/27/2009	7.02	1.243	10.1	0.1	x	0	0.4	390.83*
RL 255	11/10/2009	7.3	1.275	10.1	0.03	x	0	0.4	407.22
RL 255	4/16/2009	6.8	1.264	10.2	0.2	0	0	0.4	425.15
RL 255	11/5/2010	7.22	1.27	10.1	0.1	0.2	0	0.35	430.71
RL 255	5/6/2011	7.05	0.027	10.2	0.1	0.25	0	0.3	435.15
RL 255	10/4/2011	6.83	1.293	10.1	0.03	1	0	0	462.20
RL 255	2/20/2012	6.7	xx	10	0.03	0	0	0	445.15
RL 255	5/25/2012	6.86	xx	10.7	0.43	0.9	0	x	446.91
RL 255	10/31/2012	7.09	0.98	9.7	0.03	0.8	<1	<1	454.55
Waukesha 12 N									
RL 256	4/18/2007	x	x	x	x	x	x	x	281.66*
RL 256	9/28/2007	x	x	x	x	x	x	x	293.40*
RL 256	6/3/2008	7.33	1.132	10.6	0.08	0.05	0	x	347.81*
RL 256	5/27/2009	7.08	1.181	10.65	0.15	0	0	1	388.26*
RL 256	11/10/2009	7.27	1.164	10.6	0.23	0.05	0	0.85	429.86
RL 256	4/16/2010	6.7	1.177	10.7	0.6	0	0	1	402.31
RL 256	11/5/2010	7.13	1.12	10.7	0.17	0	0	0.8	393.23
RL 256	5/6/2011	6.82	0.027	11	0.73	0.15	0	0.9	395.75
RL 256	10/4/2011	6.95	1.185	10.7	0.07	1	0	0.1	438.68
RL 256	2/20/2012	6.91	xx	10.7	0	0.5	0	1	411.63
RL 256	5/25/2012	6.79	xx	11	0.2	0.8	0	x	400.16
RL 256	10/31/2012	7.09	0.87	10.3	0.03	1	0	1.5	423.98
Waukesha 13									
WK 947	4/16/2009	6.94	0.942	10.2	0.15	0	0	0.2	380.64
WK 947	11/5/2010	7.5	0.96	10.2	0.07	0	0	0.2	394.40
WK 947	5/6/2011	6.94	0.027	10.2	0.03	0.25	0	0.1	388.11
WK 947	10/4/2011	6.93	1.002	10.3	0.07	1	0	0.2	419.57
WK 947	2/20/2012	7.0	xx	10.2	0.03	0.7	0	0	406.92
WK 947	5/25/2012	7.04	xx	10.3	0.03	0.9	0	x	398.40
WK 947	10/31/2012	7.13	0.73	9.8	0.03	1	0	0	399.28
Lannon Rd									
Fox 0	11/2/2008	7.6	1.03	8.3	5.6	x	x	x	338.07*
Fox 0	5/26/2009	8.12	0.954	17.2	10.7	x	x	x	308.55*
Fox 0	11/11/2009	8.05	1.116	8.7	7.2	x	0	0	345.18
Fox 0	4/16/2010	7.76	0.027	17	8.5	x	x	0	287.82
Fox 0	11/7/2010	7.97	1.032	7.3	6.9	8	0	0	370.68
Fox 0	5/12/2011	7.65	0.949	17.6	10.1	12	0	0	360.17
Fox 0	10/22/2011	7.75	1.035	9.9	7.27	7	0	0	367.23
Fox 0	2/18/2012	8.09	xx	3.3	11.73	9	0	0	363.11
Fox 0	5/23/2012	7.99	xx	20.5	8.8	7	x	x	329.30
Fox 0	11/3/2012	7.29	0.72	3.6	5.4	4.5	0	0	406.24
Downtown Wksha									
Fox 1	6/4/2008	7.91	1.472	17.4	7.8	x	0	0	243.25*
Fox 1	11/2/2008	8.12	1.467	10.4	10.7	x	x	x	204.84*
Fox 1	6/4/2009	8.08	1.382	16.2	8.9	x	0	0	285.96*
Fox 1	11/11/2009	8.36	1.389	8.9	11.8	x	x	x	305.13*
Fox 1	4/16/2010	7.7	1.28	17.3	14.3	x	0	0	328.74*
Fox 1	11/7/2010	8.3	1.382	6.1	12.3	12+	0	0	308.55*
Fox 1	5/12/2011	7.67	1.261	18.9	10.7	10	0	0.15	364.00
Fox 1	10/22/2011	7.85	1.16	9.4	10.23	10	0	0	273.44
Fox 1	2/18/2012	8.28	xx	3.5	13.2	9	0	0	354.00
Fox 1	5/25/2012	7.94	xx	22.4	8.3	7	0	x	320.48
Fox 1	11/3/2012	8.07	1.0	5.2	11.8	9	0	0	326.85
Hwy 59									
Fox 2	6/4/2008	7.7	1.568	17.6	10.1	x	0	0	303.00*
Fox 2	11/2/2008	8	1.555	13.3	13.6	x	x	x	337.24*
Fox 2	6/4/2009	7.71	1.508	16.6	10.75	x	0	0	303.40*
Fox 2	11/10/2009	8.09	1.414	11.7	19	x	0	0	329.30
Fox 2	4/16/2010	7.73	1.355	14.7	13.87	x	0	0	323.54
Fox 2	11/7/2010	8.08	1.48	9.7	13.03	12+	0	0	332.91
Fox 2	5/6/2011	7.86	1.31	14.3	11.07	11	0	0	329.30
Fox 2	10/22/2011	7.55	1.276	11.9	10.5	9	0	0	276.67
Fox 2	2/18/2012	7.4	xx	6.8	12.7	9	0	0	330.18
Fox 2	5/25/2012	7.73	xx	22.1	6.8	6	0	x	303.58
Fox 2	11/3/2012	7.82	1.16	7.97	10.4	11	0	0	314.60

Sample Site	Date	pH	Specific Conductivity (mmhos/cm)	Temperature (°C)	DO (mg/L) meter	DO (mg/L) colorimetric	S2- (mg/L) colorimetric	Fe2+ (mg/L) colorimetric	Calculated HCO_3
Big Bend									
Fox 3	6/4/2008	7.63	1.009	18.2	4.41	x	0	0	285.93*
Fox 3	11/2/2008	8.14	1.107	12.2	12	x	x	x	343.59*
Fox 3	6/4/2009	8.15	0.971	18	9.3	x	x	x	313.69*
Fox 3	11/10/2009	8.29	1.081	10.1	8.7	x	0	0	339.01
Fox 3	4/21/2010	7.78	0.036	14.97	8	8	x	x	322.37
Fox 3	11/8/2010	7.34	1.133	5.73	9.47	10	0	0	331.16
Fox 3	5/6/2011	7.69	1.002	14.1	8.5	9	0	0	311.66
Fox 3	10/22/2011	7.74	1.108	10.2	9.7	9	0	0	305.49
Fox 3	2/20/2012	7.64	xx	3.4	12.4	12+	0	0	345.77
Fox 3	5/30/2012	7.72	xx	20.6	4.9	5.5	0	x	230.60
Fox 3	11/3/2012	8.07	0.88	6.7	9.2	x	x	x	258.74
Sussex Creek	11/2/2008	8.28	1.219	10.4	14	x	x	x	333.84*
Sussex Creek	5/26/2009	8.36	1.208	15.7	12.4	x	0	0	305.98*
Sussex Creek	11/11/2009	8.74	1.777	9.9	12.75	x	0	0	364.58
Sussex Creek	4/16/2010	8.4	0.029	14.03	15.78	x	0	0	327.94
Sussex Creek	11/7/2010	8.42	1.2	7.1	12.47	12+	0	0	363.07
Sussex Creek	5/12/2011	8.22	1.231	17.2	17.93	12+	0	0	360.17
Sussex Creek	10/22/2011	8.28	1.162	9.07	13.87	x	x	x	361.94
Sussex Creek	2/18/2012	8.7	xx	5.2	15.8	10	0	0	352.82
Sussex Creek	5/23/2012	8.43	xx	18.4	16.2	12+	x	x	343.71
Sussex Creek	11/3/2012	8.26	0.82	5.7	11.2	6	0	0	315.19
Hygeia Spring	11/10/2010	6.49	0.859	12.3	7.4	7	0	0	333.80
Hygeia Spring	5/6/2011	7.14	0.947	10	6.6	7	0	0	335.77
Hygeia Spring	10/5/2011	6.9	0.984	13.2	4.6	5	0	0	305.49
Hygeia Spring	2/20/2012	7.0	xx	10.4	6.2	10	0	0	305.19
Hygeia Spring	5/30/2012	7.16	xx	10.9	7.3	1.5	0	x	329.01
Hygeia Spring	10/26/2012	6.29	xx	11.6	6.3	6	0	0	324.01
Root River	4/21/2007	x	x	x	x	x	x	x	228.32*
Root River	6/6/2007	x	x	x	x	x	x	x	167.50*
Root River	9/13/2007	x	x	x	x	x	x	x	309.58*
Root River	6/4/2008	7.8	1.12	15.15	4.96	x	0	0.1	268.86*
Root River	11/2/2008	8.1	1.137	10.4	12.6	x	x	x	308.77*
Root River	6/4/2009	8.05	1.239	15.6	9.7	x	x	x	305.98*
Root River	11/10/2009	8.07	1.194	8.6	12.47	x	0	0	348.41
Root River	4/21/2010	7.79	1.231	11.7	9.77	x	x	0	341.11
Root River	11/9/2010	7.93	1.066	8.2	9.37	10	0	0	333.21
Root River	5/17/2011	7.89	1.122	11.6	11.2	10	0	0	323.42
Root River	10/22/2011	7.57	0.892	9.4	9.93	10	0	0	223.46
Root River	2/27/2012	7.46	xx	0.7	12.7	7	0	0	328.71
Root River	5/30/2012	7.22	xx	18.8	3.6	7	x	x	299.31
Root River	11/3/2012	7.94	0.77	5.8	6.6	x	x	x	286.18
Underwood Creek	4/23/2007	x	x	x	x	x	x	x	215.51*
Underwood Creek	6/6/2007	x	x	x	x	x	x	x	315.80*
Underwood Creek	9/13/2007	x	x	x	x	x	x	x	263.23*
Underwood Creek	6/4/2008	8.1	1.75	22.4	x	x	0	0.1	331.81*
Underwood Creek	11/2/2008	8.28	1.788	10.5	over maximum	x	x	x	361.57*
Underwood Creek	5/26/2009	8.14	1.71	14	10.7	x	x	0.05	344.54*
Underwood Creek	11/11/2009	9	1.615	10	over maximum	x	0	0	329.60
Underwood Creek	4/16/2010	8.2	xx	18.1	6.57	x		0	314.47
Underwood Creek	11/7/2010	8.23	1.774	6.17	over maximum	11.5	0	0	411.09
Underwood Creek	5/6/2011	8.45	1.782	18.2	16.73	12+	0	0	264.62
Underwood Creek	10/4/2011	8.1	1.462	15.23	12.13	x	x	x	428.09
Underwood Creek	2/18/2012	8.63	1.347	4.9	12.37	12+	0	0	357.82
Underwood Creek	5/23/2012	8.46	xx	27.3	18.34	12+	x	x	261.00
Underwood Creek	11/14/2012	8.0	1.16	2	17	12+	0	0	398.69

Sample Site	Date	pH	Specific Conductivity (mmhos/cm)	Temperature (°C)	DO (mg/L) meter	DO (mg/L) colorimetric	S2- (mg/L) colorimetric	Fe2+ (mg/L) colorimetric	Calculated HCO_3
Pilgrim Rd Brkfld									
EM 275	3/7/2007	x	x	x	x	x	x	x	253.92*
EM 275	9/28/2007	x	x	x	x	x	x	x	253.39*
EM 275	6/3/2008	7.2	0.875	10.5	0.12	0.08	0	x	331.81*
EM 275	5/26/2009	7.3	0.816	10	0.425	x	0	0.05	300.83*
EM 275	11/13/2009	7.57	0.881	10	0.3	0.4	0	0.05	323.42
EM 275	5/4/2010	6.9	0.831	10	1.13	0.2	0	0	332.62
EM 275	10/29/2010	7.3	0.82	10.1	0.13	0.25	0	0	325.01
EM 275	5/12/2011	6.83	0.848	10.2	1.8	1	0	0.1	342.53
EM 275	10/3/2011	6.92	0.9	10.2	0.37	1	0	0	345.47
EM 275	2/17/2012	6.99	xx	9.9	0.3	0.6	0	0	311.96
EM 275	5/23/2012	6.83	xx	10.1	1.55	2.5	0	<1	334.30
EM 275	11/14/2012	7.16	0.73	8.9	1.4	>1	0	0	295.00
Camelot 2 Brkfld									
IZ 385	3/7/2007	x	x	x	x	x	x	x	298.73*
IZ 385	9/28/2007	x	x	x	x	x	x	x	298.73*
IZ 385	6/3/2008	7.09	1.43	11.1	0.73	x	0	x	351.01*
IZ 385	5/26/2009	7.1	1.428	11.3	0.97	x	0	0.05	375.40*
IZ 385	11/13/2009	7.57	1.416	11.15	0.95	1	0	0.1	420.45
IZ 385	5/4/2010	6.47	1.4	11.2	1.57	1	0	0.1	408.46
IZ 385	10/29/2010	7.07	1.4	11	0.73	1	0	0	406.99
IZ 385	5/12/2011	6.73	1.35	11.4	1.1	1	0	0	449.26
IZ 385	10/3/2011	6.85	1.27	13.2	1.8	2	0	0	430.74
IZ 385	2/17/2012	6.95	xx	11.1	0.57	0.6	0	0	433.97
IZ 385	5/23/2012	6.71	xx	11.3	0.63	1	x	<1	433.39
IZ 385	11/14/2012	7.16	1.07	9.5	1.1	1	0	0	438.38
Industrial Brkfld									
IZ 386	3/7/2007	x	x	x	x	x	x	x	325.40*
IZ 386	9/28/2007	x	x	x	x	x	x	x	301.93*
IZ 386	6/3/2008	7.19	1.269	10.8	0.08	x	x	x	362.75*
IZ 386	5/26/2009	7.1	1.218	11.4	0.15	x	0	0.9	385.68*
IZ 386	11/13/2009	7.53	1.288	11	0.05	0.2	0	0.7	421.62
IZ 386	5/4/2010	6.9	1.24	11.1	1.4	0.05	0	1	418.70
IZ 386	10/29/2010	7	1.3	11	0.06	0.15	0	0.8	412.85
IZ 386	5/12/2011	6.75	1.271	11.1	0.06	0.2	0	1	450.44
IZ 386	10/3/2011	6.61	1.36	11.1	0.1	0.5	0	0	447.20
IZ 386	2/17/2012	6.96	xx	10.9	0.1	0.3	0	1	423.39
IZ 386	5/23/2012	6.64	xx	11.4	0.1	0.6	x	1	413.39
IZ 386	11/14/2012	7.24	1.08	9.6	0.1	0.5	0	1	452.79
St Martins Church									
SV 631	3/15/2007	x	x	x	x	x	x	x	278.46*
SV 631	9/27/2007	x	x	x	x	x	x	x	272.06*
SV 631	6/4/2008	7.35	0.829	11.1	0.07	0.16	0	0.8	319.00*
SV 631	5/27/2009	7.03	0.868	11.38	0.1	0.05	0	1.5	349.69*
SV 631	11/10/2009	7.5	0.881	11.35	1.6	0.8	0	0.9	373.99
SV 631	4/21/2010	7.01	0.051	10.9	0.33	0	x	1	380.05
SV 631	11/15/2010	6.5	0.845	11.7	0.03	0.2	0	0.7	340.53
SV 631	5/17/2011	7.14	0.832	11.2	0.06	0	0	0.9	399.87
SV 631	10/5/2011	7.07	0.835	11.93	0.03	0.9	0	1	400.16
SV 631	2/27/2012	7.06	xx	10.9	0.43	0.4	0	1	382.52
SV 631	5/30/2012	7.18	xx	11.3	0.06	0.2	0	x	382.52
SV 631	10/26/2012	7.1	0.1	10.4	0.1	0.3	0	1	373.41

Table 5. Major Ion Chemistry

* alkalinity calculated with correction factor due to incorrectly calibrated scale

Limit for analytical error requires an ion balance of less than 10%

Sample Site	Sample Collection Date	Ca (ppm)	Ca molar	Na (ppm)	Na molar	Mg (ppm)	Mg molar	K (ppm)	K molar	HCO_3 (ppm)	HCO_3 molar	Cl (ppm)	Cl molar	SO_4 (ppm)	SO_4 molar	NO_3 (ppm)	NO_3 molar	TDS calc'd (mg/L)	Ion Balance %
Waukesha 11 S																			
RL 255	4/1/2005	119.84	2.99	31.05	1.35	55.90	2.30			414.92	6.80	119.99	3.38	76.88	0.80			818.58	0.63
RL 255	4/18/2007	112.06	2.80	45.09	1.96	53.25	2.19	2.38		307.27*	5.04	130.00	3.66	63.00	0.66	0.44	0.01	757.58	8.99
RL 255	9/28/2007	86.32	2.15	57.53	2.50	46.17	1.90	2.46		309.40*	5.07	140.00	3.94	63.00	0.66	0.86	0.01	750.13	1.29
RL 255	6/3/2008	101.85	2.54	59.29	2.58	56.67	2.33	2.35	0.06	348.88*	5.72	156.19	4.40	58.48	0.61		0.00	833.76	4.42
RL 255	5/27/2009	114.48	2.78	66.45	3.03	55.70	2.29	1.94	0.07	390.83*	6.41	152.89	4.31	63.18	0.66	1.40	0.02	902.96	7.10
RL 255 ↕256	11/10/2009	109.56	2.60	80.59	2.65	54.65	2.21	2.68	0.06	407.22	6.67	139.43	3.93	75.95	0.79	5.11	0.08	875.19	0.81
RL 255	4/16/2010	109.70	2.74	82.97	3.61	55.21	2.27	2.35	0.06	425.15	6.97	170.17	4.79	69.31	0.72		0.00	914.86	1.79
RL 255	11/5/2010	106.29	2.65	82.36	3.58	56.34	2.32	2.73	0.07	430.71	7.06	172.70	4.86	69.20	0.72	1.60	0.03	921.93	0.75
RL 255	5/6/2011	110.73	2.82	78.88	3.58	55.86	2.30	2.44	0.06	435.15	7.13	170.86	4.81	73.90	0.77	1.52	0.02	929.34	4.26
RL 255	10/4/2011	111.27	2.78	82.50	3.59	56.08	2.31	2.48	0.06	462.20	7.57	175.08	4.93	74.13	0.77	0.98	0.02	964.73	0.89
RL 255	2/20/2012	110.87	2.77	83.26	3.62	52.75	2.17	2.78	0.07	445.15	7.30	180.04	5.08	74.49	0.78	2.32	0.04	951.66	1.44
RL 255	5/25/2012	109.08	2.72	84.16	3.66	53.45	2.20	2.69	0.07	446.91	7.32	181.21	5.11	73.77	0.77	1.03	0.02	952.31	1.52
RL 255	10/31/2012	111.90	2.79	94.49	4.11	52.14	2.15	2.76	0.07	454.55	7.45	180.24	5.08	73.88	0.77	0.65	0.01	970.62	0.10
Waukesha 12 N																			
RL 256	5/24/2005	109.81	2.74	20.01	0.87	51.04	2.10			403.32	6.61	89.11	2.51	66.31	0.69			739.60	0.24
RL 256	4/18/2007	101.08	2.52	28.30	1.23	49.93	2.05	2.23		281.66*	4.62	89.00	2.51	64.00	0.67	0.00	0.00	656.61	10.60
RL 256	9/28/2007	79.38	1.98	39.11	1.70	42.95	1.77	2.24		293.40*	4.81	100.00	2.82	64.00	0.67	0.00	0.00	663.18	1.45
RL 256	6/3/2008	111.51	2.78	48.09	2.09	54.67	2.25	2.25	0.06	347.81*	5.70	132.30	3.73	93.73	0.98		0.00	840.27	3.54
RL 256	5/27/2009	113.78	2.84	51.03	2.22	55.31	2.28	1.93	0.05	388.26*	6.36	129.56	3.65	93.56	0.97	0.00	0.00	889.13	2.41
RL 256 ↕255	11/10/2009	104.12	2.60	62.40	3.45	52.33	2.32	2.58	0.07	429.86	7.04	170.82	4.81	71.46	0.74	6.49	0.10	900.05	0.63
RL 256	4/16/2010	110.21	2.75	65.99	2.87	56.24	2.31	2.35	0.06	402.31	6.59	140.37	3.95	99.10	1.03		0.00	876.58	1.56
RL 256	11/5/2010	99.59	2.48	60.89	2.65	52.84	2.17	2.37	0.06	393.23	6.44	132.10	3.72	66.00	0.69		0.00	807.02	2.27
RL 256	5/6/2011	106.35	2.65	65.61	2.85	55.84	2.30	2.31	0.06	395.75	6.48	143.22	4.03	112.16	1.17	1.26	0.02	882.51	1.70
RL 256	10/4/2011	101.66	2.54	67.49	2.93	53.33	2.19	2.28	0.06	438.68	7.18	145.45	4.10	81.67	0.85	1.33	0.02	891.89	0.89
RL 256	2/20/2012	105.34	2.63	69.37	3.02	50.33	2.07	2.62	0.07	411.63	6.74	152.77	4.31	83.81	0.87	2.06	0.03	877.92	0.83
RL 256	5/25/2012	108.33	2.70	69.60	3.03	52.87	2.18	2.38	0.06	400.16	6.55	155.80	4.39	95.57	0.99	1.53	0.02	886.24	0.52
RL 256	10/31/2012	105.65	2.64	72.71	3.16	49.68	2.04	2.76	0.07	423.98	6.94	146.64	4.14	70.75	0.74	0.00	0.00	872.17	0.63
Waukesha 13																			
WK 947	11/1/2007	60.15	1.50	7.82	0.34	37.91	1.56			329.17	5.39	13.14	0.37	27.87	0.29			476.05	0.94
WK 947	4/16/2010	88.10	2.20	34.72	1.51	52.07	2.14	1.70	0.04	380.64	6.23	77.32	2.18	74.98	0.78			709.54	1.48
WK 947	11/5/2010	90.29	2.25	34.71	1.51	56.14	2.31	1.90	0.05	394.40	6.46	74.90	2.11	90.00	0.94	0.40	0.01	742.74	1.19
WK 947	5/6/2011	97.78	2.44	37.15	1.62	54.70	2.25	2.16	0.06	388.11	6.36	85.02	2.39	120.97	1.26	1.19	0.02	787.07	1.04
WK 947	10/4/2011	91.78	2.29	35.71	1.55	56.62	2.33	2.16	0.06	419.57	6.87	82.56	2.33	103.81	1.08	1.29	0.02	793.51	2.39
WK 947	2/20/2012	94.65	2.36	38.45	1.67	53.03	2.18	2.33	0.06	406.92	6.66	87.25	2.46	94.03	0.98	1.92	0.03	778.58	1.38
WK 947	5/25/2012	91.77	2.29	35.01	1.52	55.39	2.28	2.37	0.06	398.40	6.52	88.19	2.49	95.68	1.00	1.45	0.02	768.26	1.44
WK 947	10/31/2012	93.33	2.33	38.59	1.68	51.84	2.13	2.52	0.06	399.28	6.54	81.43	2.30	93.97	0.98	0.49	0.01	761.45	0.67

Sample Site	Sample Collection Date	Ca (ppm)	Ca molar	Na (ppm)	Na molar	Mg (ppm)	Mg molar	K (ppm)	K molar	HCO_3 (ppm)	HCO_3 molar	Cl (ppm)	Cl molar	SO_4 (ppm)	SO_4 molar	NO_3 (ppm)	NO_3 molar	TDS calc'd (mg/L)	Ion Balance %
Sussex WWTP	10/11/2008	92.80	2.32	260.81	11.34	39.30	1.62	14.01	0.36	169.03	2.77	409.85	11.55	91.22	0.95	35.66	0.58	943.65	7.63
Sussex WWTP	12/13/2008	100.70	2.51	307.91	13.39	41.90	1.72	12.66	0.32	257.63	4.22	679.04	19.13	87.31	0.91	26.21	0.42	1255.72	7.13
Sussex WWTP	1/23/2009	92.80	2.32	279.75	12.16	40.10	1.65	9.64	0.25	212.48	3.48	554.38	15.62	79.63	0.83	21.62	0.35	1077.91	1.84
Sussex WWTP	3/28/2009	94.00	2.35	216.60	9.42	39.70	1.63	6.73	0.17	166.54	2.73	432.41	12.18	67.51	0.70	14.05	0.23	871.00	2.95
Sussex WWTP	5/23/2009	97.40	2.43	199.85	8.69	43.40	1.79	6.44	0.16	156.26	2.56	404.03	11.38	66.91	0.70	11.53	0.19	829.55	5.38
Sussex WWTP	7/1/2009	94.00	2.35	233.25	10.14	42.10	1.73	7.47	0.19	171.23	2.81	444.05	12.51	73.58	0.77	10.01	0.16	904.45	4.17
Sussex WWTP	11/14/2009	89.03	2.22	301.06	13.09	39.99	1.65	14.13	0.36	221.00	3.62	536.60	15.12	123.17	1.28	40.14	0.65	1365.12	1.77
Sussex WWTP	4/23/2010	89.52	2.23	295.80	12.86	42.60	1.75	11.73	0.30	183.70	3.01	465.69	13.12	85.22	0.89	21.40	0.35	1195.67	7.33
Sussex WWTP	11/11/2010	83.50	2.08	281.41	12.24	36.50	1.50	16.40	0.42	186.90	3.06	471.60	13.28	91.00	0.95	19.90	0.32	1187.21	3.29
Sussex WWTP	5/12/2011	86.01	2.15	237.37	10.32	38.17	1.57	9.80	0.25	181.70	2.98	460.53	12.97	82.33	0.86	23.79	0.38	1119.69	0.12
Sussex WWTP	10/2/2011	83.74	2.09	264.36	11.49	36.22	1.49	12.69	0.32	197.50	3.24	493.92	13.91	103.32	1.08	19.37	0.31	1211.12	1.65
Sussex WWTP	2/16/2012	92.49	2.31	315.39	13.71	41.33	1.70	13.46	0.34	237.40	3.89	606.47	17.11	108.26	1.13	20.74	0.33	1435.54	3.31
Sussex WWTP	5/22/2012	91.85	2.29	267.84	11.65	47.17	1.94	12.21	0.31	213.90	3.51	545.22	15.38	98.87	1.03	18.45	0.30	1295.50	1.96
Sussex WWTP	11/3/2012	87.02	2.17	323.84	14.08	43.51	1.79	12.74	0.33	217.80	3.57	543.21	15.32	105.55	1.10	34.14	0.55	1367.81	1.57
Brookfield WWTP	10/11/2008	103.00	2.57	281.10	12.22	44.50	1.83	10.86	0.28	215.03	3.52	538.08	15.16	104.15	1.08	31.59	0.51	1113.29	0.13
Brookfield WWTP	12/13/2008	117.60	2.93	365.58	15.89	49.60	2.04	10.56	0.27	263.17	4.31	672.78	18.95	101.29	1.05	47.56	0.77	1364.97	0.05
Brookfield WWTP	1/23/2009	106.40	2.65	282.66	12.29	47.00	1.93	9.56	0.24	239.49	3.92	619.22	17.44	94.89	0.99	27.62	0.45	1187.34	4.56
Brookfield WWTP	3/28/2009	108.60	2.71	257.79	11.21	46.00	1.89	7.24	0.19	207.57	3.40	537.71	15.15	73.69	0.77	33.16	0.53	1064.20	0.05
Brookfield WWTP	5/23/2009	107.50	2.68	245.54	10.68	49.50	2.04	6.37	0.16	198.92	3.26	507.98	14.31	83.61	0.87	27.83	0.45	1028.32	1.29
Brookfield WWTP	7/1/2009	106.40	2.65	286.82	12.47	46.90	1.93	10.02	0.26	221.59	3.63	558.34	15.73	94.85	0.99	41.93	0.68	1145.25	0.26
Brookfield WWTP	11/14/2009	101.56	2.53	329.48	14.33	44.30	1.82	12.96	0.33	152.00	2.49	596.77	16.81	136.42	1.42	75.75	1.22	1449.24	3.36
Brookfield WWTP	4/23/2010	106.25	2.65	307.86	13.39	48.90	2.01	9.23	0.24	441.60	6.15	519.15	14.62	100.43	1.05	43.30	0.70	1576.72	4.78
Brookfield WWTP	11/11/2010	101.51	2.53	322.10	14.00	42.20	1.74	15.58	0.40	227.60	3.73	558.10	15.72	110.80	1.15	52.70	0.85	1430.59	0.73
Brookfield WWTP	5/12/2011	104.34	2.60	301.47	13.11	45.99	1.89	11.86	0.30	249.40	4.09	625.25	17.61	111.86	1.16	46.10	0.74	1496.27	5.01
Brookfield WWTP	10/3/2011	96.82	2.42	309.04	13.44	43.83	1.80	11.73	0.30	248.40	4.07	618.38	17.42	111.86	1.16	52.56	0.85	1492.62	5.32
Brookfield WWTP	2/16/2012	106.13	2.65	357.82	15.56	48.46	1.99	13.28	0.34	299.80	4.91	754.16	21.27	124.69	1.30	62.06	1.00	1766.41	8.37
Brookfield WWTP	5/22/2012	105.78	2.64	315.67	13.72	54.99	2.26	12.70	0.32	295.40	4.84	726.53	21.27	119.23	1.24	45.83	0.74	1676.13	10.31
Brookfield WWTP	11/14/2012	95.93	2.39	354.11	15.40	44.18	1.82	12.49	0.32	289.70	4.75	661.10	20.49	126.77	1.32	55.90	0.90	1350.47	0.22
Waukesha WWTP	2/1/2007	198.92	4.96	301.14	13.09	82.11	3.38			205.91	3.37	510.00	14.37	88.00	0.92	82.00	1.32	1497.63	17.53
Waukesha WWTP	10/4/2007	47.34	1.18	315.00	13.70	23.55	0.97			190.12	3.12	440.00	12.39	90.00	0.94	74.00	1.19	1207.29	1.58
Waukesha WWTP	9/12/2008	101.90	2.54	248.97	10.82	38.30	1.58	13.61	0.35	224.70	3.68	486.95	13.72	97.32	1.01	179.41	2.89	1166.47	6.97
Waukesha WWTP	12/13/2008	109.70	2.74	298.05	12.96	40.80	1.68	14.50	0.37	255.10	4.18	585.58	16.50	92.22	0.96	170.06	2.74	1310.91	6.69
Waukesha WWTP	1/23/2009	98.50	2.46	246.57	10.72	38.60	1.59	7.10	0.18	229.92	3.77	568.64	16.02	92.19	0.96	70.18	1.13	1121.78	9.19
Waukesha WWTP	3/28/2009	103.00	2.57	246.84	10.73	39.30	1.62	8.28	0.21	197.71	3.24	498.87	14.05	75.00	0.78	48.61	0.78	1019.91	0.82
Waukesha WWTP	5/23/2009	107.50	2.68	232.31	10.10	45.20	1.86	7.91	0.20	189.99	3.11	478.70	13.48	69.12	0.72	51.72	0.83	992.46	1.35
Waukesha WWTP	7/1/2009	105.20	2.62	244.34	10.62	42.40	1.74	8.51	0.22	198.58	3.25	488.25	13.75	71.14	0.74	76.64	1.24	1036.47	0.37
Waukesha WWTP	11/14/2009	94.28	2.35	306.29	13.32	42.14	1.73	12.96	0.33	235.70	3.86	550.70	15.51	114.89	1.20	101.92	1.64	1458.87	3.52
Waukesha WWTP	4/23/2010	99.35	2.48	287.31	12.49	42.88	1.76	8.04	0.21	205.50	3.37	492.64	13.88	90.71	0.94	79.10	1.28	1305.52	1.86
Waukesha WWTP	11/11/2010	89.55	2.23	283.30	12.32	37.50	1.54	16.06	0.41	205.30	3.36	480.50	13.54	94.80	0.99	93.90	1.51	1300.91	0.26
Waukesha WWTP	5/12/2011	101.09	2.52	275.58	11.98	42.72	1.76	11.24	0.29	246.40	4.04	604.24	17.02	105.31	1.10	75.79	1.22	1462.37	8.04
Waukesha WWTP	10/3/2011	91.81	2.29	289.22	12.57	36.10	1.49	11.25	0.29	238.60	3.91	557.43	15.70	126.24	1.31	90.45	1.46	1441.10	7.45
Waukesha WWTP	2/19/2012	93.45	2.33	306.11	13.31	36.03	1.48	12.63	0.32	255.30	4.18	602.81	17.00	122.98	1.28	99.70	1.61	1529.02	8.78
Waukesha WWTP	5/24/2012	96.04	2.40	294.52	12.81	46.10	1.90	13.15	0.34	266.00	4.36	633.59	17.87	117.09	1.22	108.60	1.75	1575.10	9.75
Waukesha WWTP	11/14/2012	90.06	2.25	307.99	13.39	38.40	1.58	13.66	0.35	254.50	4.17	597.65	16.86	110.88	1.15	120.35	1.94	1533.47	8.32

Sample Site	Sample Collection Date	Ca (ppm)	Ca molar	Na (ppm)	Na molar	Mg (ppm)	Mg molar	K (ppm)	K molar	HCO_3 (ppm)	HCO_3 molar	Cl (ppm)	Cl molar	SO_4 (ppm)	SO_4 molar	NO_3 (ppm)	NO_3 molar	TDS calc'd (mg/L)	Ion Balance %
Fox 0	11/2/2008	83.80	2.09	55.77	2.42	48.90	2.01	1.86	0.05	338.07*	5.54	120.91	3.41	85.01	0.88	13.84	0.22	796.67	1.21
Fox 0	5/26/2009	78.20	1.95	55.57	2.42	40.50	1.67	1.41	0.04	308.55*	5.06	115.51	3.25	46.45	0.48	1.01	0.02	691.47	2.07
Fox 0	11/11/2009	88.16	2.20	69.59	3.03	45.81	1.88	3.49	0.09	345.18	5.66	127.89	3.60	88.47	0.92	6.01	0.10	774.59	0.38
Fox 0	4/16/2010	75.30	1.88	72.13	3.14	39.16	1.61	1.96	0.05	287.82	4.72	111.38	3.14	52.72	0.55		0.00	640.47	6.35
Fox 0	11/7/2010	79.47	1.98	71.34	3.10	40.84	1.68	2.43	0.06	370.68	6.08	117.30	3.30	71.90	0.75	3.80	0.06	757.77	2.08
Fox 0	5/12/2011	74.55	1.86	63.11	2.74	41.82	1.72	1.76	0.05	360.17	5.90	115.97	3.27	50.08	0.52	1.78	0.03	709.25	1.44
Fox 0	10/22/2011	80.70	2.01	79.52	3.46	48.11	1.98	2.92	0.07	367.23	6.02	155.64	4.38	81.00	0.84	3.89	0.06	819.01	2.67
Fox 0	2/18/2012	85.77	2.14	67.24	2.92	45.34	1.87	2.19	0.06	363.11	5.95	127.40	3.59	78.72	0.82	2.22	0.04	772.00	1.03
Fox 0	5/23/2012	76.75	1.92	65.84	2.86	48.37	1.99	2.27	0.06	329.30	5.40	125.59	3.54	78.91	0.82	4.92	0.08	731.95	0.33
Fox 0	11/3/2012	88.70	2.21	120.42	5.24	48.43	1.99	3.06	0.08	406.24	6.66	154.64	4.36	99.99	1.04	4.91	0.08	926.39	2.03
Fox 1	4/23/2007	76.10	1.90	139.89	6.08	37.38	1.54			243.25*	3.99	190.00	5.35	56.00	0.58	4.80	0.08	782.33	10.11
Fox 1	6/6/2007	73.86	1.84	94.27	4.10	36.15	1.49			204.84*	3.36	210.00	5.92	53.00	0.55	5.30	0.09	706.82	1.41
Fox 1	9/13/2007	79.78	1.99	98.58	4.29	42.08	1.73			285.96*	4.69	180.00	5.07	43.00	0.45	5.30	0.09	775.74	4.43
Fox 1	6/4/2008	92.80	2.32	151.34	6.58	47.80	1.97	4.76	0.12	305.13*	5.00	264.44	7.45	57.74	0.60		0.00	967.80	5.58
Fox 1	11/2/2008	88.30	2.20	146.77	6.38	47.40	1.95	3.64	0.09	328.74*	5.39	270.86	7.63	73.80	0.77	25.54	0.41	1032.23	0.62
Fox 1	6/4/2009	87.20	2.18	117.82	5.12	44.60	1.84	3.28	0.08	308.55*	5.06	262.97	7.41	50.40	0.52	6.89	0.11	925.99	1.48
Fox 1	11/11/2009	83.49	2.08	137.34	5.97	43.43	1.79	4.95	0.13	326.36	5.35	255.72	7.20	71.22	0.74	10.53	0.17	933.05	1.30
Fox 1	4/16/2010	38.62	0.96	137.91	6.00	42.35	1.74	3.66	0.09	318.27	5.22	231.22	6.51	56.14	0.58		0.00	828.18	5.72
Fox 1	11/7/2010	79.00	1.97	133.12	5.79	40.71	1.68	6.69	0.17	331.45	5.43	244.20	6.88	62.50	0.65	13.20	0.21	910.87	2.12
Fox 1	5/12/2011	82.93	2.07	125.54	5.46	46.30	1.90	4.03	0.10	364.00	5.97	255.68	7.20	56.38	0.59	7.04	0.11	941.89	3.34
Fox 1	10/22/2011	54.47	1.36	116.51	5.07	41.77	1.72	3.80	0.10	273.44	4.48	233.00	6.56	54.61	0.57	7.00	0.11	784.59	4.13
Fox 1	2/18/2012	88.93	2.22	165.30	7.19	48.90	2.01	4.46	0.11	354.00	5.80	354.09	9.97	74.67	0.78	9.83	0.16	1100.18	5.19
Fox 1	5/25/2012	79.91	1.99	164.49	7.15	51.04	2.10	5.17	0.13	320.48	5.25	351.23	9.91	73.05	0.76	12.13	0.20	1057.49	4.34
Fox 1	11/3/2012	86.11	2.15	170.41	7.41	47.91	1.97	5.59	0.14	326.85	5.36	336.34	9.49	103.38	1.08	15.57	0.25	1092.16	4.41
Fox 2	4/23/2007	72.19	1.80	141.07	6.13	35.10	1.44	4.14		220.63*	3.62	200.00	5.63	55.00	0.57	12.00	0.19	771.79	8.77
Fox 2	6/6/2007	73.24	1.83	141.98	6.17	34.44	1.42	4.48		230.45*	3.78	200.00	5.63	54.00	0.56	10.00	0.16	781.67	8.42
Fox 2	9/13/2007	76.13	1.90	112.29	4.88	40.48	1.67	5.51		348.05*	5.70	180.00	5.07	47.00	0.49	15.00	0.24	874.41	0.12
Fox 2	6/4/2008	86.48	2.16	164.77	7.16	46.13	1.90	6.23	0.16	303.00*	4.97	281.68	7.93	55.94	0.58		0.00	987.71	4.64
Fox 2	11/2/2008	92.18	2.34	156.12	6.79	42.47	0.00	6.47	0.18	337.24*	5.53	284.97	8.03	47.56	0.49	21.29	0.34	1036.68	10.50
Fox 2	6/4/2009	90.56	2.26	137.39	5.97	38.18	1.57	4.23	0.11	303.40*	4.97	270.95	7.63	47.69	0.50	20.96	0.34	956.90	0.70
Fox 2	11/10/2009	89.82	2.23	150.10	6.26	38.94	1.60	5.37	0.13	329.30	5.40	279.76	7.88	71.66	0.75	19.92	0.32	984.87	4.98
Fox 2	4/16/2010	84.81	2.12	144.28	6.27	45.86	1.89	3.97	0.10	323.54	5.30	247.97	6.99	58.03	0.60		0.00	908.47	3.18
Fox 2	11/7/2010	86.45	2.16	151.31	6.58	45.35	1.87	6.70	0.17	332.91	5.46	270.30	7.61	61.80	0.64	32.60	0.53	987.43	0.29
Fox 2	5/6/2011	85.22	2.13	130.72	5.68	43.01	1.77	3.75	0.10	329.30	5.40	263.21	7.41	59.50	0.62	14.58	0.24	929.30	2.56
Fox 2	10/22/2011	66.28	1.65	132.01	5.74	51.60	2.12	4.31	0.11	276.67	4.53	265.61	7.48	59.37	0.62	17.65	0.28	873.51	0.49
Fox 2	2/18/2012	91.96	2.29	180.24	7.84	43.49	1.79	5.03	0.13	330.18	5.41	384.46	10.83	82.36	0.86	31.57	0.51	1149.30	6.74
Fox 2	5/25/2012	77.63	1.94	158.25	6.88	42.20	1.74	5.56	0.14	303.58	4.98	324.06	9.14	70.79	0.74	19.96	0.32	1002.03	5.09
Fox 2	11/3/2012	88.50	2.21	181.72	7.90	44.16	1.82	6.05	0.15	314.60	5.16	369.09	10.41	96.34	1.00	31.38	0.51	1131.83	5.77

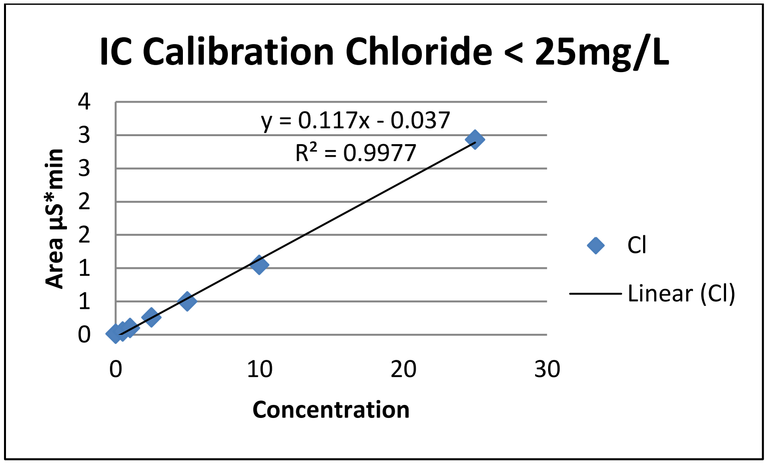
Sample Site	Sample Collection Date	Ca (ppm)	Ca molar	Na (ppm)	Na molar	Mg (ppm)	Mg molar	K (ppm)	K molar	HCO_3 (ppm)	HCO_3 molar	Cl (ppm)	Cl molar	SO_4 (ppm)	SO_4 molar	NO_3 (ppm)	NO_3 molar	TDS calc'd (mg/L)	Ion Balance %
Fox 3	4/21/2007	56.22	1.40	46.17	2.01	25.98	1.07			226.18*	3.71	140.00	3.94	45.00	0.47	5.90	0.10	577.90	11.08
Fox 3	6/6/2007	58.72	1.47	44.57	1.94	29.61	1.22			195.24*	3.20	93.00	2.62	29.00	0.30	5.20	0.08	483.35	5.77
Fox 3	9/13/2007	71.68	1.79	71.32	3.10	34.99	1.44			297.50*	5.58	130.00	3.66	36.00	0.37	7.90	0.13	740.89	2.81
Fox 3	6/4/2008	78.20	1.95	71.34	3.10	40.40	1.66	2.64	0.07	285.93*	4.69	143.41	4.04	30.66	0.32	5.20	0.08	698.81	4.78
Fox 3	11/2/2008	80.50	2.01	71.25	3.10	44.20	1.82	2.75	0.07	343.59*	5.63	152.21	4.29	47.56	0.49	21.29	0.34	812.66	1.95
Fox 3	6/4/2009	73.70	1.84	62.97	2.74	39.80	1.64	0.99	0.03	313.69*	5.14	136.38	3.84	30.50	0.32	7.09	0.11	710.13	0.08
Fox 3	11/10/2009	80.29	2.00	83.83	3.64	40.29	1.66	3.65	0.09	339.01	5.56	160.41	4.52	51.36	0.53	12.55	0.20	771.37	1.27
Fox 3	4/21/2010	78.32	1.95	109.93	4.78	41.68	1.71	3.24	0.08	322.37	5.28	174.41	4.91	48.64	0.51		0.00	778.59	4.24
Fox 3	11/8/2010	76.59	1.91	86.37	3.76	38.31	1.58	5.66	0.14	331.16	5.43	158.20	4.46	45.30	0.47	19.00	0.31	760.59	1.17
Fox 3	5/6/2011	75.02	1.87	81.49	3.54	36.27	1.49	2.60	0.07	311.66	5.11	167.47	4.72	44.15	0.46	4.79	0.08	723.44	2.29
Fox 3	10/22/2011	65.07	1.62	97.53	4.24	36.79	1.51	3.72	0.10	305.49	5.01	200.16	5.64	52.52	0.55	11.21	0.18	772.48	5.81
Fox 3	2/20/2012	77.96	1.95	100.20	4.36	43.11	1.77	3.71	0.09	345.77	5.67	226.66	6.38	61.86	0.64	13.56	0.22	872.82	6.56
Fox 3	5/30/2012	52.87	1.32	82.42	3.58	35.02	1.44	3.19	0.08	230.60	3.78	161.25	4.54	40.84	0.43	7.51	0.12	613.69	0.59
Fox 3	11/3/2012	90.27	2.25	121.99	5.30	44.53	1.83	5.02	0.13	258.74	4.24	242.61	6.83	103.40	1.08	0.00	0.00	866.56	1.40
Sussex Creek	11/2/2008	88.30	2.20	82.95	3.61	48.40	1.99	3.92	0.10	333.84*	5.47	174.40	4.91	80.53	0.84	22.54	0.36	882.79	1.34
Sussex Creek	5/26/2009	80.50	2.01	104.10	4.53	39.30	1.62	3.61	0.09	305.98*	5.01	212.77	5.99	40.56	0.42	7.04	0.11	837.76	0.40
Sussex Creek	11/11/2009	92.82	2.32	215.85	9.38	41.85	1.72	9.83	0.25	364.58	5.98	392.40	11.05	85.41	0.89	14.98	0.24	1217.73	3.63
Sussex Creek	4/16/2010	79.10	1.97	142.70	6.20	39.32	1.62	5.49	0.14	327.94	5.37	223.40	6.29	53.94	0.56			871.88	2.80
Sussex Creek	11/7/2010	84.76	2.11	83.84	3.65	41.92	1.72	4.82	0.12	363.07	5.95	161.40	4.55	82.50	0.86	11.20	0.18	833.51	3.97
Sussex Creek	5/12/2011	52.40	1.31	85.05	3.70	23.60	0.97	2.68	0.07	360.17	5.90	225.84	6.36	42.79	0.45	7.64	0.12	800.16	22.94
Sussex Creek	10/22/2011	86.01	2.15	111.95	4.87	45.00	1.85	4.43	0.11	361.94	5.93	198.79	5.60	86.24	0.90	11.64	0.19	906.00	2.03
Sussex Creek	2/18/2012	90.21	2.25	103.72	4.51	48.18	1.98	4.64	0.12	352.82	5.78	200.97	5.67	80.88	0.84	9.94	0.16	891.36	0.76
Sussex Creek	5/23/2012	81.22	2.03	120.28	5.23	51.09	2.10	5.19	0.13	343.71	5.63	235.19	6.63	76.75	0.80	14.60	0.24	928.02	1.73
Sussex Creek	11/3/2012	79.59	1.99	149.12	6.48	44.77	1.84	4.69	0.12	315.19	5.17	183.93	5.19	88.58	0.92	11.37	0.18	877.24	7.05
Hygeia Spring	11/10/2010	76.86	1.92	66.54	2.89	36.64	1.51	3.39	0.09	333.80	5.47	106.70	3.01	37.90	0.39	15.50	0.25	677.33	3.73
Hygeia Spring	5/6/2011	91.53	2.28	63.41	2.76	44.17	1.82	1.94	0.05	335.77	5.50	126.62	3.57	58.10	0.60	7.63	0.12	729.16	5.81
Hygeia Spring	10/5/2011	80.70	2.01	65.47	2.85	36.81	1.52	2.46	0.06	360.17	5.90	116.96	3.29	42.96	0.45	10.71	0.17	716.27	0.74
Hygeia Spring	2/20/2012	74.64	1.86	62.70	2.73	42.49	1.75	2.60	0.07	305.19	5.00	119.04	3.36	44.65	0.46	10.12	0.16	661.42	5.39
Hygeia Spring	5/30/2012	76.30	1.90	65.59	2.85	39.50	1.63	2.59	0.07	329.01	5.39	127.77	3.60	43.75	0.46	10.50	0.17	695.00	1.80
Hygeia Spring	10/26/2012	77.82	1.94	68.70	2.99	36.82	1.52	3.26	0.08	324.01	5.31	114.49	3.23	43.67	0.45	10.60	0.17	679.36	4.26

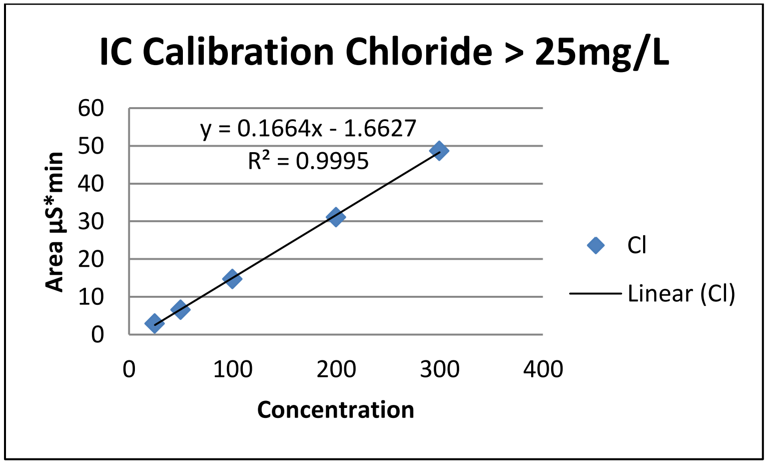
Sample Site	Sample Collection Date	Ca (ppm)	Ca molar	Na (ppm)	Na molar	Mg (ppm)	Mg molar	K (ppm)	K molar	HCO_3 (ppm)	HCO_3 molar	Cl (ppm)	Cl molar	SO_4 (ppm)	SO_4 molar	NO_3 (ppm)	NO_3 molar	TDS calc'd (mg/L)	Ion Balance %
Root River	4/21/2007	79.92	1.99	56.36	2.45	38.65	1.59			228.32*	3.74	180.00	5.07	54.00	0.56	1.20	0.02	671.21	1.72
Root River	6/6/2007	51.82	1.29	102.88	4.47	26.24	1.08			167.50*	2.75	110.00	3.10	49.00	0.51	5.50	0.09	536.98	14.01
Root River	9/13/2007	58.35	1.46	69.65	3.03	27.03	1.11			309.58*	5.07	110.00	3.10	36.00	0.37	1.10	0.02	656.13	4.52
Root River	6/4/2008	82.70	2.06	82.94	3.61	43.80	1.80	2.02	0.05	268.86*	4.41	158.53	4.47	105.10	1.09			782.53	1.47
Root River	11/2/2008	89.50	2.23	68.36	2.97	48.40	1.99	2.84	0.07	308.77*	5.06	138.09	3.89	119.59	1.24	0.00	0.00	819.84	0.24
Root River	6/4/2009	88.30	2.20	91.10	3.96	50.20	2.07	2.58	0.07	305.98*	5.01	195.64	5.51	94.85	0.99	1.98	0.03	874.53	0.13
Root River	11/10/2009	85.24	2.13	103.66	4.51	36.85	1.52	3.33	0.09	348.41	5.71	186.38	5.25	66.75	0.69	4.89	0.08	835.52	2.26
Root River	4/21/2010	79.79	1.99	123.27	5.36	44.09	1.81	2.46	0.06	341.11	5.59	201.81	5.68	61.26	0.64			853.80	1.88
Root River	11/9/2010	79.63	1.99	81.66	3.55	36.67	1.51	2.71	0.07	333.21	5.46	142.30	4.01	61.90	0.64	0.50	0.01	738.57	0.73
Root River	5/17/2011	71.63	1.79	119.69	5.20	34.52	1.42	2.35	0.06	323.42	5.30	210.35	5.93	46.64	0.49	1.26	0.02	809.86	2.25
Root River	10/22/2011	50.53	1.26	93.59	4.07	24.82	1.02	3.62	0.09	223.46	3.66	154.33	4.35	50.04	0.52	0.44	0.01	600.81	1.87
Root River	2/27/2012	99.67	2.49	269.73	11.73	49.31	2.03	2.71	0.07	328.71	5.39	1380.23	38.93	82.71	0.86	1.63	0.03	2214.71	37.73
Root River	5/30/2012	65.05	1.62	108.34	4.71	38.21	1.57	3.23	0.08	299.31	4.91	161.25	4.55	40.84	0.43	7.51	0.12	723.74	3.51
Root River	11/3/2012	77.12	1.92	93.69	4.07	48.86	2.01	4.77	0.12	286.18	4.69	143.44		163.11	1.70	3.09	0.05	820.26	55.57
Underwood Creek	4/23/2007	59.07	1.47	220.04	9.57	25.29	1.04			215.51*	3.53	320.00	9.01	46.00	0.48	5.80	0.09	922.64	3.54
Underwood Creek	6/6/2007	102.08	2.55	80.98	3.52	45.65	1.88			315.80*	5.18	430.00	12.11	55.00	0.57	2.50	0.04	1077.32	19.79
Underwood Creek	9/13/2007	105.89	2.64	118.01	5.13	40.89	1.68			263.23*	4.31	230.00	6.48	140.00	1.46	1.00	0.02	936.79	0.28
Underwood Creek	6/25/2008	131.20	3.27	147.02	6.39	56.60	2.33	3.10	0.08	331.81*	5.44	312.63	8.81	151.98	1.58		0.00	1181.95	0.78
Underwood Creek	11/2/2008	140.20	3.50	137.36	5.97	58.00	2.39	3.22	0.08	361.57*	5.93	307.46	8.66	167.26	1.74	0.00	0.00	1226.95	0.68
Underwood Creek	5/26/2009	123.30	3.08	152.70	6.64	50.40	2.07	3.10	0.08	344.54*	5.65	334.58	9.42	113.65	1.18	0.91	0.01	1172.64	1.25
Underwood Creek	11/11/2009	110.60	2.76	167.37	7.28	50.64	2.08	4.56	0.12	329.60	5.40	342.41	9.65	164.10	1.71	4.61	0.07	1173.89	4.09
Underwood Creek	4/16/2010	103.84	2.59	194.27	8.45	48.78	2.01	3.00	0.08	314.47	5.15	344.35	9.70	117.94	1.23		0.00	1126.65	1.17
Underwood Creek	11/7/2010	128.46	3.21	164.12	7.14	47.68	1.96	4.57	0.12	411.09	6.74	309.20	8.71	148.90	1.55	1.00	0.02	1215.02	2.70
Underwood Creek	5/6/2011	87.84	2.19	412.01	17.91	54.42	2.24	4.14	0.11	264.62	4.34	453.73	12.78	150.07	1.56	37.35	0.60	1464.17	12.65
Underwood Creek	10/4/2011	95.79	2.39	499.76	21.73	39.94	1.64	12.10	0.31	428.09	7.02	286.41	8.07	125.19	1.30	1.42	0.02	1488.69	25.92
Underwood Creek	2/18/2012	123.32	3.08	317.16	13.79	52.55	2.16	4.04	0.10	357.82	5.86	595.10	16.76	198.17	2.06	0.00	0.00	1648.17	4.66
Underwood Creek	5/23/2012	59.22	1.48	192.04	8.35	59.72	2.46	4.25	0.11	261.00	4.28	423.54	11.95	152.01	1.58	0.00	0.00	1151.79	8.57
Underwood Creek	11/14/2012	121.11	3.02	360.69	15.68	50.48	2.08	4.14	0.11	398.69	6.53	366.51	10.34	161.94	1.69	0.00	0.00	1463.56	12.42
St Martins Church																			
SV 631	3/15/2007	75.23	1.88	10.35	0.45	51.72	2.13		0.00	278.46*	4.56	52.00	1.46	70.00	0.73	0.10	0.00	577.82	6.52
SV 631	9/27/2007	40.44	1.01	13.03	0.57	33.81	1.39		0.00	272.06*	4.46	54.00	1.52	67.00	0.70	0.66	0.01	520.04	15.71
SV 631	6/4/2008	79.30	1.98	15.39	0.67	54.70	2.25	1.23	0.03	319.00*	5.23	44.16	1.24	68.68	0.71		0.00	628.23	7.60
SV 631	5/27/2009	88.30	2.20	15.76	0.69	58.70	2.42	0.35	0.01	349.69*	5.73	50.10	1.41	67.24	0.70	0.00	0.00	680.31	7.92
SV 631	11/10/2009	77.37	1.93	21.27	0.92	55.92	2.30	1.62	0.04	373.99	6.13	61.03	1.72	78.18	0.81	4.94	0.08	674.32	0.42
SV 631	4/21/2010	76.88	1.92	23.31	1.01	52.53	2.16	0.74	0.02	380.05	6.23	56.89	1.60	69.79	0.73		0.00	660.20	0.49
SV 631	11/15/2010	71.81	1.79	20.48	0.89	48.66	2.00	1.44	0.04	340.53	5.58	57.20	1.61	69.80	0.73		0.00	609.91	0.54
SV 631	5/17/2011	74.48	1.86	23.80	1.03	52.41	2.16	1.79	0.05	399.87	6.55	59.01	1.66	73.91	0.77	1.46	0.02	686.74	3.27
SV 631	10/5/2011	74.39	1.86	24.05	1.05	51.54	2.12	1.78	0.05	400.16	6.56	57.53	1.62	70.65	0.74	1.29	0.02	681.41	3.34
SV 631	2/27/2012	73.76	1.84	21.78	0.95	53.11	2.19	1.54	0.04	382.52	6.27	59.81	1.69	69.76	0.73	1.55	0.03	663.84	2.15
SV 631	5/30/2012	72.29	1.80	20.91	0.91	58.63	2.41	1.48	0.04	382.52	6.27	59.88	1.69	68.87	0.72	1.42	0.02	666.00	0.19
SV 631	10/26/2012	67.63	1.69	24.52	1.07	51.17	2.11	1.38	0.04	373.41	6.12	54.86	1.55	65.37	0.68	0.00	0.00	638.34	1.92

Sample Site	Sample Collection Date	Ca (ppm)	Ca molar	Na (ppm)	Na molar	Mg (ppm)	Mg molar	K (ppm)	K molar	HCO_3 (ppm)	HCO_3 molar	Cl (ppm)	Cl molar	SO_4 (ppm)	SO_4 molar	NO_3 (ppm)	NO_3 molar	TDS calc'd (mg/L)	Ion Balance %
Pilgrim Road Brkfld																			
EM 275	3/7/2007	89.17	2.22	12.67	0.55	39.42	1.62		0.00	253.92*	4.16	26.00	0.73	120.00	1.25	0.11	0.00	577.72	5.48
EM 275	9/28/2007	61.44	1.53	21.93	0.95	28.85	1.19		0.00	253.39*	4.15	41.00	1.15	140.00	1.46	0.00	0.00	582.96	12.33
EM 275	6/3/2008	99.60	2.49	17.02	0.74	43.70	1.80	2.01	0.05	331.81*	5.44	25.94	0.73	158.66	1.65		0.00	726.35	0.60
EM 275	5/26/2009	97.40	2.43	15.50	0.67	41.20	1.70	0.94	0.02	300.83*	4.93	23.09	0.65	114.95	1.20	0.00	0.00	637.08	5.78
EM 275	11/13/2009	98.65	2.46	24.35	1.06	42.15	1.73	2.63	0.07	323.42	5.30	35.50	1.00	180.70	1.88	4.70	0.08	712.10	3.14
EM 275	5/4/2010	89.85	2.24	15.03	0.65	37.27	1.53	2.31	0.06	332.62	5.45	37.20	1.05	127.40	1.33		0.00	641.69	5.11
EM 275	10/29/2010	85.21	2.13	24.23	1.05	37.80	1.56	1.86	0.05	325.01	5.33	31.50	0.89	137.30	1.43		0.00	642.91	3.48
EM275	5/12/2011	92.21	2.30	24.31	1.06	41.60	1.71	2.57	0.07	342.53	5.61	32.14	0.91	159.82	1.66	0.00	0.00	695.18	6.33
EM 275	10/3/2011	89.10	2.22	34.58	1.50	40.70	1.67	2.74	0.07	345.47	5.66	51.86	1.46	138.67	1.44	0.00	0.00	703.12	8.46
EM 275	2/17/2012	102.71	2.56	35.67	1.55	70.53	2.90	2.61	0.07	311.96	5.11	58.37	1.65	180.47	1.88	0.00	0.00	762.32	8.81
EM 275	5/23/2012	86.55	2.16	20.81	0.90	43.14	1.77	2.38	0.06	334.30	5.48	40.16	1.13	103.57	1.08	1.39	0.02	632.31	1.61
EM 275	11/14/2012	93.52	2.33	36.74	1.60	42.57	1.75	2.81	0.07	295.00	4.83	49.48	1.40	174.45	1.82	0.00	0.00	694.57	5.56
Camelot 2 Brkfld																			
IZ 385	3/7/2007	116.02	2.89	81.03	3.52	52.08	2.14			298.73*	4.90	200.00	5.63	75.00	0.78	3.80	0.06	869.53	5.62
IZ 385	9/28/2007	63.26	1.58	83.45	3.63	48.10	1.98			298.73*	4.90	190.00	5.35	72.00	0.75	4.00	0.06	802.40	4.72
IZ 385	6/3/2008	122.10	3.05	86.18	3.75	56.40	2.32	2.68	0.07	351.01*	5.75	157.77	4.44	95.86	1.00		0.00	922.37	8.82
IZ 385	5/26/2009	123.30	3.08	90.57	3.94	54.90	2.26	1.52	0.04	375.40*	6.15	218.78	6.16	70.74	0.74	3.95	0.06	993.02	2.80
IZ 385	11/13/2009	110.01	2.75	110.78	4.82	51.48	2.12	3.33	0.09	420.45	6.89	230.69	6.50	80.66	0.84	8.26	0.13	1015.67	1.90
IZ 385	5/4/2010	110.11	2.75	116.76	5.08	47.47	1.95	3.72	0.10	408.46	6.69	224.10	6.31	75.30	0.78	4.00	0.06	989.91	0.21
IZ 385	10/29/2010	108.90	2.72	120.31	5.23	47.36	1.95	3.67	0.09	406.99	6.67	218.00	6.14	71.20	0.74	3.70	0.06	980.13	1.05
IZ 385	5/12/2011	107.84	2.69	106.46	4.63	49.37	2.03	3.11	0.08	449.26	7.36	208.16	5.86	74.01	0.77	3.60	0.06	1001.81	2.32
IZ 385	10/3/2011	105.31	2.63	94.41	4.10	48.84	2.01	2.90	0.07	430.74	7.06	177.88	5.01	83.60	0.87	3.19	0.05	946.86	1.49
IZ 385	2/17/2012	112.70	2.81	100.53	4.37	51.93	2.14	2.96	0.08	433.97	7.11	214.07	6.04	75.23	0.78	3.38	0.05	994.76	1.47
IZ 385	5/23/2012	112.13	2.80	118.71	5.16	60.95	2.51	2.93	0.07	433.39	7.10	241.61	6.81	74.61	0.78	2.81	0.05	1047.14	1.06
IZ 385	11/14/2012	113.75	2.84	106.41	4.63	48.26	1.99	3.07	0.08	438.38	7.18	185.50	5.23	71.35	0.74	3.00	0.05	969.73	1.42
Industrial Brkfld																			
IZ 386	3/7/2007	119.79	2.99	50.08	2.18	53.05	2.18			325.40*	5.33	150.00	4.23	78.00	0.81	0.00	0.00	823.02	5.84
IZ 386	9/28/2007	62.45	1.56	49.50	2.15	32.71	1.35			301.93*	4.95	140.00	3.94	80.00	0.83	0.00	0.00	709.92	13.90
IZ 386	6/3/2008	122.10	3.05	52.12	2.27	57.00	2.35	2.33	0.06	362.75*	5.94	220.30	6.21	91.27	0.95		0.00	959.92	3.47
IZ 386	5/26/2009	125.50	3.13	47.01	2.04	58.00	2.39	1.30	0.03	385.68*	6.32	138.81	3.91	81.94	0.85	0.60	0.01	894.18	4.84
IZ 386	11/13/2009	117.01	2.92	77.29	3.36	56.95	2.34	3.26	0.08	421.62	6.91	191.44	5.39	89.77	0.93	4.94	0.08	962.27	1.01
IZ 386	5/4/2010	115.43	2.88	62.40	2.71	50.21	2.07	3.02	0.08	418.70	6.86	163.40	4.60	92.00	0.96		0.00	905.16	2.47
IZ 386	10/29/2010	113.39	2.83	73.45	3.19	50.29	2.07	2.63	0.07	412.85	6.77	182.10	5.13	84.10	0.88	0.40	0.01	919.21	2.06
IZ 386	5/12/2011	110.21	2.75	72.61	3.16	53.91	2.22	2.54	0.06	450.44	7.38	168.42	4.74	89.61	0.93	1.35	0.02	949.08	2.94
IZ 386	10/3/2011	112.59	2.81	82.41	3.58	54.98	2.26	2.98	0.08	447.20	7.33	188.97	5.32	85.92	0.89	1.35	0.02	976.40	2.34
IZ 386	2/17/2012	116.37	2.90	73.41	3.19	53.72	2.21	2.80	0.07	423.39	6.94	179.65	5.07	91.60	0.95	2.25	0.04	943.17	1.67
IZ 386	5/23/2012	117.04	2.92	65.37	2.84	63.14	2.60	2.63	0.07	413.39	6.78	181.31	5.11	93.18	0.97	1.65	0.03	937.72	0.32
IZ 386	11/14/2012	114.77	2.86	77.67	3.38	54.21	2.23	5.43	0.14	452.79	7.42	172.37	4.86	105.28	1.10	1.13	0.02	983.65	2.80

Table 6. WATER Institute Ion Chromatography Results

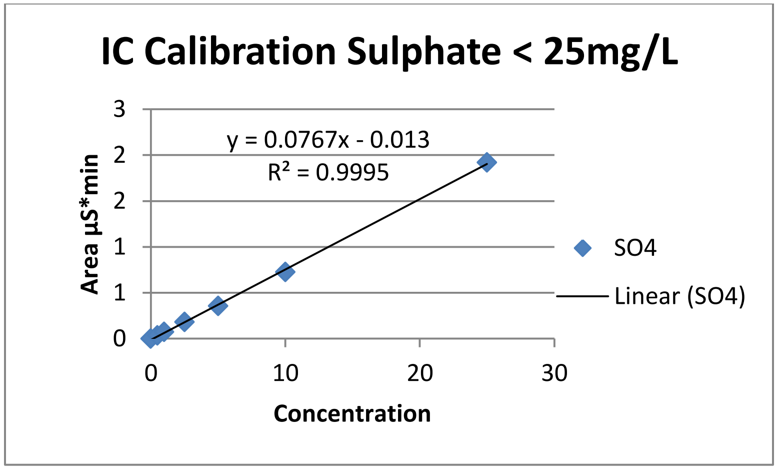
Chloride 11/4/2011	Area (µS*min)	Concentration (mg/L)	Dilution Factor	Concentration (mg/L)
Standard 1	0.05	0.50	1	0.50
Standard 2	0.10	1.00	1	1.00
Standard 3	0.26	2.50	1	2.50
Standard 4	0.50	5.00	1	5.00
Standard 5	1.05	10.00	1	10.00
Standard 6	2.93	25.00	1	25.00
Standard 7	6.61	50.00	1	50.00
Standard 8	14.71	100.00	1	100.00
Standard 9	31.08	200.00	1	200.00
Standard 10	48.67	300.00	1	300.00
Blank	0.01			
EM275 10_11	6.97	51.86	1	51.86
EM275 5_11	3.69	32.14	1	32.14
IZ386 10_11	29.78	188.97	1	188.97
IZ386 5_11	26.36	168.42	1	168.42
IZ385 10_11	27.94	177.88	1	177.88
IZ385 5_11	32.98	208.16	1	208.16
RL256 10_11	22.54	145.45	1	145.45
RL256 5_11	22.17	143.22	1	143.22
RL255 10_11	27.47	175.08	1	175.08
RL255 5_11	26.77	170.86	1	170.86
WK947 10_11	12.08	82.56	1	82.56
WK947 5_11	12.48	85.02	1	85.02
Standard 8 100ppm	17.15	100	1	100
Blank	0.01			
SV 631 10_11	7.91	57.53	1	57.53
SV 631 5_11	8.16	59.01	1	59.01
Big Bend Spring 10_11	17.80	116.96	1	116.96
Big Bend Spring 5_11	19.41	126.62	1	126.62
Sussex Crk 10_11	31.42	198.79	1	198.79
Sussex Crk 5_11	35.92	225.84	1	225.84
Root River 10_11	24.02	154.33	1	154.33
Root River 5_11	33.34	210.35	1	210.35
Underwood Crk 10_11	46.00	286.41	1	286.41
Underwood Crk 5_11	73.84	453.73	1	453.73

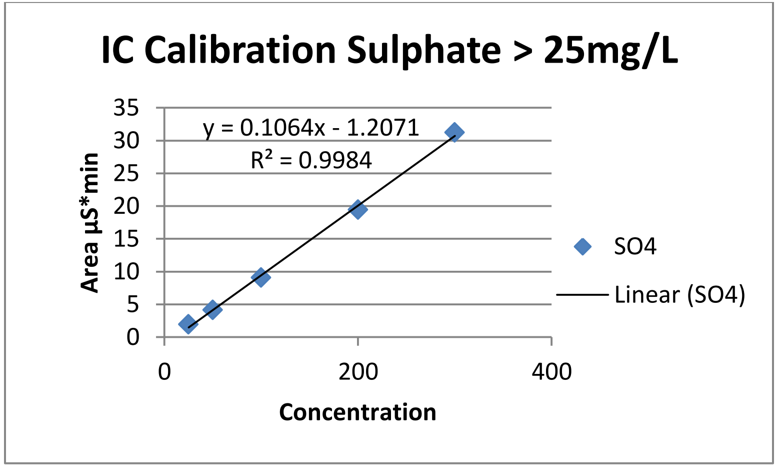




Chloride 11/2011 cont.	Area (µS*min)	Concentration (mg/L)	Dilution Factor	Concentration (mg/L)
Standard 8 100ppm	18.23	100	1	100
Blank	n.a.			
Fox 0 10_11	24.24	155.64	1	155.64
Fox 0 5_11	17.64	115.97	1	115.97
Fox 1 10_11	37.11	233.00	1	233.00
Fox 1 5_11	40.88	255.68	1	255.68
Fox 2 10_11	42.54	265.61	1	265.61
Fox 2 5_11	42.14	263.21	1	263.21
Fox 3 10_11	31.64	200.16	1	200.16
Fox 3 5_11	26.20	167.47	1	167.47
SX WWTP 10_11	80.53	493.92	1	493.92
SX WWTP 10_11 1:5	14.18	95.19	5	475.94
SX WWTP 5_11	74.97		1	
SX WWTP 5_11 1:5	13.18	89.22	5	446.11
Standard 8 100ppm	19.19	100	1	100.00
Blank	n.a.			
WK WWTP 10_11	91.09		1	
WK WWTP 10_11 1:5	16.24	107.59	5	537.97
WK WWTP 5_11	98.88		1	
WK WWTP 5_11 1:5	17.70	107.59	5	581.70
BK WWTP 10_11	101.24		1	
BK WWTP 10_11 1:5	18.15	119.07	5	595.34
BK WWTP 5_11	102.38		1	
BK WWTP 5_11 1:5	18.27	119.79	5	598.97
Blank	n.a.			

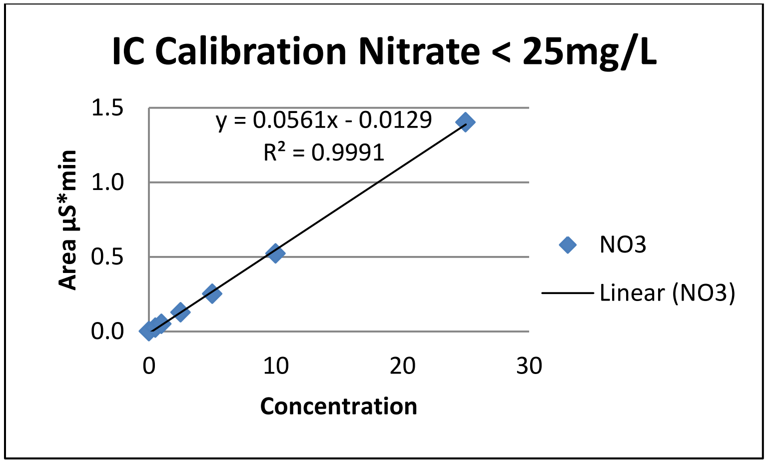
Sulphate 11/4/2011	Area (µS*min)	Concentration (mg/L)	Dilution Factor	Concentration (mg/L)
Standard 1	0.03	0.50	1	0.50
Standard 2	0.07	1.00	1	1.00
Standard 3	0.18	2.50	1	2.50
Standard 4	0.35	5.00	1	5.00
Standard 5	0.73	10.00	1	10.00
Standard 6	1.92	25.00	1	25.00
Standard 7	4.13	50.00	1	50.00
Standard 8	9.08	100.00	1	100.00
Standard 9	19.46	200.00	1	200.00
Standard 10	31.21	300.00	1	300.00
Blank	n.a.			
EM275 10_11	13.55	138.67	1	51.86
EM275 5_11	15.80	159.82	1	32.14
IZ386 10_11	7.94	85.92	1	188.97
IZ386 5_11	8.33	89.61	1	168.42
IZ385 10_11	7.69	83.60	1	177.88
IZ385 5_11	6.67	74.01	1	208.16
RL256 10_11	7.48	81.67	1	145.45
RL256 5_11	10.73	112.16	1	143.22
RL255 10_11	6.68	74.13	1	175.08
RL255 5_11	6.66	73.90	1	170.86
WK947 10_11	9.84	103.81	1	82.56
WK947 5_11	11.66	120.97	1	85.02
Standard 8 100ppm	10.46	100.00	1	100
Blank	n.a.			
SV 631 10_11	6.31	70.65	1	57.53
SV 631 5_11	6.66	73.91	1	59.01
Big Bend Spring 10_11	3.36	42.96	1	116.96
Big Bend Spring 5_11	4.97	58.10	1	126.62
Sussex Crk 10_11	7.97	86.24	1	198.79
Sussex Crk 5_11	3.35	42.79	1	225.84
Root River 10_11	4.12	50.04	1	154.33
Root River 5_11	3.76	46.64	1	210.35
Underwood Crk 10_11	12.11	125.19	1	286.41
Underwood Crk 5_11	14.76	150.07	1	453.73

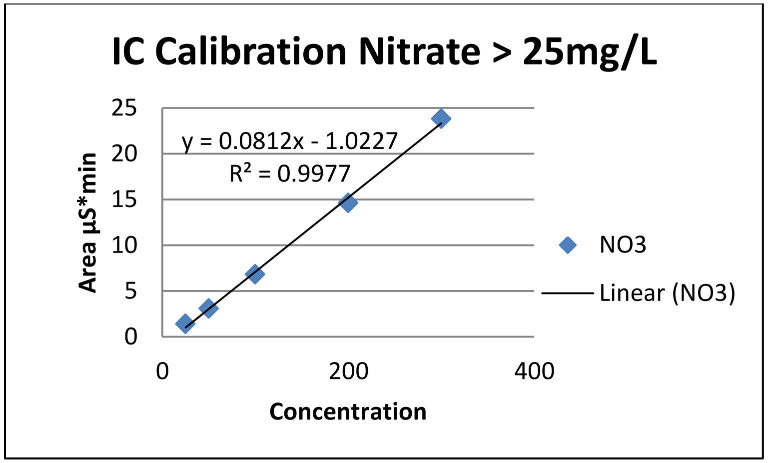




Sulphate 11/2011 cont	Area (µS*min)	Concentration (mg/L)	Dilution Factor	Concentration (mg/L)
Standard 8 100ppm	11.09	100.00	1	100
Blank	n.a.			
Fox 0 10_11	7.41	81.00	1	155.64
Fox 0 5_11	4.12	50.08	1	115.97
Fox 1 10_11	4.60	54.61	1	233.00
Fox 1 5_11	4.79	56.38	1	255.68
Fox 2 10_11	5.11	59.37	1	265.61
Fox 2 5_11	5.12	59.50	1	263.21
Fox 3 10_11	4.38	52.52	1	200.16
Fox 3 5_11	3.49	44.15	1	167.47
SX WWTP 10_11	9.79	103.32	1	493.92
SX WWTP 10_11 1:5	1.65	108.19	5	475.94
SX WWTP 5_11	7.55	82.33	1	
SX WWTP 5_11 1:5	1.31	85.93	5	446.11
Standard 8 100ppm	11.66	100.00	1	100.00
Blank	n.a.			
WK WWTP 10_11	12.23	126.24	1	
WK WWTP 10_11 1:5	1.95		5	537.97
WK WWTP 5_11	10.00	105.31	1	
WK WWTP 5_11 1:5	1.68		5	581.70
BK WWTP 10_11	10.70	111.86	1	
BK WWTP 10_11 1:5	1.79		5	595.34
BK WWTP 5_11	10.69	111.86	1	
BK WWTP 5_11 1:5	1.79		5	598.97
Blank	n.a.			

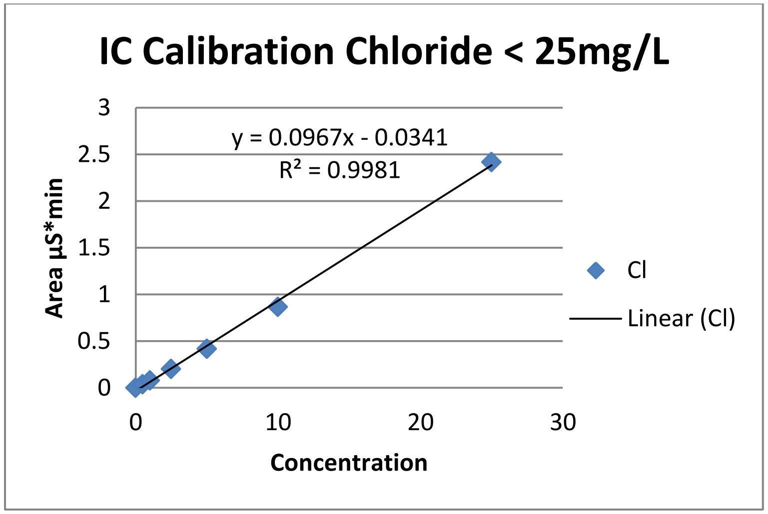
Nitrate 11/4/2011	Area (µS*min)	Concentration (mg/L)	Dilution Factor	Concentration (mg/L)
Standard 1	0.02	0.50	1	0.50
Standard 2	0.05	1.00	1	1.00
Standard 3	0.13	2.50	1	2.50
Standard 4	0.25	5.00	1	5.00
Standard 5	0.52	10.00	1	10.00
Standard 6	1.40	25.00	1	25.00
Standard 7	3.06	50.00	1	50.00
Standard 8	6.82	100.00	1	100.00
Standard 9	14.62	200.00	1	200.00
Standard 10	23.79	300.00	1	300.00
Blank	n.a.			
EM275 10_11	n.a.	na	1	na
EM275 5_11	n.a.	na	1	na
IZ386 10_11	0.06	1.35	1	1.35
IZ386 5_11	0.06	1.35	1	1.35
IZ385 10_11	0.17	3.19	1	3.19
IZ385 5_11	0.19	3.60	1	3.60
RL256 10_11	0.06	1.33	1	1.33
RL256 5_11	0.06	1.26	1	1.26
RL255 10_11	0.04	0.98	1	0.98
RL255 5_11	0.07	1.52	1	1.52
WK947 10_11	0.06	1.29	1	1.29
WK947 5_11	0.05	1.19	1	1.19
Standard 8 100ppm	7.95	11057	1	11057
Blank	n.a.			
SV 631 10_11	0.06	1.29	1	1.29
SV 631 5_11	0.07	1.46	1	1.46
Big Bend Spring 10_11	0.59	10.71	1	10.71
Big Bend Spring 5_11	0.41	7.63	1	7.63
Sussex Crk 10_11	0.64	11.64	1	11.64
Sussex Crk 5_11	0.42	7.64	1	7.64
Root River 10_11	0.01	0.44	1	0.44
Root River 5_11	0.06	1.26	1	1.26
Underwood Crk 10_11	0.07	1.42	1	1.42
Underwood Crk 5_11	2.01	37.35	1	37.35

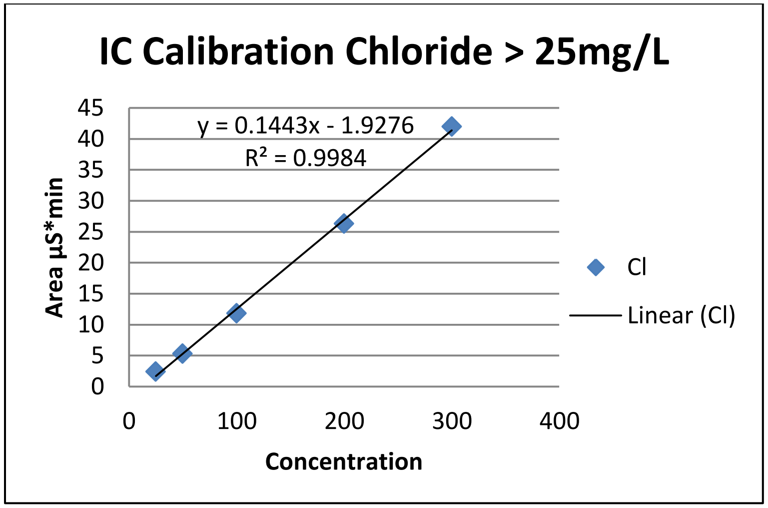




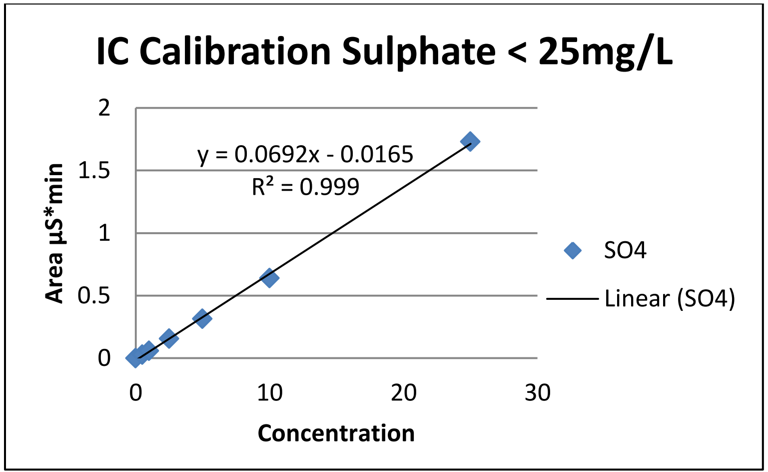
Nitrate 11/2011 cont.	Area (µS*min)	Concentration (mg/L)	Dilution Factor	Concentration (mg/L)
Standard 8 100ppm	8.46	100	1	100
Blank	n.a.			
Fox 0 10_11	0.21	3.89	1	3.89
Fox 0 5_11	0.09	1.78	1	1.78
Fox 1 10_11	0.38	7.00	1	7.00
Fox 1 5_11	0.38	7.04	1	7.04
Fox 2 10_11	0.98	17.65	1	17.65
Fox 2 5_11	0.80	14.58	1	14.58
Fox 3 10_11	0.62	11.21	1	11.21
Fox 3 5_11	0.26	4.79	1	4.79
SX WWTP 10_11	1.07	19.37	1	19.37
SX WWTP 10_11 1:5	0.21		5	
SX WWTP 5_11	1.32	23.79	1	23.79
SX WWTP 5_11 1:5	0.25		5	
Standard 8 100ppm	8.92	12255	1	12255.05
Blank	n.a.			
WK WWTP 10_11	6.32	90.45	1	90.45
WK WWTP 10_11 1:5	1.08		5	
WK WWTP 5_11	5.13	75.79	1	75.79
WK WWTP 5_11 1:5	0.90		5	
BK WWTP 10_11	3.24	52.56	1	52.56
BK WWTP 10_11 1:5	0.58		5	
BK WWTP 5_11	2.72	46.10	1	46.10
BK WWTP 5_11 1:5	0.49		5	
Blank	n.a.			

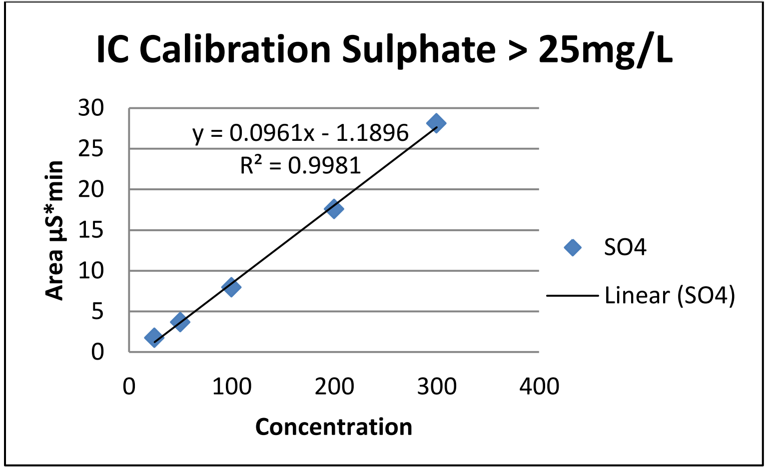
Chloride 3/29/2012	Area (µS*min)	Concentration (mg/L)	Dilution Factor	Concentration (mg/L)
Standard 1	0.04	0.50	1	0.50
Standard 2	0.08	1.00	1	1.00
Standard 3	0.20	2.50	1	2.50
Standard 4	0.42	5.00	1	5.00
Standard 5	0.87	10.00	1	10.00
Standard 6	2.42	25.00	1	25.00
Standard 7	5.28	50.00	1	50.00
Standard 8	11.83	100.00	1	100.00
Standard 9	26.28	200.00	1	200.00
Standard 10	41.97	300.00	1	300.00
Blank	n.a.			
EM275 2_12	6.50	58.37	1	58.37
IZ385 2_12	28.96	214.07	1	214.07
IZ386 2_12	24.00	179.65	1	179.65
RL255 2_12	24.05	180.04	1	180.04
RL256 2_12	20.12	152.77	1	152.77
WK947 2_12	10.66	87.25	1	87.25
SV631 2_12	6.70	59.81	1	59.81
BIG BEND SPG 2_12	15.25	119.04	1	119.04
SUSSEX CRK 2_12	27.07	200.97	1	200.97
ROOT RVR 2_12	197.24	1380.23	1	1380.23
UNDRWD CRK 2_12	89.77	635.46	1	635.46
Standard 8	14.88	100.00	1	100.00
Blank	0.01	0.00	1	0.00
Fox0 2_12	16.46	127.40	1	127.40
Fox1 2_12	47.54	342.83	1	342.83
Fox2 2_12	54.13		1	
Fox2 2_12 1:5	9.17	76.89	5	384.46
Fox3 2_12	30.78	226.66	1	226.66
SX WWTP 2_12	88.51		1	
SX WWTP 2_12 1:5	15.58	121.29	5	606.47
WK WWTP 2_12	88.74		1	
WK WWTP 2_12 1:5	15.47	120.56	5	602.81
BRK WWTP 2_12	112.25		1	
BRK WWTP 2_12 1:5	19.84	150.83	5	754.16
Standard 8 100ppm	16.27	100.00	1	100.00



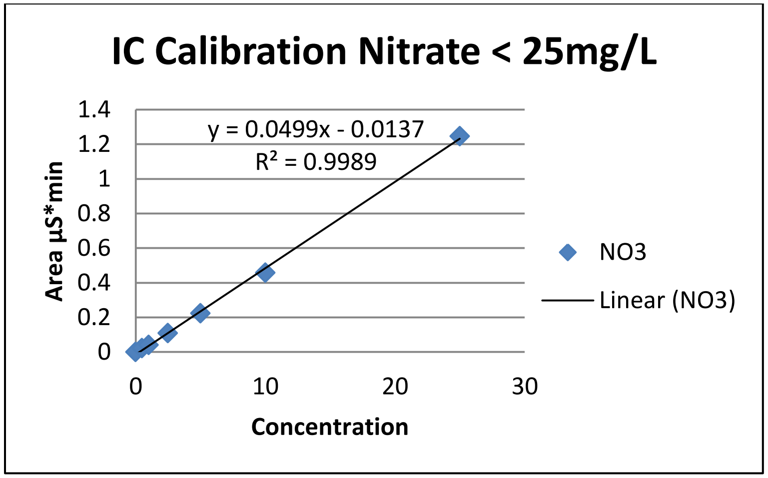


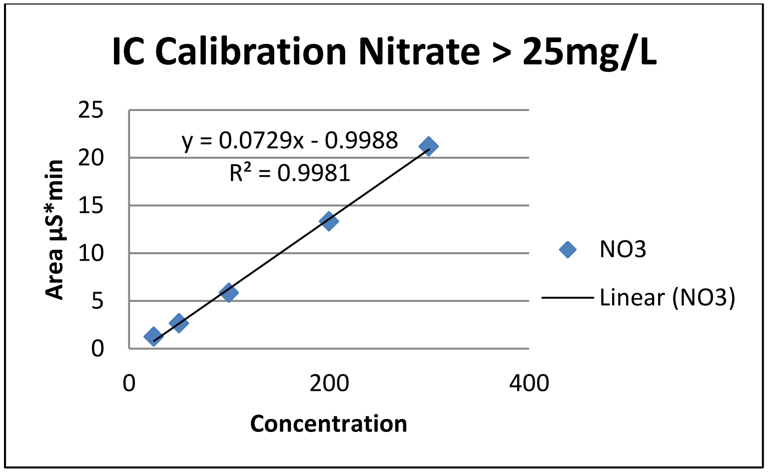
Sulfate 3/29/2012	Area (µS*min)	Concentration (mg/L)	Dilution Factor	Concentration (mg/L)
Standard 1	0.03	0.50	1	0.50
Standard 2	0.06	1.00	1	1.00
Standard 3	0.16	2.50	1	2.50
Standard 4	0.31	5.00	1	5.00
Standard 5	0.64	10.00	1	10.00
Standard 6	1.73	25.00	1	25.00
Standard 7	3.63	50.00	1	50.00
Standard 8	7.93	100.00	1	100.00
Standard 9	17.55	200.00	1	200.00
Standard 10	28.08	300.00	1	300.00
Blank	n.a.			
EM275 2_12	16.15	180.47	1	180.47
IZ385 2_12	6.04	75.23	1	75.23
IZ386 2_12	7.61	91.60	1	91.60
RL255 2_12	5.97	74.49	1	74.49
RL256 2_12	6.86	83.81	1	83.81
WK947 2_12	7.85	94.03	1	94.03
SV631 2_12	5.51	69.76	1	69.76
BIG BEND SPG 2_12	3.10	44.65	1	44.65
SUSSEX CRK 2_12	6.58	80.88	1	80.88
ROOT RVR 2_12	6.76	82.71	1	82.71
UNDRWD CRK 2_12	15.30	171.64	1	171.64
Standard 8	9.69		1	
Blank	n.a.		1	
Fox0 2_12	6.38	78.72	1	78.72
Fox1 2_12	5.85	73.24	1	73.24
Fox2 2_12	6.73	82.36	1	82.36
Fox2 2_12 1:5	1.19		5	
Fox3 2_12	4.76	61.86	1	61.86
SX WWTP 2_12	9.21	108.26	1	108.26
SX WWTP 2_12 1:5	1.59		5	
WK WWTP 2_12	10.63	122.98	1	122.98
WK WWTP 2_12 1:5	1.81		5	
BRK WWTP 2_12	10.79	124.69	1	124.69
BRK WWTP 2_12 1:5	1.83		5	
Standard 8 100ppm	10.51	100.00	1	100.00



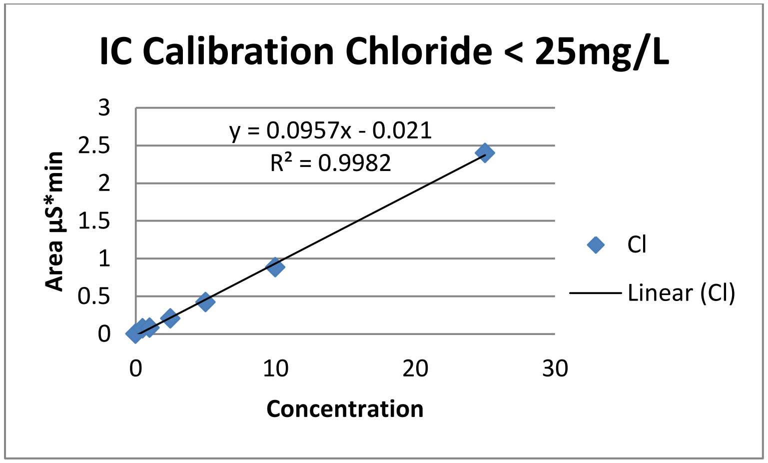


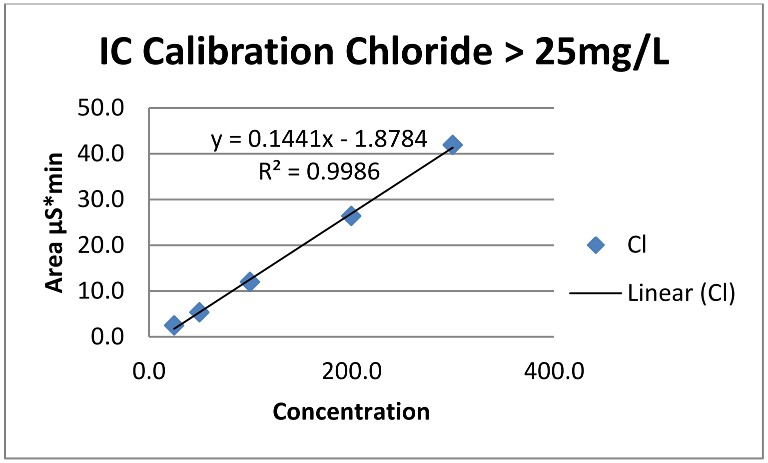
Nitrate 3/29/2012	Area (µS*min)	Concentration (mg/L)	Dilution Factor	Concentration (mg/L)
Standard 1	0.02	0.50	1	0.50
Standard 2	0.04	1.00	1	1.00
Standard 3	0.11	2.50	1	2.50
Standard 4	0.22	5.00	1	5.00
Standard 5	0.46	10.00	1	10.00
Standard 6	1.25	25.00	1	25.00
Standard 7	2.65	50.00	1	50.00
Standard 8	5.84	100.00	1	100.00
Standard 9	13.31	200.00	1	200.00
Standard 10	21.16	300.00	1	300.00
Blank	n.a.			
EM275 2_12	n.a.	na	1	na
IZ385 2_12	0.15	3.38	1	3.38
IZ386 2_12	0.10	2.25	1	2.25
RL255 2_12	0.10	2.32	1	2.32
RL256 2_12	0.09	2.06	1	2.06
WK947 2_12	0.08	1.92	1	1.92
SV631 2_12	0.06	1.55	1	1.55
BIG BEND SPG 2_12	0.49	10.12	1	10.12
SUSSEX CRK 2_12	0.48	9.94	1	9.94
ROOT RVR 2_12	0.07	1.63	1	1.63
UNDRWD CRK 2_12	0.07	1.70	1	1.70
Standard 8	7.24		1	
Blank	n.a.		1	
Fox0 2_12	0.10	2.22	1	2.22
Fox1 2_12	0.46	9.48	1	9.48
Fox2 2_12	1.30	31.57	1	31.57
Fox2 2_12 1:5	0.25		5	
Fox3 2_12	0.66	13.56	1	13.56
SX WWTP 2_12	1.02	20.74	1	20.74
SX WWTP 2_12 1:5	0.20		5	
WK WWTP 2_12	6.27	99.70	1	99.70
WK WWTP 2_12 1:5	1.09		5	
BRK WWTP 2_12	3.53	62.06	1	62.06
BRK WWTP 2_12 1:5	0.64		5	
Standard 8 100ppm	7.90		1	100.00



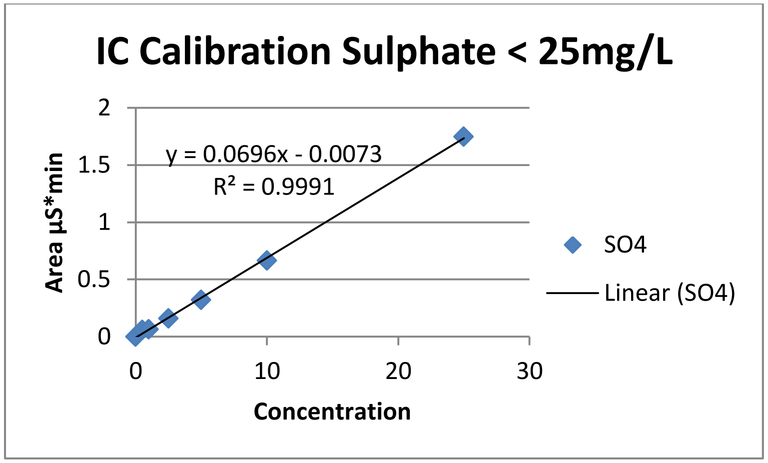


Chloride 6/2012	Area (µS*min)	Concentration (mg/L)	Dilution Factor	Concentration (mg/L)
Standard 1	0.08	0.50	1	0.50
Standard 2	0.08	1.00	1	1.00
Standard 3	0.20	2.50	1	2.50
Standard 4	0.42	5.00	1	5.00
Standard 5	0.88	10.00	1	10.00
Standard 6	2.40	25.00	1	25.00
Standard 7	5.31	50.00	1	50.00
Standard 8	11.91	100.00	1	100.00
Standard 9	26.34	200.00	1	200.00
Standard 10	41.88	300.00	1	300.00
Blank	n.a.			
EM275 5_12	3.91	40.16	1	40.16
IZ385 5_12	32.94	241.61	1	241.61
IZ386 5_12	24.25	181.31	1	181.31
RL255 5_12	24.23	181.21	1	181.21
RL256 5_12	20.57	155.80	1	155.80
WK947 5_12	10.83	88.19	1	88.19
SV631 5_12	6.75	59.88	1	59.88
BIG BEND SPG 5_12	16.53	127.77	1	127.77
SUSSEX CRK 5_12	32.01	235.19	1	235.19
ROOT RVR 5_12	29.02	214.40	1	214.40
UNDRWD CRK 5_12	59.15	423.54	1	423.54
Standard 8 100ppm	14.92	100.00	1	100.00
Blank	n.a.		1	
Fox0 5_12	16.22	125.59	1	125.59
Fox1 5_12	48.85		1	
Fox1 5_12 1:5	8.24	70.25	5	351.23
Fox2 5_12	46.76		1	
Fox2 5_12 1:5	7.46	64.81	5	324.06
Fox3 5_12	21.36	161.25	1	161.25
Fox1 2_12	49.78		1	
Fox1 2_12 1:5	8.33	70.82	5	354.09
Standard 8 100ppm	16.07	100.00	1	100.00
Blank	n.a.			
SX WWTP 5_12	78.05		1	
SX WWTP 5_12 1:5	13.83	109.04	5	545.22
WK WWTP 5_12	92.93		1	
WK WWTP 5_12 1:5	16.38	126.72	5	633.59
BRK WWTP 5_12	106.76		1	
BRK WWTP 5_12 1:5	19.06	145.31	5	726.53
Standard 8 100ppm	16.85	100.00	1	100.00

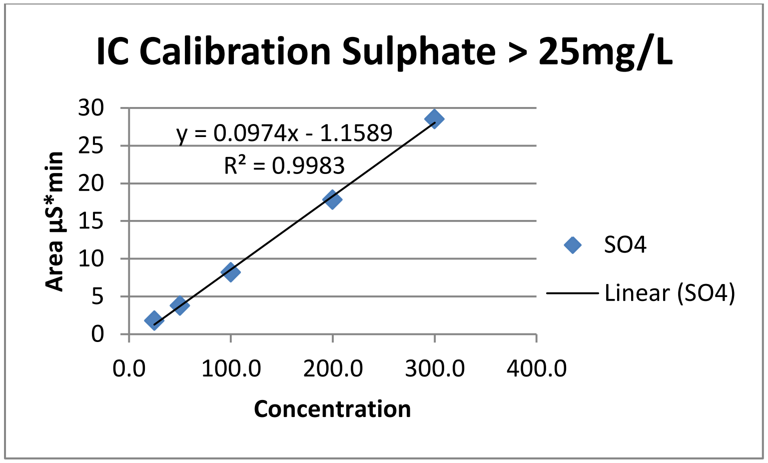




Sulphate 6/2012	Area (µS*min)	Concentration (mg/L)	Dilution Factor	Concentration (mg/L)
Standard 1	0.06	0.50	1	0.50
Standard 2	0.06	1.00	1	1.00
Standard 3	0.16	2.50	1	2.50
Standard 4	0.32	5.00	1	5.00
Standard 5	0.67	10.00	1	10.00
Standard 6	1.75	25.00	1	25.00
Standard 7	3.74	50.00	1	50.00
Standard 8	8.15	100.00	1	100.00
Standard 9	17.81	200.00	1	200.00
Standard 10	28.49	300.00	1	300.00
Blank	n.a.			
EM275 5_12	8.93	103.57	1	103.57
IZ385 5_12	6.11	74.61	1	74.61
IZ386 5_12	7.92	93.18	1	93.18
RL255 5_12	6.03	73.77	1	73.77
RL256 5_12	8.15	95.57	1	95.57
WK947 5_12	8.16	95.68	1	95.68
SV631 5_12	5.55	68.87	1	68.87
BIG BEND SPG 5_12	3.10	43.75	1	43.75
SUSSEX CRK 5_12	6.32	76.75	1	76.75
ROOT RVR 5_12	3.72	50.10	1	50.10
UNDRWD CRK 5_12	13.65	152.01	1	152.01
Standard 8 100ppm	9.88	100.00	1	100.00
Blank	n.a.		1	
Fox0 5_12	6.53	78.91	1	78.91
Fox1 5_12	5.96	73.05	1	73.05
Fox1 5_12 1:5	1.07		5	
Fox2 5_12	5.74	70.79	1	70.79
Fox2 5_12 1:5	1.00		5	
Fox3 5_12	2.82	40.84	1	40.84
Fox1 2_12	6.11	74.67	1	74.67
Fox1 2_12 1:5	1.09		5	
Standard 8 100ppm	10.55	100.00	1	100.00
Blank	n.a.			
SX WWTP 5_12	8.47	98.87	1	98.87
SX WWTP 5_12 1:5	1.51		5	
WK WWTP 5_12	10.25	117.09	1	117.09
WK WWTP 5_12 1:5	1.78		5	
BRK WWTP 5_12	10.45	119.23	1	119.23
BRK WWTP 5_12 1:5	1.81		5	
Standard 8 100ppm	11.04	100.00	1	100.00

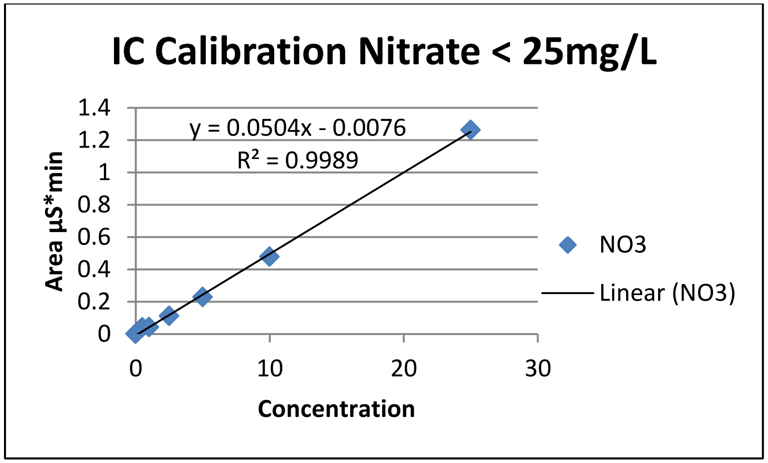


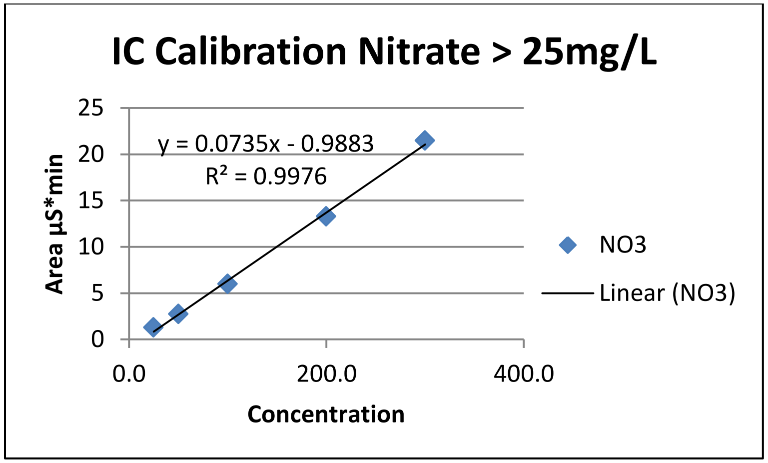
IC Calibration Sulphate < 25mg/L



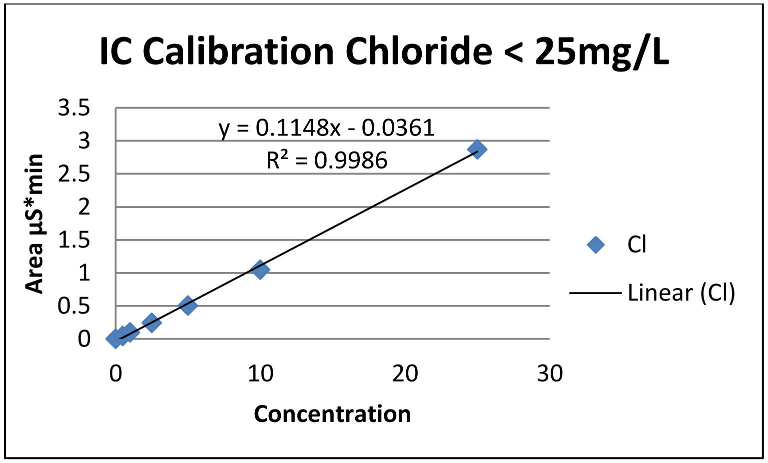
IC Calibration Sulphate > 25mg/L

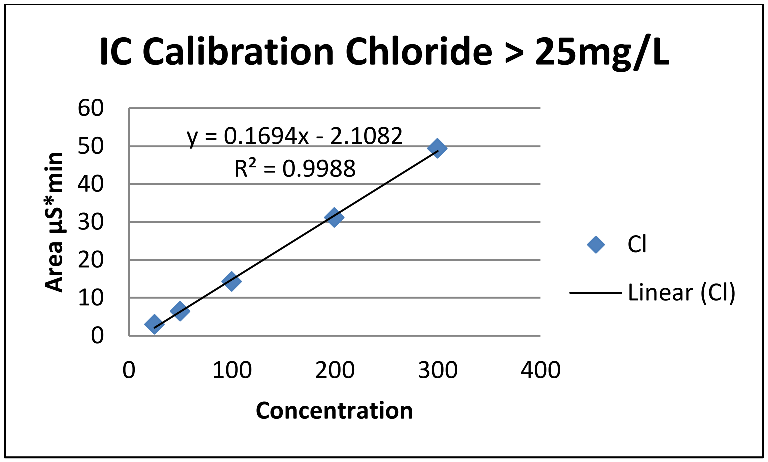
Nitrate 6/2012	Area (µS*min)	Concentration (mg/L)	Dilution Factor	Concentration (mg/L)
Standard 1	0.04	0.50	1	0.50
Standard 2	0.04	1.00	1	1.00
Standard 3	0.11	2.50	1	2.50
Standard 4	0.23	5.00	1	5.00
Standard 5	0.48	10.00	1	10.00
Standard 6	1.26	25.00	1	25.00
Standard 7	2.72	50.00	1	50.00
Standard 8	5.98	100.00	1	100.00
Standard 9	13.27	200.00	1	200.00
Standard 10	21.46	300.00	1	300.00
Blank	n.a.			
EM275 5_12	0.06	1.39	1	1.39
IZ385 5_12	0.13	2.81	1	2.81
IZ386 5_12	0.08	1.65	1	1.65
RL255 5_12	0.04	1.03	1	1.03
RL256 5_12	0.07	1.53	1	1.53
WK947 5_12	0.07	1.45	1	1.45
SV631 5_12	0.06	1.42	1	1.42
BIG BEND SPG 5_12	0.52	10.50	1	10.50
SUSSEX CRK 5_12	0.73	14.60	1	14.60
ROOT RVR 5_12	0.07	1.62	1	1.62
UNDRWD CRK 5_12	n.a.	n.a.	1	n.a.
Standard 8 100ppm	7.36	100.00	1	100.00
Blank	n.a.		1	
Fox0 5_12	0.24	4.92	1	4.92
Fox1 5_12	0.60	12.13	1	12.13
Fox1 5_12 1:5	0.12		5	
Fox2 5_12	1.01		1	
Fox2 5_12 1:5	0.19	19.96	5	19.96
Fox3 5_12	0.37	7.51	1	7.51
Fox1 2_12	0.49	9.83	1	9.83
Fox1 2_12 1:5	0.10		5	
Standard 8 100ppm	7.90	100.00	1	100.00
Blank	n.a.			
SX WWTP 5_12	0.92	18.45	1	18.45
SX WWTP 5_12 1:5	0.18		5	
WK WWTP 5_12	7.17	111.01	1	111.01
WK WWTP 5_12 1:5	1.26		5	
BRK WWTP 5_12	2.66	49.60	1	49.60
BRK WWTP 5_12 1:5	0.50		5	
Standard 8 100ppm	8.28	100.00	1	100.00



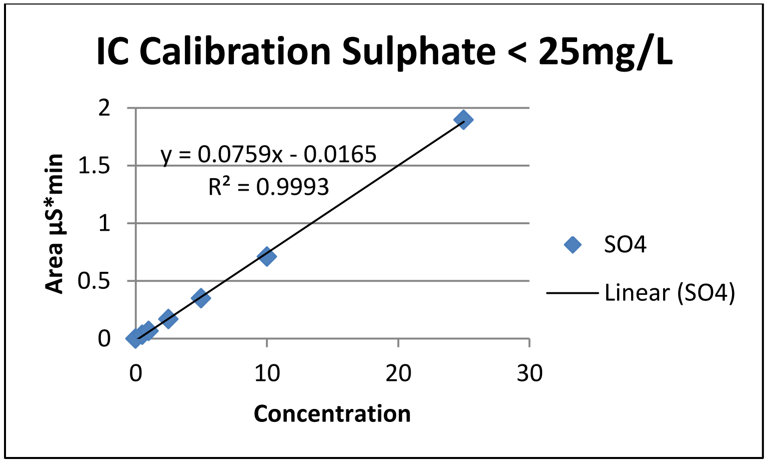


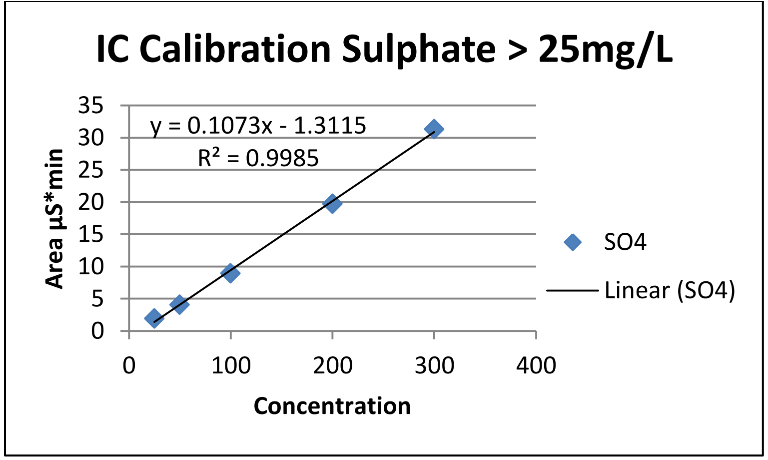
Chloride 1/2013	Area (µS*min)	Concentration (mg/L)	Dilution Factor	Concentration (mg/L)
Standard 1	0.05	0.50	1	0.50
Standard 2	0.10	1.00	1	1.00
Standard 3	0.24	2.50	1	2.50
Standard 4	0.50	5.00	1	5.00
Standard 5	1.05	10.00	1	10.00
Standard 6	2.87	25.00	1	25.00
Standard 7	6.33	50.00	1	50.00
Standard 8	14.19	100.00	1	100.00
Standard 9	31.09	200.00	1	200.00
Standard 10	49.32	300.00	1	300.00
Blank	n.a.			
EM275 11_12	6.27	49.48	1	49.48
IZ385 11_12	29.32	185.50	1	185.50
IZ386 11_12	27.09	172.37	1	172.37
RL255 11_12	28.43	180.24	1	180.24
RL256 11_12	22.73	146.64	1	146.64
WK947 11_12	11.69	81.43	1	81.43
SV631 11_12	7.18	54.86	1	54.86
BIG BEND SPG 11_12	17.29	114.49	1	114.49
SUSSEX CRK 11_12	29.05	183.93	1	183.93
ROOT RVR 11_12	22.19	143.44	1	143.44
ROOT RVR 11_12 1:5	3.72	34.43	5	172.15
ROOT RVR 2_12 1:5	42.17	261.35	5	1306.77
UNDRWD CRK 11_12	59.33		1	
UNDRWD CRK 11_12 1:5	10.31	73.30	5	366.51
UNDRWD CRK 2_12 1:5	18.05	119.02	5	595.10
UNDRWD CRK 5_12 1:5	11.91	82.76	5	413.82
blank	n.a.	n.a.		n.a.
Standard 8 100ppm	17.98	118.58	1	118.58
Fox0 11_12	24.09	154.64	1	154.64
Fox1 11_12	54.78		1	
Fox1 11_12 1:5	9.29	67.27	5	336.34
Fox2 11_12	60.40		1	
Fox2 11_12 1:5	10.40	73.82	5	369.09
Fox3 11_12	38.99	242.61	1	242.61
SX WWTP 11_12	93.72		1	
SX WWTP 11_12 1:5	16.30	108.64	5	543.21
WK WWTP 11_12	96.27		1	
WK WWTP 11_12 1:5	18.14	119.53	5	597.65
BRK WWTP 11_12	111.49		1	
BRK WWTP 11_12 1:5	20.29	132.22	5	661.10
Standard 8 100ppm	19.14	100.00	1	100.00



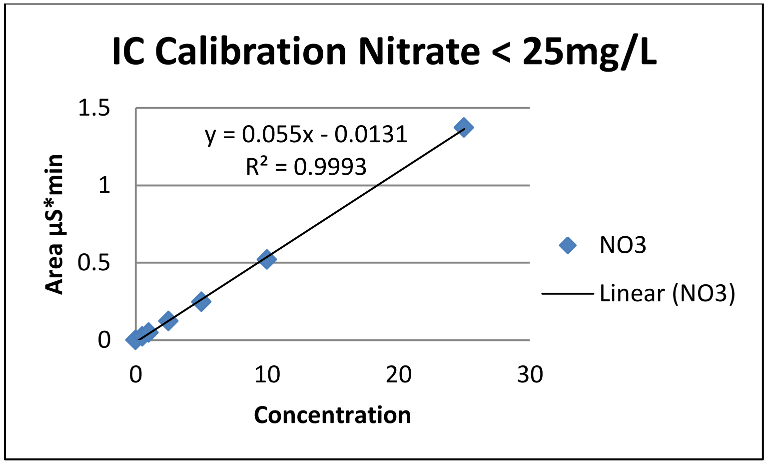


Sulfate 1/2013	Area (µS*min)	Concentration (mg/L)	Dilution Factor	Concentration (mg/L)
Standard 1	0.03	0.50	1	0.50
Standard 2	0.07	1.00	1	1.00
Standard 3	0.17	2.50	1	2.50
Standard 4	0.35	5.00	1	5.00
Standard 5	0.71	10.00	1	10.00
Standard 6	1.90	25.00	1	25.00
Standard 7	4.06	50.00	1	50.00
Standard 8	8.91	100.00	1	100.00
Standard 9	19.71	200.00	1	200.00
Standard 10	31.31	300.00	1	300.00
Blank	n.a.			
EM275 11_12	17.41	174.45	1	174.45
IZ385 11_12	6.34	71.35	1	71.35
IZ386 11_12	9.98	105.28	1	105.28
RL255 11_12	6.62	73.88	1	73.88
RL256 11_12	6.28	70.75	1	70.75
WK947 11_12	8.77	93.97	1	93.97
SV631 11_12	5.70	65.37	1	65.37
BIG BEND SPG 11_12	3.37	43.67	1	43.67
SUSSEX CRK 11_12	8.19	88.58	1	88.58
ROOT RVR 11_12	16.19	163.11	1	163.11
ROOT RVR 11_12 1:5	2.77	18.41	5	190.20
ROOT RVR 2_12 1:5	1.38	161.94	5	92.06
UNDRWD CRK 11_12	16.06	161.94	1	161.94
UNDRWD CRK 11_12 1:5	2.74	37.75	5	188.76
UNDRWD CRK 2_12 1:5	2.94	39.63	5	198.17
UNDRWD CRK 5_12 1:5	2.69	37.29	5	186.46
blank	n.a.	n.a.		n.a.
Standard 8 100ppm	11.01	114.81	1	114.81
Fox0 11_12	9.42	99.99	1	99.99
Fox1 11_12	9.78	103.38	1	103.38
Fox1 11_12 1:5	1.71		5	
Fox2 11_12	9.03	96.34	1	96.34
Fox2 11_12 1:5	1.57		5	
Fox3 11_12	9.78	103.40	1	103.40
SX WWTP 11_12	10.01	105.55	1	105.55
SX WWTP 11_12 1:5	1.69		5	
WK WWTP 11_12	10.59	110.88	1	110.88
WK WWTP 11_12 1:5	1.93		5	
BRK WWTP 11_12	12.29	126.77	1	126.77
BRK WWTP 11_12 1:5	2.11		5	
Standard 8 100ppm	n.a.	100.00	1	100.00





Nitrate 1/2013	Area (µS*min)	Concentration (mg/L)	Dilution Factor	Concentration (mg/L)
Standard 1	0.02	0.50	1	0.50
Standard 2	0.05	1.00	1	1.00
Standard 3	0.12	2.50	1	2.50
Standard 4	0.25	5.00	1	5.00
Standard 5	0.52	10.00	1	10.00
Standard 6	1.37	25.00	1	25.00
Standard 7	2.95	50.00	1	50.00
Standard 8	6.49	100.00	1	100.00
Standard 9	14.63	200.00	1	200.00
Standard 10	n.a.	300.00	1	300.00
Blank	n.a.			
EM275 11_12	n.a.	n.a.	1	n.a.
IZ385 11_12	0.15	3.00	1	3.00
IZ386 11_12	0.05	1.13	1	1.13
RL255 11_12	0.02	0.65	1	0.65
RL256 11_12	n.a.	n.a.	1	n.a.
WK947 11_12	0.01	0.49	1	0.49
SV631 11_12	n.a.	n.a.	1	n.a.
BIG BEND SPG 11_12	0.57	10.60	1	10.60
SUSSEX CRK 11_12	0.61	11.37	1	11.37
ROOT RVR 11_12	0.16	3.09	1	3.09
ROOT RVR 11_12 1:5	0.03	3.96	5	3.96
ROOT RVR 2_12 1:5	n.a.	n.a.	5	n.a.
UNDRWD CRK 11_12	n.a.	n.a.	1	n.a.
UNDRWD CRK 11_12 1:5	n.a.	n.a.	5	n.a.
UNDRWD CRK 2_12 1:5	n.a.	n.a.	5	n.a.
UNDRWD CRK 5_12 1:5	n.a.	n.a.	5	n.a.
blank	n.a.	n.a.		n.a.
Standard 8 100ppm	8.14	117.10	1	117.10
Fox0 11_12	0.26	4.91	1	4.91
Fox1 11_12	0.84	15.57	1	15.57
Fox1 11_12 1:5	0.17		5	
Fox2 11_12	1.60	31.38	1	31.38
Fox2 11_12 1:5	0.31		5	
Fox3 11_12	1.08	19.83	1	19.83
SX WWTP 11_12	1.81	34.14	1	34.14
SX WWTP 11_12 1:5	0.34		5	
WK WWTP 11_12	8.39	120.35	1	120.35
WK WWTP 11_12 1:5	1.54		5	
BRK WWTP 11_12	3.47	55.90	1	55.90
BRK WWTP 11_12 1:5	0.66		5	
Standard 8 100ppm	8.66	100.00	1	100.00



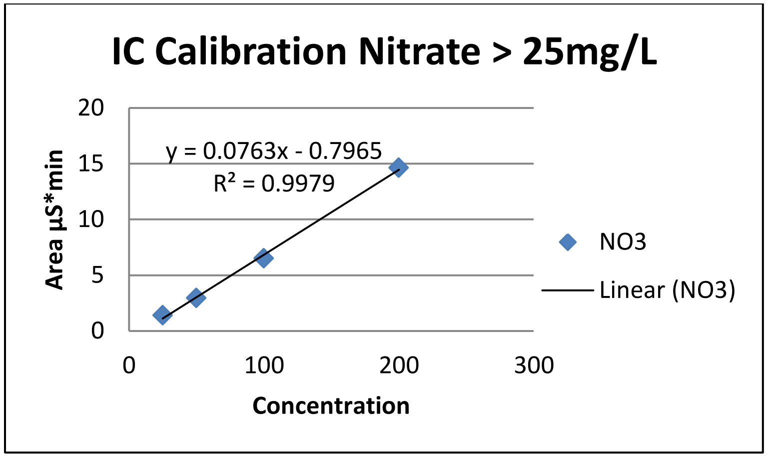
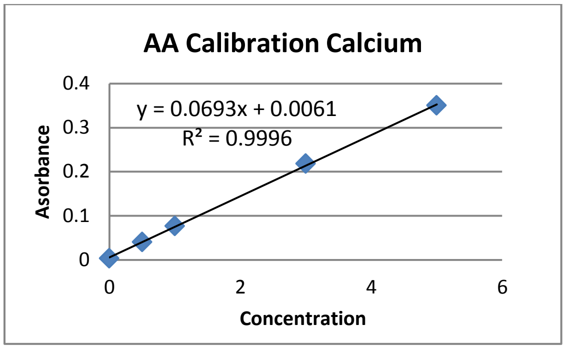
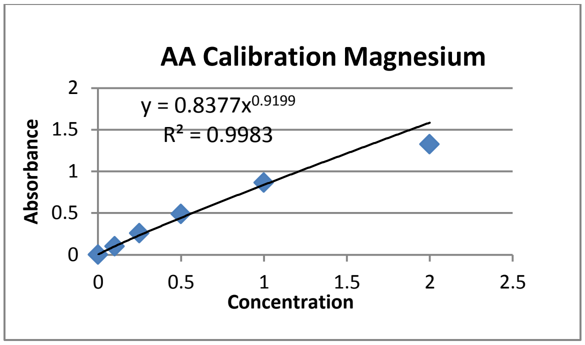


Table 7. WATER Institute Atomic Adsorption
greyed out samples exceed calibration, not accepted

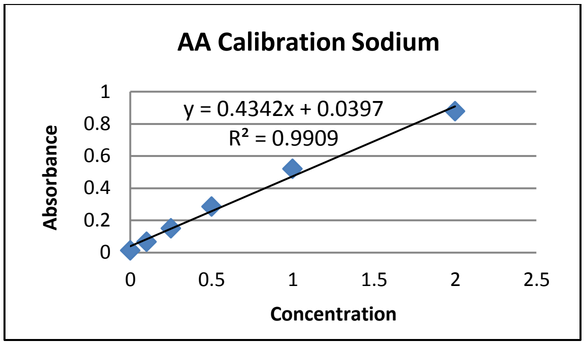
Calcium 1/2013	Signal	Conc (mg/L)	Dilution Factor	Conc (mg/L)
Blank	0.004	0.00	1	0.00
Standard 1	0.041	0.50	1	0.50
Standard 2	0.077	1.00	1	1.00
Standard 3	0.218	3.00	1	3.00
Standard 4	0.350	5.00	1	5.00
Standard 5	0.634	10.00	1	10.00
EM275 11_12	0.265	3.74	25	93.52
EM275 10_11	0.253	3.56	25	89.10
EM275 5_11	0.262	3.69	25	92.21
IZ385 11_12	0.321	4.55	25	113.75
IZ385 10_11	0.298	4.21	25	105.31
IZ385 5_11	0.305	4.31	25	107.84
IZ386 11_12	0.324	4.59	25	114.77
IZ386 2_12	0.329	4.65	25	116.37
IZ386 10_11	0.318	4.50	25	112.59
IZ386 5_11	0.312	4.41	25	110.21
RL255 11_12	0.308	4.36	25	108.95
RL255 5_12	0.308	4.36	25	109.06
RL255 2_12	0.308	4.36	25	109.05
RL256 11_12	0.293	4.14	25	103.54
RL256 5_12	0.301	4.26	25	106.53
RL256 2_12	0.291	4.11	25	102.77
standard1ppm	0.076	1.02	1	1.02
WK947 11_12	0.265	3.73	25	93.33
WK947 5_12	0.259	3.64	25	91.09
WK947 2_12	0.258	3.64	25	91.00
SV631 11_12	0.194	2.71	25	67.63
SV631 10_11	0.212	2.98	25	74.39
SV631 5_11	0.213	2.98	25	74.48
HYGEIA SPRG 11_12	0.222	3.11	25	77.82
HYGEIA SPRG 11_12	0.230	3.23	25	80.70
HYGEIA SPRG 11_12	0.260	3.66	25	91.53
Fox0 11_12	0.252	3.55	25	88.70
Fox1 11_12	0.245	3.44	25	86.11
Fox2 11_12	0.257	3.62	25	90.61
Fox2 5_12	0.217	3.04	25	76.08
Fox2 2_12	0.273	3.86	25	96.43
Fox3 11_12	0.256	3.61	25	90.27
standard 1ppm	0.075	1.00	1	1.00
SUSSEX CRK 11_12	0.227	3.18	25	79.59
SUSSEX CRK 10_11	0.245	3.44	25	86.01
SUSSEX CRK 5_11	0.151	2.10	25	52.40
ROOT RVR 11_12	0.220	3.08	25	77.12
ROOT RVR 2_12	0.282	3.99	25	99.67
ROOT RVR 10_11	0.146	2.02	25	50.53
ROOT RVR 5_11	0.205	2.87	25	71.63
UNDRWD CRK 11_12	0.342	4.84	25	121.11
UNDRWD CRK 2_12	0.348	4.93	25	123.32
UNDRWD CRK 10_11	0.272	3.83	25	95.79
UNDRWD CRK 5_11	0.250	3.51	25	87.84
SX WWTP 11_12	0.247	3.48	25	87.02
WK WWTP 11_12	0.256	3.60	25	90.06
BRK WWTP 11_12	0.272	3.84	25	95.93
Blank	0.003	0.00	1	0.00
Standard 1	0.039	0.50	1	0.50
Standard 2	0.074	1.00	1	1.00
Standard 3	0.211	3.00	1	3.00
Standard 4	0.345	5.00	1	5.00
Standard 5	0.623	10.00	1	10.00



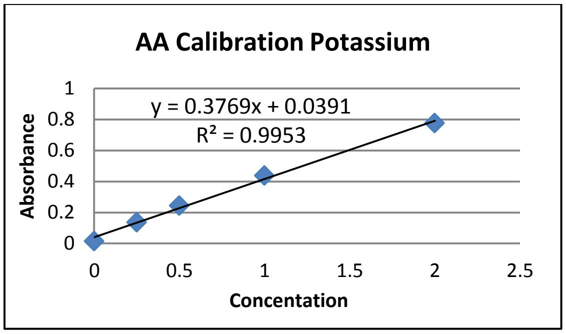
Magnesium 1/2013	Signal	Conc (mg/L)	Dilution Factor	Conc (mg/L)
Blank	0.001	0.00	1	0.00
Standard 1	0.101	0.10	1	0.10
Standard 2	0.258	0.25	1	0.25
Standard 3	0.486	0.50	1	0.50
Standard 4	0.864	1.00	1	1.00
Standard 5	1.325	2.00	1	2.00
EM275 11_12	0.722	0.85	50	42.57
EM275 10_11	0.693	0.81	50	40.70
EM275 5_11	0.707	0.83	50	41.60
IZ385 11_12	0.811	0.97	50	48.26
IZ385 10_11	0.820	0.98	50	48.84
IZ385 5_11	0.828	0.99	50	49.37
IZ386 11_12	0.902	1.08	50	54.21
IZ386 2_12	0.895	1.07	50	53.72
IZ386 10_11	0.914	1.10	50	54.98
IZ386 5_11	0.898	1.08	50	53.91
RL255 11_12	0.866	1.04	50	51.84
RL255 5_12	0.850	1.02	50	50.78
RL255 2_12	0.891	1.07	50	53.48
RL256 11_12	0.832	0.99	50	49.66
RL256 5_12	0.868	1.04	50	51.96
RL256 2_12	0.866	1.04	50	51.87
standard1ppm	0.857	1.03	1	1.03
WK947 11_12	0.856	1.02	50	51.16
WK947 5_12	0.871	1.04	50	52.15
WK947 2_12	0.882	1.06	50	52.89
SV631 11_12	0.856	1.02	50	51.17
SV631 10_11	0.861	1.03	50	51.54
SV631 5_11	0.875	1.05	50	52.41
HYGEIA SPRG 11_12	0.632	0.74	50	36.82
HYGEIA SPRG 11_12	0.632	0.74	50	36.81
HYGEIA SPRG 11_12	0.747	0.88	50	44.17
Fox0 11_12	0.813	0.97	50	48.43
Fox1 11_12	0.805	0.96	50	47.91
Fox2 11_12	0.818	0.97	50	48.74
Fox2 5_12	0.689	0.81	50	40.45
Fox2 2_12	0.772	0.92	50	45.77
Fox3 11_12	0.753	0.89	50	44.53
standard 1ppm	0.865	1.04	1	1.04
SUSSEX CRK 11_12	0.757	0.90	50	44.77
SUSSEX CRK 10_11	0.760	0.90	50	45.00
SUSSEX CRK 5_11	0.420	0.47	50	23.60
ROOT RVR 11_12	0.820	0.98	50	48.86
ROOT RVR 2_12	0.827	0.99	50	49.31
ROOT RVR 10_11	0.440	0.50	50	24.82
ROOT RVR 5_11	0.596	0.69	50	34.52
UNDRWD CRK 11_12	0.845	1.01	50	50.48
UNDRWD CRK 2_12	0.877	1.05	50	52.55
UNDRWD CRK 10_11	0.681	0.80	50	39.94
UNDRWD CRK 5_11	0.906	1.09	50	54.42
SX WWTP 11_12	0.737	0.87	50	43.51
WK WWTP 11_12	0.657	0.77	50	38.40
BRK WWTP 11_12	0.748	0.88	50	44.18
Blank	0.001	0.00	1	0.00
Standard 1	0.100	0.10	1	0.10
Standard 2	0.254	0.25	1	0.25
Standard 3	0.472	0.50	1	0.50
Standard 4	0.858	1.00	1	1.00
Standard 5	1.321	2.00	1	2.00



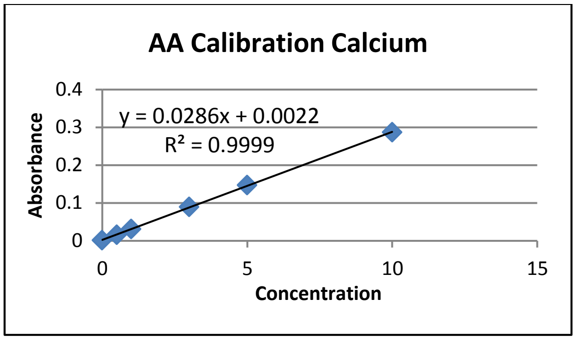
Sodium 1/2013	Signal	Conc (mg/L)	Dilution Factor	Conc (mg/L)
Blank	0.012	0.00	1	0.00
Standard 1	0.065	0.10	1	0.10
Standard 2	0.149	0.25	1	0.25
Standard 3	0.285	0.50	1	0.50
Standard 4	0.521	1.00	1	1.00
Standard 5	0.879	2.00	1	2.00
EM275 11_12	0.359	0.73	50	36.74
EM275 10_11	0.340	0.69	50	34.58
EM275 5_11	0.251	0.49	50	24.31
IZ385 11_12	0.502	1.06	100	106.41
IZ385 10_11	0.450	0.94	100	94.41
IZ385 5_11	0.502	1.06	100	106.46
IZ386 11_12	0.377	0.78	100	77.67
IZ386 2_12	0.358	0.73	100	73.41
IZ386 10_11	0.398	0.82	100	82.41
IZ386 5_11	0.355	0.73	100	72.61
RL255 11_12	0.465	0.98	100	98.04
RL255 5_12	0.421	0.88	100	87.93
RL255 2_12	0.413	0.86	100	85.94
RL256 11_12	0.365	0.75	100	74.83
RL256 5_12	0.366	0.75	100	75.04
RL256 2_12	0.350	0.72	100	71.57
standard1ppm	0.520	1.11	1	1.11
WK947 11_12	0.207	0.39	100	38.59
WK947 5_12	0.208	0.39	100	38.85
WK947 2_12	0.213	0.40	100	39.90
SV631 11_12	0.253	0.49	50	24.52
SV631 10_11	0.249	0.48	50	24.05
SV631 5_11	0.246	0.48	50	23.80
HYGEIA SPRG 11_12	0.338	0.69	100	68.70
HYGEIA SPRG 11_12	0.324	0.65	100	65.47
HYGEIA SPRG 11_12	0.315	0.63	100	63.41
Fox0 11_12	0.563	1.20	100	120.42
Fox1 11_12	0.780	1.70	100	170.41
Fox2 11_12	0.829	1.82	100	181.71
Fox2 5_12	0.744	1.62	100	162.31
Fox2 2_12	0.824	1.81	100	180.71
Fox3 11_12	0.569	1.22	100	121.99
standard 1ppm	0.519	1.10	100	110.37
SUSSEX CRK 11_12	0.687	1.49	100	149.12
SUSSEX CRK 10_11	0.526	1.12	100	111.95
SUSSEX CRK 5_11	0.409	0.85	100	85.05
ROOT RVR 11_12	0.447	0.94	100	93.69
ROOT RVR 2_12	1.211	2.70	100	269.73
ROOT RVR 10_11	0.446	0.94	100	93.59
ROOT RVR 5_11	0.559	1.20	100	119.69
UNDRWD CRK 11_12	0.823	1.80	200	360.69
UNDRWD CRK 2_12	0.728	1.59	200	317.16
UNDRWD CRK 10_11	1.125	2.50	200	499.76
UNDRWD CRK 5_11	0.934	2.06	200	412.01
SX WWTP 11_12	0.743	1.62	200	323.84
WK WWTP 11_12	0.708	1.54	200	307.99
BRK WWTP 11_12	0.808	1.77	200	354.11
Blank	0.014	0.00	1	0.00
Standard 1	0.065	0.10	1	0.10
Standard 2	0.153	0.25	1	0.25
Standard 3	0.286	0.50	1	0.50
Standard 4	0.522	1.00	1	1.00
Standard 5	0.883	2.00	1	2.00



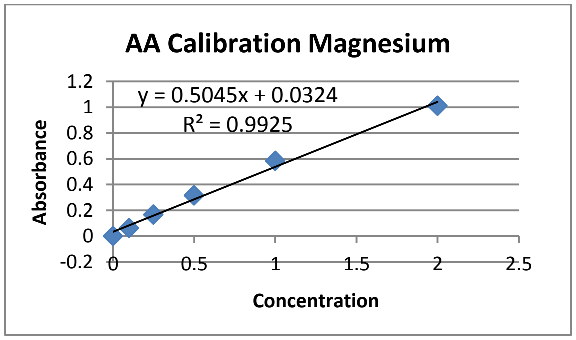
Potassium 1/2013	Signal	Conc (mg/L)	Dilution Factor	Conc (mg/L)
Blank	0.013	0.00	1	0.00
Standard 1	0.136	0.25	1	0.25
Standard 2	0.243	0.50	1	0.50
Standard 3	0.438	1.00	1	1.00
Standard 4	0.777	2.00	1	2.00
EM275 11_12	0.568	8.11	2	16.23
EM275 10_11	0.555	7.92	2	15.84
EM275 5_11	0.523	7.45	2	14.90
IZ385 11_12	0.617	8.82	2	17.64
IZ385 10_11	0.585	8.35	2	16.71
IZ385 5_11	0.625	8.93	2	17.87
IZ386 11_12	1.063	15.25	2	30.51
IZ386 2_12	0.567	8.09	2	16.19
IZ386 10_11	0.600	8.57	2	17.14
IZ386 5_11	0.517	7.37	2	14.74
RL255 11_12	0.575	8.21	2	16.42
RL255 5_12	0.563	8.03	2	16.07
RL255 2_12	0.564	8.05	2	16.10
RL256 11_12	0.569	8.13	2	16.26
RL256 5_12	0.485	6.91	2	13.82
RL256 2_12	0.540	7.70	2	15.40
standard1ppm	0.437	6.21	1	6.21
WK947 11_12	0.515	7.34	2	14.68
WK947 5_12	0.508	7.24	2	14.47
WK947 2_12	1.865	26.83	2	53.66
SV631 11_12	0.299	4.23	2	8.45
SV631 10_11	0.374	5.31	2	10.63
SV631 5_11	0.377	5.35	2	10.70
HYGEIA SPRG 11_12	0.347	4.92	4	19.66
HYGEIA SPRG 11_12	0.271	3.83	4	15.30
HYGEIA SPRG 11_12	0.222	3.11	4	12.46
Fox0 11_12	0.328	4.64	4	18.55
Fox1 11_12	0.565	8.07	4	32.28
Fox2 11_12	0.645	9.21	4	36.86
Fox2 5_12	0.560	8.00	4	31.99
Fox2 2_12	0.529	7.54	4	30.18
Fox3 11_12	0.512	7.30	4	29.20
standard 1ppm	0.430	6.11	4	24.46
SUSSEX CRK 11_12	0.481	6.86	4	27.43
SUSSEX CRK 10_11	0.457	6.50	4	26.00
SUSSEX CRK 5_11	0.291	4.12	4	16.47
ROOT RVR 11_12	0.488	6.96	4	27.83
ROOT RVR 2_12	0.295	4.17	4	16.66
ROOT RVR 10_11	0.380	5.40	4	21.58
ROOT RVR 5_11	0.261	3.67	4	14.69
UNDRWD CRK 11_12	0.430	6.11	4	24.45
UNDRWD CRK 2_12	0.420	5.97	4	23.89
UNDRWD CRK 10_11	1.179	16.93	4	67.72
UNDRWD CRK 5_11	0.429	6.10	4	24.40
SX WWTP 11_12	0.519	7.40	10	74.04
WK WWTP 11_12	0.554	7.90	10	79.03
BRK WWTP 11_12	0.510	7.27	10	72.67
Blank	0.016	0.00	1	0.00
Standard 1	0.136	0.25	1	0.25
Standard 2	0.239	0.50	1	0.50
Standard 3	0.445	1.00	1	1.00
Standard 4	0.757	2.00	1	2.00



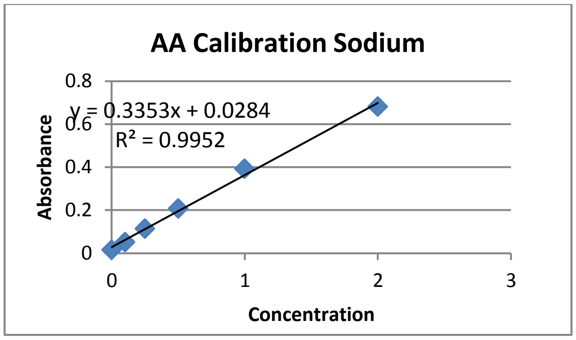
Calcium 2/25/2013	Signal	Conc (mg/L)	Dilution Factor	Conc (mg/L)
Blank	0.001	0.00	1	0.00
Standard 1	0.015	0.50	1	0.50
Standard 2	0.029	1.00	1	1.00
Standard 3	0.086	3.00	1	3.00
Standard 4	0.143	5.00	1	5.00
Standard 5	0.276	10.00	1	10.00
RL255 10_12	0.129	4.51	25	112.85
RL255 5_12	0.127	4.43	25	110.79
RL255 2_12	0.127	4.45	25	111.32
RL256 10_12	0.123	4.30	25	107.56
RL256 5_12	0.129	4.51	25	112.67
RL256 2_12	0.123	4.32	25	107.89
Fox 2 11_12	0.100	3.51	25	87.64
Fox 2 5_12	0.091	3.16	25	79.02
Fox 2 2_12	0.103	3.60	25	90.12
Blank	0.001	0.00	1	0.00
Standard 1	0.016	0.50	1	0.50
Standard 2	0.031	1.00	1	1.00
Standard 3	0.089	3.00	1	3.00
Standard 4	0.147	5.00	1	5.00
Standard 5	0.287	10.00	1	10.00



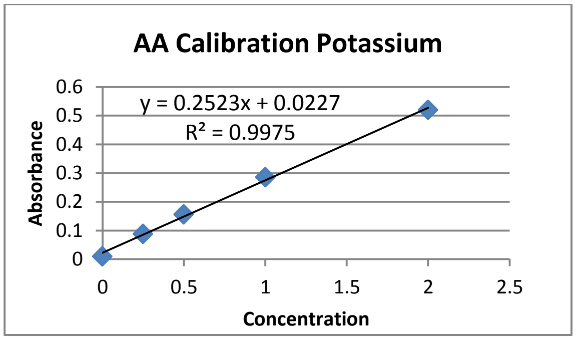
Magneium 2/25/2013	Signal	Conc (mg/L)	Dilution Factor	Conc (mg/L)
Blank	0.001	0.00	1	0.00
Standard 1	0.065	0.10	1	0.10
Standard 2	0.168	0.25	1	0.25
Standard 3	0.315	0.50	1	0.50
Standard 4	0.595	1.00	1	1.00
Standard 5	1.015	2.00	1	2.00
RL255 10_12	0.597	1.12	50	55.91
RL255 5_12	0.586	1.10	50	54.83
RL255 2_12	0.585	1.09	50	54.74
RL256 10_12	0.575	1.08	50	53.78
RL256 5_12	0.567	1.06	50	52.98
RL256 2_12	0.558	1.04	50	52.07
Fox 2 11_12	0.488	0.90	50	45.14
Fox 2 5_12	0.469	0.87	50	43.28
Fox 2 2_12	0.495	0.92	50	45.88
Blank	0.000	0.00	1	0.00
Standard 1	0.063	0.10	1	0.10
Standard 2	0.165	0.25	1	0.25
Standard 3	0.314	0.50	1	0.50
Standard 4	0.583	1.00	1	1.00
Standard 5	1.011	2.00	1	2.00



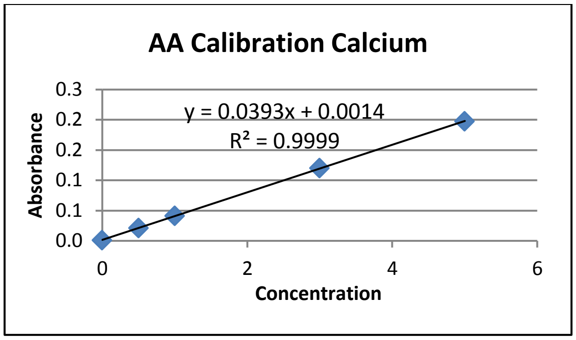
Sodium 2/25/2013	Signal	Conc (mg/L)	Dilution Factor	Conc (mg/L)
Blank	0.014	0.00	1	0.00
Standard 1	0.052	0.10	1	0.10
Standard 2	0.113	0.25	1	0.25
Standard 3	0.208	0.50	1	0.50
Standard 4	0.393	1.00	1	1.00
Standard 5	0.682	2.00	1	2.00
RL255 10_12	0.333	0.91	100	90.75
RL255 5_12	0.311	0.84	100	84.32
RL255 2_12	0.311	0.84	100	84.26
RL256 10_12	0.266	0.71	100	70.85
RL256 5_12	0.261	0.69	100	69.34
RL256 2_12	0.256	0.68	100	67.97
Fox 2 11_12	0.637	1.81	100	181.49
Fox 2 5_12	0.554	1.57	100	156.75
Fox 2 2_12	0.628	1.79	100	178.93
Blank	0.013	0.00	1	0.00
Standard 1	0.050	0.10	1	0.10
Standard 2	0.112	0.25	1	0.25
Standard 3	0.205	0.50	1	0.50
Standard 4	0.389	1.00	1	1.00
Standard 5	0.685	2.00	1	2.00



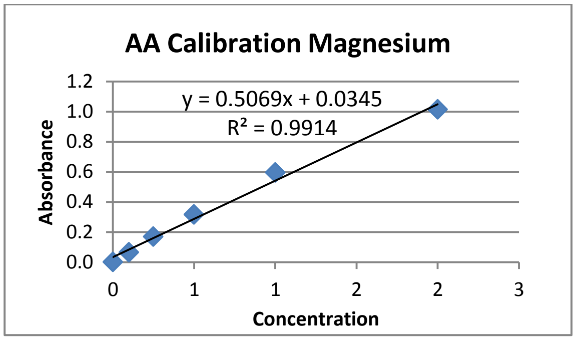
Potassium 2/25/2013	Signal	Conc (mg/L)	Dilution Factor	Conc (mg/L)
Blank	0.010	0.00	1	0.00
Standard 1	0.088	0.25	1	0.25
Standard 2	0.157	0.50	1	0.50
Standard 3	0.286	1.00	1	1.00
Standard 4	0.520	2.00	1	2.00
RL255 10_12	0.372	1.38	2	2.77
RL255 5_12	0.368	1.37	2	2.74
RL255 2_12	0.378	1.41	2	2.82
RL256 10_12	0.376	1.40	2	2.80
RL256 5_12	0.313	1.15	2	2.30
RL256 2_12	0.353	1.31	2	2.62
Fox 2 11_12	0.422	1.58	4	6.33
Fox 2 5_12	0.366	1.36	4	5.44
Fox 2 2_12	0.338	1.25	4	5.00
Blank	0.010	0.00	1	0.00
Standard 1	0.087	0.25	1	0.25
Standard 2	0.156	0.50	1	0.50
Standard 3	0.285	1.00	1	1.00
Standard 4	0.515	2.00	1	2.00



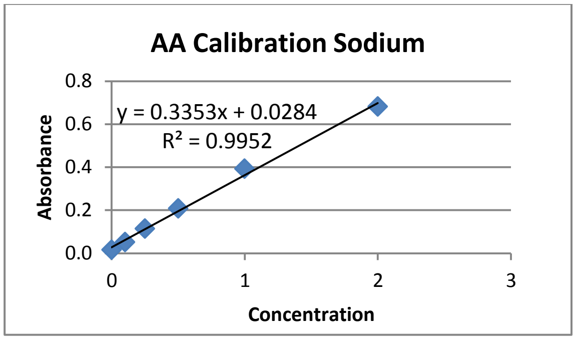
Calcium 2/27/2013	Signal	Conc (mg/L)	Dilution Factor	Conc (mg/L)
Blank	0.001	0.00	1	0.00
Standard 1	0.021	0.50	1	0.50
Standard 2	0.041	1.00	1	1.00
Standard 3	0.120	3.00	1	3.00
Standard 4	0.197	5.00	1	5.00
Standard 5	0.376	10.00	1	10.00
RL255 10_12	0.181	4.71	25	117.80
RL256 10_12	0.168	4.37	25	109.37
FX2 11_12	0.139	3.59	25	89.83



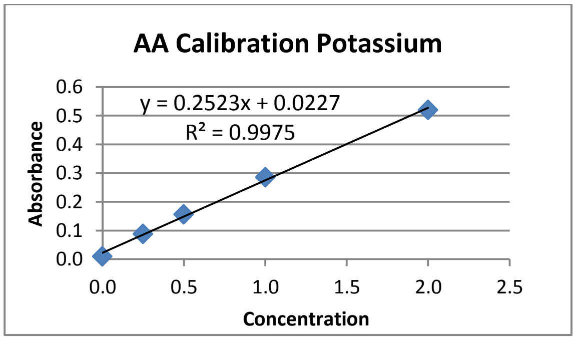
Magneium 2/27/2013	Signal	Conc (mg/L)	Dilution Factor	Conc (mg/L)
Blank	0.001	0.00	1	0.00
Standard 1	0.065	0.10	1	0.10
Standard 2	0.168	0.25	1	0.25
Standard 3	0.315	0.50	1	0.50
Standard 4	0.595	1.00	1	1.00
Standard 5	1.015	2.00	1	2.00
RL255 10_12	0.597	1.12	50	55.91
RL256 10_12	0.586	1.10	50	54.83
FX2 11_12	0.585	1.09	50	54.74



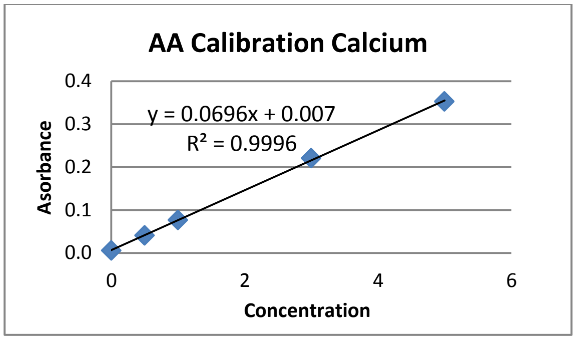
Sodium 2/27/2013	Signal	Conc (mg/L)	Dilution Factor	Conc (mg/L)
Blank	0.014	0.00	1	0.00
Standard 1	0.052	0.10	1	0.10
Standard 2	0.113	0.25	1	0.25
Standard 3	0.208	0.50	1	0.50
Standard 4	0.393	1.00	1	1.00
Standard 5	0.682	2.00	1	2.00
RL255 10_12	0.333	0.91	100	90.75
RL256 10_12	0.311	0.84	100	84.32
FX2 11_12	0.311	0.84	100	84.26



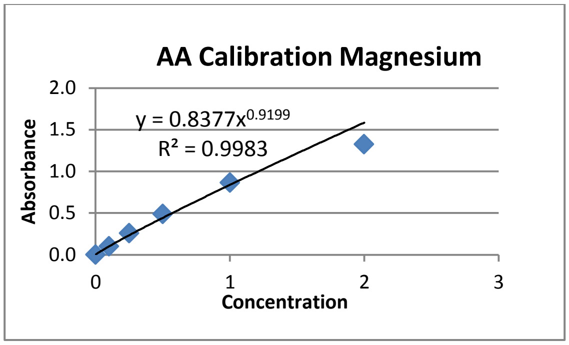
Potassium 2/27/2013	Signal	Conc (mg/L)	Dilution Factor	Conc (mg/L)
Blank	0.010	0.00	1	0.00
Standard 1	0.088	0.25	1	0.25
Standard 2	0.157	0.50	1	0.50
Standard 3	0.286	1.00	1	1.00
Standard 4	0.520	2.00	1	2.00
RL255 10_12	0.372	1.38	2	2.77
RL256 10_12	0.368	1.37	2	2.74
FX2 11_12	0.378	1.41	2	2.82



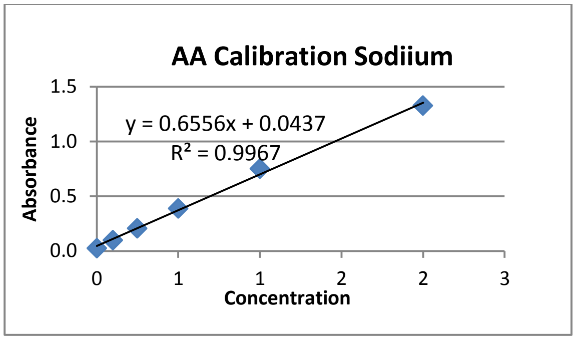
Calcium 6/15/2012	Signal	Conc (mg/L)	Dilution Factor	Conc (mg/L)
Blank	0.006	0.00	1	0.00
Standard 1	0.041	0.50	1	0.50
Standard 2	0.077	1.00	1	1.00
Standard 3	0.220	3.00	1	3.00
Standard 4	0.352	5.00	1	5.00
Standard 5	0.625	10.00	1	10.00
EM275 5_12	0.248	3.46	25	86.55
IZ385 5_12	0.319	4.49	25	112.13
IZ386 5_12	0.333	4.68	25	117.04
RL255 5_12	0.306	4.30	25	107.55
RL256 5_12	0.302	4.24	25	105.97
WK947 5_12	0.264	3.70	25	92.45
RL255 10_11_2	0.312	4.39	25	109.67
RL255 10_11_3	0.307	4.30	25	107.60
RL255 10_11_4	0.309	4.34	25	108.52
RL255 5_11_2	0.315	4.43	25	110.73
RL255 5_11_3	0.303	4.26	25	106.44
RL255 6_08	0.216	3.01	25	75.16
1ppm standard	0.071	0.04	25	0.92
RL256 10_11_2	0.302	4.24	25	106.05
RL256 10_11_3	0.297	4.16	25	104.05
RL256 10_11_4	0.298	4.19	25	104.65
RL256 5_11_2	0.318	4.48	25	111.88
RL256 5_11_3	0.314	4.41	25	110.23
RL256 6_08	0.300	4.21	25	105.30
WK947 10_11_2	0.274	3.84	25	95.95
WK947 10_11_3	0.272	3.81	25	95.18
WK947 5_11_2	0.288	4.04	25	101.01
WK947 5_11_3	0.249	3.48	25	87.10
SV631 5_12	0.208	2.89	25	72.29
1ppm standard	0.078	0.04	25	1.02
BIG BEND SPG 5_12	0.219	3.05	25	76.30
SUSSEX CRK 5_12	0.233	3.25	25	81.22
ROOT RVR 5_12	0.188	2.60	25	65.05
UNDRWD CRK 5_12	0.172	2.37	25	59.22
Fox0 5_12	0.221	3.07	25	76.75
Fox1 5_12	0.229	3.20	25	79.91
Fox2 5_12	0.224	3.12	25	77.91
Fox3 5_12	0.154	2.11	25	52.87
Fox2 10_11_2	0.003	-0.05	25	-1.26
Fox2 10_11_3	0.183	2.52	25	63.06
Fox2 5_11_2	0.242	3.38	25	84.57
Fox2 5_11_3	0.239	3.33	25	83.26
Fox2 6_08	0.228	3.18	25	79.43
SX WWTP 5_12	0.263	3.67	25	91.85
WK WWTP 5_12	0.274	3.84	25	96.04
BRK WWTP 5_12	0.302	4.23	25	105.78



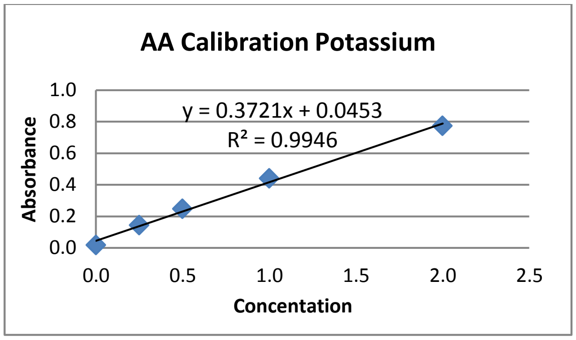
Magnesium 6/15/2012	Signal	Conc (mg/L)	Dilution Factor	Conc (mg/L)
Blank	0.001	0.00	1	0.00
Standard 1	0.101	0.10	1	0.10
Standard 2	0.258	0.25	1	0.25
Standard 3	0.486	0.50	1	0.50
Standard 4	0.864	1.00	1	1.00
Standard 5	1.325	2.00	1	2.00
EM275 5_12	0.733	0.86	50	43.14
IZ385 5_12	0.955	1.22	50	60.95
IZ386 5_12	0.982	1.26	50	63.14
RL255 5_12	0.722	0.85	50	59.11
RL256 5_12	0.693	0.81	50	57.89
WK947 5_12	0.707	0.83	50	60.01
RL255 10_11_2	0.811	0.97	50	57.88
RL255 10_11_3	0.820	0.98	50	59.34
RL255 10_11_4	0.828	0.99	50	59.55
RL255 5_11_2	0.902	1.08	50	59.20
RL255 5_11_3	0.895	1.07	50	58.91
RL255 6_08	0.914	1.10	50	59.62
1ppm standard	0.898	1.08	50	1.17
RL256 10_11_2	0.866	1.04	50	56.04
RL256 10_11_3	0.850	1.02	50	55.54
RL256 10_11_4	0.891	1.07	50	56.16
RL256 5_11_2	0.832	0.99	50	58.14
RL256 5_11_3	0.868	1.04	50	58.04
RL256 6_08	0.866	1.04	50	57.52
WK947 10_11_2	0.857	1.21	50	60.44
WK947 10_11_3	0.856	1.02	50	60.33
WK947 5_11_2	0.871	1.04	50	50.95
WK947 5_11_3	0.882	1.06	50	62.09
SV631 5_12	0.856	1.02	50	58.63
1ppm standard	0.861	1.03	50	1.16
BIG BEND SPG 5_12	0.875	1.05	50	39.50
SUSSEX CRK 5_12	0.632	0.74	50	51.09
ROOT RVR 5_12	0.632	0.74	50	38.21
UNDRWD CRK 5_12	0.747	0.88	50	59.72
Fox0 5_12	0.813	0.97	50	48.37
Fox1 5_12	0.805	0.96	50	51.04
Fox2 5_12	0.818	0.97	50	46.35
Fox3 5_12	0.689	0.81	50	35.02
Fox2 10_11_2	0.772	0.92	50	42.71
Fox2 10_11_3	0.753	0.89	50	43.29
Fox2 5_11_2	0.865	0.89	50	44.73
Fox2 5_11_3	0.757	0.90	50	46.23
Fox2 6_08	0.760	0.90	50	49.08
SX WWTP 5_12	0.785	0.94	50	47.17
WK WWTP 5_12	0.771	0.92	50	46.10
BRK WWTP 5_12	0.883	1.10	50	54.99



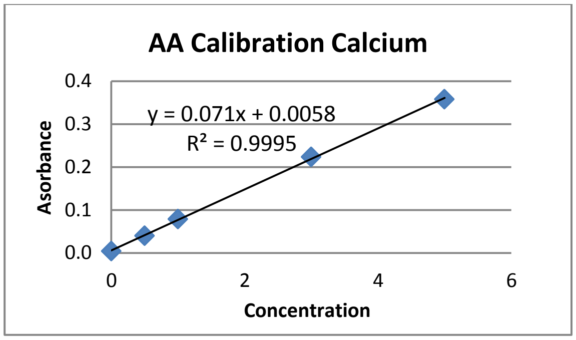
Sodium 6/15/2012	Signal	Conc (mg/L)	Dilution Factor	Conc (mg/L)
Blank	0.023	0.00	1	0.00
Standard 1	0.096	0.10	1	0.10
Standard 2	0.206	0.25	1	0.25
Standard 3	0.386	0.50	1	0.50
Standard 4	0.749	1.00	1	1.00
Standard 5	1.328	2.00	1	2.00
EM275 5_12	0.317	0.42	50	20.81
IZ385 5_12	0.822	1.19	100	118.71
IZ386 5_12	0.472	0.65	100	65.37
RL255 5_12	0.570	0.80	100	80.25
RL256 5_12	0.466	0.64	100	64.41
WK947 5_12	0.256	0.32	100	32.29
RL255 10_11_2	0.558	0.78	100	78.46
RL255 10_11_3	0.581	0.82	100	81.92
RL255 10_11_4	0.520	0.73	100	72.66
RL255 5_11_2	0.552	0.78	100	77.55
RL255 5_11_3	0.544	0.76	100	76.32
RL255 6_08	0.462	0.64	100	63.79
1ppm standard	0.737	1.06	1	1.06
RL256 10_11_2	0.471	0.65	100	65.09
RL256 10_11_3	0.467	0.64	100	64.48
RL256 10_11_4	0.471	0.65	100	65.13
RL256 5_11_2	0.459	0.63	100	63.34
RL256 5_11_3	0.478	0.66	100	66.19
RL256 6_08	0.364	0.49	100	48.83
WK947 10_11_2	0.266	0.34	100	33.91
WK947 10_11_3	0.278	0.36	100	35.73
WK947 5_11_2	0.274	0.35	100	35.17
WK947 5_11_3	0.291	0.38	100	37.66
SV631 5_12	0.318	0.42	50	20.91
1ppm standard	0.750	1.08	1	1.08
BIG BEND SPG 5_12	0.474	0.66	100	65.59
SUSSEX CRK 5_12	0.832	1.20	100	120.28
ROOT RVR 5_12	0.754	1.08	100	108.34
UNDRWD CRK 5_12	1.303	1.92	100	192.04
Fox0 5_12	0.475	0.66	100	65.84
Fox1 5_12	1.122	1.64	100	164.49
Fox2 5_12	1.064	1.56	100	155.69
Fox3 5_12	0.584	0.82	100	82.42
Fox2 10_11_2	0.897	1.30	100	130.10
Fox2 10_11_3	0.893	1.29	100	129.47
Fox2 5_11_2	0.874	1.27	100	126.70
Fox2 5_11_3	0.899	1.30	100	130.48
Fox2 6_08	1.090	1.60	100	159.64
SX WWTP 5_12	0.922	1.34	200	267.84
WK WWTP 5_12	1.009	1.47	200	294.52
BRK WWTP 5_12	1.078	1.58	200	315.67



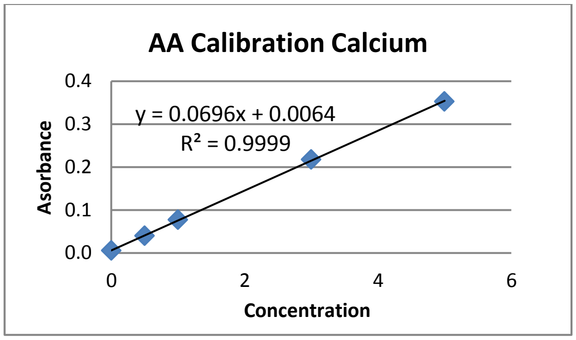
Potassium 6/15/2012	Signal	Conc (mg/L)	Dilution Factor	Conc (mg/L)
Blank	0.017	0.00	1	0.00
Standard 1	0.144	0.25	1	0.25
Standard 2	0.247	0.50	1	0.50
Standard 3	0.440	1.00	1	1.00
Standard 4	0.773	2.00	1	2.00
EM275 5_12	0.489	1.19	2	2.38
IZ385 5_12	0.590	1.46	2	2.93
IZ386 5_12	0.535	1.32	2	2.63
RL255 5_12	0.523	1.28	2	2.57
RL256 5_12	0.508	1.24	2	2.49
WK947 5_12	0.465	1.13	2	2.25
RL255 10_11_2	0.512	1.26	2	2.51
RL255 10_11_3	0.536	1.32	2	2.64
RL255 10_11_4	0.522	1.28	2	2.56
RL255 5_11_2	0.500	1.22	2	2.44
RL255 5_11_3	0.539	1.33	2	2.65
RL255 6_08	0.500	1.22	2	2.44
1ppm standard	0.440	1.06	1	1.06
RL256 10_11_2	0.472	1.15	2	2.29
RL256 10_11_3	0.507	1.24	2	2.48
RL256 10_11_4	0.494	1.21	2	2.41
RL256 5_11_2	0.483	1.18	2	2.35
RL256 5_11_3	0.513	1.26	2	2.51
RL256 6_08	0.490	1.20	2	2.39
WK947 10_11_2	0.434	1.04	2	2.09
WK947 10_11_3	0.490	1.20	2	2.39
WK947 5_11_2	0.450	1.09	2	2.18
WK947 5_11_3	0.487	1.19	2	2.37
SV631 5_12	0.321	0.74	2	1.48
1ppm standard	0.437	1.05	1	1.05
BIG BEND SPG 5_12	0.286	0.65	4	2.59
SUSSEX CRK 5_12	0.528	1.30	4	5.19
ROOT RVR 5_12	0.346	0.81	4	3.23
UNDRWD CRK 5_12	0.441	1.06	4	4.25
Fox0 5_12	0.256	0.57	4	2.27
Fox1 5_12	0.526	1.29	4	5.17
Fox2 5_12	0.576	1.43	4	5.71
Fox3 5_12	0.342	0.80	4	3.19
Fox2 10_11_2	0.472	1.15	4	4.58
Fox2 10_11_3	0.525	1.29	4	5.15
Fox2 5_11_2	0.408	0.98	4	3.90
Fox2 5_11_3	0.470	1.14	4	4.57
Fox2 6_08	0.648	1.62	4	6.47
SX WWTP 5_12	0.499	1.22	10	12.21
WK WWTP 5_12	0.534	1.31	10	13.15
BRK WWTP 5_12	0.518	1.27	10	12.70



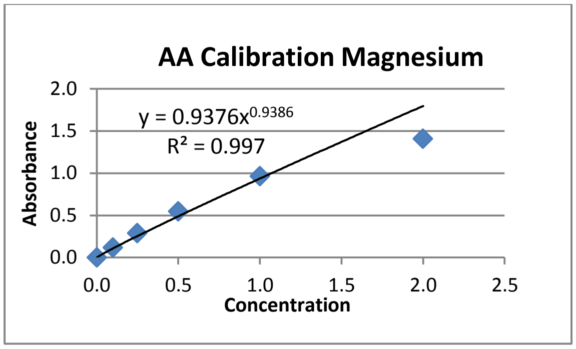
Calcium 3/2012	Signal	Conc (mg/L)	Dilution Factor	Conc (mg/L)
Blank	0.004	0	1	0
Standard 1	0.040	0.5	1	0.5
Standard 2	0.079	1	1	1
Standard 3	0.224	3	1	3
Standard 4	0.358	5	1	5
Standard 5	0.629	10	1	10
EM275 2_12	0.297	4.06	25	101.56
IZ385 2_12	0.326	4.50	25	112.48
IZ386 2_12	0.001	0.00	25	-0.04
RL255 2_12	0.325	4.49	25	112.15
RL255 10_11_1	0.319	4.40	25	109.94
RL255 10_11_2	0.169	2.23	25	55.79
RL255 10_11_3	0.339	4.71	25	117.69
RL255 5_11_1	0.319	4.39	25	109.65
RL255 5_11_2	0.175	2.32	25	58.05
RL255 5_11_3	0.327	4.52	25	113.00
RL255 6_08	0.332	4.60	25	114.99
RL255 9_07	0.329	4.55	25	113.72
RL255 4_07	0.329	4.54	25	113.53
mid standard	0.080	0.04	1	1.01
RL256 2_12	0.305	4.18	25	104.61
RL256 10_11_1	0.315	4.33	25	108.36
RL256 10_11_2	0.170	2.25	25	56.15
RL256 10_11_3	0.311	4.27	25	106.73
RL256 5_11_1	0.332	4.60	25	114.96
RL256 5_11_2	0.176	2.34	25	58.48
RL256 5_11_3	0.332	4.60	25	114.91
RL256 6_08	0.332	4.60	25	114.94
RL256 9_07	0.308	4.23	25	105.78
RL256 4_07	0.307	4.22	25	105.38
WK947 2_12	0.285	3.88	25	96.88
WK947 10_11_1	0.287	3.91	25	97.73
WK947 10_11_2	0.154	2.03	25	50.84
WK947 10_11_3	0.288	3.92	25	97.92
WK947 5_11_1	0.289	3.93	25	98.28
WK947 5_11_2	0.277	3.76	25	93.93
WK947 5_11_3	0.258	3.48	25	87.01
mid standard	0.075	0.96	1	0.96
SV631 2_12	0.215	2.88	25	72.09
BIG BEND SPG 2_12	0.218	2.92	25	72.97
SUSSEX CRK 2_12	0.262	3.54	25	88.62
ROOT RVR 2_12	0.272	3.69	25	92.14
UNDRWD CRK 2_12	0.332	4.60	25	114.98
FOX0 2_12	0.249	3.36	25	84.10
Fox0 10_11_1	0.235	3.16	25	78.97
Fox0 10_11_3	0.234	3.15	25	78.72
Fox0 5_11_1	0.218	2.92	25	72.88
Fox0 5_11_3	0.219	2.94	25	73.40
Fox0 11_10	0.250	3.37	25	84.20
Fox0 4_10	0.215	2.88	25	71.89
Fox0 11_09	0.247	3.33	25	83.17
Fox0 5_09	0.218	2.93	25	73.17
Fox0 11_08	0.244	3.29	25	82.20
mid standard	0.073	0.93	1	0.93
Fox1 2_12	0.258	3.49	25	87.31
Fox1 10_11_1	0.160	2.12	25	52.99
Fox1 10_11_3	0.170	2.25	25	56.15
Fox1 5_11_1	0.241	3.25	25	81.21
Fox1 5_11_3	0.256	3.46	25	86.52
Fox1 11_10	0.225	3.01	25	75.35
Fox1 4_10	0.243	3.27	25	81.64
Fox1 11_09	0.233	3.13	25	78.19
Fox1 5_09	0.235	3.16	25	79.01
Fox1 11_08	0.226	3.03	25	75.77
Fox1 6_08	0.242	3.26	25	81.61
Fox1 9_07	0.214	2.86	25	71.58
Fox1 6_07	0.209	2.80	25	69.95
Fox1 4_07	0.217	2.91	25	72.83



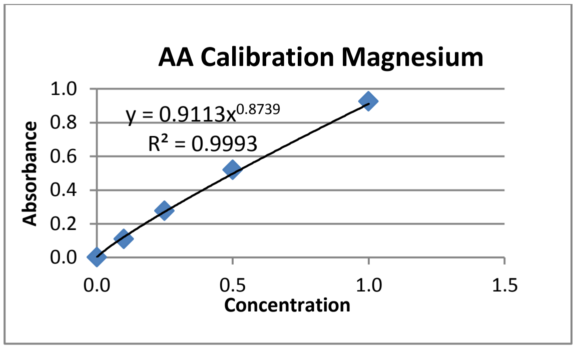
Calcium 3/2012	Signal	Conc (mg/L)	Dilution Factor	Conc (mg/L)
Blank	0.006	0	1	0
Standard 1	0.040	0.5	1	0.5
Standard 2	0.077	1	1	1
Standard 3	0.218	3	1	3
Standard 4	0.353	5	1	5
Standard 5	0.632	10	1	10
Fox2 2_12	0.255	3.55	25	88.63
Fox2 10_11_1	0.184	2.52	25	63.01
Fox2 10_11_2	0.196	2.69	25	67.18
Fox2 10_11_3	0.192	2.63	25	65.69
Fox2 5_11_1	0.233	3.22	25	80.60
Fox2 5_11_2	0.247	3.43	25	85.66
Fox2 5_11_3	0.241	3.33	25	83.37
Fox2 11_10	0.248	3.44	25	86.05
Fox2 11_08	0.250	3.47	25	86.79
Fox2 6_08	0.233	3.22	25	80.61
Fox2 9_07	0.206	2.83	25	70.83
Fox2 6_07	0.209	2.88	25	71.89
Fox2 4_07	0.204	2.80	25	70.10
mid standard	0.078	1.01	1	1.01
Fox3 2_12	0.223	3.08	25	77.04
Fox3 10_11_1	0.188	2.57	25	64.22
Fox3 10_11_3	0.188	2.58	25	64.52
Fox3 5_11_1	0.215	2.97	25	74.13
Fox3 5_11_3	0.227	3.14	25	78.41
Fox3 11_10	0.233	3.22	25	80.51
Fox3 4_10	0.230	3.18	25	79.49
Fox3 11_09	0.230	3.17	25	79.34
Fox3 5_09	0.209	2.88	25	71.98
Fox3 11_08	0.227	3.13	25	78.34
Fox3 6_08	0.221	3.04	25	76.08
Fox3 9_07	0.207	2.84	25	71.10
Fox3 6_07	0.188	2.57	25	64.29
Fox3 4_07	0.186	2.54	25	63.53
mid standard	0.077	0.04	25	1.00
SX WWTP 2_12	0.264	3.67	25	91.68
SX WWTP 10_11_1	0.240	3.31	25	82.85
SX WWTP 10_11_3	0.242	83.78	1	83.78
SX WWTP 5_11_1	0.001	-0.07	25	-1.70
SX WWTP 5_11_3	0.246	3.41	25	85.13
SX WWTP 11_10	0.248	3.43	25	85.74
SX WWTP 4_10	0.257	3.56	25	89.09
SX WWTP 11_09	0.251	3.48	25	86.99
SX WWTP 5_09	0.259	3.60	25	89.96
SX WWTP 12_08	0.255	3.53	25	88.33
WK WWTP 2_12	0.267	3.71	25	92.66
WK WWTP 10_11_1	0.262	3.64	25	91.00
WK WWTP 10_11_3	0.263	3.66	25	91.47
WK WWTP 5_11_1	0.288	4.02	25	100.42
WK WWTP 5_11_3	0.289	4.04	25	101.03
mid standard	0.077	0.04	25	1.00
WK WWTP 11_10	0.262	3.64	25	91.04
WK WWTP 4_10	0.292	4.08	25	102.11
WK WWTP 11_09	0.279	97.32	1	97.32
WK WWTP 5_09	0.286	3.99	25	99.68
WK WWTP 12_08	0.276	3.84	25	96.00
BRK WWTP 2_12	0.302	4.23	25	105.70
BRK WWTP 10_11_1	0.276	3.84	25	96.07
BRK WWTP 10_11_3	0.275	3.83	25	95.74
BRK WWTP 5_11_1	0.297	4.15	25	103.83
BRK WWTP 5_11_3	0.301	4.22	25	105.46
BRK WWTP 11_10	0.285	3.98	25	99.50
BRK WWTP 4_10	0.310	4.35	25	108.76
BRK WWTP 11_09	0.295	4.13	25	103.15
BRK WWTP 5_09	0.275	3.83	25	95.86
BRK WWTP 12_08	0.293	4.10	25	102.42



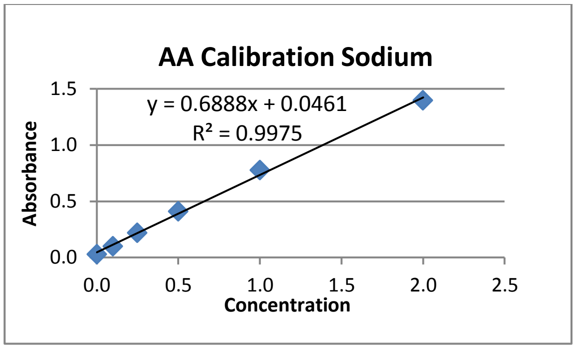
Magnesium 3/2012	Signal	Conc (mg/L)	Dilution Factor	Conc (mg/L)
Blank	0.001	0.001	1	0.001
Standard 1	0.116	0.1	1	0.1
Standard 2	0.288	0.25	1	0.25
Standard 3	0.545	0.5	1	0.5
Standard 4	0.965	1	1	1
Standard 5	1.408	2	1	2
EM275 2_12	1.295	2.82	50	70.53
IZ385 2_12	0.971	2.08	50	51.93
IZ386 2_12	1.044	2.24	50	56.07
RL255 2_12	1.015	2.18	50	54.39
RL255 10_11_1	1.004	2.15	50	53.77
RL255 10_11_2	0.992	2.12	50	53.08
RL255 10_11_3	1.012	2.17	50	54.22
RL255 5_11_1	0.999	2.14	50	53.51
RL255 5_11_2	1.000	2.14	50	53.58
RL255 5_11_3	1.000	2.14	50	53.55
RL255 6_08	1.008	2.16	50	53.99
RL255 9_07	1.016	2.18	50	54.49
RL255 4_07	1.011	2.17	50	54.16
mid standard	0.966	0.04	1	1.03
RL256 2_12	0.959	2.05	50	51.23
RL256 10_11_1	0.945	2.02	50	50.41
RL256 10_11_2	0.969	2.07	50	51.78
RL256 10_11_3	0.971	2.08	50	51.89
RL256 5_11_1	0.999	2.14	50	53.51
RL256 5_11_2	1.000	2.14	50	53.53
RL256 5_11_3	1.082	2.33	50	58.23
RL256 6_08	0.978	2.09	50	52.30
RL256 9_07	0.965	2.06	50	51.55
RL256 4_07	0.958	2.05	50	51.18
WK947 2_12	0.983	2.10	50	52.57
WK947 10_11_1	1.005	2.15	50	53.82
WK947 10_11_2	1.031	2.21	50	55.33
WK947 10_11_3	1.009	2.16	50	54.08
WK947 5_11_1	1.027	2.20	50	55.12
WK947 5_11_2	0.888	1.89	50	47.18
WK947 5_11_3	1.046	2.25	50	56.17
mid standard	0.965	0.96	1	1.03
SV631 2_12	0.992	2.12	50	53.11
BIG BEND SPG 2_12	0.805	1.70	50	42.49
SUSSEX CRK 2_12	0.906	1.93	50	48.18
ROOT RVR 2_12	0.949	2.03	50	50.67
UNDRWD CRK 2_12	1.045	2.24	50	56.12
FOX0 2_12	0.855	1.81	50	45.34
Fox0 10_11_1	0.904	1.92	50	48.11
Fox0 10_11_3	0.940	2.01	50	50.13
Fox0 5_11_1	0.793	1.67	50	41.82
Fox0 5_11_3	0.805	1.70	50	42.51
Fox0 11_10	0.921	1.96	50	49.06
Fox0 4_10	0.791	1.67	50	41.71
Fox0 11_09	0.891	1.89	50	47.35
Fox0 5_09	0.830	1.76	50	43.88
Fox0 11_08	0.982	2.10	50	52.53
mid standard	0.962	0.04	1	1.03
Fox1 2_12	0.918	1.96	50	48.90
Fox1 10_11_1	0.792	1.67	50	41.77
Fox1 10_11_3	0.821	1.74	50	43.43
Fox1 5_11_1	0.872	1.85	50	46.30
Fox1 5_11_3	0.899	1.91	50	47.84
Fox1 11_10	0.897	1.91	50	47.69
Fox1 4_10	0.866	1.84	50	45.96
Fox1 11_09	0.889	1.89	50	47.27
Fox1 5_09	0.905	1.93	50	48.14
Fox1 11_08	0.937	2.00	50	49.98
Fox1 6_08	0.965	2.06	50	51.56
Fox1 9_07	0.849	1.80	50	44.97
Fox1 6_07	0.826	1.75	50	43.69
Fox1 4_07	0.891	1.89	50	47.36



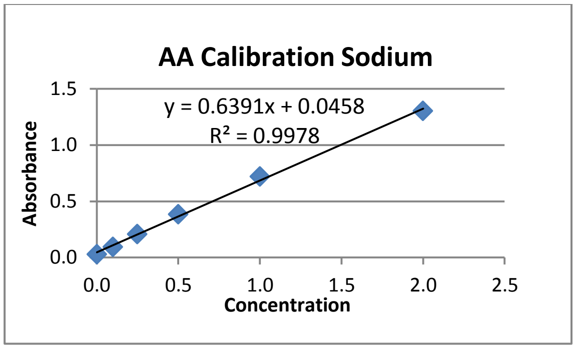
Magnesium 3/2012	Signal	Conc (mg/L)	Dilution Factor	Conc (mg/L)
Blank	0.002	0.001	1	0.001
Standard 1	0.109	0.1	1	0.1
Standard 2	0.277	0.25	1	0.25
Standard 3	0.521	0.5	1	0.5
Standard 4	0.925	1	1	1
Standard 5	1.386	2	1	2
Fox2 2_12	0.791	0.85	50	42.51
Fox2 10_11_1	1.161	1.32	50	65.97
Fox2 10_11_2	1.163	1.32	50	66.07
Fox2 10_11_3	0.691	0.73	50	36.41
Fox2 5_11_1	0.005	0.00	50	0.14
Fox2 5_11_2	0.698	0.74	50	36.87
Fox2 5_11_3	0.718	0.76	50	38.06
Fox2 11_10	0.783	0.84	50	42.03
Fox2 11_08	0.739	0.79	50	39.34
Fox2 6_08	0.797	0.86	50	42.91
Fox2 9_07	0.750	0.80	50	40.02
Fox2 6_07	0.673	0.71	50	35.33
Fox2 4_07	0.670	0.70	50	35.16
mid standard	0.918	1.01	50	50.41
Fox3 2_12	0.800	0.86	50	43.11
Fox3 10_11_1	0.697	0.74	50	36.79
Fox3 10_11_3	0.700	0.74	50	36.98
Fox3 5_11_1	0.688	0.73	50	36.27
Fox3 5_11_3	0.666	0.70	50	34.90
Fox3 11_10	0.768	0.82	50	41.13
Fox3 4_10	0.741	0.79	50	39.45
Fox3 11_09	0.764	0.82	50	40.84
Fox3 5_09	0.719	0.76	50	38.12
Fox3 11_08	0.757	0.81	50	40.45
Fox3 6_08	0.710	0.75	50	37.56
Fox3 9_07	0.674	0.71	50	35.42
Fox3 6_07	0.628	0.65	50	32.66
Fox3 4_07	0.548	0.56	50	27.95
mid standard	0.913	1.00	50	50.12
SX WWTP 2_12	0.772	0.83	50	41.33
SX WWTP 10_11_1	0.688	0.72	50	36.22
SX WWTP 10_11_3	0.705	0.75	50	37.30
SX WWTP 5_11_1	0.720	0.76	50	38.17
SX WWTP 5_11_3	0.726	0.77	50	38.52
SX WWTP 11_10	0.740	0.79	50	39.38
SX WWTP 4_10	0.806	0.87	50	43.47
SX WWTP 11_09	0.764	0.82	50	40.86
SX WWTP 5_09	0.751	0.80	50	40.09
SX WWTP 12_08	0.727	0.77	50	38.63
WK WWTP 2_12	0.684	0.72	50	36.03
WK WWTP 10_11_1	0.685	0.72	50	36.10
WK WWTP 10_11_3	0.693	0.73	50	36.58
WK WWTP 5_11_1	0.794	0.85	50	42.72
WK WWTP 5_11_3	0.774	0.83	50	41.48
mid standard	0.728	0.77	50	38.69
WK WWTP 11_10	0.732	0.78	50	38.91
WK WWTP 4_10	0.773	0.83	50	41.42
WK WWTP 11_09	0.742	0.79	50	39.51
WK WWTP 5_09	0.797	0.86	50	42.87
WK WWTP 12_08	0.746	0.80	50	39.77
BRK WWTP 2_12	0.887	0.97	50	48.46
BRK WWTP 10_11_1	0.787	0.85	50	42.30
BRK WWTP 10_11_3	0.792	0.85	50	42.56
BRK WWTP 5_11_1	0.847	0.92	50	45.99
BRK WWTP 5_11_3	0.850	0.92	50	46.16
BRK WWTP 11_10	0.836	0.91	50	45.33
BRK WWTP 4_10	0.880	0.96	50	48.06
BRK WWTP 11_09	0.842	0.91	50	45.68
BRK WWTP 5_09	0.866	0.94	50	47.15
BRK WWTP 12_08	0.871	0.95	50	47.45



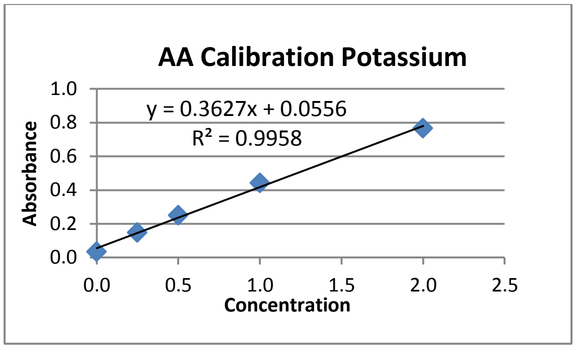
Sodium 3/2012	Signal	Conc (mg/L)	Dilution Factor	Conc (mg/L)
Blank	0.028	0.001	1	0.001
Standard 1	0.098	0.1	1	0.1
Standard 2	0.218	0.25	1	0.25
Standard 3	0.409	0.5	1	0.5
Standard 4	0.778	1	1	1
Standard 5	1.399	2	1	2
EM275 2_12	0.537	0.71	50	35.67
IZ385 2_12	0.739	1.01	100	100.53
IZ386 2_12	0.515	0.68	100	68.06
RL255 2_12	0.594	0.80	100	79.59
RL255 10_11_1	0.588	0.79	100	78.63
RL255 10_11_2	0.565	0.75	100	75.40
RL255 10_11_3	0.583	0.78	100	77.93
RL255 5_11_1	0.575	0.77	100	76.80
RL255 5_11_2	0.554	0.74	100	73.73
RL255 5_11_3	0.577	0.77	100	77.11
RL255 6_08	0.421	0.54	100	54.36
RL255 9_07	0.487	0.64	100	64.07
RL255 4_07	0.402	0.52	100	51.60
mid standard	0.766	1.04	1	1.04
RL256 2_12	0.519	0.69	100	68.59
RL256 10_11_1	0.516	0.68	100	68.15
RL256 10_11_2	0.475	0.62	100	62.32
RL256 10_11_3	0.476	0.62	100	62.43
RL256 5_11_1	0.497	0.66	100	65.52
RL256 5_11_2	0.466	0.61	100	61.00
RL256 5_11_3	0.492	0.65	100	64.72
RL256 6_08	0.419	0.54	100	54.07
RL256 9_07	0.342	0.43	100	42.93
RL256 4_07	0.286	0.35	100	34.76
WK947 2_12	0.301	0.37	100	37.00
WK947 10_11_1	0.287	0.35	100	34.98
WK947 10_11_2	0.267	0.32	100	32.09
WK947 10_11_3	0.312	0.39	100	38.63
WK947 5_11_1	0.287	0.35	100	35.00
WK947 5_11_2	0.276	0.33	100	33.32
WK947 5_11_3	0.306	0.38	100	37.77
mid standard	0.769	1.05	1	1.05
SV631 2_12	0.346	0.44	50	21.78
BIG BEND SPG 2_12	0.478	0.63	100	62.70
SUSSEX CRK 2_12	0.761	1.04	100	103.72
ROOT RVR 2_12	2.335	3.32	100	332.30
UNDRWD CRK 2_12	1.926	2.73	100	272.95
FOX0 2_12	0.509	0.67	100	67.24
Fox0 10_11_1	0.594	0.80	100	79.52
Fox0 10_11_3	0.641	0.86	100	86.34
Fox0 5_11_1	0.481	0.63	100	63.11
Fox0 5_11_3	0.498	0.66	100	65.57
Fox0 11_10	0.523	0.69	100	69.30
Fox0 4_10	0.470	0.62	100	61.52
Fox0 11_09	0.516	0.68	100	68.23
Fox0 5_09	0.552	0.73	100	73.47
Fox0 11_08	0.526	0.70	100	69.59
mid standard	0.783	1.07	1	1.07
Fox1 2_12	1.185	1.65	100	165.30
Fox1 10_11_1	0.849	1.17	100	116.51
Fox1 10_11_3	0.845	1.16	100	116.05
Fox1 5_11_1	0.911	1.26	100	125.54
Fox1 5_11_3	0.964	1.33	100	133.21
Fox1 11_10	0.959	1.33	100	132.56
Fox1 4_10	0.879	1.21	100	120.96
Fox1 11_09	0.950	1.31	100	131.19
Fox1 5_09	1.022	1.42	100	141.65
Fox1 11_08	1.072	1.49	100	148.91
Fox1 6_08	1.083	1.51	100	150.61
Fox1 9_07	0.738	1.00	100	100.45
Fox1 6_07	0.851	1.17	100	116.90
Fox1 4_07	0.770	1.05	100	105.08



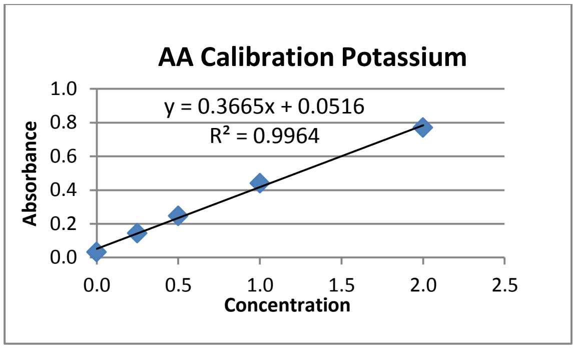
Sodium 3/2012	Signal	Conc (mg/L)	Dilution Factor	Conc (mg/L)
Blank	0.029	0.001	1	0.001
Standard 1	0.095	0.1	1	0.1
Standard 2	0.207	0.25	1	0.25
Standard 3	0.383	0.5	1	0.5
Standard 4	0.720	1	1	1
Standard 5	1.303	2	1	2
Fox2 2_12	1.203	1.81	100	181.08
Fox2 10_11_1	0.879	1.30	100	130.36
Fox2 10_11_2	0.868	1.29	100	128.65
Fox2 10_11_3	0.868	1.29	100	128.61
Fox2 5_11_1	0.856	1.27	100	126.83
Fox2 5_11_2	0.866	1.28	100	128.35
Fox2 5_11_3	0.875	1.30	100	129.67
Fox2 11_10	0.990	1.48	100	147.69
Fox2 11_08	1.079	1.62	100	161.69
Fox2 6_08	1.076	1.61	100	161.26
Fox2 9_07	0.808	1.19	100	119.23
Fox2 6_07	0.845	1.25	100	125.04
Fox2 4_07	0.761	1.12	100	111.86
mid standard	0.709	1.04	1	1.04
Fox3 2_12	0.686	1.00	100	100.20
Fox3 10_11_1	0.669	0.98	100	97.53
Fox3 10_11_3	0.688	1.00	100	100.46
Fox3 5_11_1	0.567	0.81	100	81.49
Fox3 5_11_3	0.609	0.88	100	88.05
Fox3 11_10	0.621	0.90	100	90.04
Fox3 4_10	0.680	0.99	100	99.17
Fox3 11_09	0.544	0.78	100	77.93
Fox3 5_09	0.555	0.80	100	79.73
Fox3 11_08	0.639	0.93	100	92.76
Fox3 6_08	0.538	0.77	100	76.95
Fox3 9_07	0.523	0.75	100	74.71
Fox3 6_07	0.443	0.62	100	62.18
Fox3 4_07	0.403	0.56	100	55.81
mid standard	0.695	1.02	1	1.02
SX WWTP 2_12	1.054	1.58	200	315.39
SX WWTP 10_11_1	0.891	1.32	200	264.36
SX WWTP 10_11_3	0.946	1.41	200	281.57
SX WWTP 5_11_1	0.804	1.19	200	237.37
SX WWTP 5_11_3	0.794	1.17	200	234.25
SX WWTP 11_10	0.964	1.44	200	287.50
SX WWTP 4_10	0.948	1.41	200	282.37
SX WWTP 11_09	0.991	1.48	200	295.89
SX WWTP 5_09	0.834	1.23	200	246.74
SX WWTP 12_08	1.275	1.92	200	384.62
WK WWTP 2_12	1.024	1.53	200	306.11
WK WWTP 10_11_1	0.926	1.38	200	275.58
WK WWTP 10_11_3	0.953	1.42	200	284.03
WK WWTP 5_11_1	0.970	1.45	200	289.22
WK WWTP 5_11_3	0.985	1.47	200	293.96
mid standard	0.707	1.03	1	1.03
WK WWTP 11_10	0.958	1.43	200	285.40
WK WWTP 4_10	0.979	1.46	200	291.99
WK WWTP 11_09	0.944	1.41	200	281.17
WK WWTP 5_09	0.928	1.38	200	276.16
WK WWTP 12_08	1.126	1.69	200	337.92
BRK WWTP 2_12	1.189	1.79	200	357.82
BRK WWTP 10_11_1	1.033	1.55	200	309.04
BRK WWTP 10_11_3	1.085	1.63	200	325.21
BRK WWTP 5_11_1	1.009	1.51	200	301.47
BRK WWTP 5_11_3	1.021	1.53	200	305.17
BRK WWTP 11_10	1.068	1.60	200	320.05
BRK WWTP 4_10	1.039	1.55	200	310.94
BRK WWTP 11_09	1.078	1.62	200	323.01
BRK WWTP 5_09	0.983	1.47	200	293.15
BRK WWTP 12_08	1.289	1.95	200	389.20



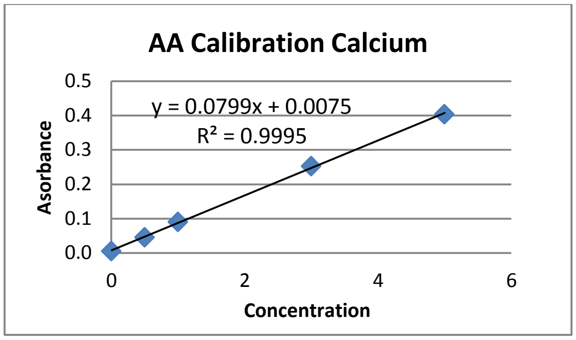
Potassium 3/2012	Signal	Conc (mg/L)	Dilution Factor	Conc (mg/L)
Blank	0.034	0	1	0
Standard 1	0.147	0.25	1	0.25
Standard 2	0.250	0.5	1	0.5
Standard 3	0.441	1	1	1
Standard 4	0.766	2	1	2
EM275 2_12	0.529	1.30	2	2.61
IZ385 2_12	0.592	1.48	2	2.96
IZ386 2_12	0.551	1.37	2	2.73
RL255 2_12	0.554	1.37	2	2.75
RL255 10_11_1	0.495	1.21	2	2.42
RL255 10_11_2	0.493	1.21	2	2.41
RL255 10_11_3	0.549	1.36	2	2.72
RL255 5_11_1	0.486	1.19	2	2.37
RL255 5_11_2	0.490	1.20	2	2.39
RL255 5_11_3	0.520	1.28	2	2.56
RL255 6_08	0.514	1.26	2	2.53
RL255 9_07	0.501	1.23	2	2.46
RL255 4_07	0.488	1.19	2	2.38
mid standard	0.773	1.98	1	1.98
RL256 2_12	0.523	1.29	2	2.58
RL256 10_11_1	0.457	1.11	2	2.22
RL256 10_11_2	0.457	1.11	2	2.21
RL256 10_11_3	0.490	1.20	2	2.39
RL256 5_11_1	0.471	1.15	2	2.29
RL256 5_11_2	0.474	1.15	2	2.31
RL256 5_11_3	0.497	1.22	2	2.44
RL256 6_08	0.477	1.16	2	2.33
RL256 9_07	0.462	1.12	2	2.24
RL256 4_07	0.461	1.12	2	2.23
WK947 2_12	0.477	1.16	2	2.33
WK947 10_11_1	0.443	1.07	2	2.13
WK947 10_11_2	0.429	1.03	2	2.06
WK947 10_11_3	0.474	1.15	2	2.30
WK947 5_11_1	0.435	1.05	2	2.09
WK947 5_11_2	0.432	1.04	2	2.08
WK947 5_11_3	0.487	1.19	2	2.38
mid standard	0.442	1.06	1	1.06
SV631 2_12	0.334	0.77	2	1.54
BIG BEND SPG 2_12	0.291	0.65	4	2.60
SUSSEX CRK 2_12	0.476	1.16	4	4.64
ROOT RVR 2_12	0.326	0.75	4	2.98
UNDRWD CRK 2_12	0.448	1.08	4	4.33
FOX0 2_12	0.254	0.55	4	2.19
Fox0 10_11_1	0.320	0.73	4	2.92
Fox0 10_11_3	0.357	0.83	4	3.32
Fox0 5_11_1	0.215	0.44	4	1.76
Fox0 5_11_3	0.249	0.53	4	2.14
Fox0 11_10	0.335	0.77	4	3.08
Fox0 4_10	0.289	0.64	4	2.57
Fox0 11_09	0.361	0.84	4	3.37
Fox0 5_09	0.274	0.60	4	2.41
Fox0 11_08	0.352	0.82	4	3.27
mid standard	0.443	1.07	1	1.07
Fox1 2_12	0.460	1.12	4	4.46
Fox1 10_11_1	0.400	0.95	4	3.80
Fox1 10_11_3	0.456	1.10	4	4.41
Fox1 5_11_1	0.421	1.01	4	4.03
Fox1 5_11_3	0.467	1.13	4	4.53
Fox1 11_10	0.580	1.44	4	5.78
Fox1 4_10	0.412	0.98	4	3.93
Fox1 11_09	0.475	1.16	4	4.62
Fox1 5_09	0.465	1.13	4	4.51
Fox1 11_08	0.600	1.50	4	6.01
Fox1 6_08	0.576	1.43	4	5.74
Fox1 9_07	0.488	1.19	4	4.77
Fox1 6_07	0.420	1.00	4	4.01
Fox1 4_07	0.438	1.05	4	4.22



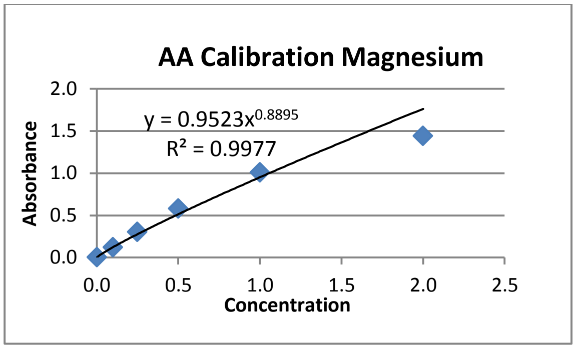
Potassium 3/2012	Signal	Conc (mg/L)	Dilution Factor	Conc (mg/L)
Blank	0.032	0	1	0
Standard 1	0.144	0.25	1	0.25
Standard 2	0.246	0.5	1	0.5
Standard 3	0.440	1	1	1
Standard 4	0.771	2	1	2
Fox2 2_12	0.500	1.22	4	4.89
Fox2 10_11_1	0.459	1.11	4	4.44
Fox2 10_11_2	0.459	1.11	4	4.45
Fox2 10_11_3	0.532	1.31	4	5.24
Fox2 5_11_1	0.406	0.97	4	3.87
Fox2 5_11_2	0.405	0.96	4	3.86
Fox2 5_11_3	0.478	1.16	4	4.65
Fox2 11_10	0.656	1.65	4	6.60
Fox2 11_08	0.705	1.78	4	7.14
Fox2 6_08	0.660	1.66	4	6.64
Fox2 9_07	0.557	1.38	4	5.51
Fox2 6_07	0.462	1.12	4	4.48
Fox2 4_07	0.431	1.03	4	4.14
mid standard	0.443	1.07	1	1.07
Fox3 2_12	0.392	0.93	4	3.71
Fox3 10_11_1	0.392	0.93	4	3.72
Fox3 10_11_3	0.420	1.01	4	4.03
Fox3 5_11_1	0.289	0.65	4	2.60
Fox3 5_11_3	0.296	0.67	4	2.67
Fox3 11_10	0.448	1.08	4	4.33
Fox3 4_10	0.341	0.79	4	3.15
Fox3 11_09	0.340	0.79	4	3.15
Fox3 5_09	0.277	0.61	4	2.45
Fox3 11_08	0.421	1.01	4	4.03
Fox3 6_08	0.324	0.74	4	2.98
Fox3 9_07	0.378	0.89	4	3.56
Fox3 6_07	0.269	0.59	4	2.38
Fox3 4_07	0.254	0.55	4	2.21
mid standard	0.435	1.05	1	1.05
SX WWTP 2_12	0.545	1.35	10	13.46
SX WWTP 10_11_1	0.517	1.27	10	12.69
SX WWTP 10_11_3	0.563	1.40	10	13.96
SX WWTP 5_11_1	0.411	0.98	10	9.80
SX WWTP 5_11_3	0.460	1.12	10	11.15
SX WWTP 11_10	0.612	1.53	10	15.30
SX WWTP 4_10	0.477	1.16	10	11.61
SX WWTP 11_09	0.587	1.46	10	14.62
SX WWTP 5_09	0.416	1.00	10	9.95
SX WWTP 12_08	0.662	1.67	10	16.66
WK WWTP 2_12	0.514	1.26	10	12.63
WK WWTP 10_11_1	0.464	1.12	10	11.25
WK WWTP 10_11_3	0.515	1.27	10	12.65
WK WWTP 5_11_1	0.464	1.12	10	11.24
WK WWTP 5_11_3	0.509	1.25	10	12.48
mid standard	0.433	1.04	1	1.04
WK WWTP 11_10	0.574	1.43	10	14.26
WK WWTP 4_10	0.617	1.54	10	15.42
WK WWTP 11_09	0.568	1.41	10	14.09
WK WWTP 5_09	0.473	1.15	10	11.49
WK WWTP 12_08	0.674	1.70	10	16.98
BRK WWTP 2_12	0.538	1.33	10	13.28
BRK WWTP 10_11_1	0.482	1.17	10	11.73
BRK WWTP 10_11_3	0.532	1.31	10	13.10
BRK WWTP 5_11_1	0.486	1.19	10	11.86
BRK WWTP 5_11_3	0.529	1.30	10	13.03
BRK WWTP 11_10	0.596	1.48	10	14.84
BRK WWTP 4_10	0.468	1.14	10	11.36
BRK WWTP 11_09	0.552	1.37	10	13.65
BRK WWTP 5_09	0.457	1.11	10	11.07
BRK WWTP 12_08	0.621	1.55	10	15.55



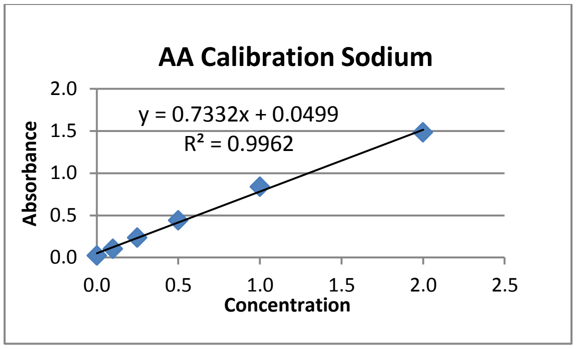
Calcium 12/18/2011	Signal	Conc (mg/L)	Dilution Factor	Conc (mg/L)
Blank	0.005	0	1	0
Standard 1	0.045	0.5	1	0.5
Standard 2	0.090	1	1	1
Standard 3	0.253	3	1	3
Standard 4	0.404	5	1	5
Standard 5	0.733	10	1	10
Fox2_11_08	0.311	3.80	25	94.88
RL255_5_09	0.367	4.50	25	112.46
RL256_5_09	0.362	4.44	25	111.06
Fox2_5_09	0.290	3.53	25	88.32
RL255_11_09	0.345	4.22	25	105.52
RL256_11_09	0.362	4.43	25	110.85
Fox2_11_09	0.296	3.61	25	90.31
RL255_4_10	0.357	4.38	25	109.43
RL256_4_10	0.360	4.41	25	110.22
WK947_4_10	0.291	3.55	25	88.71
Fox2_4_10	0.281	3.42	25	85.60
Std1ppm	0.088	1.00	1	1.00
RL255_11_10	0.353	4.32	25	108.09
RL256_11_10	0.329	4.03	25	100.74
WK947_11_10	0.305	3.72	25	92.97
Fox2_11_10	0.297	3.63	25	90.72
RL255_5_11	0.372	4.57	25	114.19
RL256_5_11	0.380	4.66	25	116.58
WK947_5_11	0.337	4.12	25	102.97
Fox2_5_11	0.293	3.58	25	89.42
RL255_10_11	0.372	4.56	25	113.90
RL256_10_11	0.356	4.37	25	109.18
WK947_10_11	0.325	3.97	25	99.30
Fox2_10_11	0.229	2.77	25	69.19
Std1ppm	0.093	1.07	1	1.07
RL255_5_11_first	0.368	4.51	25	112.70
RL256_5_11_first	0.378	4.63	25	115.83
WK947_5_11_first	0.339	4.15	25	103.68
WK947_5_11_second	0.339	4.15	25	103.75
Fox2_5_11_first	0.279	3.40	25	85.08
Fox2_5_11_second	0.286	3.49	25	87.14
RL255_10_11_first	0.370	4.53	25	113.32
RL255_10_11_second	0.367	4.50	25	112.55
RL256_10_11_first	0.357	4.37	25	109.24
RL256_10_11_second	0.352	4.31	25	107.73
WK947_10_11_first	0.331	4.05	25	101.27
Fox2_10_11_first	0.218	2.64	25	65.93
Fox2_10_11_second	0.223	2.69	25	67.37



Magnesium 12/18/2011	Signal	Conc (mg/L)	Dilution Factor	Conc (mg/L)
Blank	0.002	0.001	1	0.001
Standard 1	0.120	0.1	1	0.1
Standard 2	0.304	0.25	1	0.25
Standard 3	0.579	0.5	1	0.5
Standard 4	1.009	1	1	1
Standard 5	1.443	2	1	2
Fox2_11_08	0.161	0.14	50	6.79
RL255_5_09	1.043	1.11	50	55.40
RL256_5_09	1.039	1.10	50	55.12
Fox2_5_09	0.754	0.77	50	38.45
RL255_11_09	1.007	1.06	50	53.23
RL256_11_09	1.044	1.11	50	55.42
Fox2_11_09	0.674	0.68	50	33.91
RL255_4_10	1.035	1.10	50	54.90
RL256_4_10	1.049	1.12	50	55.76
WK947_4_10	0.944	0.99	50	49.49
Fox2_4_10	0.891	0.93	50	46.42
Std1ppm	0.999	1.06	1	1.06
RL255_11_10	1.039	1.10	50	55.13
RL256_11_10	0.982	1.04	50	51.76
WK947_11_10	1.040	1.10	50	55.18
Fox2_11_10	0.907	0.95	50	47.36
RL255_5_11	1.073	1.14	50	57.17
RL256_5_11	1.032	1.09	50	54.72
WK947_5_11	0.981	1.03	50	51.70
Fox2_5_11	0.910	0.95	50	47.50
RL255_10_11	1.057	1.12	50	56.19
RL256_10_11	0.991	1.05	50	52.27
WK947_10_11	1.066	1.14	50	56.78
Fox2_10_11	0.833	0.86	50	42.99
Std1ppm	0.998	1.05	1	1.05
RL255_5_11_first	1.038	1.10	50	55.08
RL256_5_11_first	1.032	1.09	50	54.72
WK947_5_11_first	1.069	1.14	50	56.94
WK947_5_11_second	1.078	1.15	50	57.45
Fox2_5_11_first	0.002	0.00	50	0.06
Fox2_5_11_second	0.862	0.89	50	44.68
RL255_10_11_first	1.040	1.10	50	55.21
RL255_10_11_second	1.045	1.11	50	55.52
RL256_10_11_first	0.994	1.05	50	52.45
RL256_10_11_second	1.011	1.07	50	53.47
WK947_10_11_first	1.046	1.11	50	55.58
Fox2_10_11_first	1.311	1.43	50	71.59
Fox2_10_11_second	0.846	0.87	50	43.75



Sodium 12/18/2011	Signal	Conc (mg/L)	Dilution Factor	Conc (mg/L)
Blank	0.023	0.001	1	0.001
Standard 1	0.103	0.1	1	0.1
Standard 2	0.235	0.25	1	0.25
Standard 3	0.440	0.5	1	0.5
Standard 4	0.839	1	1	1
Standard 5	1.483	2	1	2
Fox2_11_08	1.264	1.66	100	165.53
RL255_5_09	0.580	0.72	100	72.31
RL256_5_09	0.450	0.55	100	54.53
Fox2_5_09	1.136	1.48	100	148.07
RL255_11_09	0.470	0.57	100	57.32
RL256_11_09	0.606	0.76	100	75.82
Fox2_11_09	1.108	1.44	100	144.37
RL255_4_10	0.652	0.82	100	82.08
RL256_4_10	0.511	0.63	100	62.92
WK947_4_10	0.283	0.32	100	31.71
Fox2_4_10	1.043	1.35	100	135.46
Std1ppm	0.846	1.09	1	1.09
RL255_11_10	0.641	0.81	100	80.60
RL256_11_10	0.504	0.62	100	61.88
WK947_11_10	0.290	0.33	100	32.76
Fox2_11_10	1.173	1.53	100	153.20
RL255_5_11	0.670	0.85	100	84.50
RL256_5_11	0.548	0.68	100	67.92
WK947_5_11	0.327	0.38	100	37.75
Fox2_5_11	1.023	1.33	100	132.67
RL255_10_11	0.730	0.93	100	92.75
RL256_10_11	0.581	0.72	100	72.43
WK947_10_11	0.314	0.36	100	35.97
Fox2_10_11	1.034	1.34	100	134.19
Std1ppm	0.844	1.08	1	1.08
RL255_5_11_first	0.682	0.86	100	86.13
RL256_5_11_first	0.568	0.71	100	70.59
WK947_5_11_first	0.337	0.39	100	39.07
WK947_5_11_second	0.354	0.41	100	41.49
Fox2_5_11_first	1.034	1.34	100	134.16
Fox2_5_11_second	1.054	1.37	100	136.90
RL255_10_11_first	0.701	0.89	100	88.73
RL255_10_11_second	0.717	0.91	100	90.95
RL256_10_11_first	0.586	0.73	100	73.13
RL256_10_11_second	0.585	0.73	100	72.96
WK947_10_11_first	0.334	0.39	100	38.66
Fox2_10_11_first	1.049	1.36	100	136.23
Fox2_10_11_second	1.065	1.38	100	138.46



Potassium 12/18/2011	Signal	Conc (mg/L)	Dilution Factor	Conc (mg/L)
Blank	0.000	0	1	0
Standard 1	0.115	0.25	1	0.25
Standard 2	0.215	0.5	1	0.5
Standard 3	0.397	1	1	1
Standard 4	0.712	2	1	2
Fox2_11_08	0.626	1.71	4	6.85
RL255_5_09	0.475	1.28	2	2.56
RL256_5_09	0.479	1.30	2	2.59
Fox2_5_09	0.479	1.30	4	5.18
RL255_11_09	0.444	1.19	2	2.39
RL256_11_09	0.500	1.35	2	2.71
Fox2_11_09	0.467	1.26	4	5.05
RL255_4_10	0.533	1.45	2	2.90
RL256_4_10	0.515	1.40	2	2.80
WK947_4_10	0.393	1.05	2	2.10
Fox2_4_10	0.384	1.02	4	4.10
Std1ppm	0.337	0.89	1	0.89
RL255_11_10	0.493	1.33	2	2.67
RL256_11_10	0.419	1.12	2	2.25
WK947_11_10	0.411	1.10	2	2.20
Fox2_11_10	0.561	1.53	4	6.12
RL255_5_11	0.434	1.17	2	2.33
RL256_5_11	0.391	1.04	2	2.09
WK947_5_11	0.401	1.07	2	2.15
Fox2_5_11	0.336	0.89	4	3.56
RL255_10_11	0.443	1.19	2	2.38
RL256_10_11	-0.154	-0.51	2	-1.01
WK947_10_11	0.416	1.12	2	2.23
Fox2_10_11	0.410	1.10	4	4.40
Std1ppm	0.326	0.86	1	0.86
RL255_5_11_first	0.433	1.16	2	2.33
RL256_5_11_first	0.410	1.10	2	2.20
WK947_5_11_first	0.374	1.00	2	1.99
WK947_5_11_second	0.377	1.00	2	2.01
Fox2_5_11_first	0.331	0.87	4	3.49
Fox2_5_11_second	0.333	0.88	4	3.52
RL255_10_11_first	0.435	1.17	2	2.34
RL255_10_11_second	0.434	1.17	2	2.33
RL256_10_11_first	0.398	1.07	2	2.13
RL256_10_11_second	0.398	1.06	2	2.13
WK947_10_11_first	0.364	0.97	2	1.94
Fox2_10_11_first	0.394	1.05	4	4.21
Fox2_10_11_second	0.393	1.05	4	4.20

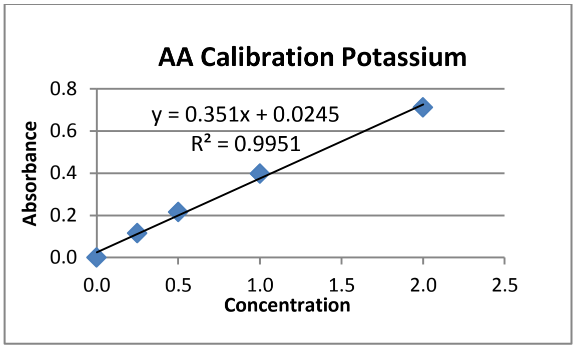


Table 8. Averages and Standard Deviations: RL255

bold dates are sample collection dates, plain text are analysis dates,
analysis dates ending in _# are dilutions of the same sample prepared on different dates, as are analysis dates followed by 1st or 2nd

Calcium		
18-Apr-07	**ppm**	**mmol**
	110.46	2.76
3/22/2012	113.66	2.84
AVE	112.06	2.80
03-Jun-08		
	115.40	2.88
3/22/2012	114.99	2.87
6/15/2012	75.16	1.88
AVE	101.85	2.54
STD		0.58
RSD		22.70
27-May-09		
	116.50	2.91
12/18/2011	112.46	2.81
AVE	114.48	2.86
16-Apr-10		
	109.98	2.74
12/18/2011	109.43	2.73
AVE	109.70	2.74
05-Nov-10		
	104.48	2.61
12/18/2011	108.09	2.70
AVE	106.29	2.65
06-May-11		
12/18/2011	114.19	2.85
12/2011 1st	112.70	2.81
3/22/2012_1	110.11	2.75
3/22/2012_2	107.79	2.69
3/22/2012_3	113.18	2.82
6/15/2012_2	110.73	2.76
6/15/2012_3	106.44	2.66
AVE	110.73	2.76
STD		0.07
RSD		2.59

04-Oct-11	**ppm**	**mmol**
12/18/2011	113.90	2.84
12/2011 1st	113.32	2.83
12/2011 2nd	112.55	2.81
3/22/2012_1	110.38	2.75
3/22/2012_2	108.09	2.70
3/22/2012_3	117.44	2.93
6/15/2012_2	109.67	2.74
6/15/2012_3	107.60	2.68
6/15/2012_4	108.52	2.71
AVE	111.27	2.78
STD		0.08
RSD		2.94
20-Feb-12		
3/22/2012	112.40	2.80
1/9/2013	109.05	2.72
2/25/2013	111.16	2.77
AVE	110.87	2.77
STD		0.04
RSD		1.52
25-May-12		
6/15/2012	107.55	2.68
1/9/2013	109.06	2.72
2/25/2013	110.63	2.76
AVE	109.08	2.72
STD		0.04
RSD		1.41
31-Oct-12		
1/9/2013	108.95	2.72
2/25/2013	112.69	2.81
2/27/2013	114.06	2.85
AVE	111.90	2.79
STD		0.07
RSD		2.36

Magnesium		
18-Apr-07	**ppm**	**mmol**
	52.35	2.15
3/22/2012	54.16	2.23
AVE	53.25	2.19
03-Jun-08		
	56.40	2.32
3/22/2012	53.99	2.22
6/15/2012	59.62	2.45
AVE	56.67	2.33
STD		0.12
RSD		4.99
27-May-09		
	56.00	2.30
12/18/2011	55.40	2.28
AVE	55.70	2.29
16-Apr-10		
	55.52	2.28
12/18/2011	54.90	2.26
AVE	55.21	2.27
05-Nov-10		
	57.55	2.37
12/18/2011	55.13	2.27
AVE	56.34	2.32
06-May-11		
12/18/2011	57.17	2.35
12/2011 1st	55.08	2.27
3/22/2012_1	53.51	2.20
3/22/2012_2	53.58	2.20
3/22/2012_3	53.55	2.20
6/15/2012_2	59.20	2.44
6/15/2012_3	58.91	2.42
AVE	55.86	2.30
STD		0.10
RSD		4.55

04-Oct-11	**ppm**	**mmol**
12/18/2011	56.19	2.31
12/2011 1st	55.21	2.27
12/2011 2nd	55.52	2.28
3/22/2012_1	53.77	2.21
3/22/2012_2	53.08	2.18
3/22/2012_3	54.22	2.23
6/15/2012_2	57.88	2.38
6/15/2012_3	59.34	2.44
6/15/2012_4	59.55	2.45
AVE	56.08	2.31
STD		0.10
RSD		4.22
20-Feb-12		
3/22/2012	54.39	2.24
1/9/2013	53.48	2.20
2/25/2013	50.38	2.07
AVE	52.75	2.17
STD		0.09
RSD		3.98
25-May-12		
6/15/2012	59.11	2.43
1/9/2013	50.78	2.09
2/25/2013	50.46	2.08
AVE	53.45	2.20
STD		0.20
RSD		9.18
31-Oct-12		
1/9/2013	51.84	2.13
2/25/2013	51.47	2.12
2/27/2013	53.10	2.18
AVE	52.14	2.15
STD		0.04
RSD		1.63

Sodium		
18-Apr-07	**ppm**	**mmol**
	38.59	1.68
3/23/2012	51.60	2.24
AVE	45.09	1.96
03-Jun-08		
	59.70	2.60
3/23/2012	54.36	2.36
6/15/2012	63.79	2.77
AVE	59.29	2.58
STD		0.21
RSD		7.98
27-May-09		
	60.60	2.63
12/18/2011	72.31	3.14
AVE	66.45	2.89
16-Apr-10		
	83.86	3.65
12/18/2011	82.08	3.57
AVE	82.97	3.61
05-Nov-10		
	84.12	3.66
12/18/2011	80.60	3.50
AVE	82.36	3.58
06-May-11		
12/18/2011	84.50	3.67
12/2011 1st	86.13	3.74
3/23/2012_1	76.80	3.34
3/23/2012_2	73.73	3.21
3/23/2012_3	77.11	3.35
6/15/2012_2	77.55	3.37
6/15/2012_3	76.32	3.32
AVE	78.88	3.43
STD		0.20
RSD		5.82

04-Oct-11	**ppm**	**mmol**
12/18/2011	92.75	4.03
12/2011 1st	88.73	3.86
12/2011 2nd	90.95	3.95
3/23/2012_1	78.63	3.42
3/23/2012_2	75.40	3.28
3/23/2012_3	77.93	3.39
6/15/2012_2	78.46	3.41
6/15/2012_3	81.92	3.56
6/15/2012_4	77.74	3.38
AVE	82.50	3.59
STD		0.28
RSD		7.91
20-Feb-12		
3/23/2012	79.59	3.46
1/9/2013	85.94	3.74
2/25/2013	84.26	3.66
AVE	83.26	3.62
STD		0.14
RSD		3.95
25-May-12		
6/15/2012	80.25	3.49
1/9/2013	87.93	3.82
2/25/2013	84.32	3.67
AVE	84.16	3.66
STD		0.17
RSD		4.57
31-Oct-12		
1/9/2013	98.04	4.26
2/25/2013	90.75	3.95
2/27/2013	94.69	4.12
AVE	94.49	4.11
STD		0.16
RSD		3.86

Potassium		
18-Apr-07	**ppm**	**mmol**
3/26/2012	2.38	0.06
	2.38	0.06
03-Jun-08		
	2.08	0.05
3/26/2012	2.53	0.06
6/15/2012	2.44	0.06
AVE	2.35	0.06
STD		0.01
RSD		10.13
27-May-09		
	1.32	0.03
12/18/2011	2.56	0.07
AVE	1.94	0.05
16-Apr-10		
	1.81	0.05
12/18/2011	2.90	0.07
AVE	2.35	0.06
05-Nov-10		
	2.79	0.07
12/18/2011	2.67	0.07
AVE	2.73	0.07
06-May-11		
12/18/2011	2.33	0.06
12/2011 1st	2.33	0.06
3/26/2012_1	2.37	0.06
3/26/2012_2	2.39	0.06
3/26/2012_3	2.56	0.07
6/15/2012_2	2.43	0.06
6/15/2012_3	2.64	0.07
AVE	2.44	0.06
STD		0.00
RSD		4.96

04-Oct-11	**ppm**	**mmol**
12/18/2011	2.38	0.06
12/2011 1st	2.34	0.06
12/2011 2nd	2.33	0.06
3/26/2012_1	2.42	0.06
3/26/2012_2	2.41	0.06
3/26/2012_3	2.72	0.07
6/15/2012_2	2.51	0.06
6/15/2012_3	2.64	0.07
6/15/2012_4	2.56	0.07
AVE	2.48	0.06
STD		0.00
RSD		5.49
20-Feb-12		
3/26/2012	2.75	0.07
1/9/2013	2.79	0.07
2/25/2013	2.82	0.07
AVE	2.78	0.07
STD		0.00
RSD		1.23
25-May-12		
6/15/2012	2.57	0.07
1/9/2013	2.78	0.07
2/25/2013	2.74	0.07
AVE	2.69	0.07
STD		0.00
RSD		4.16
31-Oct-12		
1/9/2013	2.84	0.07
2/25/2013	2.77	0.07
2/27/2013	2.67	0.07
AVE	2.76	0.07
STD		0.00
RSD		3.11

Table 9. Averages and Standard Deviations: RL256

bold dates are sample collection dates, plain text are analysis dates,
analysis dates ending in _# are dilutions of the same sample prepared on different dates, as are analysis dates followed by 1st or 2nd

Calcium		
18-Apr-07	**ppm**	**mmol**
	95.94	2.39
3/22/2012	106.21	2.65
AVE	101.08	2.52
03-Jun-08		
	114.30	2.85
3/22/2012	114.94	2.87
6/15/2012	105.30	2.63
AVE	111.51	2.78
STD		0.13
RSD		4.84
27-May-09		
	116.50	2.91
12/18/2011	111.06	2.77
AVE	113.78	2.84
16-Apr-10		
	110.20	2.75
12/18/2011	110.22	2.75
AVE	110.21	2.75
05-Nov-10		
	98.43	2.46
12/18/2011	100.74	2.51
AVE	99.59	2.48
06-May-11		
12/18/2011	116.58	2.91
12/2011 1st	115.83	2.89
3/22/2012_1	114.96	2.87
3/22/2012_2	60.03	1.50
3/22/2012_3	114.92	2.87
6/15/2012_2	111.88	2.79
6/15/2012_3	110.23	2.75
AVE	106.35	2.65
STD		0.51
RSD		19.32

04-Oct-11	**ppm**	**mmol**
12/18/2011	109.18	2.72
12/2011 1st	109.24	2.73
12/2011 2nd	107.73	2.69
3/22/2012_1	108.94	2.72
3/22/2012_2	57.67	1.44
3/22/2012_3	107.45	2.68
6/15/2012_2	106.05	2.65
6/15/2012_3	104.05	2.60
6/15/2012_4	104.65	2.61
AVE	101.66	2.54
STD		0.41
RSD		16.33
20-Feb-12		
3/22/2012	105.51	2.63
1/9/2013	102.77	2.56
2/25/2013	107.73	2.69
AVE	105.34	2.63
STD		0.06
RSD		2.36
25-May-12		
6/15/2012	105.97	2.64
1/9/2013	106.53	2.66
2/25/2013	112.50	2.81
AVE	108.33	2.70
STD		0.09
RSD		3.34
31-Oct-12		
1/9/2013	103.54	2.58
2/25/2013	107.40	2.68
2/27/2013	106.01	2.65
AVE	105.65	2.64
STD		0.05
RSD		1.85

Magnesium		
18-Apr-07	**ppm**	**mmol**
	48.68	2.00
3/22/2012	51.18	2.11
AVE	49.93	2.05
03-Jun-08		
	54.20	2.23
3/22/2012	52.30	2.15
6/15/2012	57.52	2.37
AVE	54.67	2.25
STD		0.11
RSD		4.84
27-May-09		
	55.50	2.28
12/18/2011	55.12	2.27
AVE	55.31	2.28
16-Apr-10		
	56.73	2.33
12/18/2011	55.76	2.29
AVE	56.24	2.31
05-Nov-10		
	53.93	2.22
12/18/2011	51.76	2.13
AVE	52.84	2.17
06-May-11		
12/18/2011	54.72	2.25
12/2011 1st	54.72	2.25
3/22/2012_1	53.51	2.20
3/22/2012_2	53.53	2.20
3/22/2012_3	58.23	2.40
6/15/2012_2	58.14	2.39
6/15/2012_3	58.04	2.39
AVE	55.84	2.30
STD		0.09
RSD		3.94

04-Oct-11	**ppm**	**mmol**
12/18/2011	52.27	2.15
12/2011 1st	52.45	2.16
12/2011 2nd	53.47	2.20
3/22/2012_1	50.41	2.07
3/22/2012_2	51.78	2.13
3/22/2012_3	51.89	2.13
6/15/2012_2	56.04	2.31
6/15/2012_3	55.54	2.29
6/15/2012_4	56.16	2.31
AVE	53.33	2.19
STD		0.09
RSD		3.93
20-Feb-12		
3/22/2012	51.23	2.11
1/9/2013	51.87	2.13
2/25/2013	47.90	1.97
AVE	50.33	2.07
STD		0.09
RSD		4.23
25-May-12		
6/15/2012	57.89	2.38
1/9/2013	51.96	2.14
2/25/2013	48.75	2.01
AVE	52.87	2.18
STD		0.19
RSD		8.77
31-Oct-12		
1/9/2013	49.66	2.04
2/25/2013	49.49	2.04
2/27/2013	49.88	2.05
AVE	49.68	2.04
STD		0.01
RSD		0.40

Sodium		
18-Apr-07	**ppm**	**mmol**
	21.83	0.95
3/23/2012	34.76	1.51
AVE	28.30	1.23
03-Jun-08		
	41.37	1.80
3/23/2012	54.07	2.35
6/15/2012	48.83	2.12
AVE	48.09	2.09
STD		0.28
RSD		13.28
27-May-09		
	47.53	2.07
12/18/2011	54.53	2.37
AVE	51.03	2.22
16-Apr-10		
	69.06	3.00
12/18/2011	62.92	2.74
AVE	65.99	2.87
05-Nov-10		
	59.90	2.60
12/18/2011	61.88	2.69
AVE	60.89	2.65
06-May-11		
12/18/2011	67.92	2.95
12/2011 1st	70.59	3.07
3/23/2012_1	65.52	2.85
3/23/2012_2	61.00	2.65
3/23/2012_3	64.72	2.81
6/15/2012_2	63.34	2.75
6/15/2012_3	66.19	2.88
AVE	65.61	2.85
STD		0.13
RSD		4.73

04-Oct-11	**ppm**	**mmol**
12/18/2011	72.43	3.15
12/2011 1st	73.13	3.18
12/2011 2nd	72.96	3.17
3/23/2012_1	68.15	2.96
3/23/2012_2	62.32	2.71
3/23/2012_3	62.43	2.71
6/15/2012_2	65.09	2.83
6/15/2012_3	64.48	2.80
6/15/2012_4	66.41	2.89
AVE	67.49	2.93
STD		0.19
RSD		6.52
20-Feb-12		
3/23/2012	68.59	2.98
1/9/2013	71.57	3.11
2/25/2013	67.97	2.96
AVE	69.37	3.02
STD		0.08
RSD		2.77
25-May-12		
6/15/2012	64.41	2.80
1/9/2013	75.04	3.26
2/25/2013	69.34	3.01
AVE	69.60	3.03
STD		0.23
RSD		7.65
31-Oct-12		
1/9/2013	74.83	3.25
2/25/2013	70.85	3.08
2/27/2013	72.45	3.15
AVE	72.71	3.16
STD		0.09
RSD		2.75

Potassium		
18-Apr-07		
3/26/2012	2.23	0.06
	2.23	0.06
03-Jun-08		
	2.04	0.09
3/26/2012	2.33	0.10
6/15/2012	2.39	0.10
AVE	2.25	0.10
STD		0.01
RSD		8.38
27-May-09		
	1.27	0.03
12/18/2011	2.59	0.07
AVE	1.93	0.05
16-Apr-10		
	1.91	0.05
12/18/2011	2.80	0.07
AVE	2.35	0.06
05-Nov-10		
	2.49	0.06
12/18/2011	2.25	0.06
AVE	2.37	0.06
06-May-11		
12/18/2011	2.09	0.05
12/2011 1st	2.20	0.06
3/26/2012_1	2.29	0.06
3/26/2012_2	2.31	0.06
3/26/2012_3	2.44	0.06
6/15/2012_2	2.35	0.06
6/15/2012_3	2.51	0.06
AVE	2.31	0.06
STD		0.00
RSD		6.17

04-Oct-11		
12/18/2011	2.12	0.05
12/2011 1st	2.13	0.05
12/2011 2nd	2.13	0.05
3/26/2012_1	2.22	0.06
3/26/2012_2	2.21	0.06
3/26/2012_3	2.39	0.06
6/15/2012_2	2.29	0.06
6/15/2012_3	2.48	0.06
6/15/2012_4	2.56	0.07
AVE	2.28	0.06
STD		0.00
RSD		7.20
20-Feb-12		
3/26/2012	2.58	0.07
1/9/2013	2.66	0.07
2/25/2013	2.62	0.07
AVE	2.62	0.07
STD		0.00
RSD		1.52
25-May-12		
6/15/2012	2.49	0.06
1/9/2013	2.37	0.06
2/25/2013	2.30	0.06
AVE	2.38	0.06
STD		0.00
RSD		3.97
31-Oct-12		
1/9/2013	2.81	0.07
2/25/2013	2.80	0.07
2/27/2013	2.66	0.07
AVE	2.76	0.07
STD		0.00
RSD		3.09

Table 10. Averages and Standard Deviations: WK947

bold dates are sample collection dates, plain text are analysis dates,

analysis dates ending in _# are dilutions of the same sample prepared on different dates, as are analysis dates followed by 1^{st} or 2^{nd}

Well	Sample Collection Date	pH	Calcium (ppm)	Magnesium (ppm)	Sodium (ppm)	Magnesium (ppm)	Potassium (ppm)	Alkalinity (ppm)	Chloride (ppm)	Sulfate (ppm)
WK 947	4/16/2010	6.90	88.10	52.07	34.72	52.07	1.70	380.64	77.32	74.98
	11/5/2010	7.50	90.29	56.14	34.71	56.14	1.90	394.40	74.90	90.00
	5/6/2011	6.94	97.78	54.70	37.15	54.70	2.16	388.11	85.02	120.97
	10/4/2011	6.93	91.78	56.62	35.71	56.62	2.16	419.57	82.56	103.81
	2/20/2012	7.00	94.65	53.03	38.45	53.03	2.33	406.92	87.25	94.03
	5/25/2012	7.04	91.77	55.39	35.01	55.39	2.37	398.40	88.19	95.68
	10/31/2012	7.13	93.33	51.84	38.59	51.84	2.52	399.28	81.43	93.97
	AVERAGE	**7.06**	**92.53**	**54.26**	**36.33**	**54.26**	**2.16**	**398.19**	**82.38**	**96.21**
	STD	**0.21**	**3.12**	**1.95**	**1.71**	**1.95**	**0.28**	**12.64**	**4.95**	**13.97**
	RSD%	**2.94**	**3.37**	**3.59**	**4.72**	**3.59**	**13.16**	**3.17**	**6.01**	**14.52**

Calcium		
16-Apr-10	**ppm**	**mmol**
	87.50	2.18
12/18/2011	88.71	2.21
AVE	88.10	2.20
05-Nov-10		
	87.62	2.19
12/18/2011	92.97	2.32
AVE	90.29	2.25
06-May-11		
12/18/2011	102.97	2.57
12/2011 1st	103.68	2.59
12/2011 2nd	103.75	2.59
3/22/2012_1	99.67	2.49
3/22/2012_2	95.41	2.38
3/22/2012_3	88.63	2.21
6/15/2012_2	101.01	2.52
6/15/2012_3	87.10	2.17
AVE	97.78	2.44
STD		0.17
RSD		6.86
04-Oct-11		
12/18/2011	99.30	2.48
12/2011 1st	101.27	2.53
3/22/2012_1	99.13	2.47
3/22/2012_2	52.30	1.30
3/22/2012_3	99.32	2.48
6/15/2012_2	95.95	2.39
6/15/2012_3	95.18	2.37
AVE	91.78	2.29
STD		0.44
RSD		19.11
20-Feb-12		
3/22/2012	98.30	2.45
1/9/2013	91.00	2.27
AVE	94.65	2.36
25-May-12		
6/15/2012	92.45	2.31
1/9/2013	91.09	2.27
AVE	91.77	2.29
31-Oct-12		
1/9/2013	93.33	2.33
AVE	93.33	2.33

Magnesium		
16-Apr-10	**ppm**	**mmol**
	54.65	2.25
12/18/2011	49.49	2.04
AVE	52.07	2.14
05-Nov-10		
	57.10	2.35
12/18/2011	55.18	2.27
AVE	56.14	2.31
06-May-11		
12/18/2011	51.70	2.13
12/2011 1st	56.94	2.34
12/2011 2nd	57.45	2.36
3/22/2012_1	55.12	2.27
3/22/2012_2	47.18	1.94
3/22/2012_3	56.17	2.31
6/15/2012_2	50.95	2.10
6/15/2012_3	62.09	2.55
AVE	54.70	2.25
STD		0.19
RSD		8.44
04-Oct-11		
12/18/2011	56.78	2.34
12/2011 1st	55.58	2.29
3/22/2012_1	53.82	2.21
3/22/2012_2	55.33	2.28
3/22/2012_3	54.08	2.23
6/15/2012_2	60.44	2.49
6/15/2012_3	60.33	2.48
AVE	56.62	2.33
STD		0.11
RSD		4.86
20-Feb-12		
3/22/2012	52.57	2.16
1/9/2013	53.48	2.20
AVE	53.03	2.18
25-May-12		
6/15/2012	60.01	2.47
1/9/2013	50.78	2.09
AVE	55.39	2.28
31-Oct-12		
1/9/2013	51.84	2.13
AVE	51.84	2.13

Sodium		
16-Apr-10	**ppm**	**mmol**
	37.73	1.64
12/18/2011	31.71	1.38
AVE	34.72	1.51
05-Nov-10		
	36.65	1.59
12/18/2011	32.76	1.42
AVE	34.71	1.51
06-May-11		
12/18/2011	37.75	1.64
12/2011 1st	39.07	1.70
12/2011 2nd	41.49	1.80
3/23/2012_1	35.00	1.52
3/23/2012_2	33.32	1.45
3/23/2012_3	37.77	1.64
6/15/2012_2	35.17	1.53
6/15/2012_3	37.66	1.64
AVE	37.15	1.62
STD		0.11
RSD		6.96
04-Oct-11		
12/18/2011	35.97	1.56
12/2011 1st	38.66	1.68
3/23/2012_1	34.98	1.52
3/23/2012_2	32.09	1.40
3/23/2012_3	38.63	1.68
6/15/2012_2	33.91	1.47
6/15/2012_3	35.73	1.55
AVE	35.71	1.55
STD		0.10
RSD		6.68
20-Feb-12		
3/23/2012	37.00	1.61
1/9/2013	39.90	1.73
AVE	38.45	1.67
25-May-12		
6/15/2012	31.16	1.35
1/9/2013	38.85	1.69
AVE	35.01	1.52
31-Oct-12		
1/9/2013	38.59	1.68
AVE	38.59	1.68

Potassium		
16-Apr-10	**ppm**	**mmol**
	1.30	0.03
12/18/2011	2.10	0.05
AVE	1.70	0.04
05-Nov-10		
	1.59	0.04
12/18/2011	2.20	0.06
AVE	1.90	0.05
06-May-11		
12/18/2011	2.15	0.05
12/2011 1st	1.99	0.05
12/2011 2nd	2.01	0.05
3/22/2012_1	2.09	0.05
3/22/2012_2	2.08	0.05
3/22/2012_3	2.38	0.06
6/15/2012_2	2.18	0.06
6/15/2012_3	2.37	0.06
AVE	2.16	0.06
STD		0.00
RSD		6.92
04-Oct-11		
12/18/2011	2.23	0.06
12/2011 1st	1.94	0.05
3/22/2012_1	2.13	0.05
3/22/2012_2	2.06	0.05
3/22/2012_3	2.30	0.06
6/15/2012_2	2.09	0.05
6/15/2012_3	2.39	0.06
AVE	2.16	0.06
STD		0.00
RSD		7.20
20-Feb-12		
3/22/2012	2.33	0.06
1/9/2013	bad	
AVE	2.33	0.06
25-May-12		
6/15/2012	2.25	0.06
1/9/2013	2.49	0.06
AVE	2.37	0.06
31-Oct-12		
1/9/2013	2.52	0.06
AVE	2.52	0.06

Table 11. Averages and Standard Deviations: Fox River Sites

bold dates are sample collection dates, plain text are analysis dates,
analysis dates ending in _# are dilutions of the same sample prepared on different dates, as are analysis dates followed by 1st or 2nd

River Site	Sample Collection Date	pH	Calcium (ppm)	Magnesium (ppm)	Sodium (ppm)	Magnesium (ppm)	Potassium (ppm)	Alkalinity (ppm)	Chloride (ppm)	Sulfate (ppm)
Fox 0	11/2/2008	7.60	83.80	48.90	55.77	48.90	1.86	386.59	120.91	85.01
	5/26/2009	8.12	78.20	40.50	55.57	40.50	1.41	352.82	115.51	46.45
	11/11/2009	8.05	88.16	45.81	69.59	45.81	3.49	345.18	127.89	88.47
	4/16/2010	7.76	75.30	39.16	72.13	39.16	1.96	287.82	111.38	52.72
	11/7/2010	7.97	79.47	40.84	71.34	40.84	2.43	370.68	117.30	71.90
	5/12/2011	7.65	74.55	41.82	63.11	41.82	1.76	360.17	115.97	50.08
	10/22/2011	7.75	80.70	48.11	79.52	48.11	2.92	367.23	155.64	81.00
	2/18/2012	8.09	85.77	45.34	67.24	45.34	2.19	363.11	127.40	78.72
	5/23/2012	7.99	76.75	48.37	65.84	48.37	2.27	329.30	125.59	78.91
	11/3/2012	7.29	88.70	48.43	120.42	48.43	3.06	406.24	154.64	99.99
	AVERAGE	**7.83**	**81.14**	**44.73**	**72.05**	**44.73**	**2.33**	**356.92**	**127.22**	**73.32**
	STD	**0.27**	**5.20**	**3.80**	**18.50**	**3.80**	**0.65**	**32.23**	**15.69**	**17.91**
	RSD%	**3.39**	**6.41**	**8.49**	**25.68**	**8.49**	**27.79**	**9.03**	**12.33**	**24.42**
Fox 1	4/23/2007	8.00	76.10	37.38	139.89	37.38		278.16	190.00	56.00
	6/6/2007	8.21	73.86	36.15	94.27	36.15		234.24	210.00	53.00
	9/13/2007	8.03	79.78	42.08	98.58	42.08		327.00	180.00	43.00
	6/4/2008	7.91	92.80	47.80	151.34	47.80	4.76	348.92	264.44	57.74
	11/2/2008	8.12	88.30	47.40	146.77	47.40	3.64	375.92	270.86	73.80
	6/4/2009	8.08	87.20	44.60	117.82	44.60	3.28	352.82	262.97	50.40
	11/11/2009	8.36	83.49	43.43	137.34	43.43	4.95	326.36	255.72	71.22
	4/16/2010	7.70	38.62	42.35	137.91	42.35	3.66	318.27	231.22	56.14
	11/7/2010	8.30	79.00	40.71	133.12	40.71	6.69	331.45	244.20	62.50
	5/12/2011	7.67	82.93	46.30	125.54	46.30	4.03	364.00	255.68	56.38
	10/22/2011	7.85	54.47	41.77	116.51	41.77	3.80	273.44	233.00	54.61
	2/18/2012	8.28	88.93	48.90	165.30	48.90	4.46	354.00	354.09	74.67
	5/25/2012	7.94	79.91	51.04	164.49	51.04	5.17	320.48	351.23	73.05
	11/3/2012	8.07	86.11	47.91	170.41	47.91	5.59	326.85	336.34	103.38
	AVERAGE	**8.04**	**77.96**	**44.13**	**135.66**	**44.13**	**4.55**	**323.71**	**259.98**	**63.28**
	STD	**0.21**	**14.63**	**4.37**	**23.52**	**4.37**	**1.01**	**38.71**	**54.63**	**15.06**
	RSD%	**2.63**	**18.76**	**9.90**	**17.34**	**9.90**	**22.31**	**11.96**	**21.01**	**23.80**
Fox 3	4/21/2007	8.00	56.22	25.98	46.17	25.98		258.64	140.00	45.00
	6/6/2007	7.99	58.72	29.61	44.57	29.61		223.26	93.00	29.00
	9/13/2007	7.90	71.68	34.99	71.32	34.99		389.00	130.00	36.00
	6/4/2008	7.63	78.20	40.40	71.34	40.40	2.64	326.96	143.41	30.66
	11/2/2008	8.14	80.50	44.20	71.25	44.20	2.75	392.90	152.21	47.56
	6/4/2009	8.15	73.70	39.80	62.97	39.80	0.99	358.70	136.38	30.50
	11/10/2009	8.59	80.29	40.29	83.83	40.29	3.65	339.01	160.41	51.36
	4/21/2010	7.80	78.32	41.68	109.93	41.68	3.24	322.37	174.41	48.64
	11/8/2010	7.34	76.59	38.31	86.37	38.31	5.66	331.16	158.20	45.30
	5/6/2011	7.69	75.02	36.27	81.49	36.27	2.60	311.66	167.47	44.15
	10/22/2011	7.74	65.07	36.79	97.53	36.79	3.72	305.49	200.16	52.52
	2/20/2012	7.64	77.96	43.11	100.20	43.11	3.71	345.77	226.66	61.86
	5/30/2012	7.72	52.87	35.02	82.42	35.02	3.19	230.60	161.25	40.84
	11/3/2012	8.07	90.27	44.53	121.99	44.53	5.02	258.74	242.61	103.40
	AVERAGE	**7.89**	**72.53**	**37.93**	**80.81**	**37.93**	**3.38**	**313.87**	**163.30**	**47.63**
	STD	**0.30**	**10.59**	**5.35**	**22.09**	**5.35**	**1.24**	**53.64**	**38.91**	**18.58**
	RSD%	**3.86**	**14.60**	**14.11**	**27.34**	**14.11**	**36.85**	**17.09**	**23.83**	**39.00**

River Site	Sample Collection Date	pH	Calcium (ppm)	Magnesium (ppm)	Sodium (ppm)	Magnesium (ppm)	Potassium (ppm)	Alkalinity (ppm)	Chloride (ppm)	Sulfate (ppm)
Fox 2	4/23/2007		72.19	35.10	141.07	35.10	4.14	252.30	200.00	55.00
	6/6/2007	8.39	73.24	34.44	141.98	34.44	4.48	263.52	200.00	54.00
	9/13/2007	8.02	76.13	40.48	112.29	40.48	5.51	398.00	180.00	47.00
	6/4/2008	7.70	86.48	46.13	164.77	46.13	6.23	346.48	281.68	55.94
	11/2/2008	8.00	92.18	42.47	156.12	42.47	6.47	385.63	284.97	47.56
	6/4/2009	7.71	90.56	38.18	137.39	38.18	4.23	346.94	270.95	47.69
	11/10/2009	8.09	89.82	38.94	150.10	38.94	5.37	329.30	279.76	71.66
	4/16/2010	7.74	84.81	45.86	144.28	45.86	3.97	323.54	247.97	58.03
	11/7/2010	8.08	86.45	45.35	151.31	45.35	6.70	332.91	270.30	61.80
	5/6/2011	7.86	85.22	43.01	130.72	43.01	3.75	329.30	263.21	59.50
	10/22/2011	7.55	66.28	51.60	132.01	51.60	4.31	276.67	265.61	59.37
	2/18/2012	7.40	91.96	43.49	180.24	43.49	5.03	330.18	384.46	82.36
	5/25/2012	7.73	77.63	42.20	158.25	42.20	5.56	303.58	324.06	70.79
	11/3/2012	7.82	88.50	44.16	181.72	44.16	6.05	314.60	369.09	96.34
	AVERAGE	**7.85**	**82.96**	**42.24**	**148.73**	**42.24**	**5.13**	**323.78**	**273.00**	**61.93**
	STD	**0.26**	**8.31**	**4.59**	**18.97**	**4.59**	**0.99**	**41.16**	**58.59**	**14.09**
	RSD%	**3.32**	**10.02**	**10.86**	**12.75**	**10.86**	**19.38**	**12.71**	**21.46**	**22.75**

Calcium		
23-Apr-07	**ppm**	**mmol**
	73.40	1.83
3/26/2012	70.98	1.77
AVE	72.19	1.80
06-Jun-07		
	73.71	1.84
3/26/2012	72.78	1.82
AVE	73.24	1.83
13-Sep-07		
	80.55	2.01
3/26/2012	71.70	1.79
AVE	76.13	1.90
04-Jun-08		
	98.50	2.46
3/26/2012	81.52	2.03
6/15/2012	79.43	1.98
AVE	86.48	2.16
STD		0.26
RSD		12.09
02-Nov-08		
	94.00	2.35
12/18/2011	94.88	2.37
3/26/2012	87.65	2.19
AVE	92.18	2.30
STD		0.10
RSD		4.28
04-Jun-09		
	92.80	2.32
12/18/2011	88.32	2.20
AVE	90.56	2.26
10-Nov-09		
	89.32	2.23
12/18/2011	90.31	2.25
AVE	89.82	2.24
17-Apr-10		
	84.03	2.10
12/18/2011	85.60	2.14
AVE	84.81	2.12
07-Nov-10		
	81.71	2.04
12/18/2011	90.72	2.26
3/26/2012	86.92	2.17
AVE	86.45	2.16
STD		0.11
RSD		5.23

06-May-11	**ppm**	**mmol**
12/18/2011	89.42	2.23
12/2011 1st	85.08	2.12
12/2011 2nd	87.14	2.17
3/26/2012_1	81.51	2.03
3/26/2012_2	86.53	2.16
3/26/2012_3	84.26	2.10
6/15/2012_2	84.57	2.11
6/15/2012_3	83.26	2.08
AVE	85.22	2.13
STD		0.06
RSD		2.88
22-Oct-11		
12/18/2011	69.19	1.73
12/2011 1st	65.93	1.65
12/2011 2nd	67.37	1.68
3/26/2012_1	63.85	1.59
3/26/2012_2	68.04	1.70
3/26/2012_3	66.55	1.66
6/15/2012_3	63.06	1.57
AVE	66.28	1.65
STD		0.06
RSD		3.33
18-Feb-12		
3/26/2012	89.47	2.23
1/9/2013	96.43	2.41
2/25/2013	89.99	2.25
AVE	91.96	2.29
STD		0.10
RSD		4.21
25-May-12		
6/15/2012	77.91	1.94
1/9/2013	76.08	1.90
2/25/2013	78.92	1.97
AVE	77.63	1.94
STD		0.04
RSD		1.85
3-Nov-12		
1/9/2013	90.61	2.26
2/25/2013	87.51	2.18
2/27/2013	87.37	2.18
AVE	88.50	2.21
STD		0.05
RSD		2.07

Magnesium		
23-Apr-07	**ppm**	**mmol**
	35.04	1.44
3/26/2012	35.16	1.45
AVE	35.10	1.44
06-Jun-07		
	33.56	1.38
3/26/2012	35.33	1.45
AVE	34.44	1.42
13-Sep-07		
	40.94	1.68
3/26/2012	40.02	1.65
AVE	40.48	1.67
04-Jun-08		
	46.40	1.91
3/26/2012	42.91	1.77
6/15/2012	49.08	2.02
AVE	46.13	1.90
STD		0.13
RSD		6.71
02-Nov-08		
	45.60	1.88
3/26/2012	39.34	1.62
AVE	42.47	1.75
STD		
RSD		
04-Jun-09		
12/18/2011	38.18	1.57
	38.18	1.57
10-Nov-09		
	43.96	1.81
12/18/2011	33.91	1.40
AVE	38.94	1.60
17-Apr-10		
	45.31	1.86
12/18/2011	46.42	1.91
AVE	45.86	1.89
07-Nov-10		
	46.66	1.92
12/18/2011	47.36	1.95
3/26/2012	42.03	1.73
AVE	45.35	1.87
STD		0.12
RSD		6.40

06-May-11	**ppm**	**mmol**
12/18/2011	47.50	1.95
12/2011 2nd	44.68	1.84
3/26/2012_2	36.87	1.52
3/26/2012_3	38.06	1.57
6/15/2012_2	44.73	1.84
6/15/2012_3	46.23	1.90
AVE	43.01	1.77
STD		0.18
RSD		10.32
22-Oct-11		
12/18/2011	42.99	1.77
12/2011 1st	71.59	2.95
12/2011 2nd	43.75	1.80
3/26/2012_1	65.97	2.71
3/26/2012_2	66.07	2.72
3/26/2012_3	36.41	1.50
6/15/2012_2	42.71	1.76
6/15/2012_3	43.29	1.78
AVE	51.60	2.12
STD		0.57
RSD		26.72
18-Feb-12		
3/26/2012	42.51	1.75
1/9/2013	45.77	1.88
2/25/2013	42.19	1.74
AVE	43.49	1.79
STD		0.08
RSD		4.56
25-May-12		
6/15/2012	46.35	1.91
1/9/2013	40.45	1.66
2/25/2013	39.80	1.64
AVE	42.20	1.74
STD		0.15
RSD		8.55
3-Nov-12		
1/9/2013	48.74	2.01
2/25/2013	41.51	1.71
2/27/2013	42.23	1.74
AVE	44.16	1.82
STD		0.16
RSD		9.02

Sodium		
23-Apr-07	**ppm**	**mmol**
	170.27	7.40
3/26/2012	111.86	4.86
AVE	141.07	6.13
06-Jun-07		
	158.93	6.91
3/26/2012	125.04	5.44
AVE	141.98	6.17
13-Sep-07		
	105.35	4.58
3/26/2012	119.23	5.18
AVE	112.29	4.88
04-Jun-08		
mh	173.41	7.54
3/26/2012	161.26	7.01
6/15/2012	159.64	6.94
AVE	164.77	7.16
STD		0.33
RSD		4.57
02-Nov-08		
	141.14	6.14
12/18/2011	165.53	7.20
3/26/2012	161.69	7.03
AVE	156.12	6.79
STD		0.57
RSD		8.40
04-Jun-09		
	126.71	5.51
12/18/2011	148.07	6.44
AVE	137.39	5.97
10-Nov-09		
	155.82	6.77
12/18/2011	144.37	6.28
AVE	150.10	6.53
17-Apr-10		
	153.10	6.66
12/18/2011	135.46	5.89
AVE	144.28	6.27
07-Nov-10		
	153.04	6.65
12/18/2011	153.20	6.66
3/26/2012	147.69	6.42
AVE	151.31	6.58
STD		0.14
RSD		2.07

06-May-11	**ppm**	**mmol**
12/18/2011	132.67	5.77
12/2011 1st	134.16	5.83
12/2011 2nd	136.90	5.95
3/26/2012_1	126.83	5.51
3/26/2012_2	128.35	5.58
3/26/2012_3	129.67	5.64
6/15/2012_2	126.70	5.51
6/15/2012_3	130.48	5.67
AVE	130.72	5.68
STD		0.16
RSD		2.77
22-Oct-11		
12/18/2011	134.19	5.83
12/2011 1st	136.23	5.92
12/2011 2nd	138.46	6.02
3/26/2012_1	130.36	5.67
3/26/2012_2	128.65	5.59
3/26/2012_3	128.61	5.59
6/15/2012_2	130.10	5.66
6/15/2012_3	129.47	5.63
AVE	132.01	5.74
STD		0.16
RSD		2.86
18-Feb-12		
3/26/2012	181.08	7.87
1/9/2013	180.71	7.86
2/25/2013	178.93	7.78
AVE	180.24	7.84
STD		0.05
RSD		0.64
25-May-12		
6/15/2012	155.69	6.77
1/9/2013	162.31	7.06
2/25/2013	156.75	6.82
AVE	158.25	6.88
STD		0.15
RSD		2.25
3-Nov-12		
1/9/2013	181.71	7.90
2/25/2013	181.49	7.89
2/27/2013	181.96	7.91
AVE	181.72	7.90
STD		0.01
RSD		0.13

Potassium		
23-Apr-07	**ppm**	**mmol**
3/26/2012	4.14	0.11
	4.14	0.11
06-Jun-07		
3/26/2012	4.48	0.11
	4.48	0.11
13-Sep-07		
3/26/2012	5.51	0.14
	5.51	0.14
04-Jun-08		
	5.57	0.14
3/26/2012	6.64	0.17
6/15/2012	6.47	0.17
AVE	6.23	0.16
STD		0.01
RSD		9.24
02-Nov-08		
	5.41	0.14
12/18/2011	6.85	0.18
3/26/2012	7.14	0.18
AVE	6.47	0.17
STD		0.02
RSD		14.27
04-Jun-09		
	3.28	0.08
12/18/2011	5.18	0.13
AVE	4.23	0.11
10-Nov-09		
	5.70	0.15
12/18/2011	5.05	0.13
AVE	5.37	0.14
17-Apr-10		
	3.84	0.10
12/18/2011	4.10	0.10
AVE	3.97	0.10

06-May-11	**ppm**	**mmol**
12/18/2011	2.15	0.05
12/2011 1st	3.49	0.09
12/2011 2nd	3.52	0.09
3/26/2012_1	3.87	0.10
3/26/2012_2	3.86	0.10
3/26/2012_3	4.65	0.12
6/15/2012_2	3.90	0.10
6/15/2012_3	4.57	0.12
AVE	3.75	0.10
STD		0.02
RSD		20.71
22-Oct-11		
12/18/2011	2.23	0.06
12/2011 1st	4.21	0.11
12/2011 2nd	4.20	0.11
3/26/2012_1	4.44	0.11
3/26/2012_2	4.45	0.11
3/26/2012_3	5.24	0.13
6/15/2012_2	4.58	0.12
6/15/2012_3	5.15	0.13
AVE	4.31	0.11
STD		0.02
RSD		21.52
18-Feb-12		
3/26/2012	4.89	0.13
1/9/2013	5.20	0.13
2/25/2013	5.00	0.13
AVE	5.03	0.13
STD		0.00
RSD		3.10
25-May-12		
6/15/2012	5.71	0.15
1/9/2013	5.53	0.14
2/25/2013	5.44	0.14
AVE	5.56	0.14
STD		0.00
RSD		2.42
3-Nov-12		
1/9/2013	6.43	0.16
2/25/2013	6.33	0.16
2/27/2013	5.39	0.14
AVE	6.05	0.15
STD		0.01
RSD		9.44

Table 12. Averages and Standard Deviations: WWTPs
bold dates are sample collection dates, plain text are analysis dates,
analysis dates ending in _# are dilutions of the same sample prepared on different dates, as are analysis dates followed by 1st or 2nd

WWTP	Sample Collection Date	Calcium (ppm)	Magnesium (ppm)	Sodium (ppm)	Magnesium (ppm)	Potassium (ppm)	Alkalinity (ppm)	Chloride (ppm)	Sulfate (ppm)
Brookfield	10/11/2008	103.00	44.50	281.10	44.50	10.86	215.03	538.08	104.15
	12/13/2008	117.60	49.60	365.58	49.60	10.56	263.17	672.78	101.29
	1/23/2009	106.40	47.00	282.66	47.00	9.56	239.49	619.22	94.89
	3/28/2009	108.60	46.00	257.79	46.00	7.24	207.57	537.71	73.69
	5/23/2009	107.50	49.50	245.54	49.50	6.37	198.92	507.98	83.61
	7/1/2009	106.40	46.90	286.82	46.90	10.02	221.59	558.34	94.85
	11/14/2009	101.56	44.30	329.48	44.30	12.96	152.00	596.77	136.42
	4/23/2010	106.25	48.90	307.86	48.90	9.23	441.60	519.15	100.43
	11/11/2010	101.51	42.20	322.10	42.20	15.58	227.60	558.10	110.80
	5/12/2011	104.34	45.99	301.47	45.99	11.86	249.40	625.25	111.86
	10/3/2011	96.82	43.83	309.04	43.83	11.73	248.40	618.38	111.86
	2/16/2012	106.13	48.46	357.82	48.46	13.28	299.80	754.16	124.69
	5/22/2012	105.78	54.99	315.67	54.99	12.70	295.40	726.53	119.23
	11/14/2012	95.93	44.18	354.11	44.18	12.49	289.70	661.10	126.77
Sussex	10/11/2008	92.80	39.30	260.81	39.30	14.01	169.03	409.85	91.22
	12/13/2008	100.70	41.90	307.91	41.90	12.66	257.63	679.04	87.31
	1/23/2009	92.80	40.10	279.75	40.10	9.64	212.48	554.38	79.63
	3/28/2009	94.00	39.70	216.60	39.70	6.73	166.54	432.41	67.51
	5/23/2009	97.40	43.40	199.85	43.40	6.44	156.26	404.03	66.91
	7/1/2009	94.00	42.10	233.25	42.10	7.47	171.23	444.05	73.58
	11/14/2009	89.03	39.99	301.06	39.99	14.13	221.00	536.60	123.17
	4/23/2010	89.52	42.60	295.80	42.60	11.73	183.70	465.69	85.22
	11/11/2010	83.50	36.50	281.41	36.50	16.40	186.90	471.60	91.00
	5/12/2011	86.01	38.17	237.37	38.17	9.80	181.70	460.53	82.33
	10/2/2011	83.74	36.22	264.36	36.22	12.69	197.50	493.92	103.32
	2/16/2012	92.49	41.33	315.39	41.33	13.46	237.40	606.47	108.26
	5/22/2012	91.85	47.17	267.84	47.17	12.21	213.90	545.22	98.87
	11/14/2012	87.02	43.51	323.84	43.51	12.74	217.80	543.21	105.55
Waukesha	2/1/2007	198.92	82.11	301.14	82.11		205.91	510.00	88.00
	10/4/2007	47.34	23.55	315.00	23.55		190.12	440.00	90.00
	9/12/2008	101.90	38.30	248.97	38.30	13.61	224.70	486.95	97.32
	12/13/2008	109.70	40.80	298.05	40.80	14.50	255.10	585.58	92.22
	1/23/2009	98.50	38.60	246.57	38.60	7.10	229.92	568.64	92.19
	3/28/2009	103.00	39.30	246.84	39.30	8.28	197.71	498.87	75.00
	5/23/2009	107.50	45.20	232.31	45.20	7.91	189.99	478.70	69.12
	7/1/2009	105.20	42.40	244.34	42.40	8.51	198.58	488.25	71.14
	11/14/2009	94.28	42.14	306.29	42.14	12.96	235.70	550.70	114.89
	4/23/2010	99.35	42.88	287.31	42.88	8.04	205.50	492.64	90.71
	11/11/2010	89.55	37.50	283.30	37.50	16.06	205.30	480.50	94.80
	5/12/2011	101.09	42.72	275.58	42.72	11.24	246.40	604.24	105.31
	10/3/2011	91.81	36.10	289.22	36.10	11.25	238.60	557.43	126.24
	2/19/2012	93.45	36.03	306.11	36.03	12.63	255.30	602.81	122.98
	5/24/2012	96.04	46.10	294.52	46.10	13.15	266.00	633.59	117.09
	11/14/2012	90.06	38.40	307.99	38.40	13.66	254.50	597.65	110.88
	AVERAGE	**99.33**	**43.19**	**286.04**	**43.19**	**11.27**	**225.50**	**548.12**	**98.10**
	STD	**18.82**	**7.86**	**36.63**	**7.86**	**2.73**	**48.84**	**81.42**	**17.93**
	RSD%	**18.95**	**18.20**	**12.81**	**18.20**	**24.19**	**21.66**	**14.85**	**18.28**

Table 13. Trace Element Results

Well		**B ppb**	**I ppb**	**Li ppb**	**River Site**		**B ppb**	**I ppb**	**Li ppb**	**WWTP**		**B ppb**	**I ppb**	**Li ppb**
RL255	6/3/2008	24.42	<0.05	4.58	**Fox 0**	7/10/2008	30.52	<0.05	1.78	**Brookfield**	5/23/2009	182.73	<0.05	11.49
	5/27/2009	41.01	<0.05	5.6		5/26/2009	41.37	<0.05	3.38		11/14/2009	194.29	20	11.9
	11/10/2009	47.36	<0.05	5.62		11/11/2009	62.64	<0.05	5		4/23/2010	199.97	<0.05	12.03
	4/16/2010	49.56	<0.05	6.22		4/16/2010	41.8	0.1	2.73		11/11/2010	216.69	14.3	12.19
	11/5/2010	50.98	19.9	4.74		11/7/2010	50.87	<0.05	3.83		5/12/2011	146.09	28.4	7.96
	5/6/2011	50.51	14.2	6.06		5/12/2011	41.47	<0.05	3.65		10/11/2012	220.72	<0.05	15.34
	2/12/2012	40.34	53.7	8.3	**Fox 2**	6/4/2008	97.54	<0.05	5.55	**Sussex**	5/23/2009	147.8	<0.05	5.44
RL256	6/3/2008	26.62	<0.05	7.22		6/4/2009	80.02	<0.05	4.53		11/14/2009	188.87	<0.05	7.18
	5/27/2009	43.07	<0.05	6.5		11/10/2009	96.33	<0.05	4.13		4/23/2010	171.52	3	6.97
	11/10/2009	41.05	<0.05	5.03		4/16/2010	106.93	<0.05	4.42		11/11/2010	219.05	<0.05	8.01
	4/16/2010	45.52	3	8.81		11/7/2010	100.53	<0.05	5.6		5/12/2011	79.13	<0.05	2.82
	11/5/2010	44.31	<0.05	7.31		5/6/2011	61.12	<0.05	4.49		10/11/2012	232.1	11.5	7.26
	5/6/2011	49.98	<0.05	6.38		10/11/2012	178.38	17.1	5.21	**Waukesha**	5/23/2009	148.21	<0.05	7.31
WK947	4/16/2010	51.5	<0.05	7.62	**Fox 3**	6/4/2008	48.7	<0.05	3.72		11/14/2009	204.2	<0.05	8.62
	11/5/2010	47.29	<0.05	5.37		6/4/2009	57.07	<0.05	2.44		4/23/2010	187.53	5.8	9.91
	5/6/2011	44.95	<0.05	6.25		11/10/2009	66.75	<0.05	3.93		11/11/2010	205.2	<0.05	9.05
						4/21/2010	58.21	<0.05	3.24		5/12/2011	100.87	<0.05	3.02
Check	std 2 ppm	1879.8	1827	2000.7		11/8/2010	61.43	<0.05	4.62		10/11/2012	255.68	<0.05	8.71
Check	std 2 ppm	1695.2	1474	1957		5/6/2011	57.71	<0.05	2.79					
Check	blk	1.35	<0.05	0.7		10/11/2012	101.12	45.4	5.17					

Table 14. Stable Isotopes Results

Well		**δ(18_16) Meanδ**	**δ(D_H) Mean**	**River Site**		**δ(18_16) Meanδ**	**δ(D_H) Mean**
RL255	Feb-12	-9.44	-61.83	**Fox 0**	Feb-12	-9.43	-62.92
	Oct-11	-9.38	-61.08		Oct-11	-8.47	-56.94
	Nov-10	-9.29	-60.40		Nov-10	-8.39	-55.61
	Nov-09	-9.17	-59.82		Nov-09	-8.85	-58.87
	Group Ave	-9.32	-60.78		Group Ave	-8.78	-58.58
	Group Std	0.12	0.87		Group Std	0.47	3.19
	RSD%	-1.25	-1.42		RSD%	-5.40	-5.44
	d-excess	**13.78**			**d-excess**	**11.69**	
RL256	Feb-12	-9.21	-60.06	**Fox 2**	Feb-12	-8.96	-61.55
	Oct-11	-9.21	-59.98		Oct-11	-6.96	-50.01
	Nov-10	-9.18	-59.68		Nov-10	-8.09	-55.14
	Nov-09	-9.15	-59.48		Nov-09	-8.41	-57.04
	Group Ave	-9.19	-59.80		Group Ave	-8.11	-55.93
	Group Std	0.03	0.27		Group Std	0.85	4.78
	RSD%	-0.29	-0.45		RSD%	-10.44	-8.54
	d-excess	**13.71**			**d-excess**	**8.92**	
WK 947	Feb-12	-9.17	-59.64	**WWTP**			
	Oct-11	-9.18	-59.76	**Brookfield**	Oct-11	-10.62	-72.44
	Nov-10	-9.11	-59.20	**Sussex**	Oct-11	-9.77	-65.29
	Group Ave	-9.16	-59.53	**Waukesha**	Oct-11	-9.83	-65.63
	Group Std	0.04	0.30		Group Ave	-10.07	-67.79
	RSD%	-0.41	-0.50		Group Std	0.47	4.03
	d-excess	**13.72**			RSD%	-4.69	-5.95
					d-excess	**12.81**	

Appendix C:

PHREEQC Modeling Data

RL255 Inverse Modeling Input File

```
SOLUTION 1 initial wauk 1 1_05
   temp      10
   pH        7.8
   pe        8.4
   redox     pe
   units     mmol/l
   density   1
   Alkalinity 6.8
   Ca        2.99
   Cl        3.38
   K         0.01
   Mg        2.3
   Na        1.35
   S(6)      0.8
   -water    1 # kg
SOLUTION 2 infilling fx2 aveall
   temp      10
   pH        7.85
   pe        8.4
   redox     pe
   units     mmol/l
   density   1
   Ca        2.07
   Mg        1.61
   Na        6.45
   K         0.13
   Alkalinity 5.01
   Cl        7.69
   S(6)      0.64
   -water    1 # kg
SOLUTION 3 wauk ave 2/12 5/12 10/12
   temp      10
   pH        6.88
   pe        8.4
   redox     pe
   units     mmol/l
   density   1
   Ca        2.76
   Mg        2.17
   Na        3.80
   K         0.07
   Alkalinity 7.36
   Cl        5.09
   S(6)      0.77
   -water    1 # kg

INVERSE_MODELING 1
   -solutions      1       2       3
   -uncertainty   0.1     0.1     0.1
   -phases
      Calcite
      Dolomite
      CO2(g)
      #CaX2
      #MgX2
      #NaX
   -balances
      Cl        0.03     0.03     0.03
      K         0.1      0.1      0.2
      S(6)       0.1      0.1      0.1
                     Na        0.1      0.1      0.1
   -range           1000
   -tolerance         1e-010
   -mineral_water     true

SELECTED_OUTPUT
   -file              F:\FOR ANNA\Major Ions\THESIS data\PHREEQC\Well RL255\INVERSE_RL255_unc_ave_3.out.sel
   -reset              true
   -totals             Alkalinity  Ca  Mg  K  Na  Cl
   -molalities          CaCO3  CO2  MgCO3
   -saturation_indices  Calcite  Dolomite  CO2(g)
   -gases              CO2(g)
   -inverse_modeling      true
END
```

RL256 Inverse Modeling Input File

```
SOLUTION 1 initial wauk12 1_05
   temp      10
   pH       6.90
   pe       8.4
   redox    pe
   units    mmol/l
   density   1
   Alkalinity 6.61
   Ca       2.74
   Cl       2.51
   K        0.01
   Mg       2.10
   Na       .87
   S(6)     0.69
   -water   1 # kg
SOLUTION 2 infilling fx2 aveall
    temp      10
   pH       7.85
   pe       8.4
   redox    pe
   units    mmol/l
   density   1
   Ca       2.07
   Mg       1.61
   Na       6.45
   K        0.13
   Alkalinity 5.01
   Cl       7.69
   S(6)     0.64
   -water   1 # kg
SOLUTION 3 wauk ave 2/12 5/12 10/12          INVERSE_MODELING 1
   temp      10                                -solutions     1      2      3
   pH       6.93                               -uncertainty   0.1     0.1     0.1
   pe       8.4                                -phases
   redox    pe                                    Calcite
   units    mmol/l                                Dolomite
   density   1                                    CO2(g)
   Ca       2.66                               -balances
   Mg       2.10                                  Cl       0.03     0.03     0.03
   Na       3.07                                  K        0.1     0.1     0.2
   K        0.07                                  S(6)      0.1     0.1     0.2
   Alkalinity 6.74                                Na        0.1     0.1     0.1
   Cl       4.28                               -range          1000
   S(6)     0.87                               -tolerance       1e-010
   -water   1 # kg                             -mineral_water     true
SELECTED_OUTPUT
   -file          F:\FOR ANNA\Major Ions\THESIS data\PHREEQC\Well RL256\INVERSE_RL256_unc_ave_3.out.sel
   -reset           true
   -totals          Alkalinity  Ca  Mg  K  Na  Cl
   -molalities        CaCO3  CO2  MgCO3
   -saturation_indices  Calcite  Dolomite  CO2(g)
   -gases            CO2(g)
   -inverse_modeling     true
END
```

Table 15. PHREEQC Inverse Modeling Output File RL255

First result line with grey background was the inverse output selected to be used in the advective/dispersive model

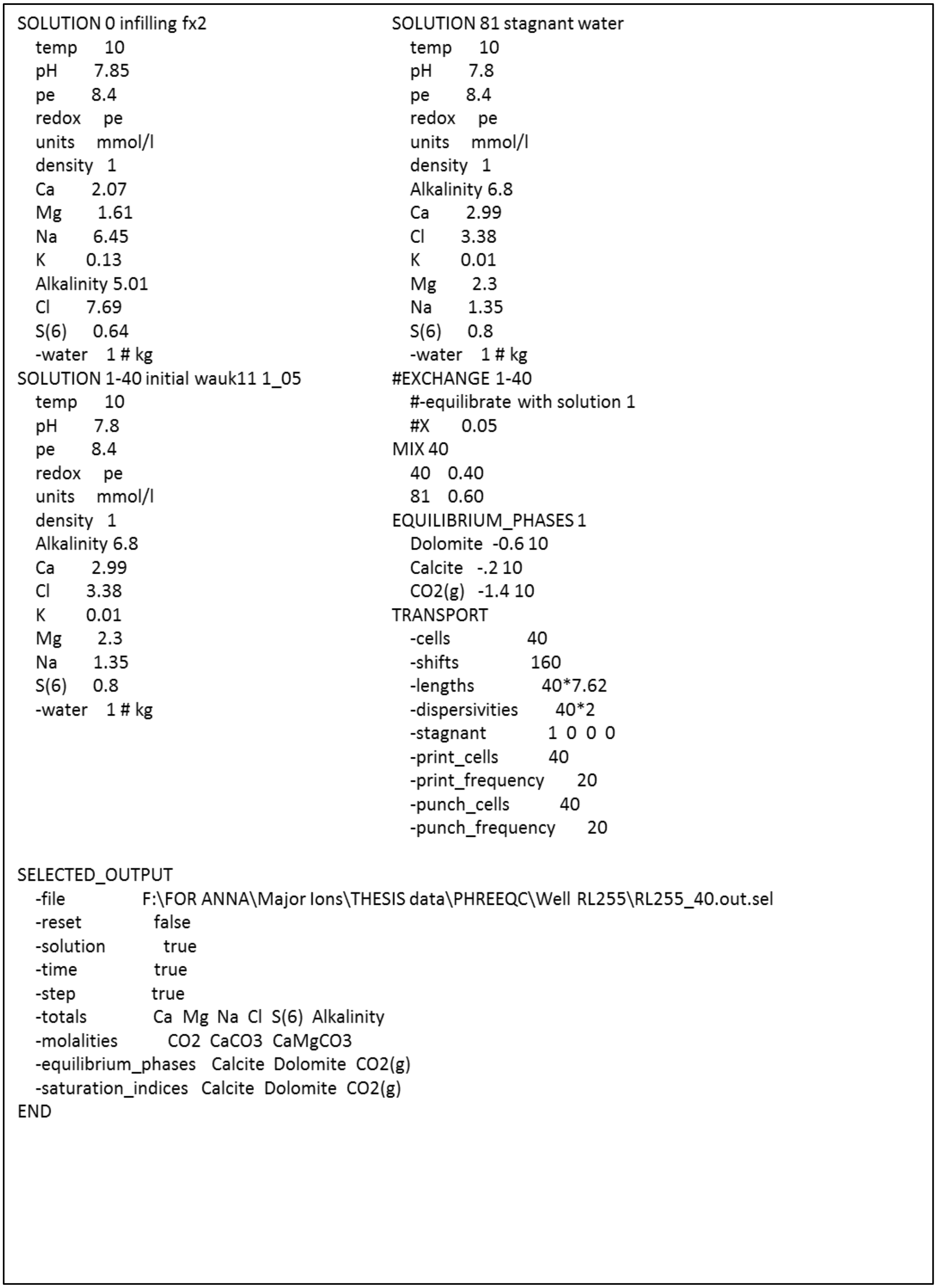
soln	dist_x	time	step	pH	pe	reaction	temp	Alk	mu	mass_H2O	charge	pct_err	Alkalinity	Ca
1 RL255	-99	-99	-99	7.8	8.4	-99	10	0.0068051	0.0167144	1	0.00016	0.713965	6.81E-03	2.99E-03
2 FOX2	-99	-99	-99	7.85	8.4	-99	10	0.0050143	0.0175637	1	-4.00E-05	-0.147406	5.01E-03	2.07E-03
3 LATE 255	-99	-99	-99	6.88	8.4	-99	10	0.0073665	0.0184817	1	-0.00026	-0.977199	7.37E-03	2.76E-03
Sum_resid	Sum_Delta/U	MaxFracEr	Soln 1	min	max	Soln 2	min	max	Soln 3	min	max	Calcite	min	max
3.62E+00	4.95E+00	1.77E-01	6.03E-01	5.30E-01	6.55E-01	3.97E-01	3.45E-01	4.70E-01	1.00E+00	1.00E+00	1.00E+00	3.48E-04	-9.88E-04	9.55E-04
7.08E+00	9.69E+00	1.77E-01	6.03E-01	5.65E-01	6.55E-01	3.97E-01	3.45E-01	4.35E-01	1.00E+00	1.00E+00	1.00E+00	0.00E+00	0.00E+00	0.00E+00
4.73E+00	6.76E+00	1.77E-01	6.03E-01	5.30E-01	6.55E-01	3.97E-01	3.45E-01	4.70E-01	1.00E+00	1.00E+00	1.00E+00	6.36E-04	-8.83E-05	7.35E-04
3.76E+00	6.20E+00	1.56E-01	5.91E-01	5.30E-01	6.55E-01	4.09E-01	3.45E-01	4.70E-01	1.00E+00	1.00E+00	1.00E+00	0.00E+00	0.00E+00	0.00E+00
soln	Mg	K	Na	Cl	m_CaCO	m_CO2	m_MgCO3	si_Calcite	si_Dolomite	si_CO2(g)	pressure	total mol	volume	g_CO2(g)
1 RL255	2.30E-03	1.00E-05	1.35E-03	3.38E-03	2.72E-05	2.64E-04	1.17E-05	0.7122	1.2171	-2.3076	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2 FOX2	1.61E-03	1.30E-04	6.46E-03	7.70E-03	1.58E-05	1.74E-04	6.89E-06	0.4755	0.749	-2.4877	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3 LATE 255	2.17E-03	7.01E-05	3.80E-03	5.09E-03	3.26E-06	2.40E-03	1.44E-06	-0.2085	-0.6163	-1.3481	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Dolomite	min	max	CO2(g)	min	max								
	1.44E-04	-3.15E-04	6.09E-04	2.85E-03	1.75E-03	3.97E-03								
	0.00E+00	0.00E+00	0.00E+00	1.96E-03	1.78E-03	2.33E-03								
	0.00E+00	0.00E+00	0.00E+00	2.85E-03	1.75E-03	3.42E-03								
	3.23E-04	-4.41E-05	6.09E-04	2.87E-03	1.75E-03	3.94E-03								

Table 16. PHREEQC Inverse Modeling Output File RL256

Fourth result line with grey background was the inverse output selected to be used in the advective/dispersive model

soln	dist_x	time	step	pH	pe	reaction	temp	Alk	mu	mass_H2O	charge	pct_err	Alkalinity	Ca
1 RL256	-99	-99	-99	6.9	8.4	-99	10	0.0066144	0.0150599	1	6.00E-05	0.299393	6.61E-03	2.74E-03
2 FOX2	-99	-99	-99	7.85	8.4	-99	10	0.0050143	0.0175637	1	-4.00E-05	-0.147406	5.01E-03	2.07E-03
3 LATE 256	-99	-99	-99	6.93	8.4	-99	10	0.0067454	0.0172247	1	-0.0001	-0.411948	6.75E-03	2.66E-03
Sum_resid	Sum_Delta/U	MaxFracEr	Soln 1	min	max	Soln 2	min	max	Soln 3	min	max	Calcite	min	max
3.70E+00	5.35E+00	2.00E-01	6.54E-01	6.07E-01	6.59E-01	3.46E-01	3.41E-01	3.93E-01	1.00E+00	1.00E+00	1.00E+00	2.70E-06	-9.40E-04	9.06E-04
8.95E+00	1.17E+01	2.00E-01	6.54E-01	6.21E-01	6.59E-01	3.46E-01	3.41E-01	3.79E-01	1.00E+00	1.00E+00	1.00E+00	0.00E+00	0.00E+00	0.00E+00
8.76E+00	1.16E+01	2.00E-01	6.54E-01	6.07E-01	6.59E-01	3.46E-01	3.41E-01	3.93E-01	1.00E+00	1.00E+00	1.00E+00	-3.18E-04	-7.97E-04	5.33E-04
4.97E+00	8.11E+00	2.00E-01	6.54E-01	6.07E-01	6.59E-01	3.46E-01	3.41E-01	3.93E-01	1.00E+00	1.00E+00	1.00E+00	3.42E-04	-3.03E-04	6.98E-04
3.70E+00	5.35E+00	2.00E-01	6.54E-01	6.07E-01	6.59E-01	3.46E-01	3.41E-01	3.93E-01	1.00E+00	1.00E+00	1.00E+00	0.00E+00	0.00E+00	0.00E+00
8.93E+00	1.17E+01	2.00E-01	6.54E-01	6.07E-01	6.59E-01	3.46E-01	3.41E-01	3.93E-01	1.00E+00	1.00E+00	1.00E+00	2.11E-05	-3.02E-04	6.02E-05
8.92E+00	1.17E+01	2.00E-01	6.54E-01	6.07E-01	6.59E-01	3.46E-01	3.41E-01	3.93E-01	1.00E+00	1.00E+00	1.00E+00	0.00E+00	0.00E+00	0.00E+00
6.92E+00	1.04E+01	2.00E-01	6.54E-01	6.07E-01	6.59E-01	3.46E-01	3.41E-01	3.93E-01	1.00E+00	1.00E+00	1.00E+00	0.00E+00	0.00E+00	0.00E+00
soln	Mg	K	Na	Cl	m_CaCO	m_CO2	m_MgCO3	si_Calcite	si_Dolomite	si_CO2(g)	pressure	total mol	volume	g_CO2(g)
1 RL256	2.10E-03	1.00E-05	8.71E-04	2.51E-03	3.22E-06	2.08E-03	1.38E-06	-0.2149	-0.6407	-1.4103	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2 FOX2	1.61E-03	1.30E-04	6.46E-03	7.70E-03	1.58E-05	1.74E-04	6.89E-06	0.4755	0.749	-2.4877	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3 LATE 256	2.10E-03	7.01E-05	3.07E-03	4.28E-03	3.28E-06	1.97E-03	1.45E-06	-0.2062	-0.6097	-1.4345	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Dolomite	min	max	CO2(g)	min	max								
	1.70E-04	-2.36E-04	5.94E-04	9.00E-04	-2.45E-04	2.14E-03								
	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00								
	1.70E-04	-2.36E-04	4.28E-04	0.00E+00	0.00E+00	0.00E+00								
	0.00E+00	0.00E+00	0.00E+00	9.00E-04	-2.45E-04	1.96E-03								
	1.71E-04	-1.51E-04	5.08E-04	9.00E-04	-2.45E-04	2.14E-03								
	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00								
	1.05E-05	-1.51E-04	3.01E-05	0.00E+00	0.00E+00	0.00E+00								
	0.00E+00	0.00E+00	0.00E+00	4.04E-04	-8.63E-05	8.68E-04								

RL255 Advective/Dispersive Modeling Input Files



```
SOLUTION 0 infilling fx2
   temp      10
   pH        7.85
   pe        8.4
   redox     pe
   units     mmol/l
   density   1
   Ca        2.07
   Mg        1.61
   Na        6.45
   K         0.13
   Alkalinity 5.01
   Cl        7.69
   S(6)      0.64
   -water    1 # kg
SOLUTION 1-40 initial wauk11 1_05
   temp      10
   pH        7.8
   pe        8.4
   redox     pe
   units     mmol/l
   density   1
   Alkalinity 6.8
   Ca        2.99
   Cl        3.38
   K         0.01
   Mg        2.3
   Na        1.35
   S(6)      0.8
   -water    1 # kg
SOLUTION 81 stagnant water
   temp      10
   pH        7.8
   pe        8.4
   redox     pe
   units     mmol/l
   density   1
   Alkalinity 6.8
   Ca        2.99
   Cl        3.38
   K         0.01
   Mg        2.3
   Na        1.35
   S(6)      0.8
   -water    1 # kg
#EXCHANGE 1-40
   #-equilibrate with solution 1
   #X      0.05
MIX 40
   40   0.40
   81   0.60
EQUILIBRIUM_PHASES 1
   Dolomite  -0.6 10
   Calcite   -.2 10
   CO2(g)   -1.4 10
TRANSPORT
   -cells              40
   -shifts             160
   -lengths            40*7.62
   -dispersivities     40*2
   -stagnant           1  0  0  0
   -print_cells        40
   -print_frequency    20
   -punch_cells        40
   -punch_frequency    20

SELECTED_OUTPUT
   -file              F:\FOR ANNA\Major Ions\THESIS data\PHREEQC\Well RL255\RL255_40.out.sel
   -reset              false
   -solution           true
   -time               true
   -step               true
   -totals             Ca  Mg  Na  Cl  S(6)  Alkalinity
   -molalities         CO2  CaCO3  CaMgCO3
   -equilibrium_phases  Calcite  Dolomite  CO2(g)
   -saturation_indices  Calcite  Dolomite  CO2(g)
END
```

RL256 Advective/Dispersive Modeling Input Files

```
SOLUTION 0 infilling fx2
   temp      10
   pH        7.85
   pe        8.4
   redox     pe
   units     mmol/l
   density   1
   Ca        2.07
   Mg        1.61
   Na        6.45
   K         0.13
   Alkalinity 5.01
   Cl        7.69
   S(6)      0.64
   -water    1 # kg
SOLUTION 1-40 initial wauk12 1_05
   temp      10
   pH        6.90
   pe        8.4
   redox     pe
   units     mmol/l
   density   1
   Alkalinity 6.61
   Ca        2.74
   Cl        2.51
   K         0.01
   Mg        2.10
   Na        .87
   S(6)      0.69
   -water    1 # kg
```

```
SOLUTION 81 stagnant water
   temp      10
   pH        6.90
   pe        8.4
   redox     pe
   units     mmol/l
   density   1
   Alkalinity 6.61
   Ca        2.74
   Cl        2.51
   K         0.01
   Mg        2.10
   Na        .87
   S(6)      0.69
   -water    1 # kg
#EXCHANGE 1-40
   #X        0.05
   #-equilibrate with solution 1
MIX 40
   40    0.35
   81    0.65
EQUILIBRIUM_PHASES 1
   Calcite   -0.2 10
   CO2(g)    -1.4 10
   Dolomite  -0.6 10
TRANSPORT
   -cells               40
   -shifts              160
   -lengths             40*15.25
   -dispersivities      40*5
   -stagnant            1  0  0  0
   -print_cells         40
   -print_frequency     20
   -punch_cells         40
   -punch_frequency     20
```

```
SELECTED_OUTPUT
   -file              F:\FOR ANNA\Major Ions\THESIS data\PHREEQC\Well RL256\RL256_35.out.sel
   -reset              false
   -solution           true
   -time               true
   -step               true
   -totals             Ca  Mg  Na  Cl  S(6)  Alkalinity
   -molalities         CO2  CaCO3  CaMgCO3
   -equilibrium_phases   Calcite  Dolomite  CO2(g)
   -saturation_indices   Calcite  Dolomite  CO2(g)
END
```