Stantec Consulting Ltd.
300W-675 Cochrane Drive, Markham ON L3R 0B8

April 28, 2016
File: 160900764

Attention: Mr. Paul Dalmazzi
Hydro One Networks Inc.
483 Bay Street
North Tower, 14th Floor
Toronto Ontario M5G 2P5
Canada

Dear Mr. Dalmazzi,

Reference: Clarington TS - Response to Nitrate Question from November 2015 CLC Meeting

Hydro One Networks Inc. (Hydro One) is currently in the process of completing construction on their Clarington Transformer Station (Clarington TS) in Clarington, Ontario. Hydro One established the Clarington Community Liaison Committee (CLC) in 2014 to serve as one of several ways for Hydro One and community representatives to exchange information during the construction phase of the project. As part of Hydro One's condition of the Minister of the Environment's denial of Part II Order request, a CLC Meeting was held on November 30th, 2015 at the Solina Community Hall, in nearby Solina, Ontario.

The CLC Meeting saw presentations from Hydro One on the progress of construction, and from Stantec Consulting Ltd. (Stantec) on the findings presented in the 2015 Annual Groundwater and Surface Water Monitoring Report (Stantec, November 2015). The audience in attendance to observe the CLC Meeting included the Ontario Ministry of the Environment (MOECC), the Town of Clarington and its third party reviewer SLR Consulting Ltd. (SLR), as well as representatives of the media. Representatives of the local Enniskillen Environmental Association were not in attendance; however, one local resident did attend the meeting.

A representative of SLR posed a question regarding the relationship between the concentrations of nitrates detected in groundwater sampling (in the 2015 Annual Monitoring Report) and other factors, including shallow vs. deep wells, and potential correlation with bacteriological analyses results (E. coli). The following provides background information on nitrate in groundwater and a summary discussion on correlations between nitrate concentrations, depth of groundwater samples, as well as bacteriological and groundwater chemistry indicator parameters.

For the purpose of clearly defining areas described in this letter (and consistent with previous reporting), the Clarington TS lands owned by Hydro One are referred to as the *Project Area*, within which the area to be occupied by the transformer station itself is referred to as the *Station Site*.

Reference: Clarington TS - Response to Nitrate Question from November 2015 CLC Meeting

BACKGROUND

Nitrate is a chemical compound of one part nitrogen and three parts oxygen that is commonly represented by the symbol **NO_3**. It is the most common form of nitrogen found in groundwater.

Nitrate is derived from nitrogen, a commonly used plant nutrient supplied by inorganic fertilizers and animal manure. Organic nitrogen found in decaying plant matter and animal excrement is naturally converted by bacteria and fungi through nitrogen cycle processes to ammonium, then nitrite, and then nitrate. Other anthropogenic sources of nitrate include lawn fertilizers, septic systems, and domestic animals in residential areas. Additionally, airborne nitrogen compounds given off by industry and automobiles accumulate in the atmosphere and are deposited on the ground surface during precipitation events and as dry particles by wind.

The MOECC provides the following summary of potential nitrate sources: "*Nitrates are present in water (particularly ground water) as a result of decay of plant or animal material, the use of agricultural fertilizers, domestic sewage or treated wastewater contamination, or geological formations containing soluble nitrogen compounds*" (MOECC, June 2006).

The potential risk for groundwater contamination by nitrate depends both on the concentration of nitrogen input to the ground surface, the degree to which an underlying aquifer is vulnerable to nitrate infiltration from the ground surface, and the cumulative effect of nitrate accumulation.

Though nitrate is relatively non-toxic, a high nitrate concentration in drinking water is an environmental health concern because it can harm infants, particularly those under the age of six months, by reducing the ability of blood to transport oxygen. In groundwater, nitrate has no taste or scent, and can only be detected through laboratory analyses. The Ontario Drinking Water Quality Standard (ODWQS) Maximum Acceptable Concentration (MAC) for nitrate in drinking water is 10 milligrams per litre (mg/L) as nitrogen.

DATA ANALYSES – ON SITE MONITORING WELLS

NITRATE CONCENTRATION VS DEPTH

Stantec compared nitrate concentrations found in samples collected from Project Area groundwater monitoring wells with the depth of the screened interval of each monitoring well. The monitoring well nest at MW5-14 provides a comparison of nitrate concentration with depth below ground surface. The following **Table 1** lists the well, screened interval depth, and nitrate concentration from Fall 2015 monitoring in MW5 monitoring wells. Nitrate concentrations are observed to decrease significantly with depth, reducing from 11.2 mg/L in MW5-14S(2) (very shallow), to 8.6 mg/L in MW5-14S (shallow), and was below laboratory detectable limits in the intermediate and deep wells MW5-14I and MW5-14D.

Reference: Clarington TS - Response to Nitrate Question from November 2015 CLC Meeting

Table 1- Nitrate Concentrations at MW5 Well Nest

Monitoring Well ID	Screened Interval Depth (mBGS)	Nitrate Concentration (mg/L)
MW5-14S(2)	2.5 to 4.0	11.2
MW5-14S	3.1 to 6.1	8.6
MW5-14I	37.1 to 40.1	<0.1
MW5-14D	52.4 to 54.0	<0.1

Note: Laboratory detection limit is 0.1 mg/L

UPGRADIENT MONITORING WELLS

Monitoring Wells MW1-13S, MW1-13D, MW6-14, and MW7-14 are installed on the east side of the Station Site, approximately 20 m upgradient of the graded slope. The following **Table 2** presents nitrate concentration detected during Fall 2015 groundwater monitoring of the eastern Project Area monitoring wells. Nitrate was detected at relatively high concentrations in the shallow well MW1-13S near the middle of the graded slope, but not detected at depth at the same monitoring location in MW1-13D. Nitrate was also detected at low concentrations at the northeast corner of the Station Site in MW6-14, but not at the southeast corner in MW7-14.

Table 2 - Nitrate Concentrations at Upgradient Wells

Monitoring Well ID	Screened Interval Depth (mBGS)	Nitrate Concentration (mg/L)
MW1-13S	3.1 to 6.1	16.7
MW6-14	6.1 to 7.6	0.3
MW7-14	6.1 to 7.6	<0.1
MW1-13D	12.2 to 15.24	<0.1

Note: Laboratory detection limit is 0.1 mg/L

The highest concentration of nitrate in Fall 2015 monitoring results was observed at MW1-13S, a shallow monitoring well located east and upgradient of the Station Site (presented in **Table 3**, below). The upgradient side of the Station Site is a farmed field that is not owned by Hydro One, with residences using septic systems located further upgradient.

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LATERAL MIGRATION OF NITRATE IN SHALLOW GROUNDWATER

Nitrate concentrations in shallow monitoring wells are observed to decrease along the shallow groundwater flow path across the Project Area from east to west and southwest, with nitrate concentrations well below the ODWQS at the western and southern shallow monitoring wells, MW3-13S and MW4-13S (**Table 3**). Though shallow groundwater upgradient of the Station Site was found to have nitrate concentrations above the ODWQS of 10 mg/L in Fall 2015 monitoring, shallow groundwater leaving the Project Area remained well below 10 mg/L.

Table 3 - Nitrate Concentrations in Shallow Wells

Monitoring Well ID	Screened Interval Depth (mBGS)	Nitrate Concentration (mg/L)
MW1-13S (East)	3.1 to 6.1	16.7
MW5-14S(2) (Central)	2.5 to 4.0	11.2
MW5-14S (Central)	3.1 to 6.1	8.6
MW3-13S (West)	3.7 to 6.7	2.1
MW4-13S (South)	1.5 to 4.6	0.2

While the Station Site was formerly leased by Hydro One to local farmers for agricultural use, fertilizers have not been used within the Project Area since 2014. However, it is believed agricultural use continues on the lands immediately upgradient of the Project Area to the east. There is currently no septic system within the Project Area, and none is planned to be constructed as part of the Clarington TS.

NITRATE CONCENTRATION VS GROUNDWATER QUALITY INDICATOR PARAMETERS

Stantec also compared nitrate concentrations observed in Project Area monitoring wells with other groundwater quality parameters that may be associated with fertilizer or septic system use, and other common groundwater characterizing indicator parameters, including:

- Sodium
- Chloride
- Hardness
- Orthophosphate
- Phosphorus
- Potassium
- pH
- Turbidity
- Alkalinity

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Nitrate concentrations from 2014 and 2015 groundwater monitoring were plotted against each of the water quality parameters listed above and are presented in Figures 1 through 9 for monitoring wells at the MW 5 location, and in Figures 10 through 18 for the monitoring wells located on the east side of the Station Site (MW1-13, MW6-14, and MW7-14). Analyses of groundwater quality results revealed the following general trends in concentrations of the indicator parameters listed above, including:

- Elevated sodium concentration in shallow wells;
- Increased hardness concentration (as $CaCo_3$) in shallow wells; and
- Slightly increased potassium concentration in shallow wells.

While nitrate was only detected in shallow Project Area monitoring wells, no other significant correlation between nitrate and the above indicator parameters was found based on Project Area monitoring results.

DATA ANALYSES – PRIVATE WELLS

Private wells are monitored semi-annually for the same water quality parameters as the Project Area wells, with the addition of bacteriological parameter analyses. Stantec completed analyses of nitrate concentrations reported in samples collected from private wells participating in the Private Well Monitoring Program and grouped the results into samples collected from shallow depth, intermediate depth, and deeper private wells. The laboratory results were plotted against bacteriological parameter and groundwater quality indicator parameter results and are presented in Figures 19 through 29.

Analyses of private groundwater quality results revealed the following general trends in concentrations of the indicator parameters listed above, including:

- Detection of E. coli only found in shallow wells;
- Detection of Total Coliforms predominantly in shallow wells, with no correlation to nitrate concentrations;
- Elevated sodium concentration predominantly in shallow wells;
- Elevated chloride concentration in shallow wells; and
- Elevated hardness concentration (as $CaCo_3$) in the majority of sampled wells.

Nitrate was detected in all water quality samples collected from shallow and intermediate depth private wells, but only detected in 12% of samples collected from deep private wells (all detections from one deep private well). Of the nitrate detections from shallow and intermediate private wells, only one sample from a shallow well exceeded the ODWQS of 10 mg/L for nitrate. However, no other significant correlation between nitrate and the above bacteriological parameters or groundwater indicator parameters was found.

Reference: Clarington TS - Response to Nitrate Question from November 2015 CLC Meeting

While Stantec cannot present individual private well water quality results in a plan map for public distribution, we did complete an assessment of the spatial distribution of nitrate concentrations in private wells participating in the Private Well Monitoring Program. Fall 2015 nitrate concentrations detected in shallow private wells upgradient of the Project Area ranged from <0.1 mg/L to 6.0 mg/L, with no observed trend or gradient in concentration. There are no shallow private wells located downgradient of the Station Site, and nitrate was not detected any downgradient deeper private wells. Nitrate concentrations in shallow and intermediate depth private wells located in the adjacent Farewell Creek sub-watershed ranged from 1.1 mg/L to 8.5 mg/L, with no indication of a lateral gradient correlating with shallow groundwater flow direction.

Nitrate detection in deeper private wells was found to be below the laboratory detection limit in all wells, with the exception of one private well. All elevated nitrate concentrations, though all below the ODWQS, were from one deep well located upgradient of the Project Area. Nitrate was not detected in an adjacent deep private well, indicating the well with detected nitrate may have a poorly functioning well seal. As a result, downward migration of nitrate appears to be limited as a result of very slow downward infiltration of shallow groundwater through the thick deposit of Newmarket Till to the intermediate and deeper groundwater system.

CONCLUSIONS

Nitrate in groundwater is common in shallow agricultural communities, having potential common sources of nitrate from fertilizers, septic system leaching, and the natural decaying process of vegetation and animal matter. Project Area water quality results demonstrate that nitrate concentrations in shallow monitoring wells across the Project Area decrease as shallow groundwater flows from east to west and southwest across the Project Area. Though shallow groundwater upgradient of the Station Site was found to have nitrate concentrations above the ODWQS of 10 mg/L in Fall 2015 monitoring, shallow groundwater leaving the Project Area remained well below 10 mg/L.

The source of nitrate within the Project Area is interpreted to be former land use prior to construction, and potential existing fertilizer use on farmed lands immediately upgradient of the Project Area. Further, monitoring data indicates that Station Site construction and land use within the Project Area have not contributed, and will not contribute to increasing nitrate concentrations in the shallow groundwater system.

Nitrate concentrations within shallow and intermediate depth private wells are interpreted to be due to local factors the capture zone of the individual wells, including fertilizer use, septic systems, animal manure, natural decaying processes, and potentially the condition of the individual well seals. However, private well water quality monitoring data indicates that there is no correlation between nitrate concentrations and the concentrations of bacteriological parameters E. coli and total coliforms.

Reference: Clarington TS - Response to Nitrate Question from November 2015 CLC Meeting

Nitrate was only detected in one deep private well, while all other deep wells indicate there is limited downward migration of nitrate from the shallow to the deep groundwater system.

CLOSURE

We trust this response letter addressing the nitrate question posed at the November 30, 2015 Community Liaison Meeting addresses your request for a specific discussion on nitrate water quality results. Should you have any questions relating to the Groundwater and Surface Water Monitoring program, please feel free to contact Brant Gill at (905) 415-6330, or brant.gill@stantec.com.

Regards,

STANTEC CONSULTING LTD.

PROFESSIONAL GEOSCIENTIST
J. BRANT GILL
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Attachment: Water Quality Figure 1 through Figure 29

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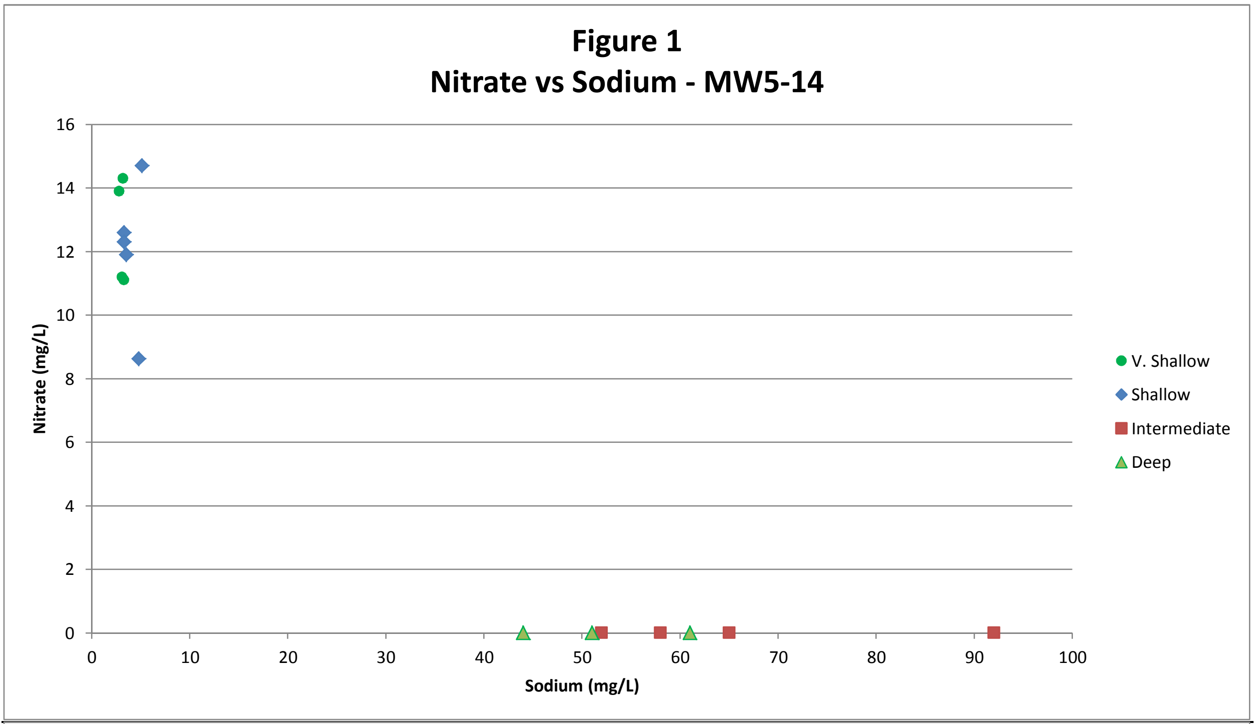

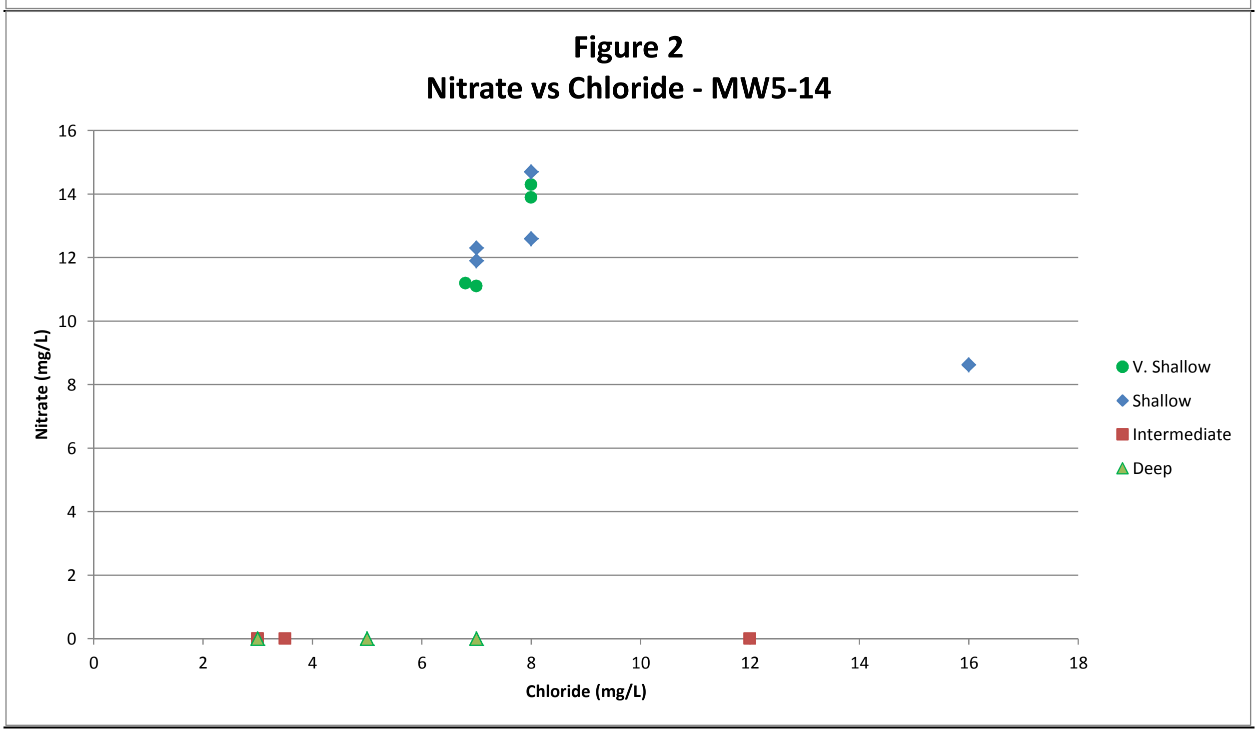

Notes:

Privte well chemistry data collected as part of Hydro One Networks Inc. Private Well Monitoring Program.

Data presented to be read in conjuntion with accompanying letter report, dated April 29 ,2016.

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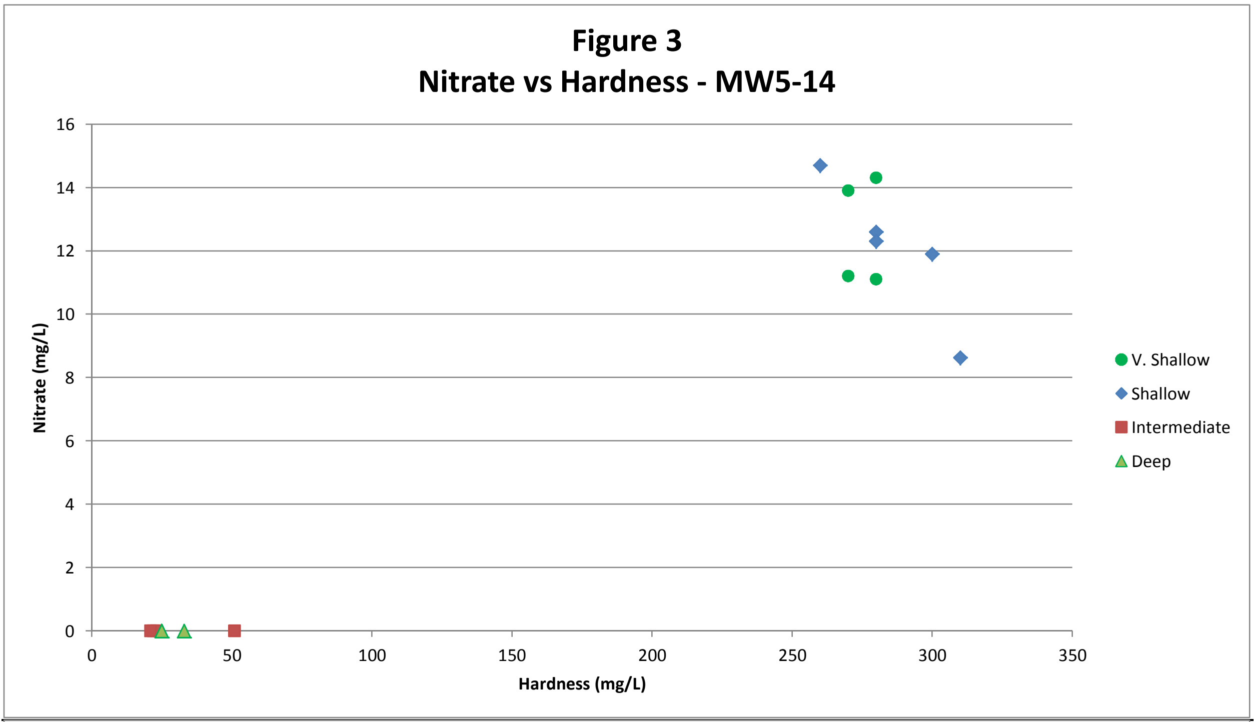
Figure No.

Figure 1 and Figure 2

Title **Monitoring Well Water Quality**
Nitrate vs Sodium
Nitrate vs Chloride



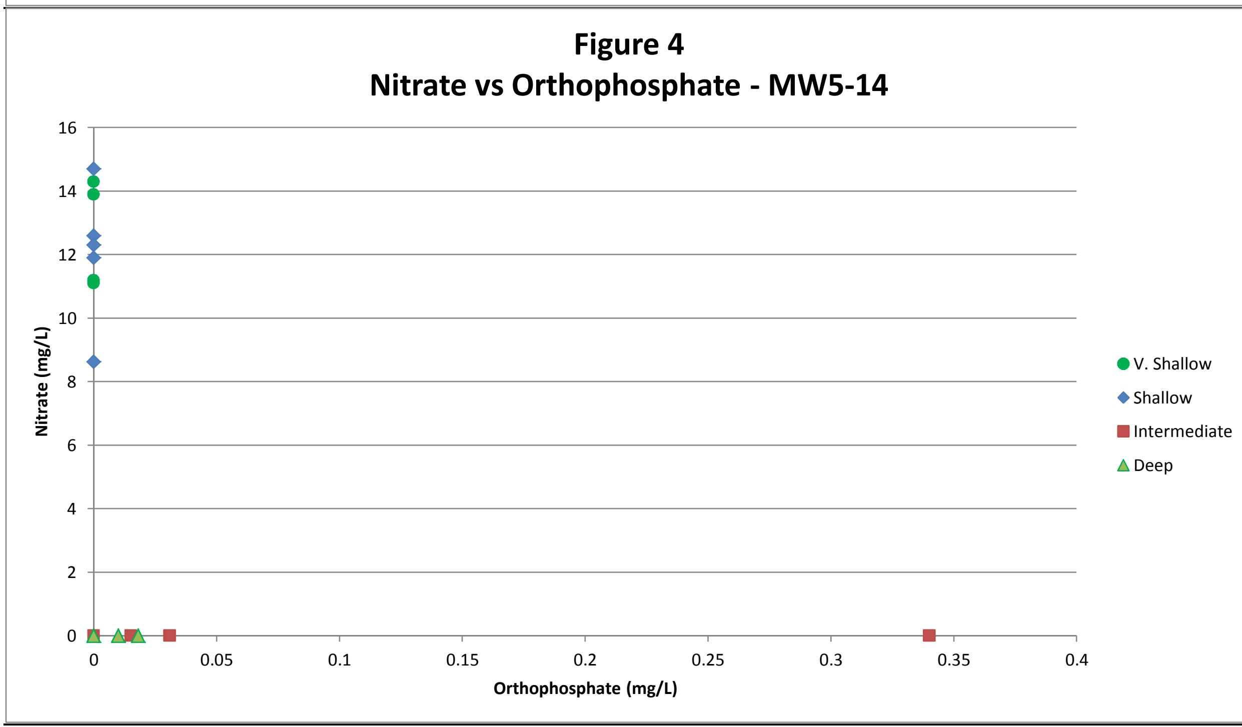


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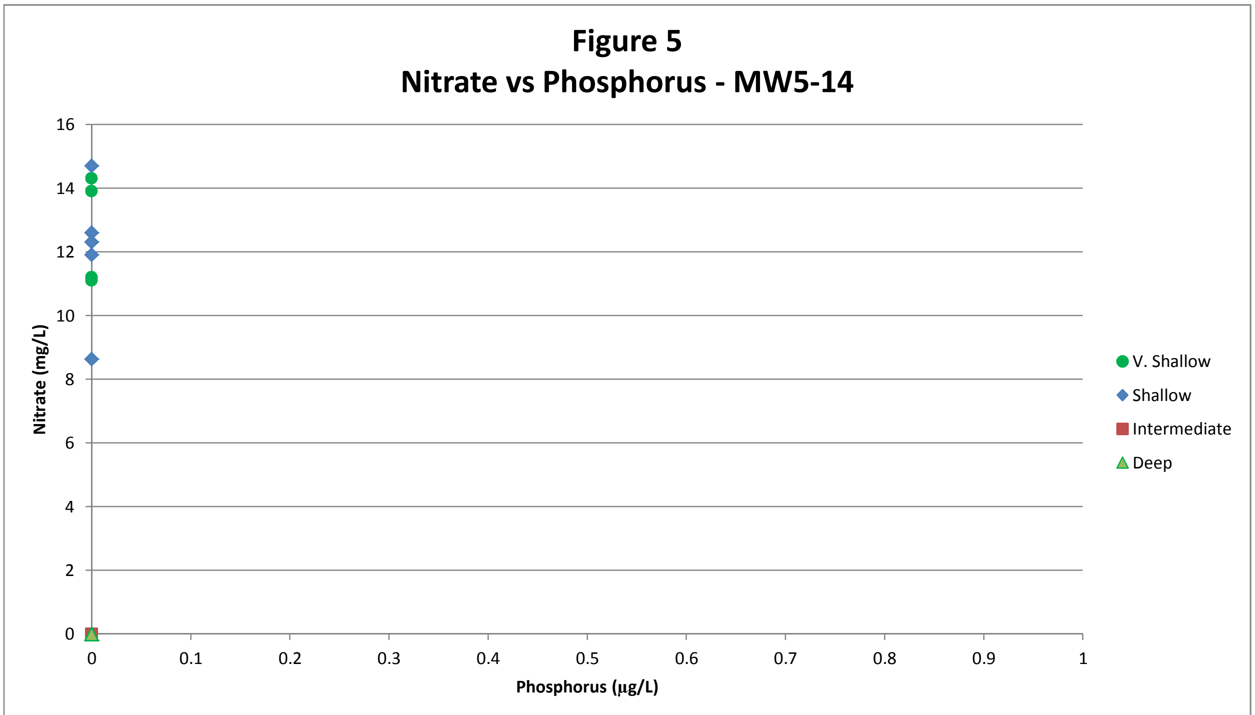
Figure No.

Figure 3 and Figure 4

Title **Monitoring Well Water Quality**
Nitrate vs Hardness
Nitrate vs Orthophosphate



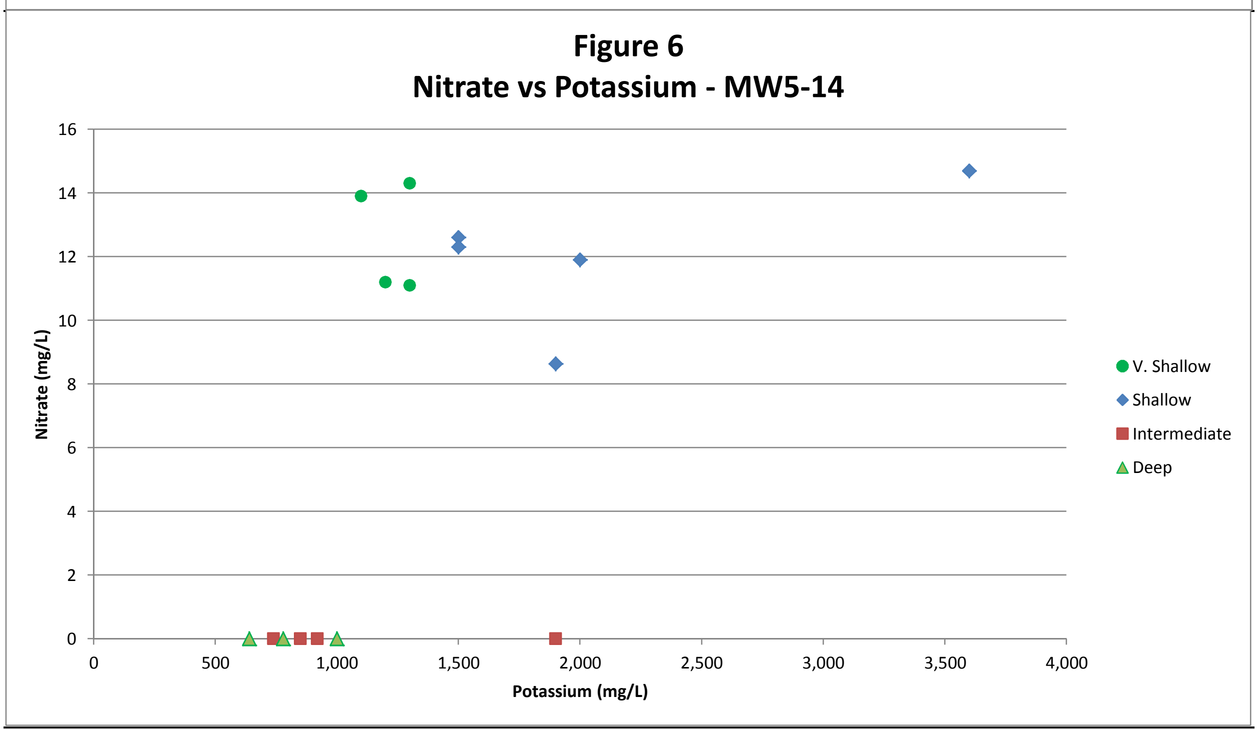


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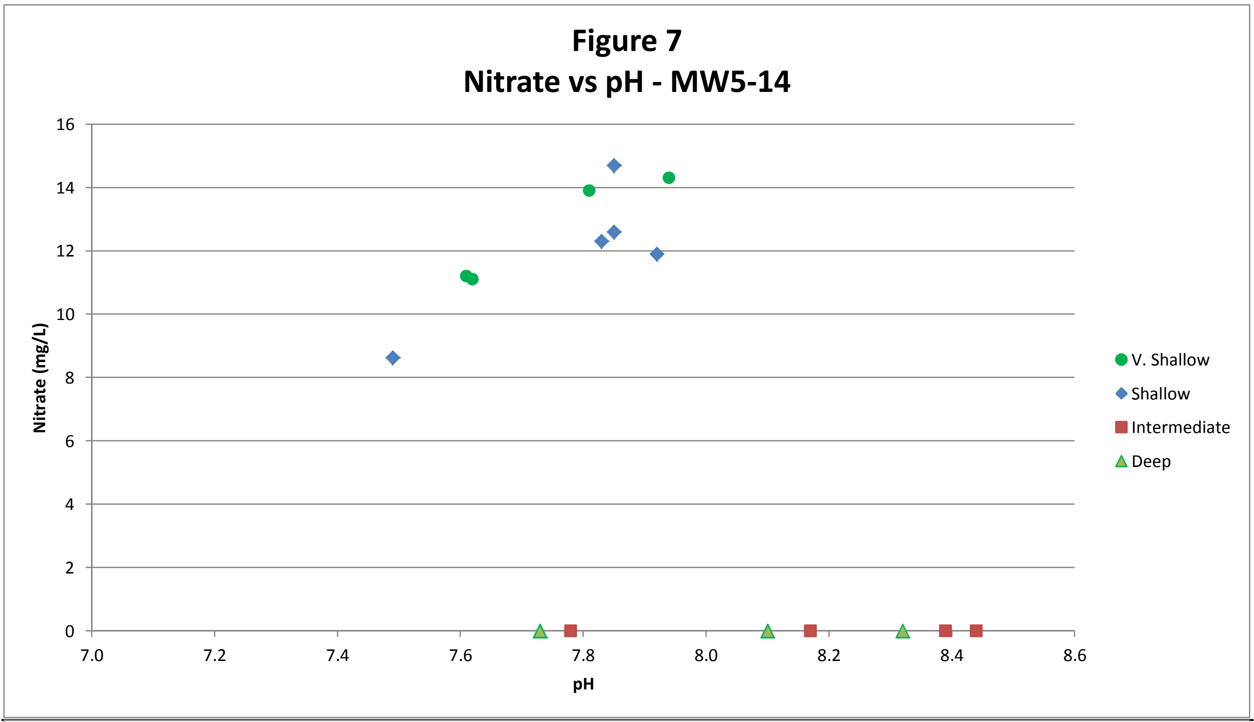
Figure No.

Figure 5 and Figure 6

Title **Monitoring Well Water Quality**
Nitrate vs Phosphorus
Nitrate vs Potassium



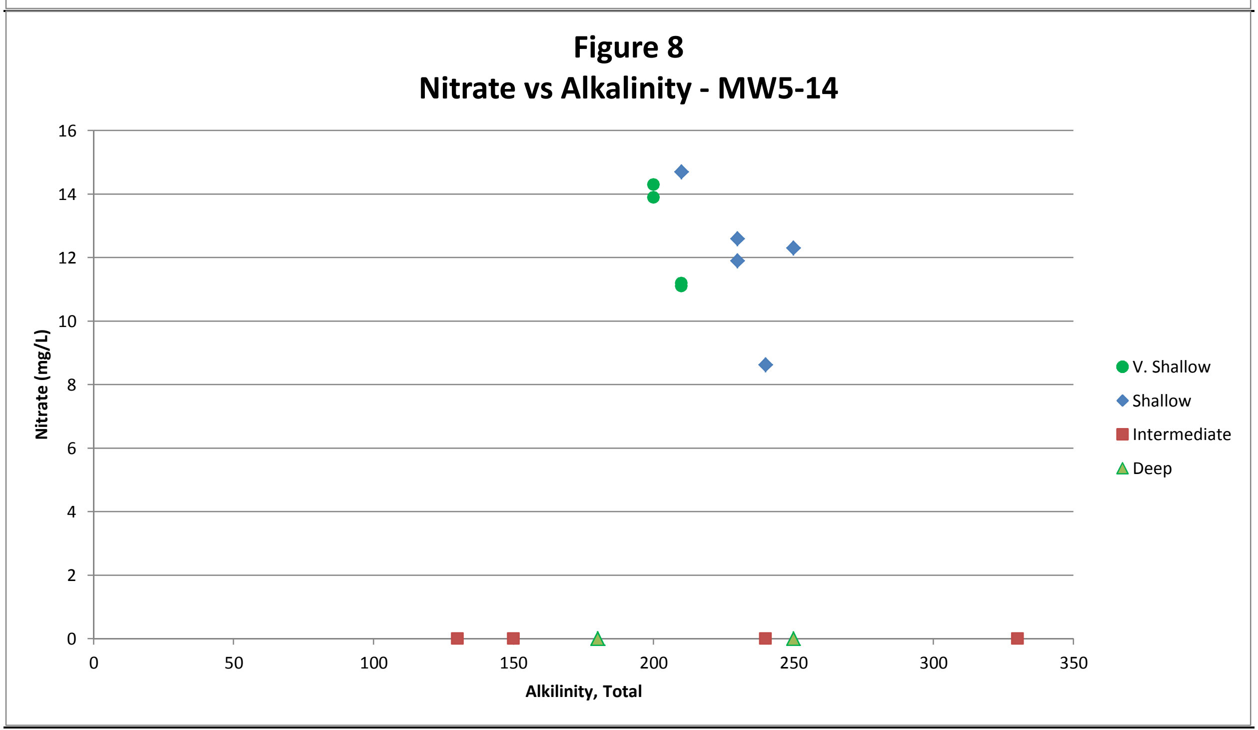


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Figure No.

Figure 7 and Figure 8

Title **Monitoring Well Water Quality**
Nitrate vs pH
Nitrate vs Alkalinity

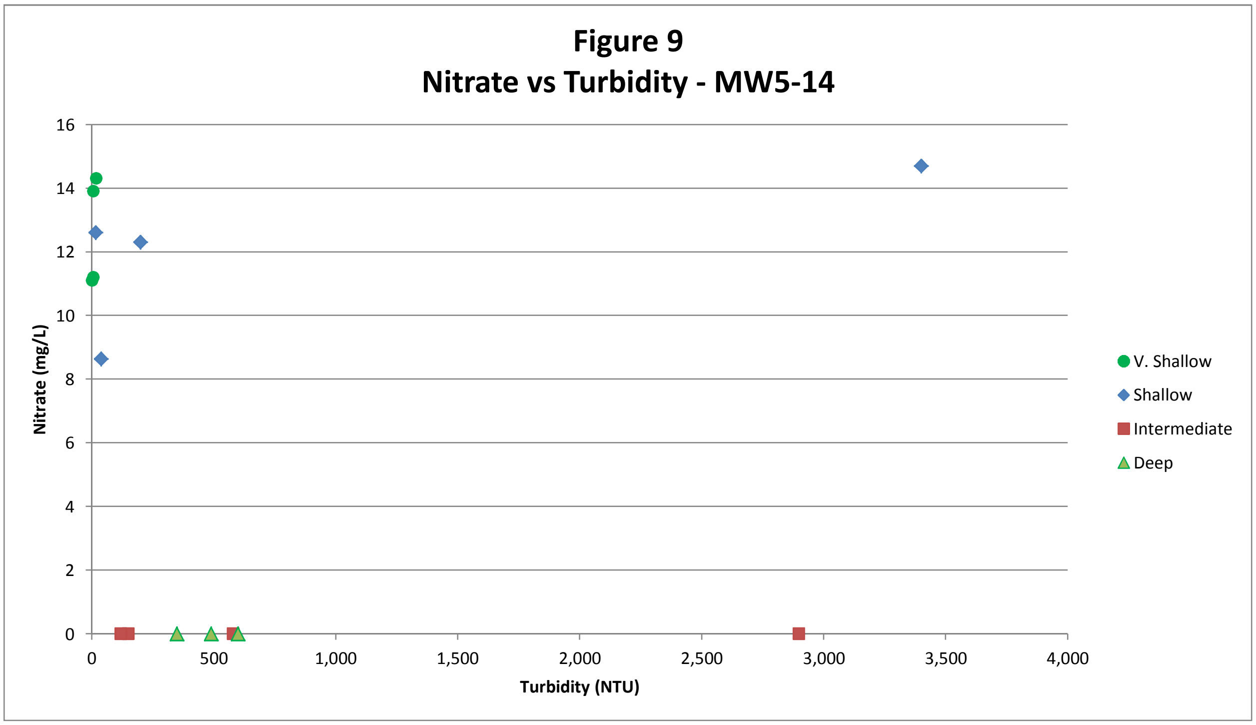

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Figure No.

Figure 9

Title **Monitoring Well Water Quality**
Nitrate vs Turbidity

Figure 10
Nitrate vs Sodium - MW1-13, MW6-14, MW7-14

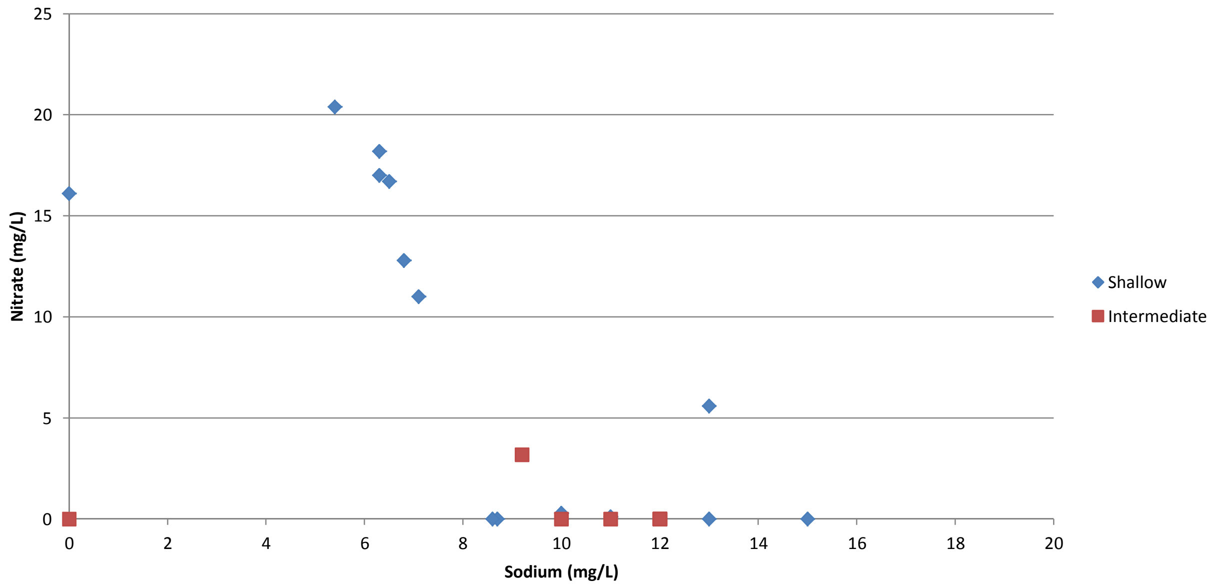

Figure 11
Nitrate vs Chloride - MW1-13, MW6-14, MW7-14

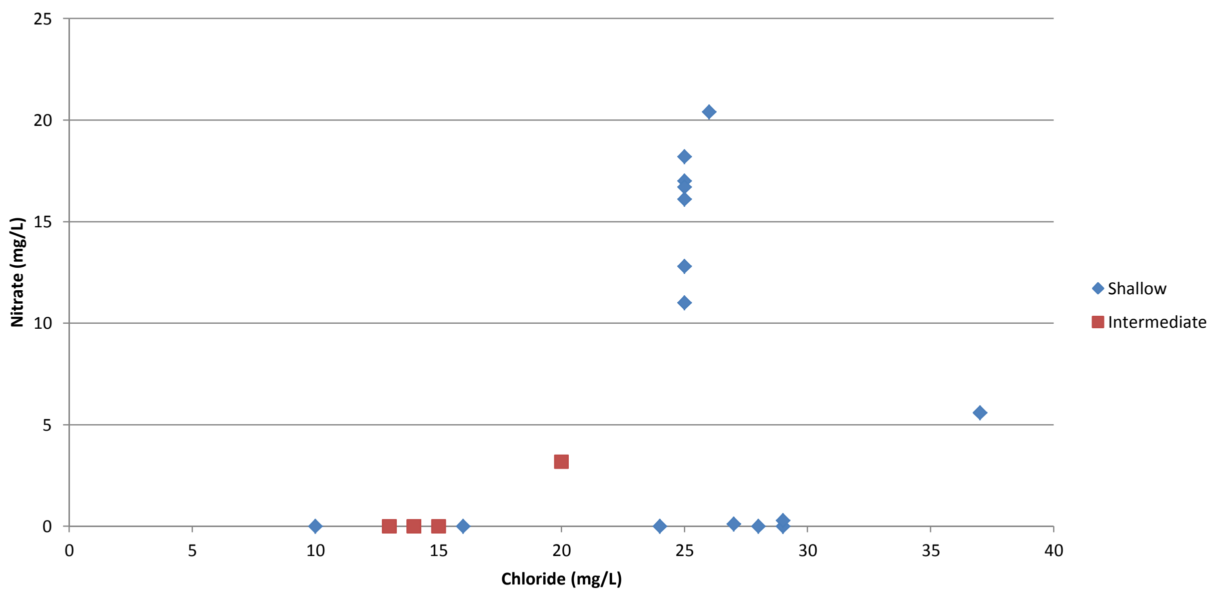

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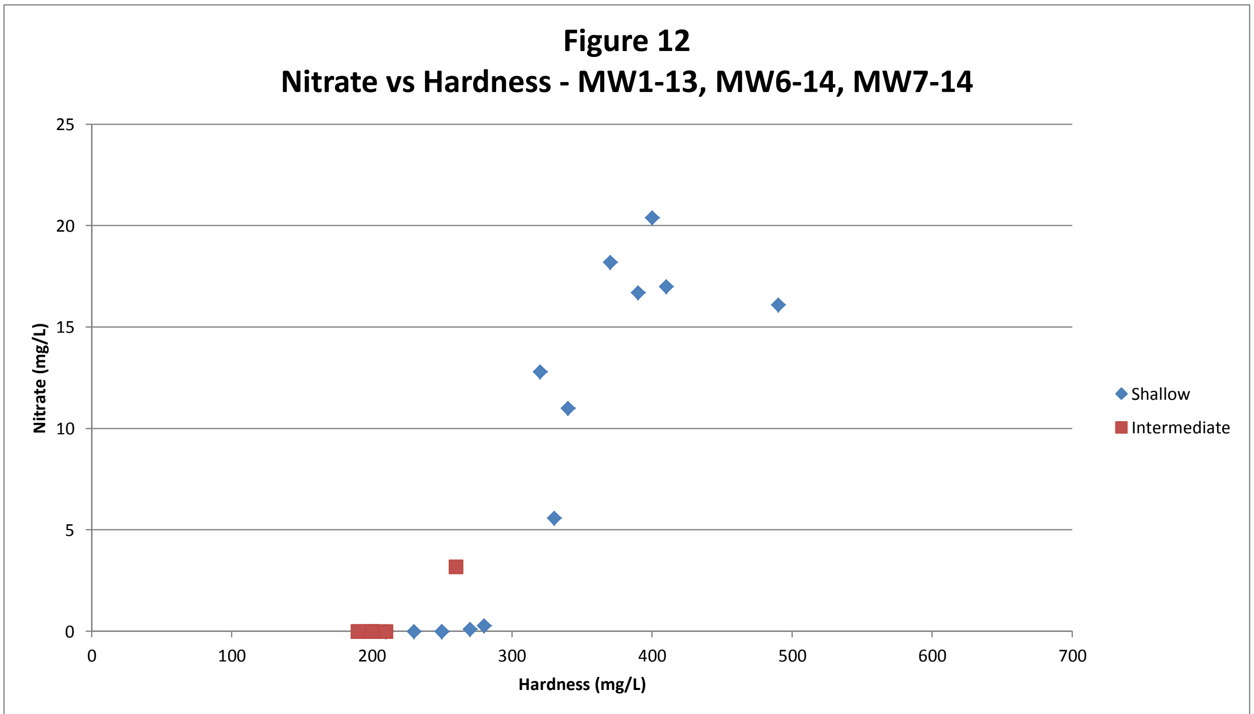
Figure No.

Figure 10 and Figure 11

Title **Monitoring Well Water Quality**
Nitrate vs Sodium
Nitrate vs Chloride



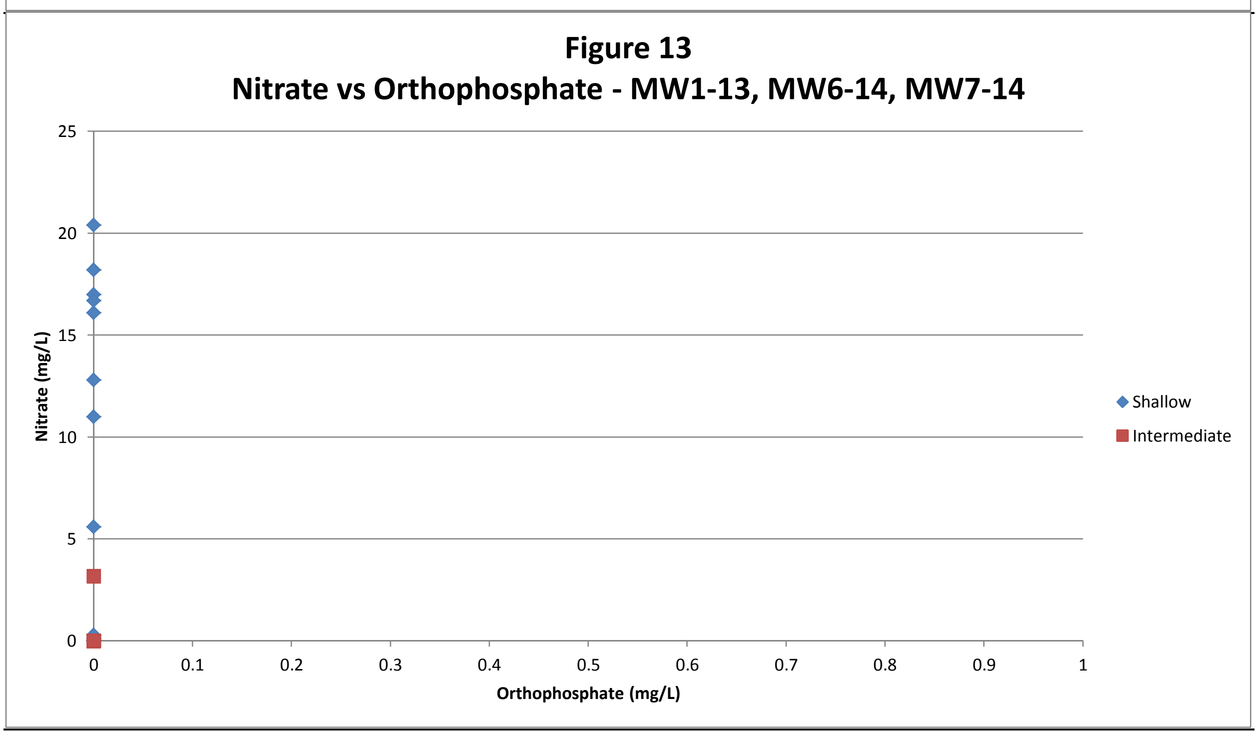


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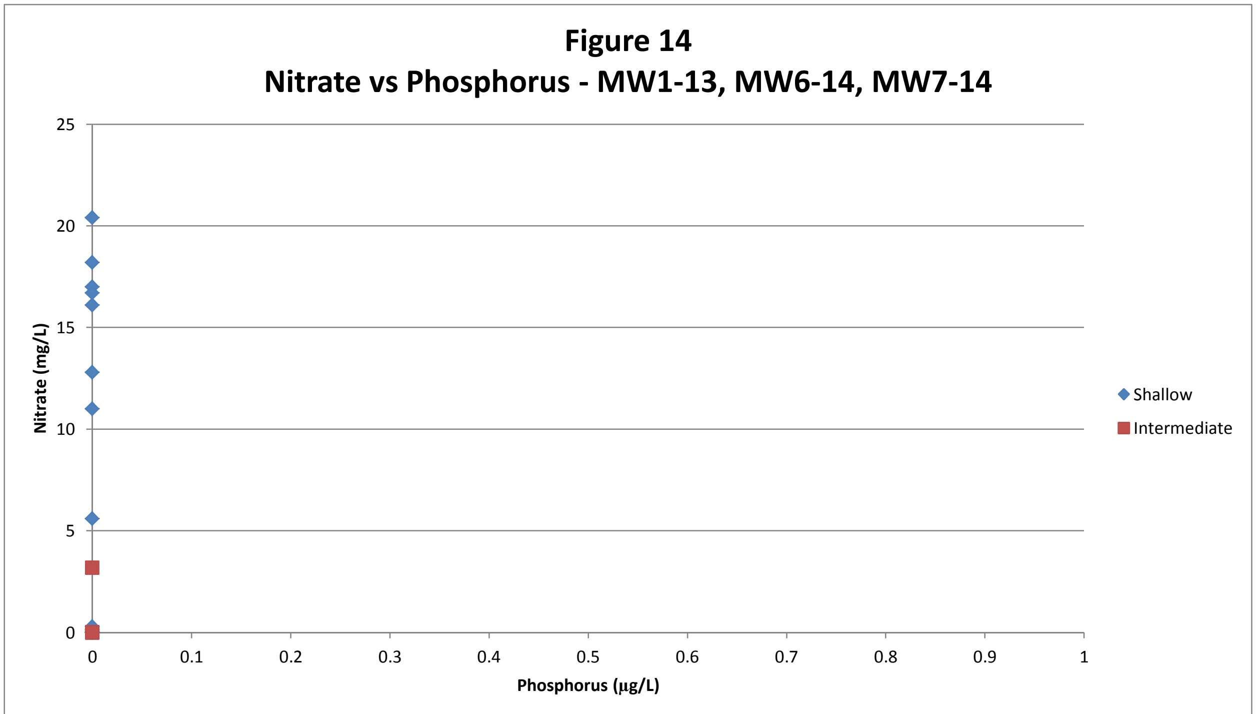
Figure No.

Figure 12 and Figure 13

Title **Monitoring Well Water Quality**
Nitrate vs Hardness
Nitrate vs Orthophosphate



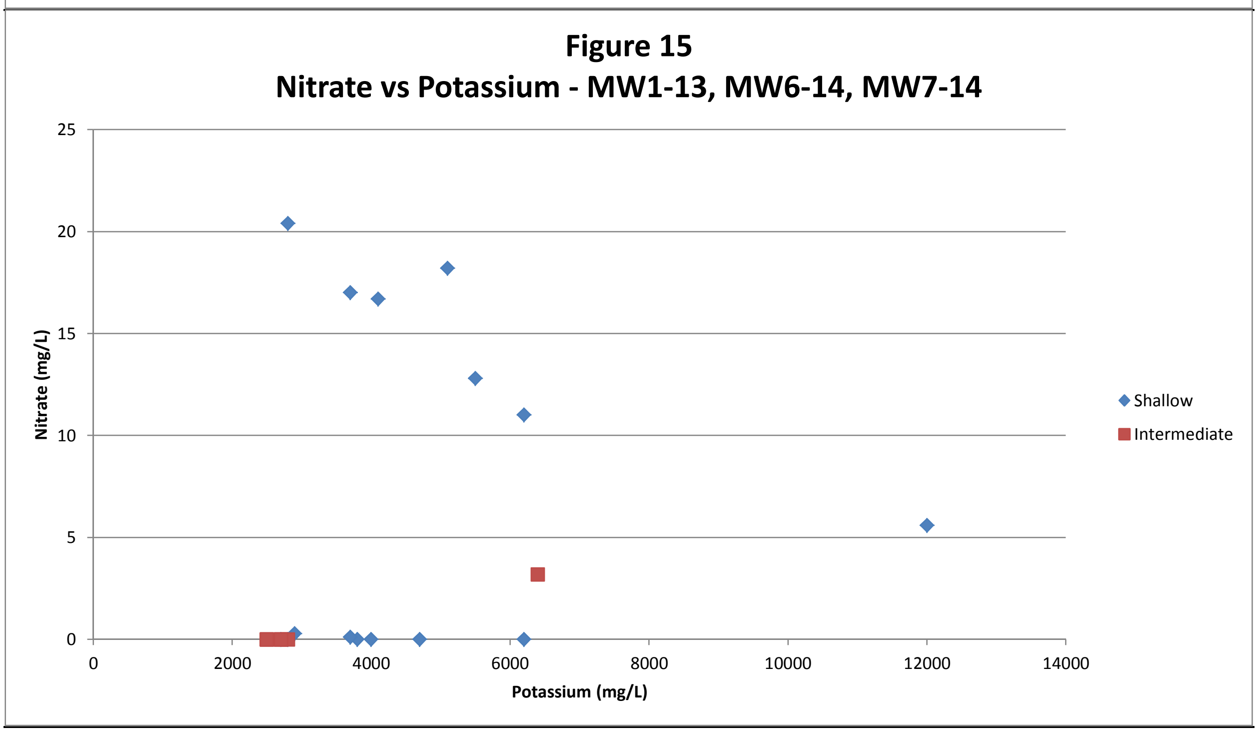


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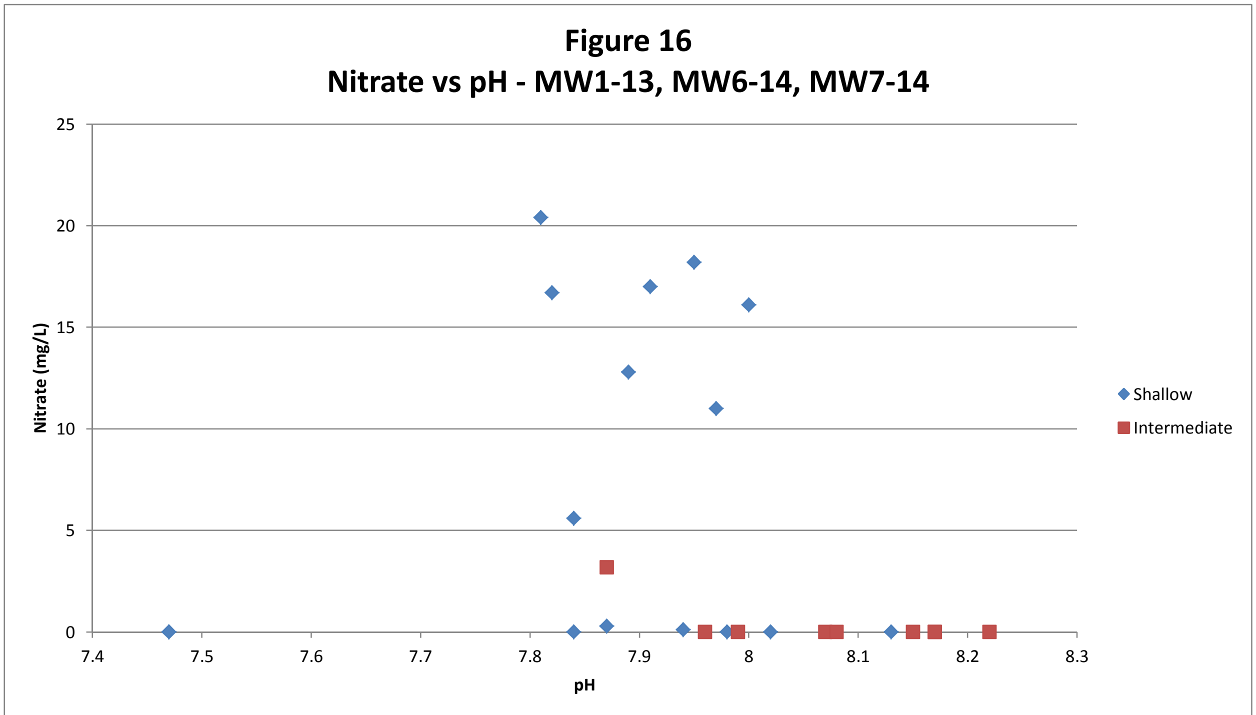
Figure No.

Figure 14 and Figure 15

Title **Monitoring Well Water Quality**
Nitrate vs Phosphorus
Nitrate vs Potassium



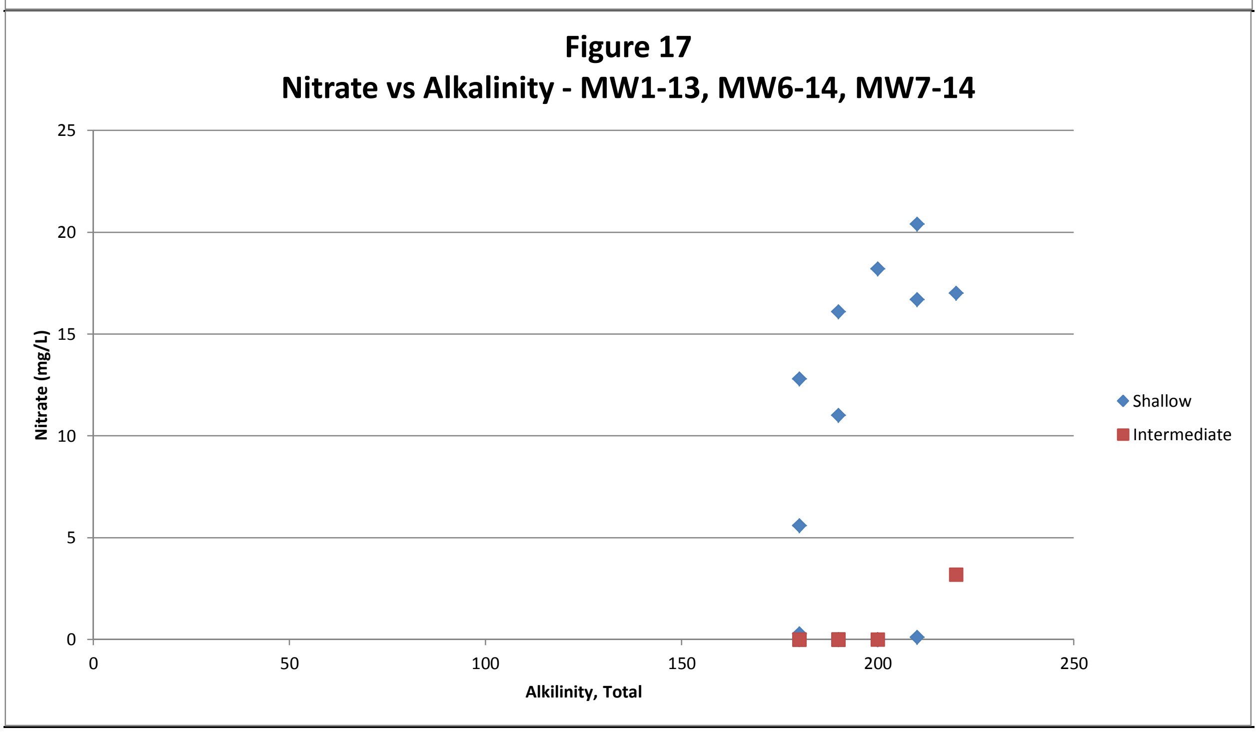


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Figure No.

Figure 16 and Figure 17

Title **Monitoring Well Water Quality**
Nitrate vs pH
Nitrate vs Alkalinity

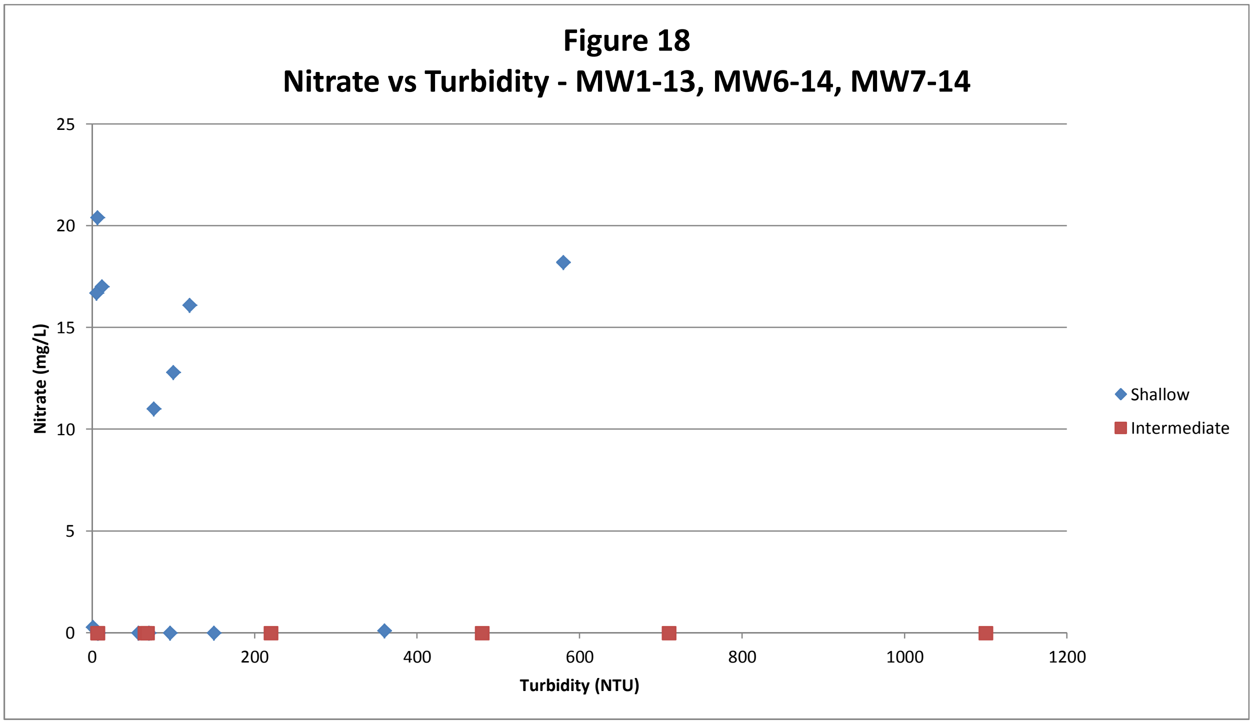

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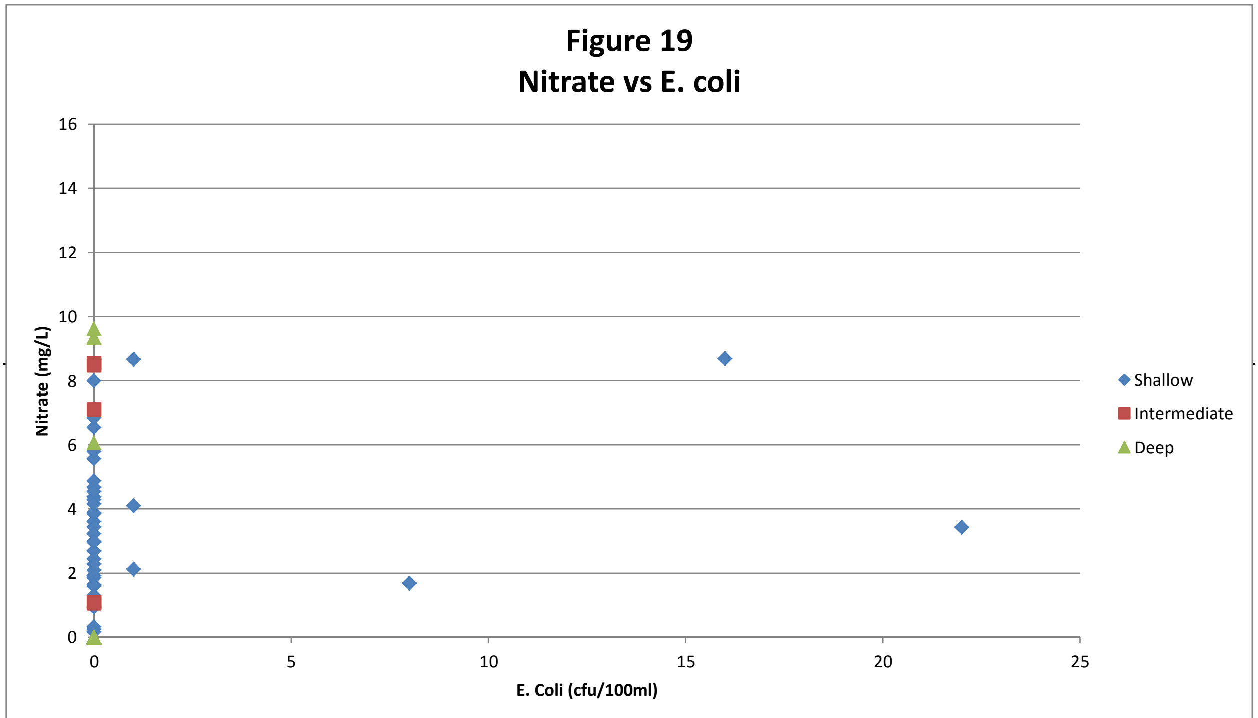
Figure No.

Figure 18

Title **Monitoring Well Water Quality**
Nitrate vs Turbidity



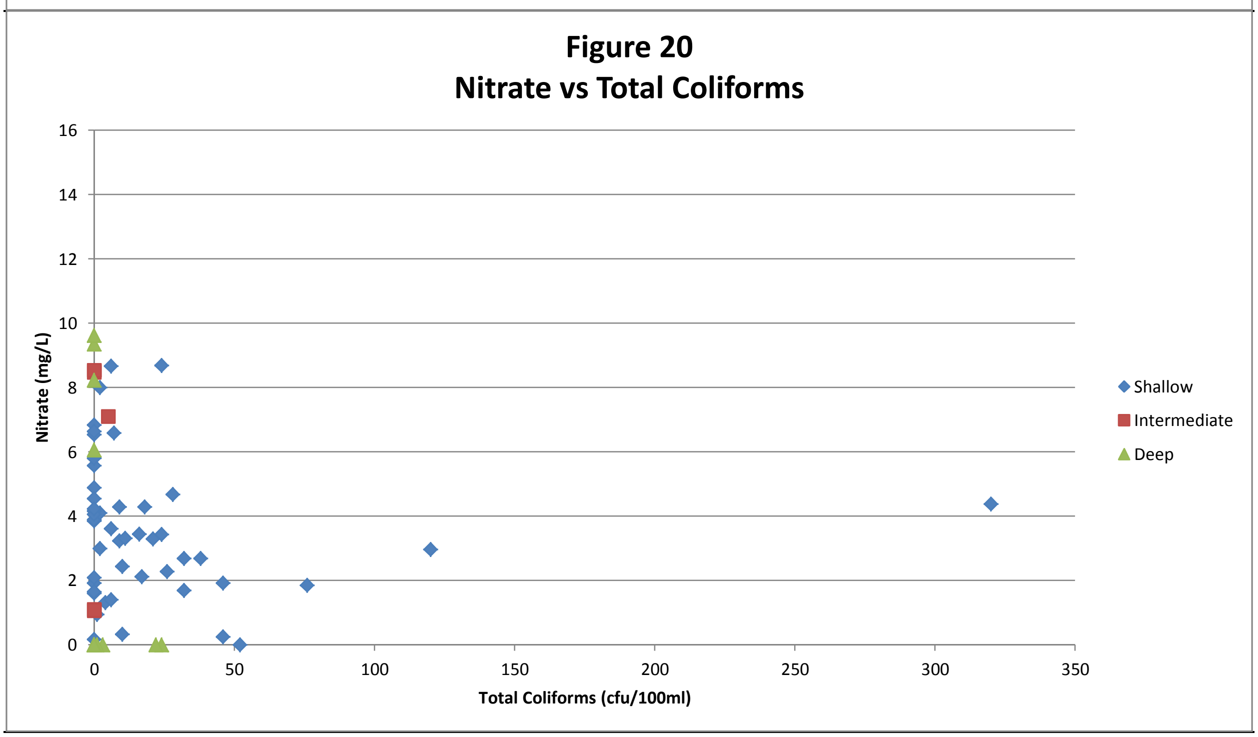


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Figure No.

Figure 19 and Figure 20

Title **Private Well Water Quality**
Nitrate vs E. coli
Nitrate vs Total Coliforms

Figure 21
Nitrate vs Sodium

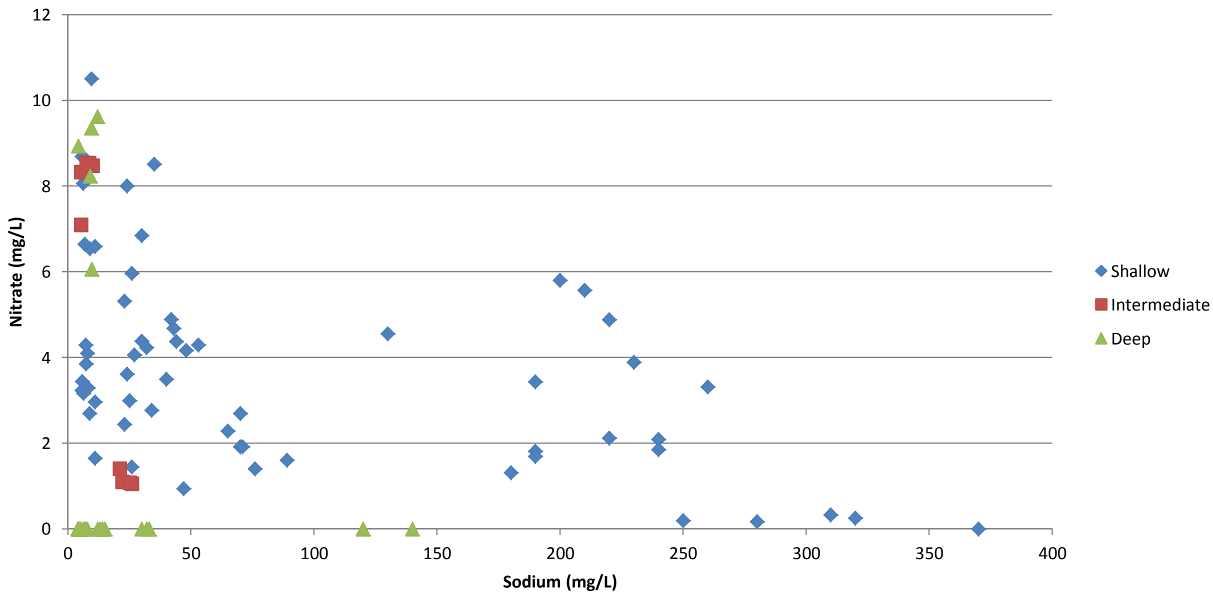

Figure 22
Nitrate vs Chloride

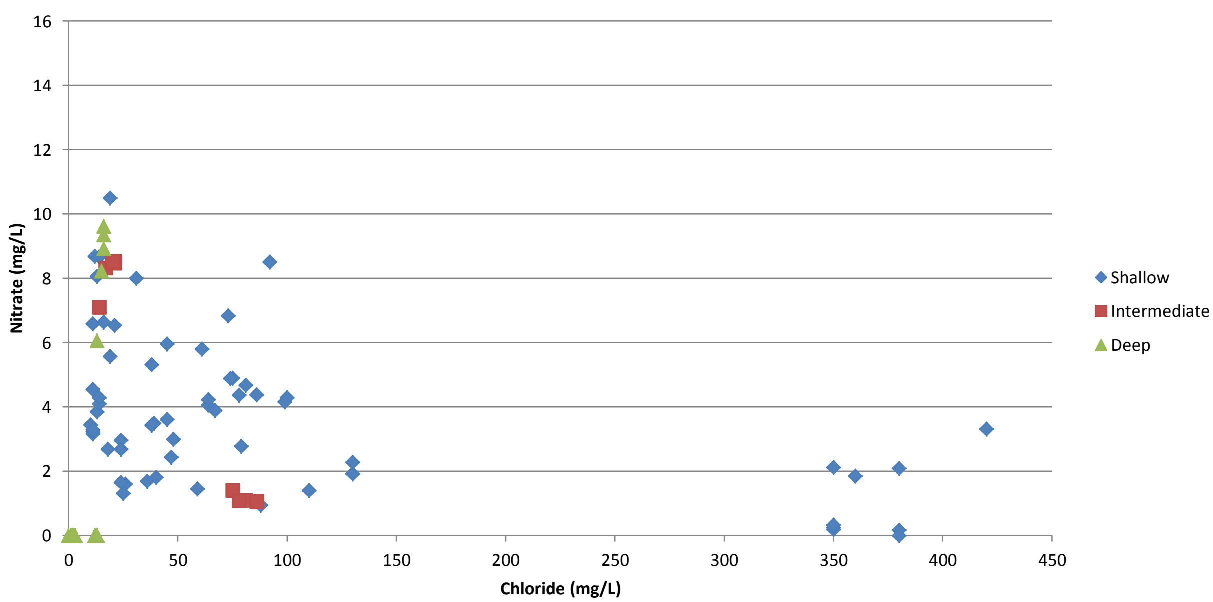

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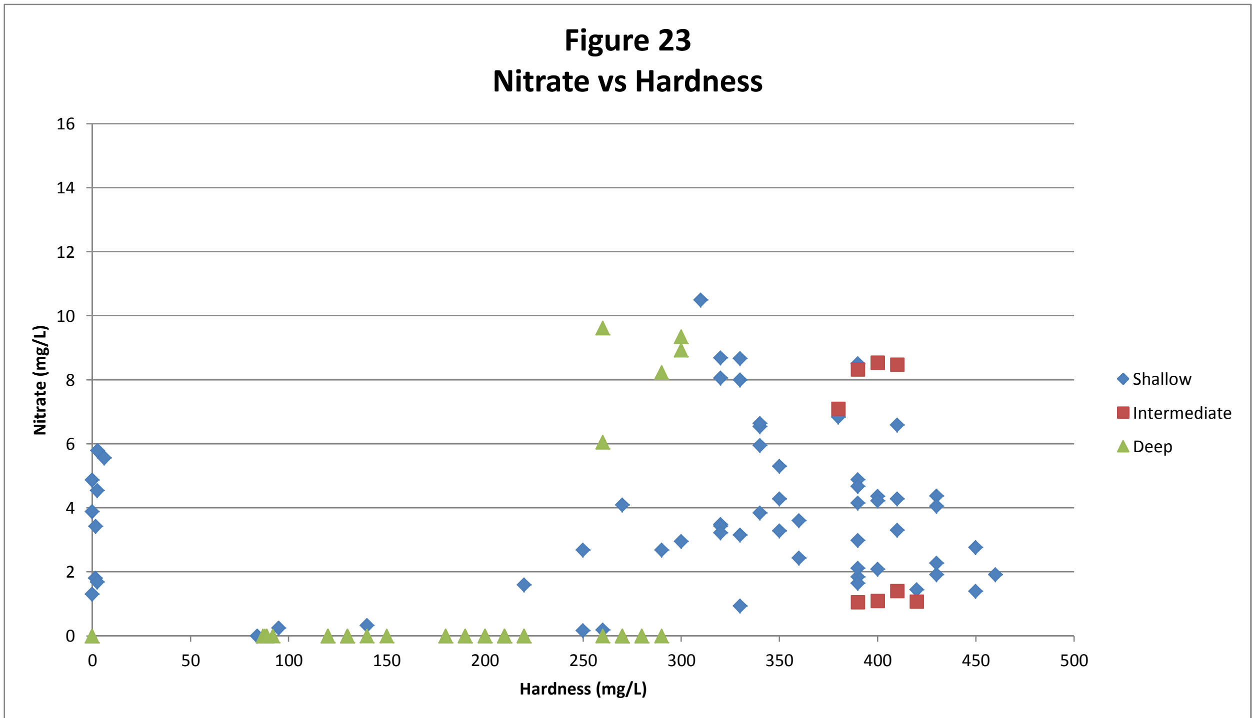
Figure No.

Figure 21 and Figure 22

Title **Private Well Water Quality**
Nitrate vs Sodium
Nitrate vs Chloride



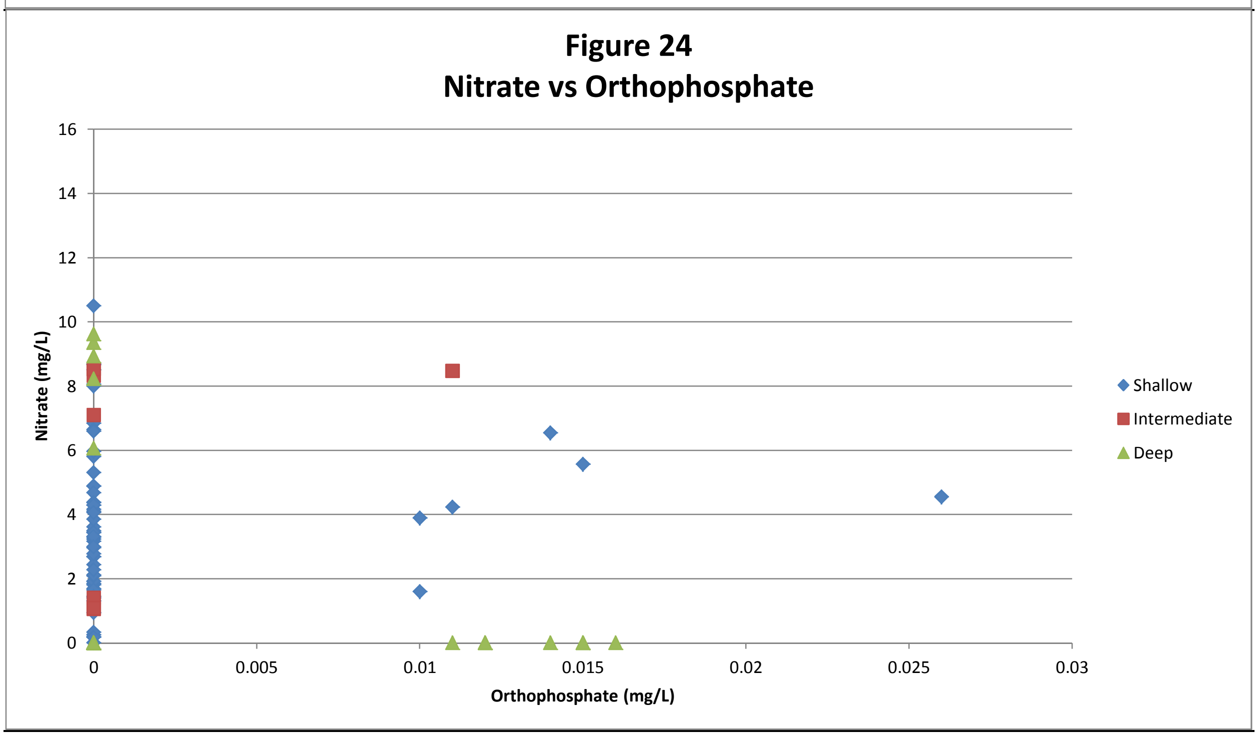


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Figure No.

Figure 23 and Figure 24

Title **Private Well Water Quality**
Nitrate vs Hardness
Nitrate vs Orthophosphate

Figure 25
Nitrate vs Phosphorus

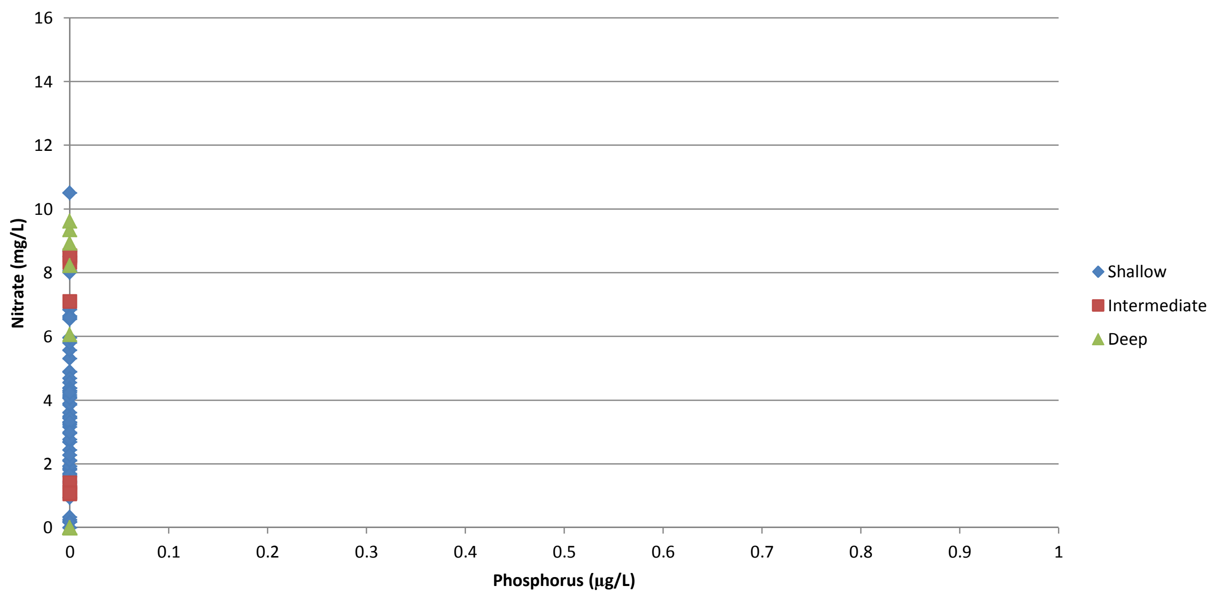

Figure 26
Nitrate vs Potassium

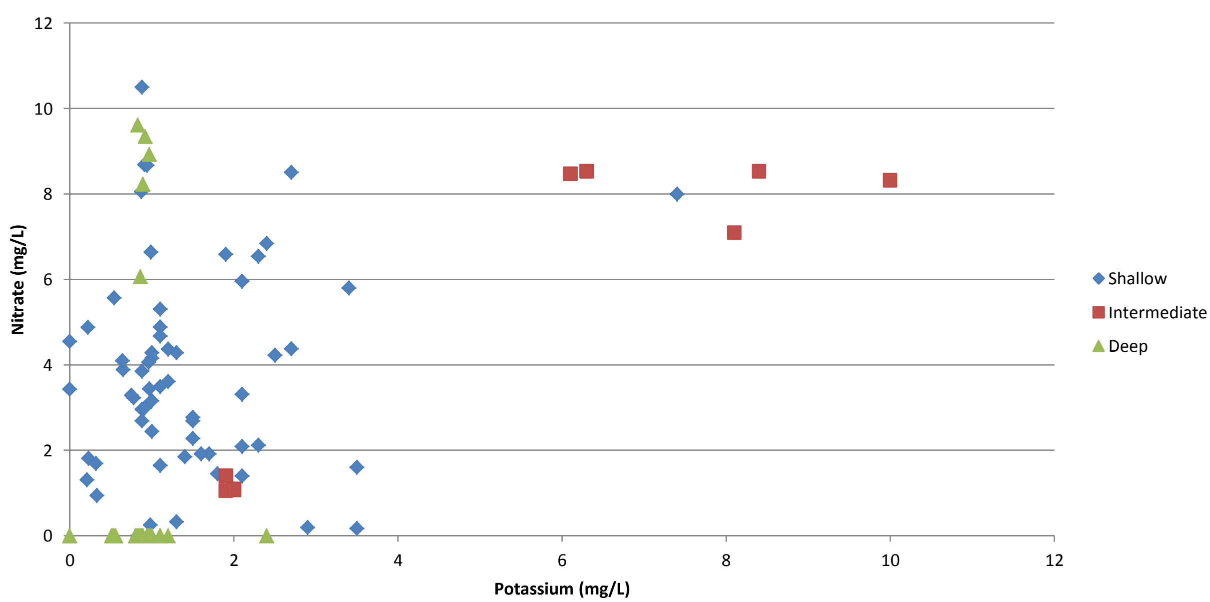

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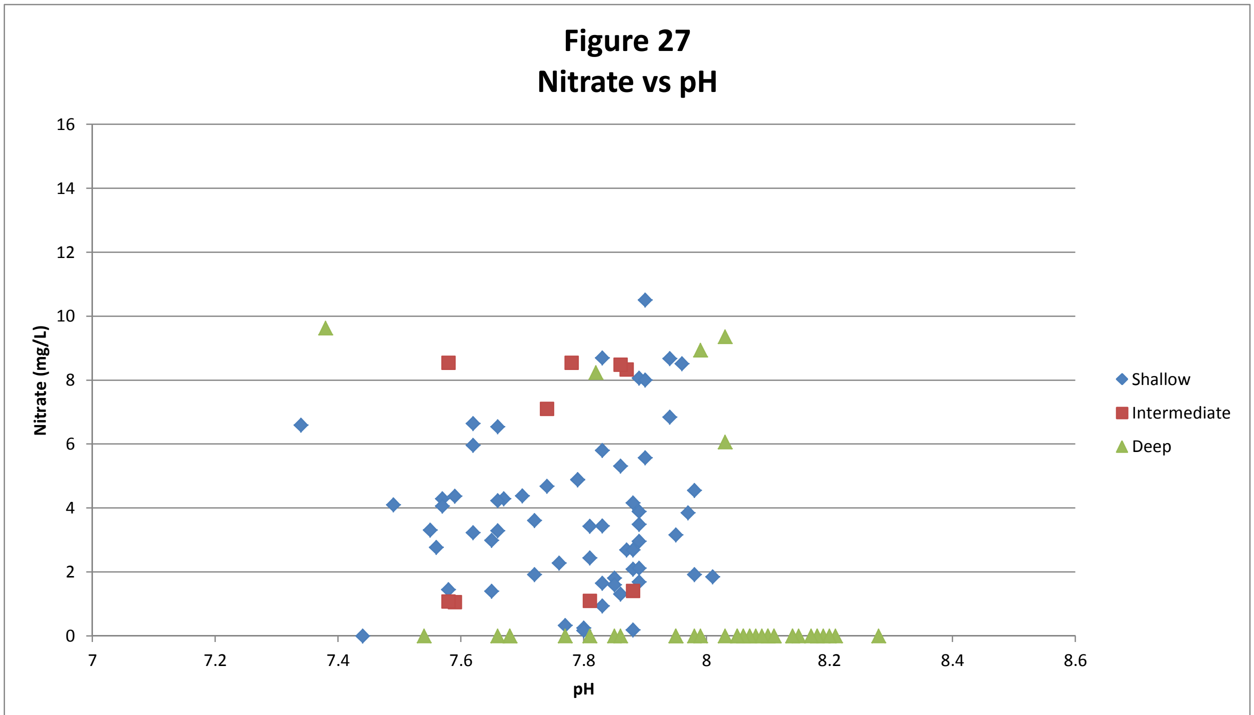
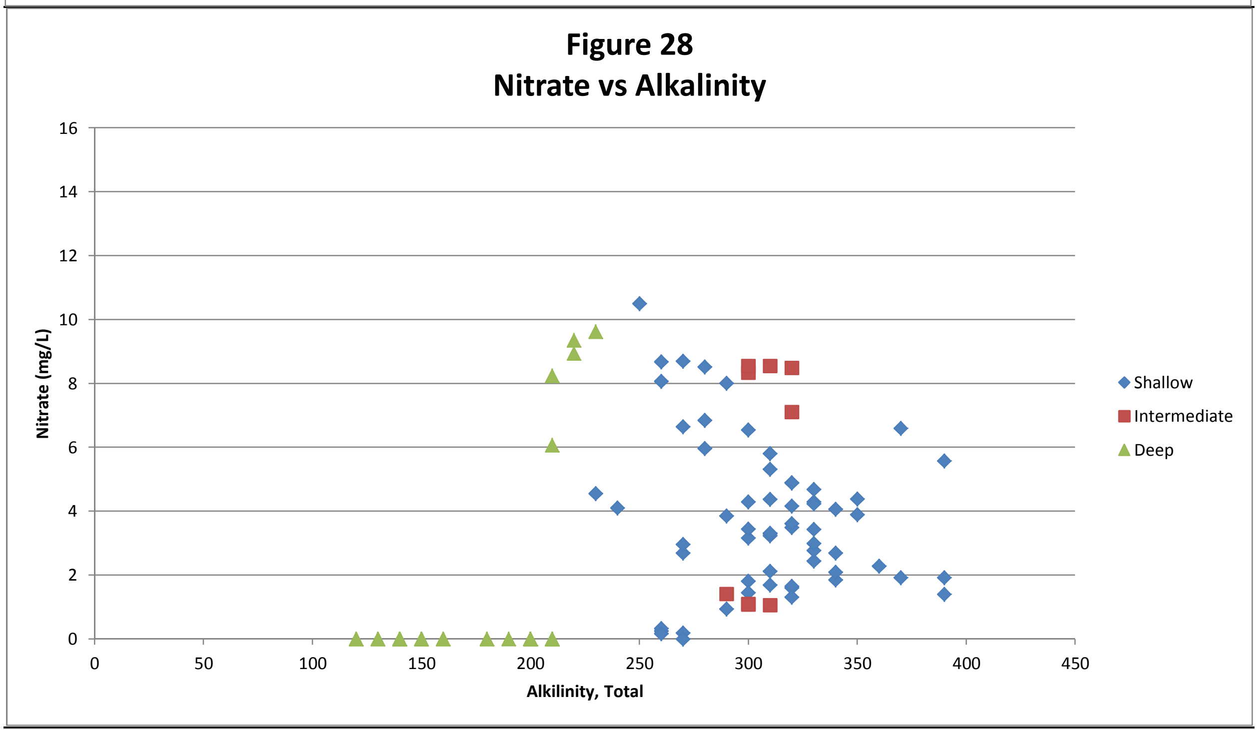
Figure No.

Figure 25 and Figure 26

Title **Private Well Water Quality**
Nitrate vs Phosphorus
Nitrate vs Potassium





Notes:

Privte well chemistry data collected as part of Hydro One Networks Inc. Private Well Monitoring Program.

Data presented to be read in conjuntion with accompanying letter report, dated April 29 ,2016.

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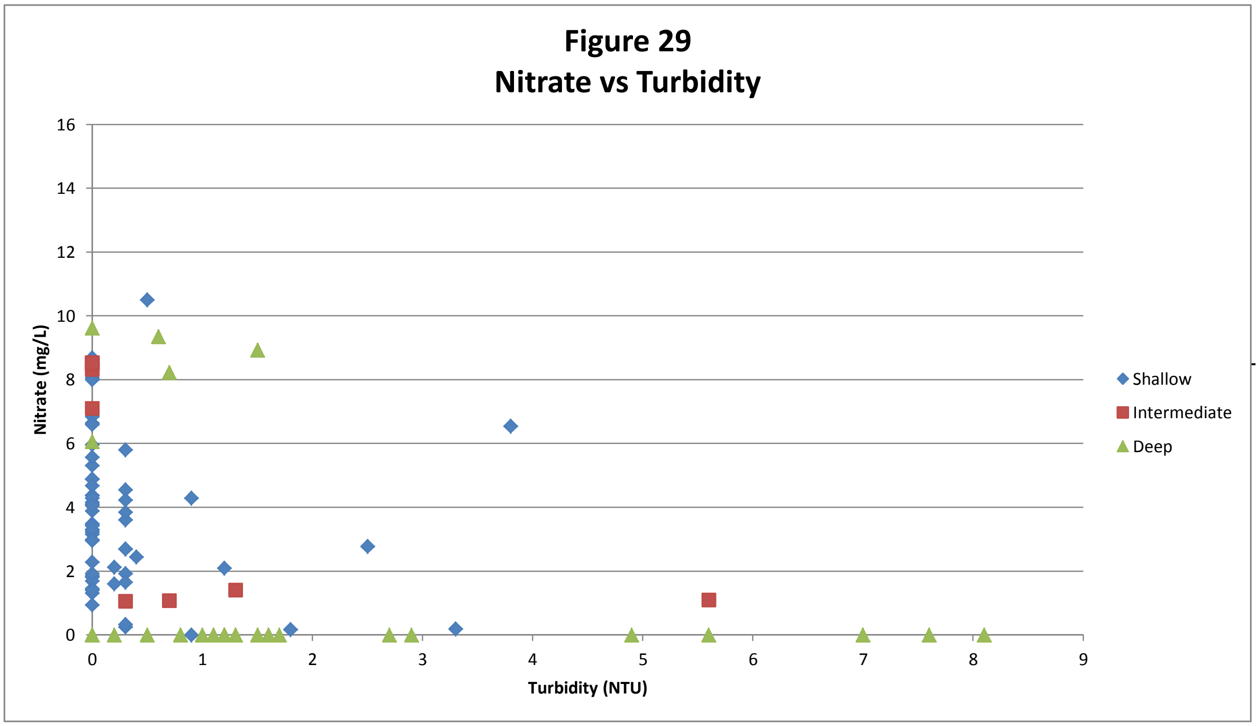
Client/Project

Hydro One Networks Inc.
Nitrate Reponse Letter
Hydro One - Clarington Transformer Station

Figure No.

Figure 27 and Figure 28

Title **Private Well Water Quality**
Nitrate vs pH
Nitrate vs Alkalinity



Notes:

Privte well chemistry data collected as part of Hydro One Networks Inc. Private Well Monitoring Program.

Data presented to be read in conjuntion with accompanying letter report, dated April 29 ,2016.

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Hydro One - Clarington Transformer Station

Figure No.

Figure 29

Title **Private Well Water Quality**
Nitrate vs Turbidity