

Rio Algom Mining LLC

July 29, 2016

Mr. Jeffrey A. Whited
Nuclear Regulatory Commission
Two White Flint, Mail Stop T8F5
11545 Rockville Pike
Rockville, MD 20852

Re: **Ambrosia Lake Facility**
License SUA-1473, Docket No. 40-8905
License Condition #34
1st Half 2016 Groundwater Stability Monitoring Report

Dear Mr. Whited:

Pursuant to license condition #34 for License SUA-1473, attached is the Semi-Annual Groundwater Stability Monitoring Report for the First Half of 2016. This report describes the results associated with the groundwater stability monitoring plan established by Amendment #56.

A digital copy of the report is also included in the package.

If you have any questions or need additional information, please call me at (209)736-4803.

Sincerely,
Rio Algom Mining LLC



Theresa Ballaine
Manager

Attachment: As stated

cc: NRC – Document Control (certified mail)
NMED, Kurt Vollbrecht (email)
DOE, Rich Bush (email)
Mike Schierman, ERG (email)

RIO ALGOM LLC AMBROSIA LAKE FACILITY

License SUA-1473 Docket 40-8905

Groundwater Stability Monitoring Report First Half 2016

July 29, 2016

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ACRONYMS AND ABBREVIATIONS

ACL	alternate concentration limit
AOD	Assurance of Discontinuance
CAP	corrective action program
GPS	groundwater protection standard
KD	Dakota Sandstone
LTSM	long-term surveillance and maintenance boundary
mg/L	milligrams per liter
NMED	New Mexico Environment Department
NRC	Nuclear Regulatory Commission
pCi/L	picocuries per liter
POC	point of compliance
POE	point of exposure
RAML	Rio Algom Mining LLC
Site	Rio Algom Mining LLC – Ambrosia Lake Facility
SOP	standard operating procedure
TRA	Tres Hermanos A
TRB	Tres Hermanos B

**RIO ALGOM MINING LLC
AMBROSIA LAKE FACILITY
GROUNDWATER STABILITY MONITORING REPORT – FIRST HALF 2016**

Nuclear Regulatory Commission (NRC) source material license SUA-1473, Condition #34(D), requires Rio Algom Mining LLC (RAML) to submit semiannual groundwater monitoring reports associated with the facility's groundwater stability monitoring plan established by Amendment 56. Condition 34.D states:

Submit, by February 1 and August 1 of each year groundwater monitoring reports to include a minimum of the following: potentiometric surface maps for each aquifer; time vs. concentration plots for all parameters for which ACLs have been issued, hydrographs for the downgradient most trend well or POE well in each aquifer, hydraulic gradient calculations, and tabulated analytical data for each ACL parameter for each well.

1.0 BACKGROUND

RAML's Ambrosia Lake facility (Site) is located in McKinley County, approximately 24 miles due north of Grants, New Mexico, in the Ambrosia Lake valley. Uranium milling activities started at the Site in 1957. The waste management structures were Tailings Impoundments 1 and 2, Decantation Pond 3, and Evaporation Ponds 4 through 10. Tailings Impoundments 1 and 2 were built in 1958, along with Pond 3 at the eastern toe of Tailings Impoundment 1, to accept decanted tailings liquids. Tailings were first produced at the Site in November 1958. In 1976, RAML diverted the natural course of the Arroyo del Puerto east of Ponds 4, 5, and 6, and lined Ponds 9 and 10. The solids fraction of the tailings was disposed through a slurry transfer system to the tailings impoundments, while the liquids fraction was transferred to the evaporation ponds. Evaporation Pond residues from Ponds 3, 4, 5, 6, 7, and 8 were placed in Tailings Impoundments 1 and 2 prior to final reclamation. All the aforementioned tailings impoundments and ponds were unlined. Seepage from the tailings impoundments and Evaporation Ponds 3 through 6, along with seepage from unrelated mining and milling operations, saturated and impacted the alluvium of the Arroyo del Puerto. Seepage from the tailings impoundments and Evaporation Ponds 7 and 8 recharged and impacted the Tres Hermanos B sandstones within the Mancos Formation shale, and the Dakota Sandstone, which underlies the Mancos Formation.

Consequently, in 1983, RAML entered into an Assurance of Discontinuance (AOD) with the State of New Mexico Environmental Improvement Division (currently the New Mexico Environment Department [NMED]) to minimize the future impact of mill tailings solutions seepage on groundwater. The approved AOD remedial action required the construction and maintenance of an interceptor trench (IT-1) and the cessation of discharges to unlined Ponds 4

through 8. These ponds were taken out of service in 1983. In the late 1990s, RAML added interceptor trenches IT-2, IT-3, and IT-4 south of Pond 10 to collect seepage potentially missed by IT-1.

In 1986, after the State of New Mexico relinquished its licensing authority over uranium mill activities, NRC reasserted jurisdiction at the Site and required that the Site begin a groundwater detection monitoring program. Data from this program were the basis for the groundwater protection standards (GPSs) established for the Site by NRC, and a corrective action program (CAP) for the groundwater was developed based on this information. The CAP required pumping, treating, and discharging treated groundwater into the Arroyo del Puerto. The treated groundwater would sweep through the alluvium, creating a hydraulic barrier between the tailings ponds and the Arroyo del Puerto while flushing existing impacts toward the interceptor trench where it was captured and disposed of into tailings impoundment 1. RAML implemented the CAP beginning in the mid-1980s, however, the CAP and its requirements to pump and treat were removed when the alternate concentration limit (ACL) petition was granted by the NRC in 2006.

Mining and milling operations in the area have had two notable hydrologic effects: creation and maintenance of a saturated zone at the base of the alluvium, and creation of a cone of depression in bedrock aquifers due to dewatering of underground mines. The saturated zone in the alluvium has continued to decrease since the mine dewatering, milling processes, and CAP was terminated.

2.0 FIRST HALF 2016 ACTIVITIES

Activities associated with the groundwater monitoring program at the mill facility during the first half of 2016 consisted of performing sampling pursuant to SUA-1473. The well network was designed to track and assess groundwater impacts between the tailings impoundment and the point of exposure (POE) which is the long-term surveillance and maintenance boundary (LTSM) in the alluvium, Tres Hermanos A, Tres Hermanos B, and the Dakota Sandstone. Figures 1-4 are well network maps showing the location of monitoring wells and the groundwater elevation for each hydrostratigraphic unit. The ACLs for the Site are presented in **Table 1** below.

**Table 1. Rio Algom Mining – Ambrosia Lake Operation
Alternate Concentration Limits**

Parameter	Dakota	Tres Hermanos A	Tres Hermanos B	Alluvium
U-nat (mg/L)	1.6	No ACL	1.6	23
Th-230 (pCi/L)	945	945	945	13,627
Ra-226 and -228 (pCi/L)	218	218	218	3,167
Pb-210 (pCi/L)	88	88	88	1,274
Gross Alpha (pCi/L)	No ACL	No ACL	No ACL	8,402
Molybdenum (mg/L)	No ACL	No ACL	No ACL	176
Nickel (mg/L)	6.8	No ACL	6.8	98
Selenium (mg/L)	No ACL	No ACL	No ACL	49
Chloride (mg/L)	3,200	1,070	2,810	7,110
Nitrate (mg/L)	22.8	9.2	7.7	351
Sulfate (mg/L)	6,480	2,584	4,760	12,000
Total Dissolved Solids (mg/L)	14,100	6,400	11,700	26,100

mg/L = milligrams per liter

pCi/L = picocuries per liter

Appendix 1 of this report contains the analytical data for the Dakota, Tres Hermanos A, Tres Hermanos B, and alluvial units. **Appendix 2** contains the time versus concentration plots for the ACL parameters for the Dakota, Tres Hermanos A, Tres Hermanos B, and alluvial units.

Appendix 3 contains the hydrographs for the most downgradient monitoring well for the Dakota, Tres Hermanos A, Tres Hermanos B, and alluvial units. The most notable observation in the data is that the potentiometric surface in the alluvium continues to decline. For example, RAML has observed a decline of over 30 feet at monitoring well 32-69 since February of 2005. This drop is attributable to the discontinuance of the alluvial CAP, which was maintaining the artificial water mound in the vicinity of the Site. RAML's groundwater flow model projected a 65- to 100-year period for the alluvium to dewater following cessation of the CAP. This water table drop acts to slow the lateral migration rate of milling-related seepage.

RAML determined the hydraulic gradients by calculating the difference in groundwater elevation between the most upgradient point of compliance (POC) well in each unit and the farthest downgradient well in the same unit. That value was then divided by the distance along a flow path between the two wells. Results of these calculations are summarized below:

- Dakota Sandstone – 0.036 foot per foot
- Tres Hermanos A Sandstone – 0.002 foot per foot
- Tres Hermanos B Sandstone – 0.016 foot per foot
- Alluvium – 0.008 foot per foot

Appendix 4 contains the potentiometric surface maps for the Dakota, Tres Hermanos A, Tres Hermanos B, and alluvial units.

3.0 IMPROVEMENTS TO THE MONITORING PROGRAM

Improvements to the groundwater monitoring program include replacing monitoring wells where measured total depth varied from total depth on construction logs, or wells with visible or suspected damage. The ACL wells that have been replaced are alluvial wells 5-03, 5-08, and 5-73; Dakota wells 30-48 KD and 32-45 KD; Tres Hermanos A well 31-01 TRA; and Tres Hermanos B well 31-02 TRB. The well-replacement program was completed in 2013. Analytical data and time-concentration plots for the replacement wells are included in **Appendices 1 and 2**, respectively, and sampling results are discussed in Section 4.0.

Dedicated pumps have been installed in 17 of the NRC groundwater monitoring network wells including 5-03 ALL-R, 5-08 ALL-R, 5-73 ALL-R, 30-48 KD-R, 31-02 TRB-R, 32-45 KD-R, 32-50 TRB-R, 36-06 KD, 33-01 TRA, 19-77 TRB, 31-67 TRB, 36-02 TRB, 32-59 ALL, 31-61 ALL, 31-65 ALL, and 5-04 ALL. A dedicated electric submersible pump was installed in 17-01 KD due to its depth.

3.1 Wells Requiring Further Investigation

Monitoring wells 30-02 KD and 30-01 TRA have not contained sufficient water to collect a sample since 2012 and 2009, respectively. Review of the well construction diagrams for 30-02 KD and 30-01 TRA revealed 20 feet of solid casing (or sump) below the bottom of the screened interval in each well.

Desaturation of the alluvium and upper bedrock units is expected at the Site due to the termination of surface water discharge associated with the groundwater CAP in 2006. The unusual well construction of 30-02 KD and 30-01 TRA (20 foot sump) creates uncertainty in groundwater elevation measurements, since the water levels in those wells is below the screened interval. 30-02 KD is one of six monitoring wells in the Dakota aquifer. According to available screen depth and depth-to-water measurements, the last sample collected from within the screened interval of 30-02 KD was in 1988. Similarly, a representative groundwater sample from within the screened interval for 30-01 TRA was last collected in 1998. Collecting a sample from the screened interval of these monitoring wells ensures that the sample is representative of formation groundwater, however, since the water levels are below the screened interval, the water in the sumps is likely stagnant water. For these reasons, RAML proposes to review historical data for these wells and present justification for plugging and abandoning these wells in a request for a license amendment.

4.0 DATA EVALUATION

As a component of the ACL approval process, NRC not only established ACLs for specific parameters, but also maintained the GPSs for those constituents for which ACLs were not proposed. Data collected during the first half of 2016 were compared to ACLs and GPSs. Notable results are described in detail in the following sections.

4.1 Dakota Sandstone

Analytical results from groundwater samples collected from the Dakota well network are tabulated in **Appendix 1** and presented in time series plots for the ACL parameters in **Appendix 2**. Dakota monitoring wells 36-06 KD and 32-45 KD-R have been monitored on a monthly basis due to exceedances of GPSs for beryllium, cadmium, and gross alpha in 36-06 KD and molybdenum in 32-45 KD-R. The results of monthly monitoring are discussed below. Groundwater sampling results from Dakota monitoring wells 17-01 KD, 30-48 KD-R, and 5-02 KD did not reveal any exceedances of ACLs or GPSs in the first half of 2016. As discussed in Section 3.1, well 30-02 KD does not contain enough water for sample collection.

4.1.1 36-06 KD

Monitoring well 36-06 KD has been monitored on a monthly basis for beryllium, cadmium, gross alpha, and uranium. RAML's interpretation, as previously discussed with NRC, is that fluctuations in groundwater quality in 36-06 KD appear to be linked to surface reclamation work.

4.1.1.1 Beryllium and Cadmium

Elevated beryllium concentrations were identified in 2006 in Dakota POC monitoring well 36-06 KD. As a result of this condition, RAML submitted a proposed CAP on January 15, 2007, to address the beryllium concentrations present within monitoring well 36-06 KD. This CAP was approved by NRC on April 30, 2007.

The initial increasing trend in beryllium concentrations (2001-2007) correlated with surface field work in the vicinity of the well. The increasing trend in beryllium has stabilized, and concentrations trended downward after 2007. RAML proposed to continue monthly monitoring of well 36-06 KD for beryllium so that additional data would be available. Although the beryllium concentration in groundwater samples from monitoring well 36-06 KD continues to exceed the GPS of 0.01 mg/L, it appears to be relatively stable between 0.015 and 0.0225 mg/L since 2014 (**Table 2** and **Figure 1**).

Table 2. First Half 2016 Analytical Summary for Beryllium and Cadmium in Monitoring Well 36-06 KD

Date	Beryllium (mg/L)	Cadmium (mg/L)
GPS (mg/L)	0.01	0.01
1/14/2016	0.0197	0.0107
2/11/2016	0.0177	0.0073
3/21/2016	0.01603	0.0103
4/12/2016	0.01927	0.0097
5/5/2016	0.02114	0.0102
6/13/2016	0.01802	0.0057

*Bold values indicate an exceedance of the KD GPS.

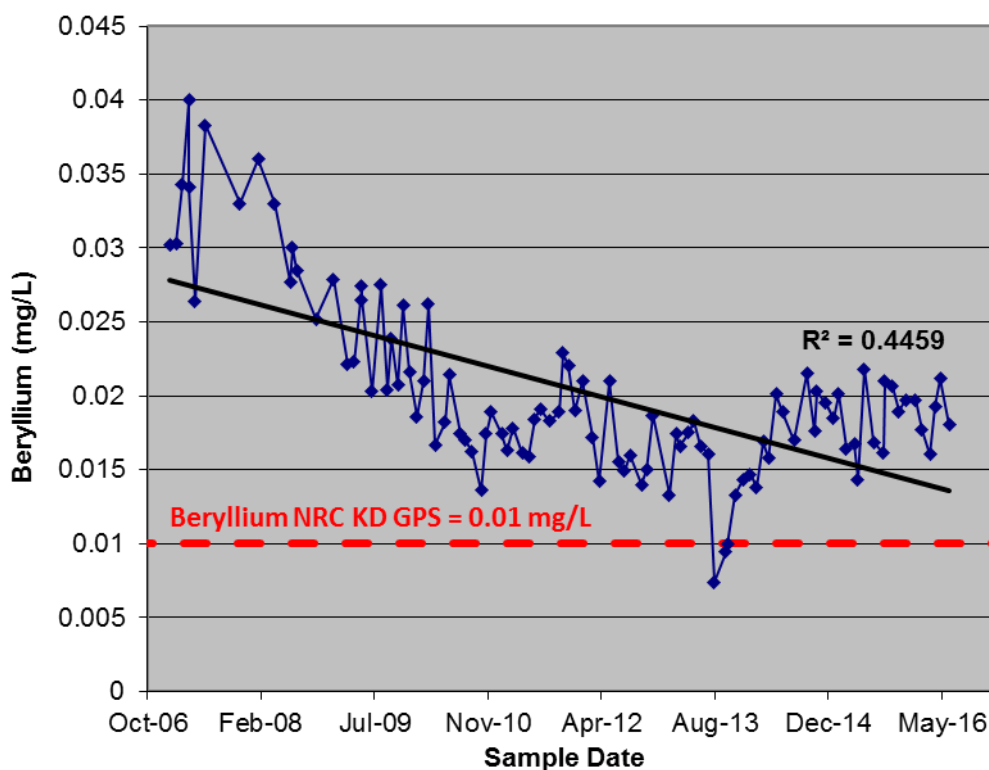


Figure 1. Beryllium Concentrations in Dakota Monitoring Well 36-06 KD

In 2009 RAML instituted a policy of third-party review of laboratory data within five working days of receiving it. As a result of this policy, RAML was made aware that cadmium concentrations in the samples of groundwater from monitoring well 36-06 KD had exceeded the GPS of 0.01 mg/L during several sampling rounds beginning in November 2007 (**Figure 2**). Cadmium concentrations in monitoring well 36-06 KD follow a pattern that is very similar to both

uranium and beryllium concentrations in the same well. These constituents increase when pH decreases and decrease when pH increases. As with uranium and beryllium, cadmium concentrations continue to exhibit an overall decreasing trend and were below the GPS in samples collected during the February, April, and June sampling events for monitoring well 36-06 KD (Table 2 and Figure 2).

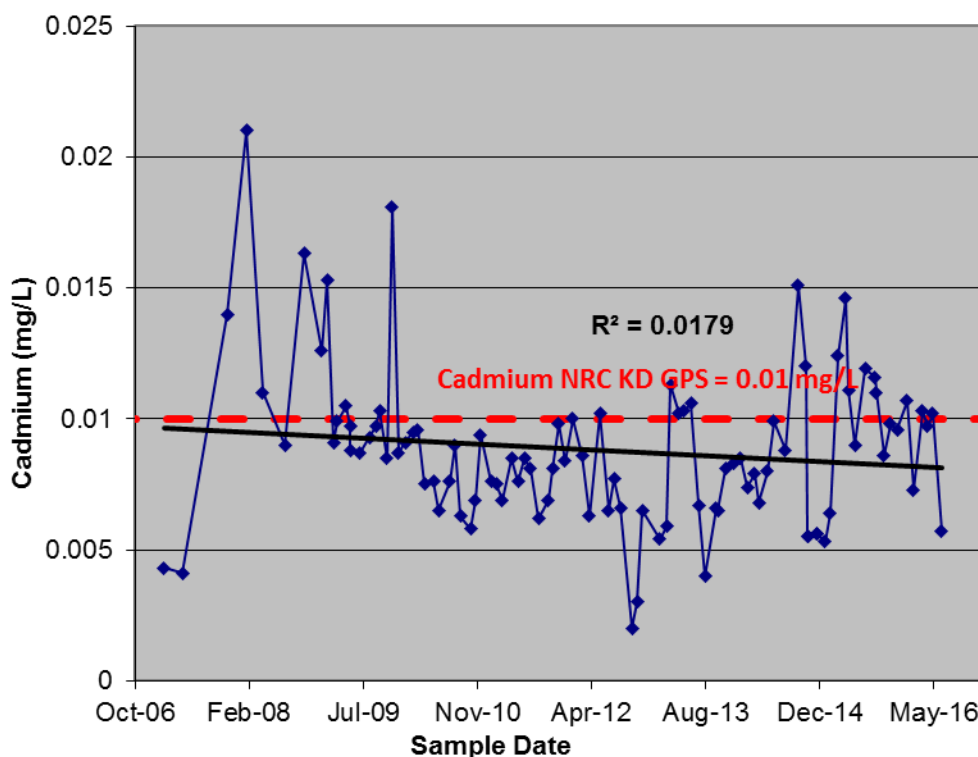


Figure 2. Cadmium Concentrations in Dakota Monitoring Well 36-06 KD

4.1.1.2 Gross Alpha and Uranium

At the time of the Bedrock ACL application (AVM and AHA, 2000), gross alpha, among other constituents, was in exceedance of the GPS in the Dakota aquifer. Since ACLs were being proposed for alpha emitters Th-230 and Ra-226, an ACL for gross alpha was deemed unnecessary and duplicative. The Bedrock ACL application proposed that the GPS for gross alpha be removed from the license as a hazardous constituent in bedrock aquifers and noted that a GPS for gross alpha is unnecessary since the alpha activity hazard is addressed by ACLs for uranium, Th-230, Ra-226, and Pb-210 (which decays to Po-210). Additionally, the Proposed Groundwater Stability Monitoring Plan (included in the December 7, 2005, Response to RAIs Accession number ML053480214 [RAML, 2005]) does not list gross alpha as a monitoring constituent for any of the bedrock units. In the Technical Evaluation Report, which was prepared by the NRC (NRC, 2006) to document its review of the of the various submittals during the six-year ACL application process, NRC acknowledges that gross alpha was evaluated as a

constituent of concern and that the proposed ACLs (including ACLs for radiologic constituents) are appropriate and protective of human health and the environment; however, an ACL for gross alpha was never proposed by RAML, likely because the ACLs for the major alpha-emitting constituents were proposed instead and because the GPS for gross alpha was requested to be removed from the license.

In order to evaluate the gross alpha counts in water from 36-06 KD, factors including alpha-emitting constituents, laboratory uncertainty, and alpha-emitter compliance standards were considered. Semiannual samples collected in 36-06 KD are also analyzed for alpha emitters Th-230 and Ra-226. The monthly samples are only analyzed for gross alpha and uranium. **Table 3** shows the results of these alpha emitters, the calculated gross alpha based on these results, the measured gross alpha minus uranium, and the corresponding ACL/GPSs from 2014 to the present. It is important to note that alpha emitters in the Dakota Sandstone are subject to ACLs, while gross alpha has a more conservative GPS. The sum of the ACLs for the major alpha emitters (Th-230 and Ra-226) is 1,163 pCi/L, which is 20 times greater than the gross alpha GPS of 56 pCi/L.

Table 3. Summary of the Effects of Gross Alpha Calculation Methods in Monitoring Well 36-06 KD.

Date Sampled	Ra-226 (pCi/L)	Th-230 (pCi/L)	Gross Alpha ^A (Summed Isotopes) (pCi/L)	Gross Alpha (U Corrected) (pCi/L)
GPS/ACL	218 (ACL)	945 (ACL)	56 (GPS)	56 (GPS)
3/17/2014	9.3	25	34.3	-60.3
6/10/2014	9.2	29	38.2	55.5
9/24/2014	10	25	35	-122
11/6/2014	15	13	28	68.9
2/11/2015	12	30	42	-39.4
8/26/2015	11	13	24	-66.1
2/11/2016	16	11	27	-18

*Bold values indicate an exceedance of the KD gross alpha GPS of 56 pCi/L.

^AGross Alpha (Summed Isotopes) is calculated from the sum of Ra-226 and Th-230 activities. Isotopes selected for the Gross Alpha summation have long half lives, are alpha emitters, and are sourced from either U-238 or Th-232, the most abundant isotopes of each element.

The gross alpha analysis is performed in accordance with EPA Method 900.0. This method is a commonly used gross alpha screening method for groundwater. The corrected gross alpha values are presented in **Table 4**. Three out of six of the corrected gross alpha values (gross alpha – gross alpha derived from uranium) were greater than the GPS of 56 pCi/L in the first half of 2016. **Figure 3** shows gross alpha results over time with error bars signifying the range of possible results. The Dakota Sandstone does not have an ACL for gross alpha, but does have ACLs for

the other alpha emitters. Monthly sampling and analysis will continue for gross alpha and uranium in 36-06 KD pending preparation of a license amendment with proposed modifications to the gross alpha standards in the upper bedrock units

Table 4. First Half 2016 Analytical Summary for Gross Alpha and Uranium in Monitoring Well 36-06 KD

Date	Corrected Gross Alpha Value (pCi/L)	Uranium (mg/L)
GPS/ACL	56 (GPS)	1.6 (ACL)
1/14/2016	61.2	0.834
2/11/2016	-17.9	0.773
3/21/2016	280	0.493
4/12/2016	-24.6	0.09472
5/5/2016	-6.7	1.01
6/13/2016	83.1	0.7864

*Bold values indicate an exceedance of the KD GPS or ACL.

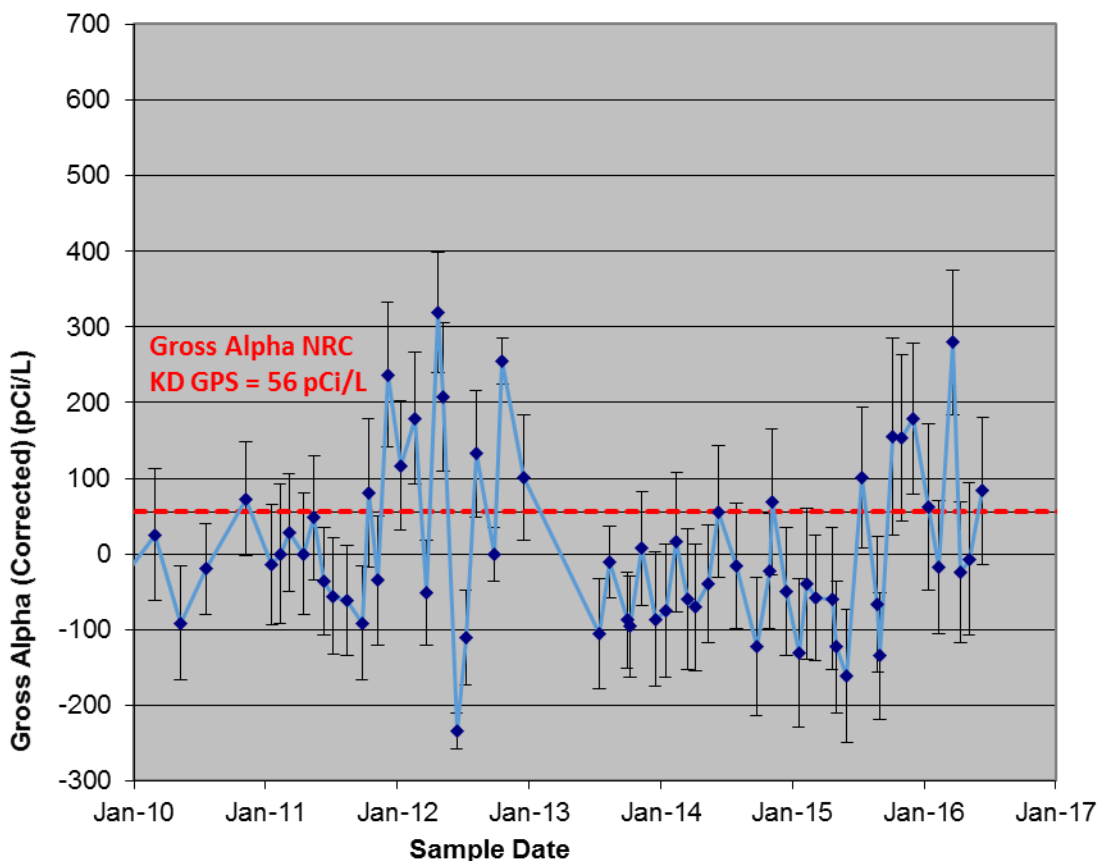


Figure 3. Gross Alpha Activities in Dakota Monitoring Well 36-06 KD

4.1.2 32-45 KD-R

Pursuant to Condition 34.F and Criterion 5D of 10 CFR part 40 Appendix A, RAML proposed a CAP to address the exceedances of nitrate and molybdenum in 32-45 KD-R in the *Groundwater Stability Monitoring Report, Second Half 2014* (RAML, 2015a). Since 32-45 KD-R is a replacement well, RAML proposed the continuation of monthly monitoring for these parameters through 2016 to gather more information as the well continues to stabilize.

4.1.2.1 Nitrate and Molybdenum

Nitrate and molybdenum concentrations in groundwater from 32-45 KD-R exceeded the ACL and GPS from the initial sampling event in the second half of 2013. In the *Groundwater Stability Monitoring Report for the Second Half 2014* (RAML, 2015), RAML proposed to continue monthly monitoring for nitrate and molybdenum in 32-45 KD-R through 2015 as the well continues to stabilize. Nitrate concentrations in monitoring well 32-45 KD-R have continued to decrease and have remained below the ACL of 22.8 mg/L since April 2015. RAML ceased monthly analysis of nitrate in 32-45 KD-R after the February 2016 event as described in the *Groundwater Stability Monitoring Report, Second Half 2015* (RAML, 2016). Concentrations of molybdenum in 32-45 KD-R reached a maximum concentration of 0.505 mg/L in March of 2015, and continue to exceed the GPS of 0.06 mg/L. **Table 5** presents nitrate and molybdenum concentrations in monitoring well 32-45 KD-R during the first half of 2016.

Table 5. First Half 2016 Analytical Result Summary for Nitrate and Molybdenum in Monitoring Well 32-45 KD-R

Sample Date	Nitrate (mg/L)	Molybdenum (mg/L)
GPS/ACL	22.8 (ACL)	0.06 (GPS)
1/14/2016	4.82	0.352
2/11/2016	2.81	0.327
3/21/2016	--	0.3778
4/12/2016	--	0.294
5/5/2016	--	0.2882
6/13/2016	--	0.2666

*Bold values indicate an exceedance of the KD GPS or ACL.

Time series plots of nitrate (**Figure 4**) and molybdenum (**Figure 5**) in 32-45 KD-R show that concentrations during the first half of 2016 appear to follow a generally decreasing trend. While molybdenum remains above the GPS of 0.06 mg/L, the concentrations appear to be stabilizing. Nitrate concentrations have remained below the ACL of 22.8 mg/L since April of 2015. Nitrate in 32-45 KD-R will continue to be analyzed and reported on a semiannual basis.

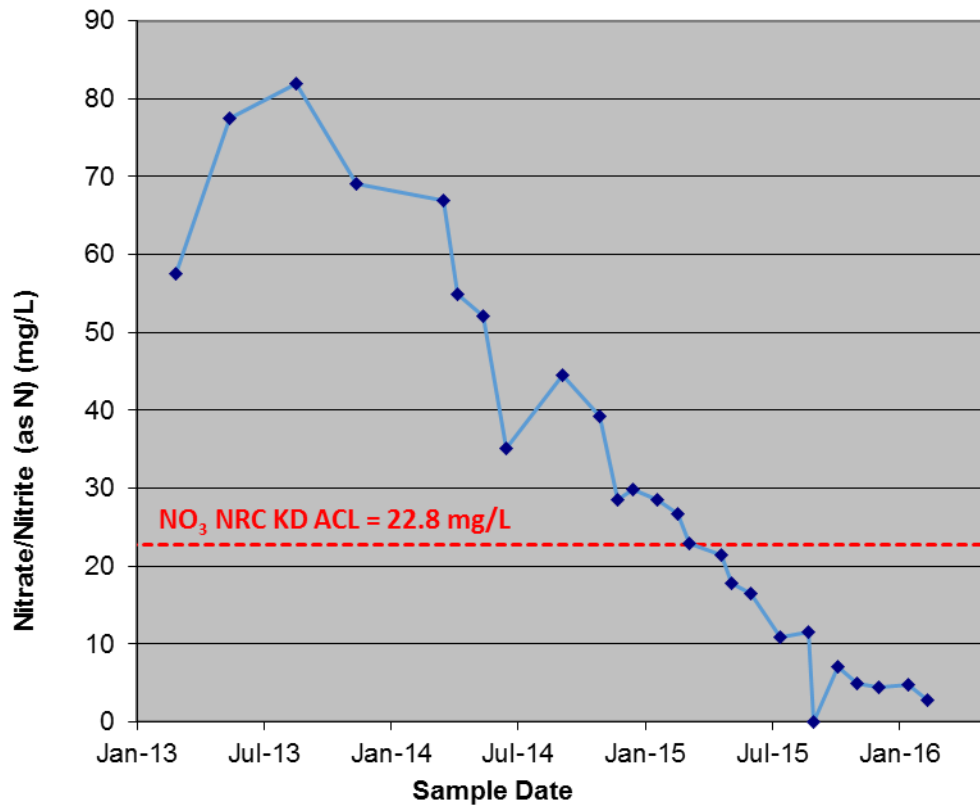


Figure 4. Nitrate/Nitrite (as N) Concentrations in Dakota Monitor Well 32-45 KD-R

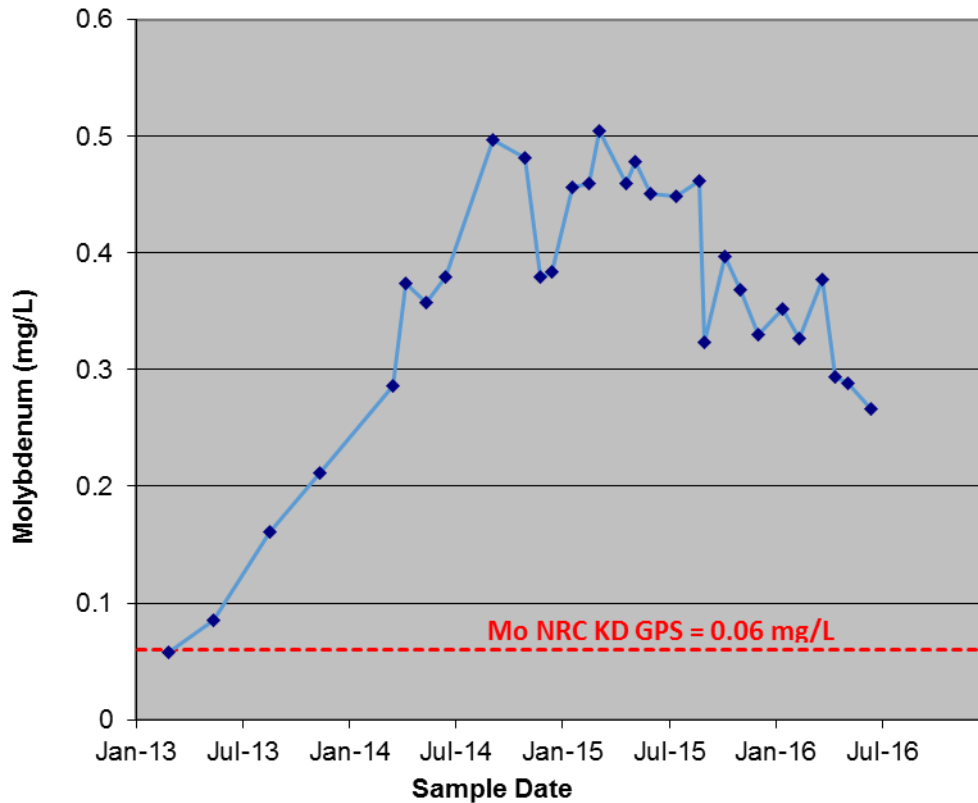


Figure 5. Molybdenum Concentration in Dakota Monitoring Well 32-45 KD-R

Molybdenum is known to occur naturally near uranium deposits (Guilbert & Park, 1986). Molybdenum is not included in primary or secondary EPA Maximum Contaminant Levels for drinking water; however, NMED has a molybdenum standard for irrigation, which is 1.0 mg/L, and concentrations of molybdenum in this well are less than that standard.

Monthly sampling and analysis for molybdenum will continue pending preparation of a License amendment, which may include a proposed GPS modification or an ACL for molybdenum in the Dakota aquifer.

4.2 Tres Hermanos A

Analytical results from Tres Hermanos A wells are tabulated in **Appendix 1** and presented graphically as time series plots in **Appendix 2**. As discussed in Section 3.1, well 30-01 TRA did not contain enough water to collect a sample. Groundwater from Tres Hermanos A wells 31-01 TRA-R and 33-01 TRA did not exceed ACLs or GPSs.

4.3 Tres Hermanos B

Analytical results from Tres Hermanos B wells are tabulated in **Appendix 1** and presented graphically as time series plots in **Appendix 2**. Well 36-01 TRB was last sampled in 2009, and has not contained enough water for a sample since then. Groundwater collected from Tres Hermanos B wells 19-77 TRB, 31-02 TRB-R, 31-67 TRB, and 36-02 TRB did not exceed ACLs or GPSs in the first half of 2016.

4.3.1 31-02 TRB-R

Uranium concentrations in groundwater samples collected from former monitoring well 31-02 TRB from July through November of 2011 exceeded the ACL of 1.6 mg/L. RAML continued monthly sampling, and uranium concentrations were observed below the ACL throughout 2012. As part of the Site-wide well-replacement program, monitoring well 31-02 TRB was identified for replacement and a new well (31-02 TRB-R) was installed on December 14, 2012. Monthly sampling and analysis for uranium and gross alpha in well 31-02 TRB-R continued and results are provided below.

4.3.1.1 Uranium and Gross Alpha

Results from groundwater sampling for the first half of 2016 are presented in **Table 6**.

Table 6. First Half 2016 Analytical Summary for Uranium and Gross Alpha in Monitoring Well 31-02 TRB-R

Date	Uranium (mg/L)	Gross Alpha Corrected (pCi/L)
ACL/GPS	1.6 (ACL)	21 (GPS)
1/14/2016	0.0046	2.52
2/10/2016	0.0039	-11.1
3/21/2016	0.0032	42.9
4/12/2016	0.0045	16
5/5/2016	0.0045	38
6/13/2016	0.0032	1.46

*Bold values indicate an exceedance of the TRB GPS.

Uranium concentrations in this replacement well have never exceeded the ACL, and gross alpha was below the GPS of 21 pCi/L in the first half of 2016, with the exception of two results in March and May. (**Figure 6**).

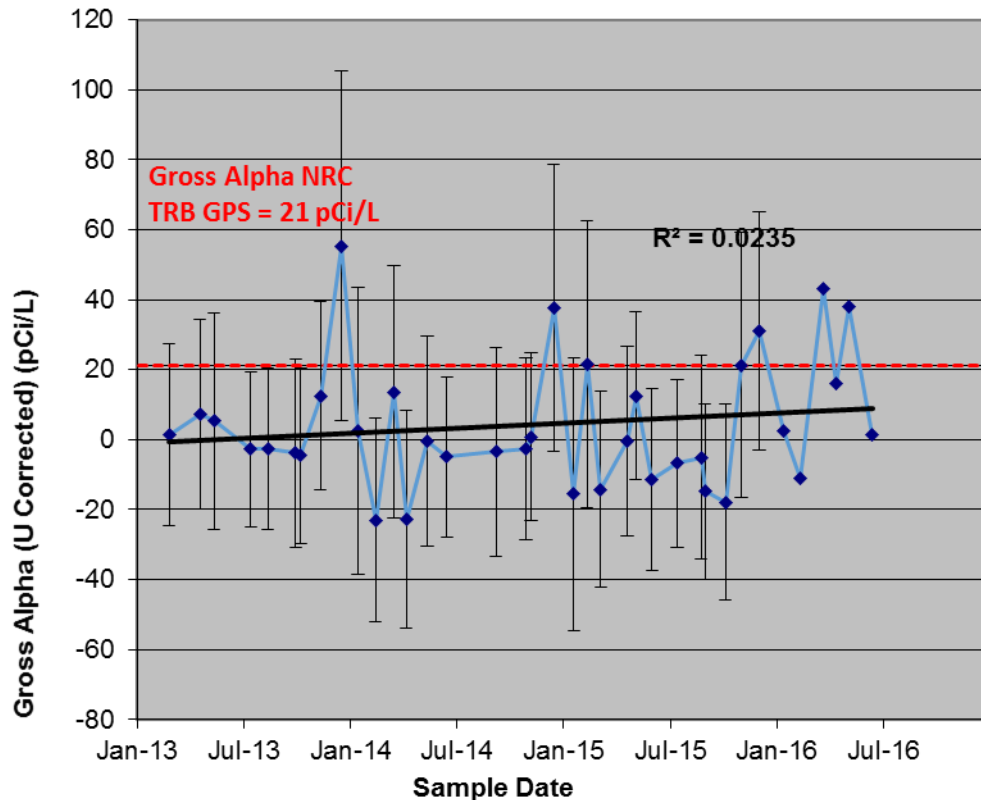


Figure 6. Gross Alpha (U Corrected) Activities in Tres Hermanos B Monitoring Well 31-02 TRB-R

As with the gross alpha results in 36-06 KD described in Section 4.1.1.2, the Tres Hermanos B does not have an ACL for gross alpha, but does have ACLs for the other alpha emitters. Monthly sampling and analysis will continue for gross alpha and uranium in 31-02 TRB-R, pending preparation of a license amendment with proposed modifications to the gross alpha standards in the upper bedrock units.

4.4 Alluvium

Analytical results from the alluvial well network are tabulated in **Appendix 1** and presented graphically as time series plots in **Appendix 2**. MW-24 ALL did not contain enough water to collect a sample. Groundwater from all other alluvial wells did not exceed ACLs.

5.0 CONCLUSIONS

Table 7 summarizes the notable results from the first half of 2016 groundwater monitoring and provides path forward recommendations.

**Table 7. Rio Algom Mining – Ambrosia Lake
First Half 2016 Summary and Path Forward**

Well	Summary	Status	Path Forward
36-06 KD	Beryllium, cadmium, and gross alpha above GPSs	CAP submitted for beryllium 2007; monthly monitoring (plus uranium)	Continue with monthly monitoring until development and approval of ACLs or GPS modification for gross alpha for License Amendment.
32-45 KD-R	Molybdenum above GPS	Replacement well stabilizing, monthly monitoring	Continue with monthly monitoring and quarterly reporting for molybdenum until concentrations drop below the GPS; consider revision of GPS for molybdenum in upcoming License Amendment.
31-02 TRB-R	Gross alpha above GPS	Replacement well stabilizing; monthly monitoring	Continue monthly monitoring and quarterly reporting until well stabilizes; consider revision of GPS or ACLs for License Amendment.

RAML proposes to continue monthly sampling of constituents exceeding their GPS. Replacement wells that are in the process of stabilization will also be sampled on a monthly basis for constituents exceeding GPSs or ACLs. If exceedances continue to occur after wells have stabilized, a CAP will be proposed and submitted to NRC. Wells with construction specifications that allow for collection of samples that may not be representative of formation conditions will be monitored for total depth and depth to water, and sampled if the water level is sufficient.

Monitoring of the well network is required on a semiannual basis, with the exception of the wells involved in accelerated monthly sampling. RAML will continue to conduct monthly and semiannual monitoring in accordance with the requirements in Condition #34 of the License.

6.0 REFERENCES

- AVM Environmental Services, Inc., and Applied Hydrology Associates, Inc. (AVM and AHA), 2000. *Corrective Action Program and Alternate Concentration Limits Petition for Upper Most Bedrock Units Ambrosia Lake Uranium Mill Facility Near Grants, New Mexico*.
- Guilbert, J.M. and C.F. Park, 1986. *The Geology of Ore Deposits*. Waveland Press, IL.
- Rio Algom Mining LLC (RAML), 2005. Response to Request for Additional Information. Rio Algom Mining LLC License Amendment for Alternate Concentration Limits Non-Hazardous Constituents. December 2005. ML053480214, Dec. 7.
- , 2015a. *Rio Algom LLC Ambrosia Lake Facility, License SUA-1473 Docket 40-8905, Groundwater Stability Monitoring Report, Second Half 2014*.
- , 2015b. *Groundwater Monitoring Standard Operating Procedure*.
- , 2016. *Rio Algom LLC Ambrosia Lake Facility, License SUA-1473 Docket 40-8905, Groundwater Stability Monitoring Report, First Half 2016*.
- U.S. Nuclear Regulatory Commission (NRC), 2006. *Technical Evaluation Report Alternate Concentration Limits Application, Rio Algom Mining, LLC. Ambrosia Lake Uranium Mill Facility, New Mexico*.

APPENDIX 1

Stability Monitoring Plan
Analytical Results

RIO ALGOM MINING LLC
1st HALF 2016
DAKOTA WELL RESULTS - ACL PARAMETERS

Well	Date		Depth To Water	Total Depth	Spec. (Cond.)	Temp C	pH s.u.	Chloride (mg/L)	Nitrate (mg/L)	T.D.S. (mg/L)	Sulfate (mg/L)
17-01 KD	2/16/2016	Q1 2016	-	-	1486	18.7	9.96	14.8	<0.02	1010	694
30-02 KD	2/1/2016	Q1 2016	308.35	313.4			Insufficient Water				
30-48 KD-R	2/18/2016	Q1 2016	326.16	358.73	4958	13.76	6.87	521	<0.02	4170	2070
32-45 KD-R	2/11/2016	Q1 2016	257.7	283.97	2455	12.3	7.01	118	2.81	1900	902
36-06 KD	2/11/2016	Q1 2016	184.36	197.67	8976	13.44	3.95	1280	<0.02	8340	4060
5-02 KD	2/15/2016	Q1 2016	187.18	190.37	1359	15.07	7.75	11.1	0.94	792	183

ACL								3200	22.8	14100	6480
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Well	Date		Ni (mg/L)	U-nat (mg/L)	Th-230 (pCi/L)	Pb-210 (pCi/L)	Ra-226+Ra-228 (pCi/L)
17-01 KD	2/16/2016	Q1 2016	<0.0006	<0.0001	0.07	-1.4	1.3 y
30-02 KD	2/1/2016	Q1 2016			Insufficient Water		
30-48 KD-R	2/18/2016	Q1 2016	<0.003	<0.0005	-0.25	15	5.6 y
32-45 KD-R	2/11/2016	Q1 2016	0.0045	0.0783	0.16	-5.8	3 y
36-06 KD	2/11/2016	Q1 2016	0.207	0.773	11	2.2	25 y
5-02 KD	2/15/2016	Q1 2016	0.0006 B	0.0022	0.24	1.7	1.7 y

ACL			6.8	1.6	945	88	218
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Total depth could not be measured at 17-01 KD.

Well 30-02 KD contained insufficient water for sample collection.

< = constituent was not detected above the method detection limit.

'y' indicates the value is calculated from analytical results.

'B' indicates that the analyte was detected in both the blank and sample.

RIO ALGOM MINING LLC
1st HALF 2016
TRA WELL RESULTS - ACL PARAMETERS

Well	Date		Depth To Water	Total Depth	Spec. (Cond.)	Temp C	pH s.u.	Chloride (mg/L)	Nitrate (mg/L)	T.D.S. (mg/L)	Sulfate (mg/L)
30-01 TRA	2/1/2016	Q1 2016	204.95	207.55				Insufficient Water			
31-01 TRA-	2/12/2016	Q1 2016	204.9	213.7	2114	13.29	7.27	32	0.07 B	1760	765
33-01 TRA	2/9/2016	Q1 2016	118.65	181.4	3848	13.3	7.65	32.2	0.03 B	2700	1740
ACL								1070	9.2	6400	2584

Well	Date		Th-230 (pCi/L)	Pb-210 (pCi/L)	Ra-226+Ra-228 (pCi/L)
30-01 TRA	2/1/2016	Q1 2016		Insufficient Water	
31-01 TRA-	2/12/2016	Q1 2016	-0.05	-5.5	1.48 y
33-01 TRA	2/9/2016	Q1 2016	-0.29	-2.9	1.62 y
ACL			945	88	218

< = constituent was not detected above the method detection limit.

Well 30-01TRA contained insufficient water for sample collection.

'y' indicates the value is calculated from analytical results.

'B' indicates that the analyte was detected in both the blank and sample.

RIO ALGOM MINING LLC
1st HALF 2016
TRB WELL RESULTS - ACL PARAMETERS

Well	Date		Depth To Water	Total Depth	Spec. (Cond.)	Temp C	pH s.u.	Chloride (mg/L)	Nitrate (mg/L)	T.D.S. (mg/L)	Sulfate (mg/L)
19-77 TRB	2/10/2016	Q1 2016	272.31	288.25	4512	14.11	7.03	16.5	0.47	3340	1870
31-02 TRB-	2/10/2016	Q1 2016	96.7	128.32	9164	12.7	6.36	1150	<0.02	8160	3670
31-67 TRB	2/10/2016	Q1 2016	34.41*	96.29	8271	12	6.33	1060	<0.02	7120	3460
36-01 TRB	2/1/2016	Q1 2016	-	58.50				Dry			
36-02 TRB	2/11/2016	Q1 2016	50.5	57.49	10723	12.87	6.3		<0.02	7700	3030
ACL								2810	7.7	11700	4760

Well	Date		Ni (mg/L)	U-nat (mg/L)	Th-230 (pCi/L)	Pb-210 (pCi/L)	Ra-226+Ra-228 (pCi/L)
19-77 TRB	2/10/2016	Q1 2016	0.002 B	0.0088	0.63	-14	0.82 y
31-02 TRB-	2/10/2016	Q1 2016	0.003 B	0.0039	0.07	-2.5	10.1 y
31-67 TRB	2/10/2016	Q1 2016	0.008 B	0.014	0.37	-3.8	14.4 y
36-01 TRB	2/1/2016	Q1 2016			Dry		
36-02 TRB	2/11/2016	Q1 2016			Insufficient Water		
ACL			6.8	1.6	945	88	218

* value was recorded 8/24/2015

< = constituent was not detected above the method detection limit.

Monitor Wells 36-01 TRB and 36-02 TRB contained insufficient water for sample collection.

'y' indicates the value is calculated from analytical results.

'B' indicates that the analyte was detected in both the blank and sample.

RIO ALGOM MINING LLC
1st HALF 2016
ALLUVIAL WELL RESULTS - ACL PARAMETERS

Well	Date		Depth To Water	Total Depth	Spec. (Cond.)	Temp C	pH s.u.	Chloride (mg/L)	Nitrate (mg/L)	T.D.S. (mg/L)	Sulfate (mg/L)
5-73 ALL-R	2/8/2016	Q1 2016	21.2	35.67	7572	11.99	6.31	1210	1.02	5710	2290
5-03 ALL-R	2/8/2016	Q1 2016	26.2	55.76	5259	12.48	7.09	563	0.46	4340	2330
5-04 ALL	2/8/2016	Q1 2016	24.1	60.21	62.96	12.33	8.18	890	<0.02	5420	2750
5-08 ALL-R	2/8/2016	Q1 2016	37.03	76.5	4352	12.73	7.44	227	14.8	3920	1990
31-61 ALL	2/9/2016	Q1 2016	16.41	29.08	17291	13.1	6.15	2390	2.94	13500	6340
31-65 ALL	2/10/2016	Q1 2016	13.81	41.49	16643	11.02	6.04	2570	<0.02	14600	6860
32-59 ALL	2/9/2016	Q1 2016	21.36	28.36	6230	12.01	7.25	676	2.51	4800	2460
MW-24 ALL	2/1/2016	Q1 2016	50.21	50.33			Insufficient Water				
ACL								7110	351	26100	12000

RIO ALGOM MINING LLC
1st HALF 2016
ALLUVIAL WELL RESULTS - ACL PARAMETERS

Well	Date		Mo (mg/L)	Ni (mg/L)	Se (mg/L)	U-nat (mg/L)	Th-230 (pCi/L)	Pb-210 (pCi/L)	Ra-226+Ra-228 (pCi/L)	Gross Alpha (pCi/L)
5-73 ALL-R	2/8/2016	Q1 2016	0.004 B	0.007 B	0.254	1.3	0.12	-1.6	1.27 y	-101 y
5-03 ALL-R	2/8/2016	Q1 2016	<0.003	0.003 B	0.0015 B	0.101	-0.13	1.4	0.93 y	-2 y
5-04 ALL	2/8/2016	Q1 2016	<0.003	<0.003	<0.001	<0.0005	0	-4	1.01 y	-19
5-08 ALL-R	2/8/2016	Q1 2016	0.005	0.002 B	0.0021 B	0.0244	-0.06	-8.2	0.57 y	16 y
31-61 ALL	2/9/2016	Q1 2016	<0.005	0.054	0.0058	0.703	0.16	-6.3	3.32 y	-211 y
31-65 ALL	2/10/2016	Q1 2016	<0.005	0.128	0.0032 B	0.098	-0.06	-5.3	1.74 y	-43 y
32-59 ALL	2/9/2016	Q1 2016	0.006 B	0.004 B	0.0153	0.1998	-0.11	-1.9	0.76 y	-49 y
MW-24 ALL	2/1/2016	Q1 2016				Insufficient Water				
ACL			176	98	49	23	13627	1274	3167	8402

< = constituent was not detected above the method detection limit.

'y' indicates the value is calculated from analytical results.

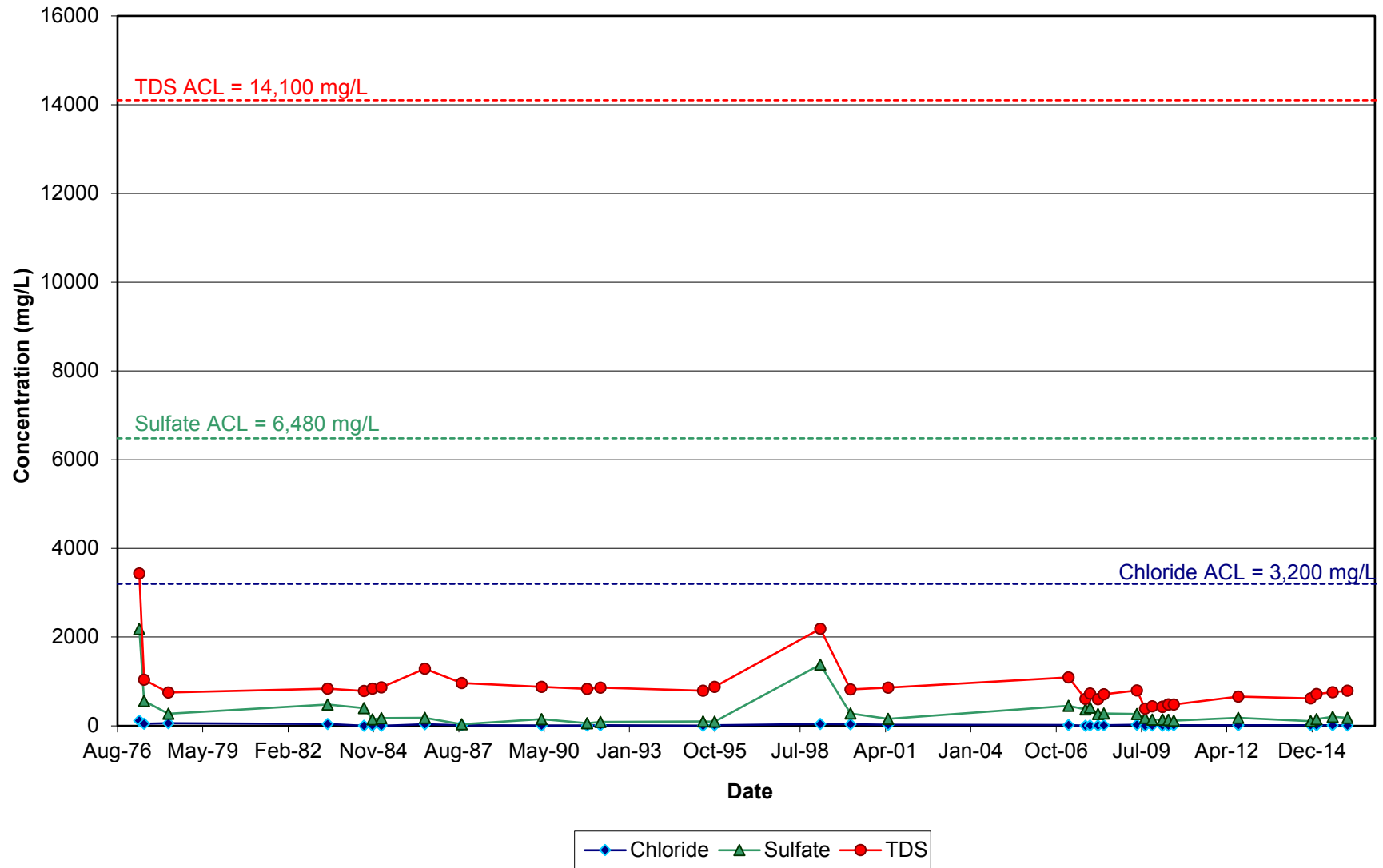
'B' indicates that the analyte was detected in both the blank and sample.

APPENDIX 2

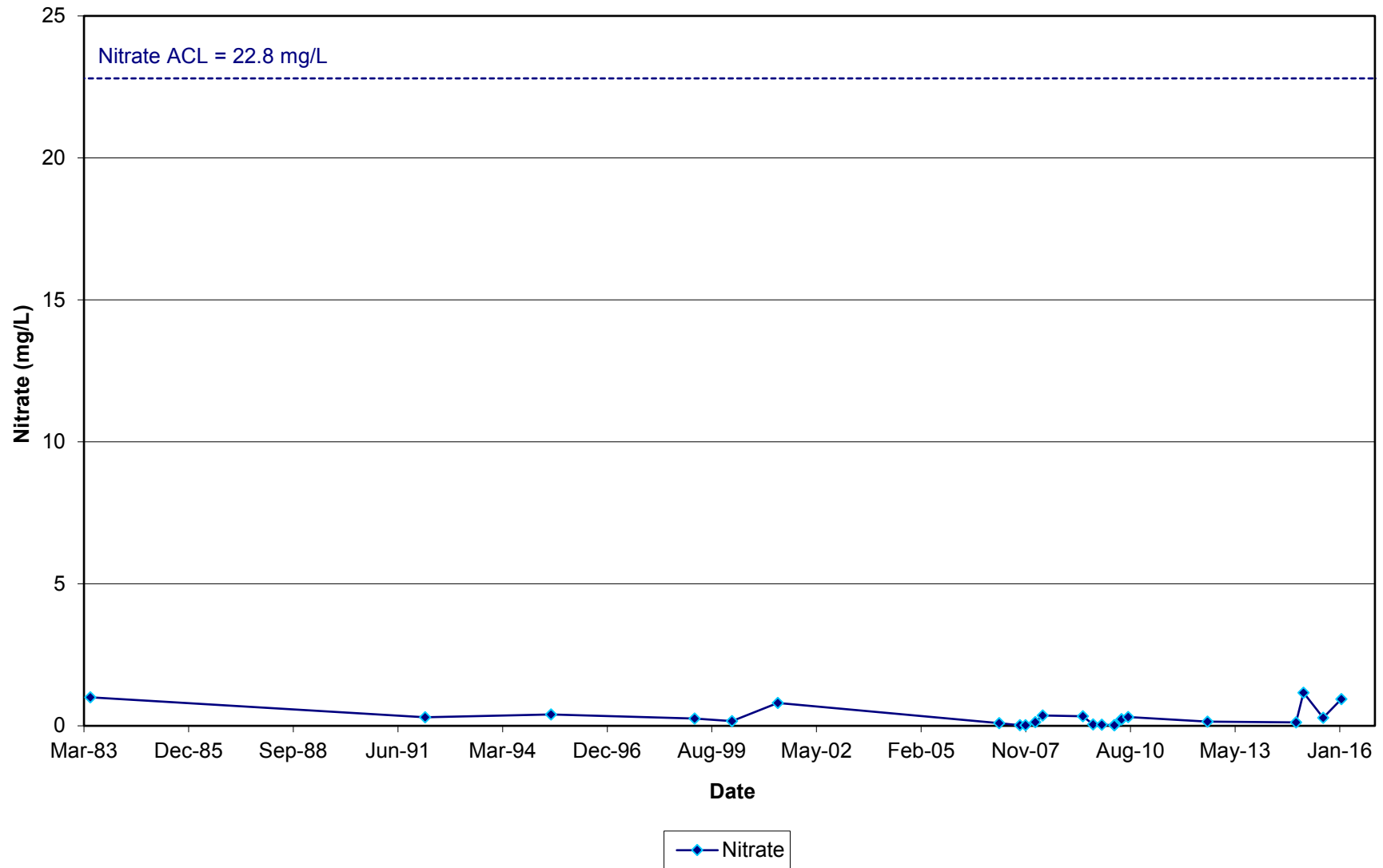
Stability Monitoring Plan
Time Versus Concentration Plots

Stability Monitoring Plan
Time Versus Concentration Plots
Dakota

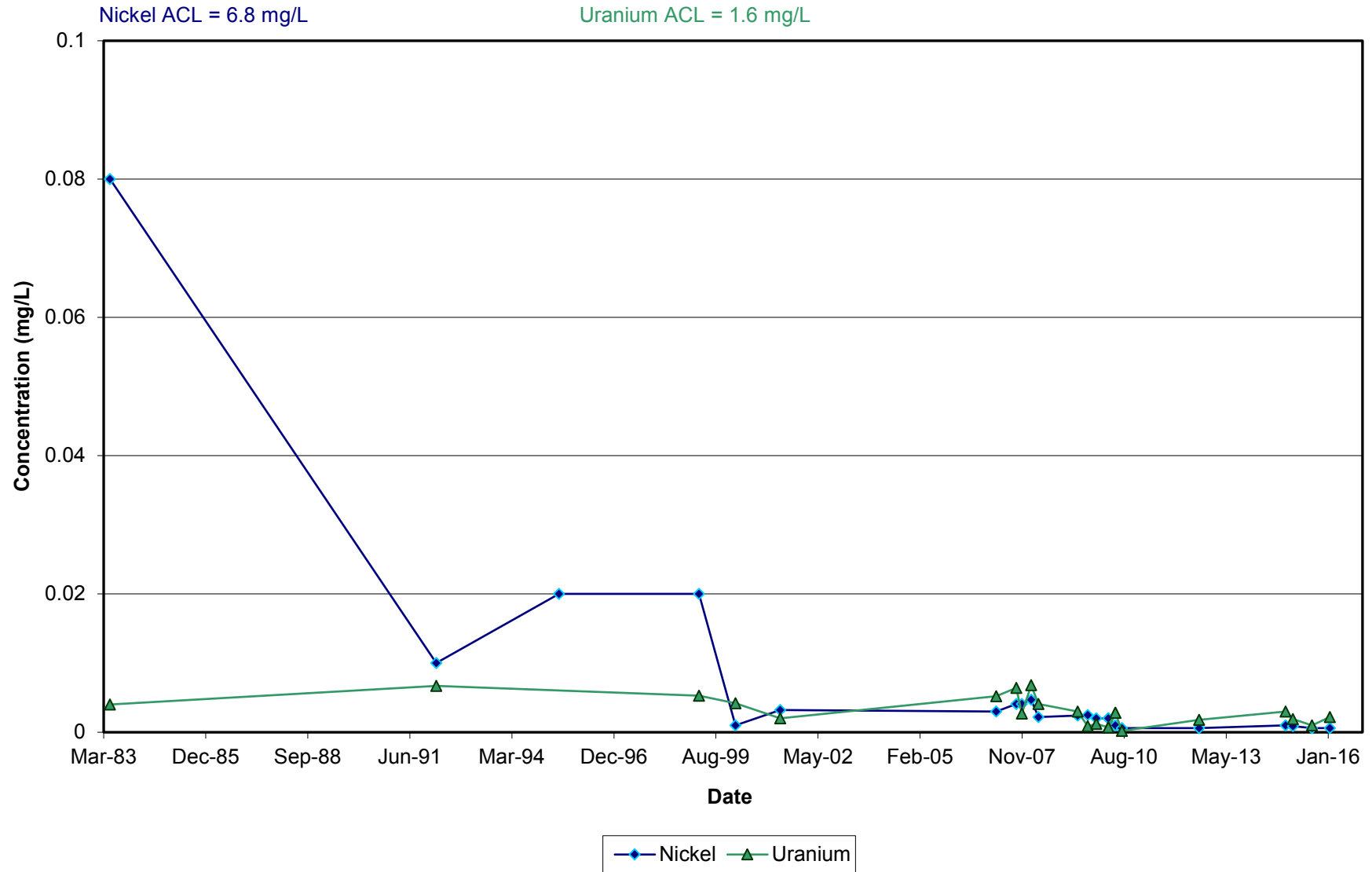
Anions and TDS in Monitoring Well 5-02 KD



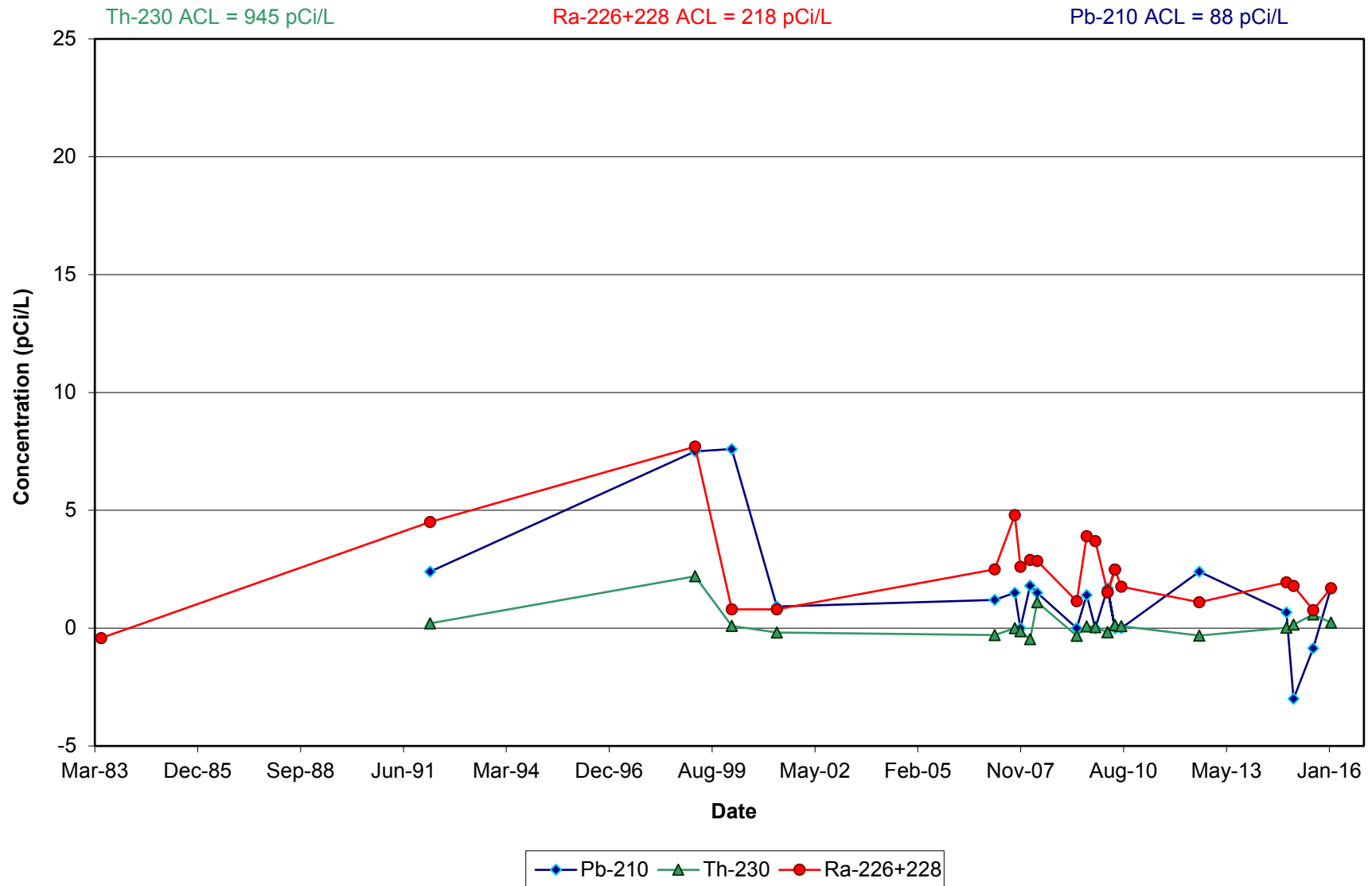
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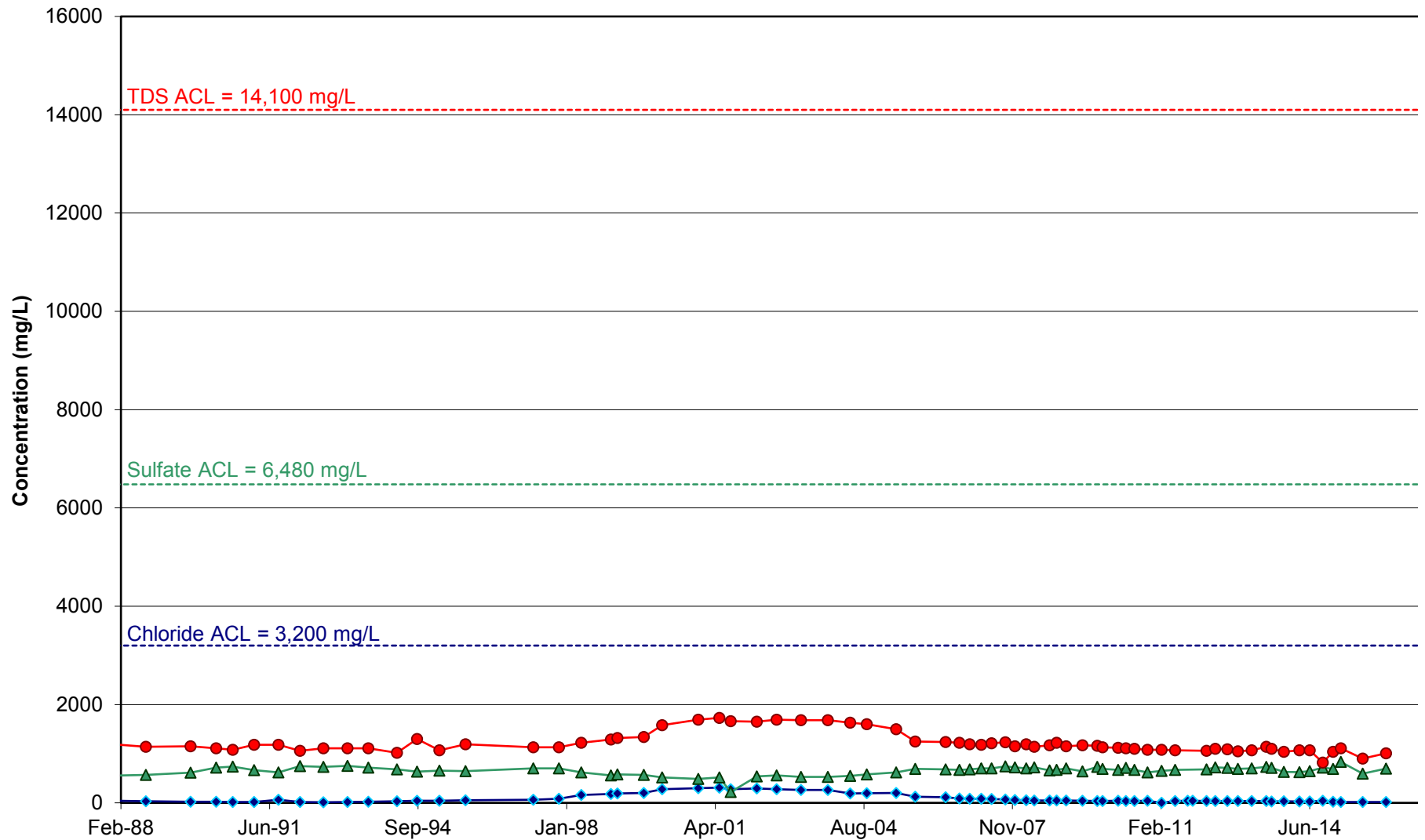
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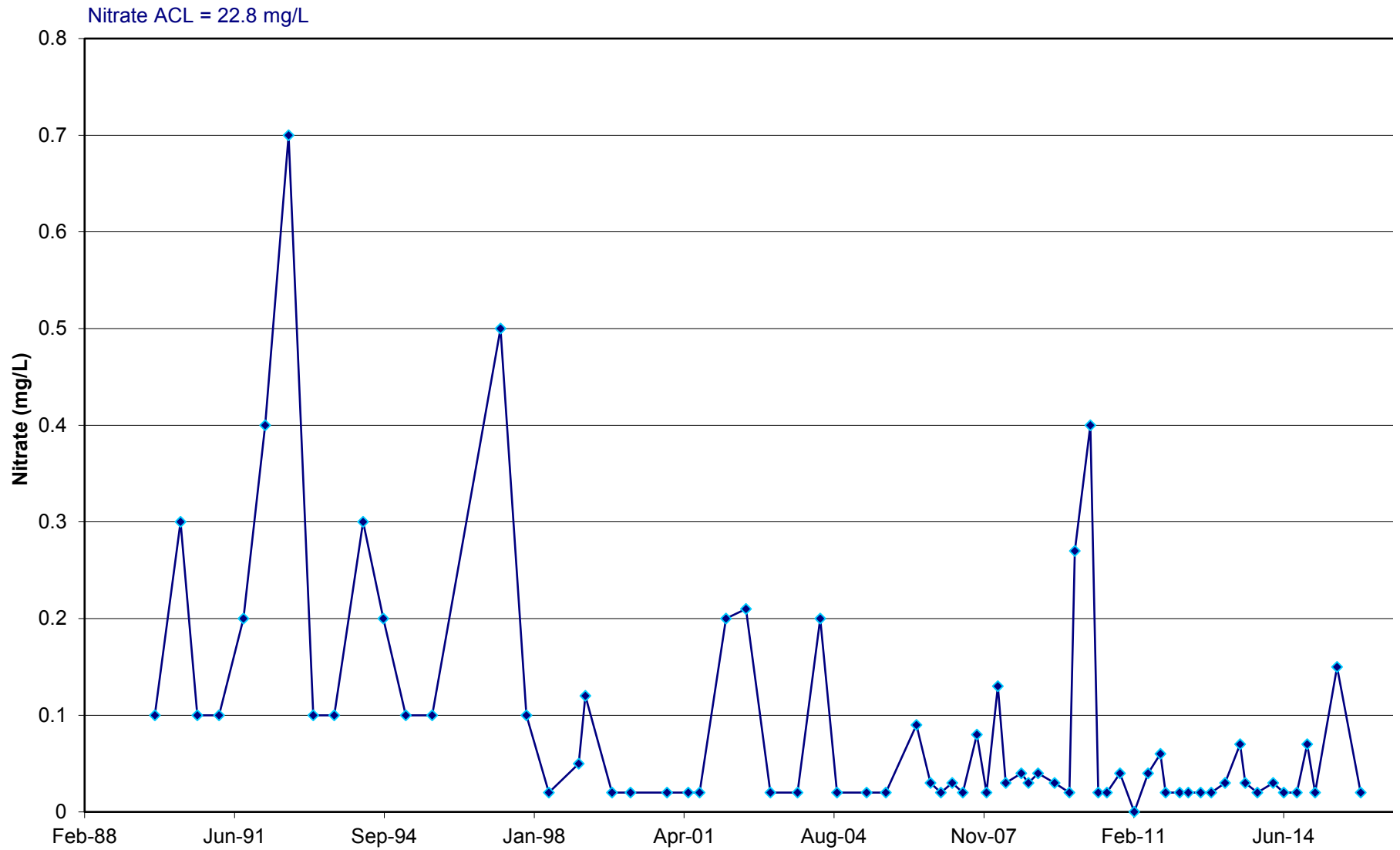
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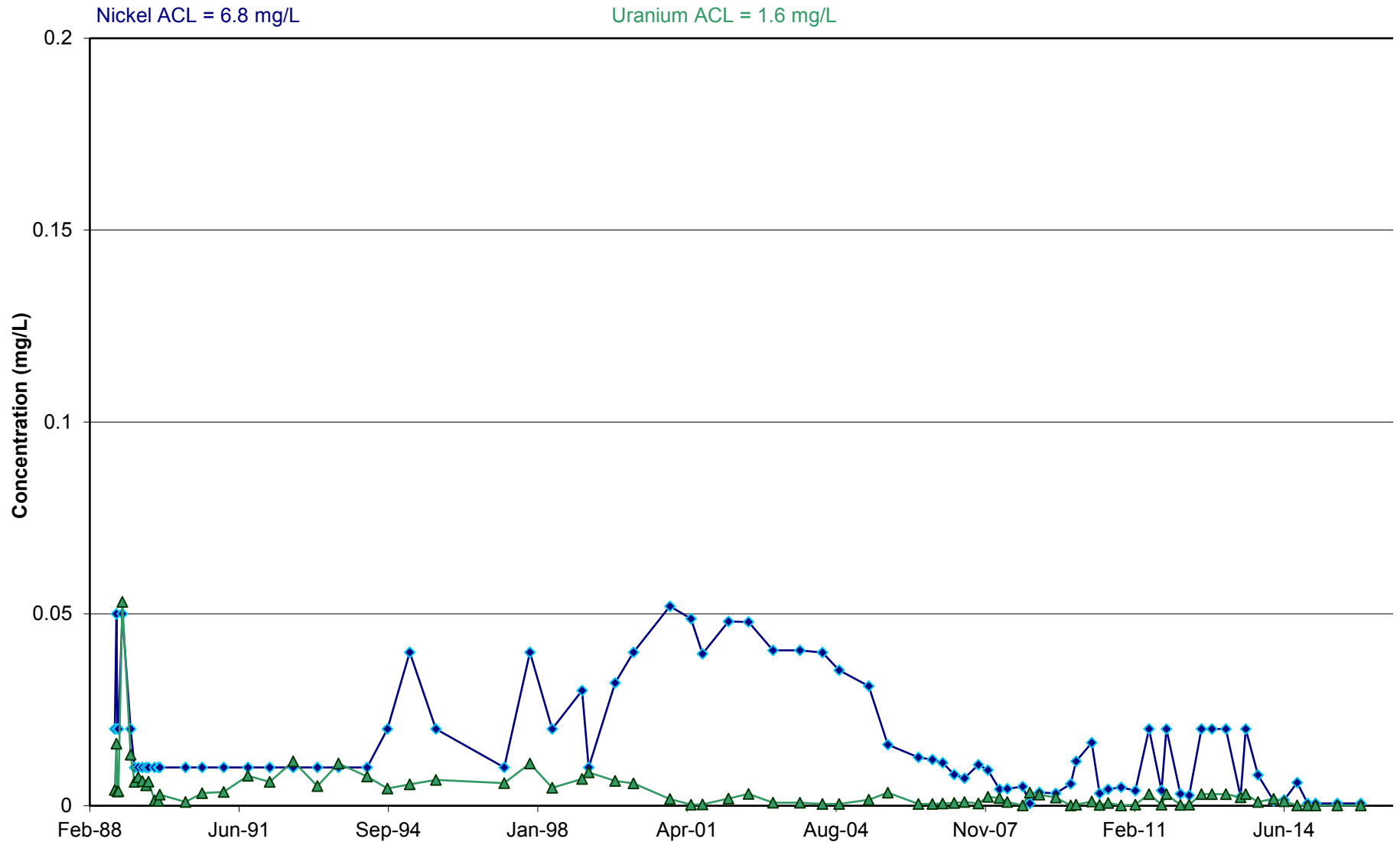
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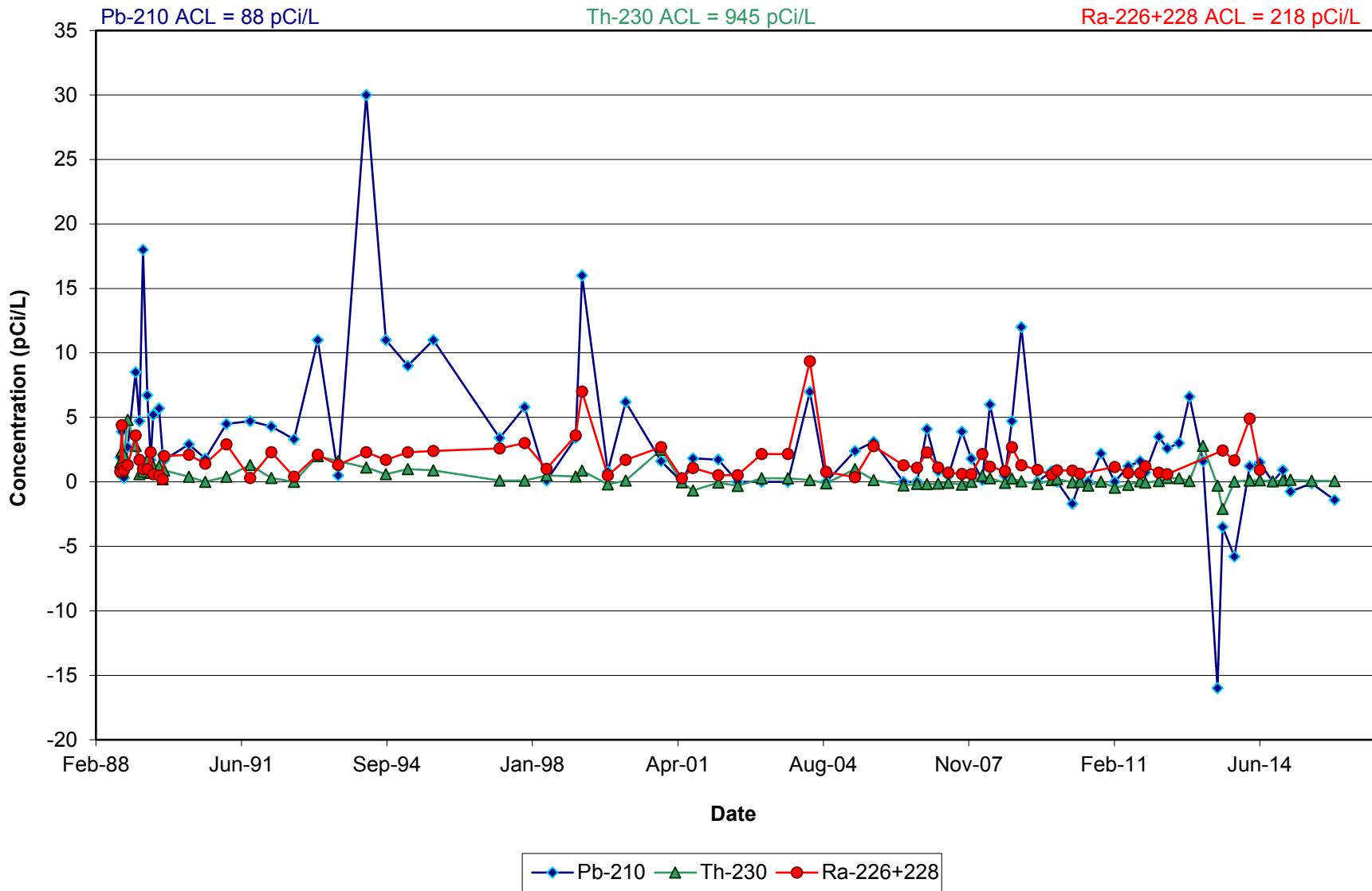
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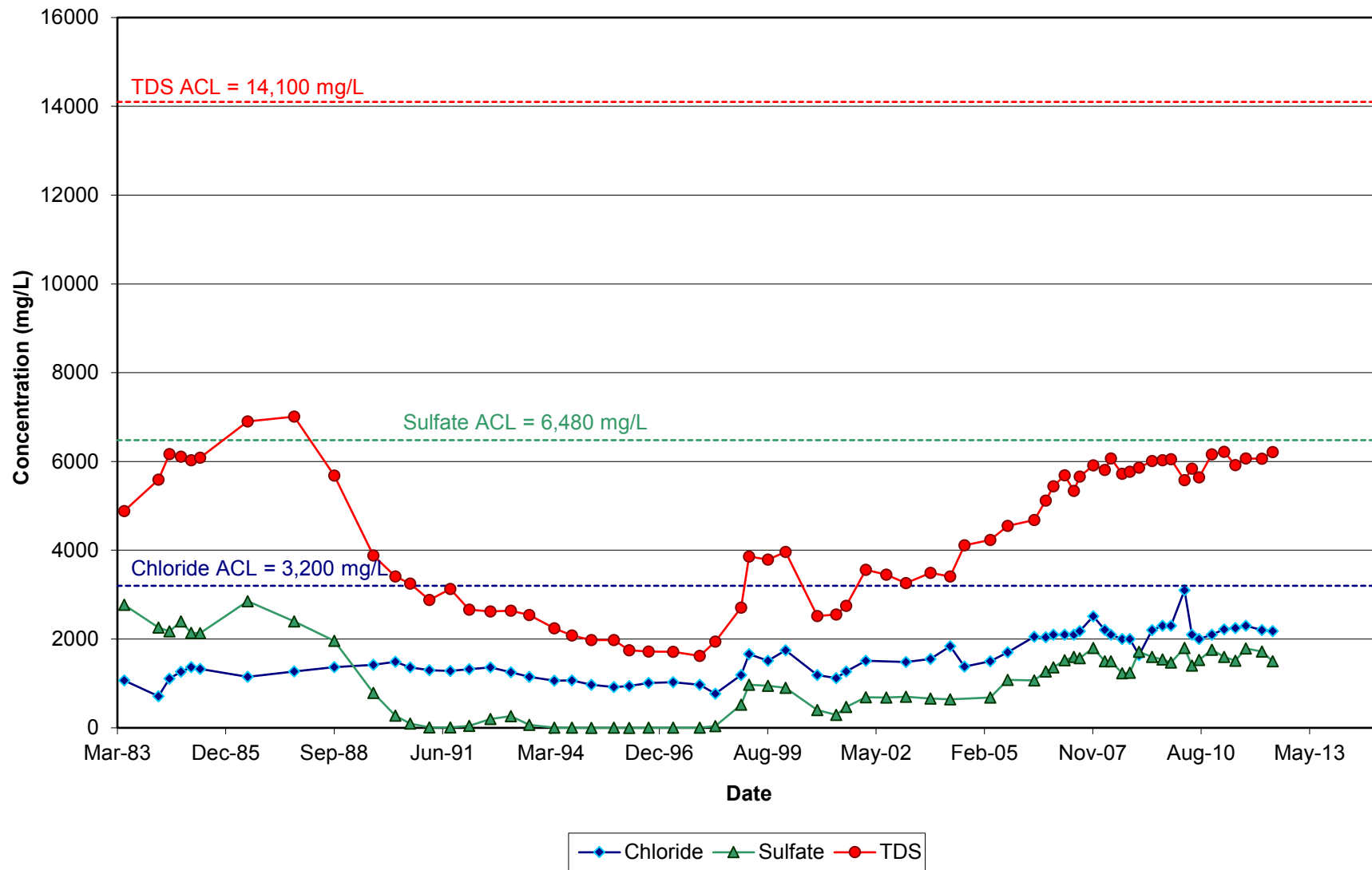
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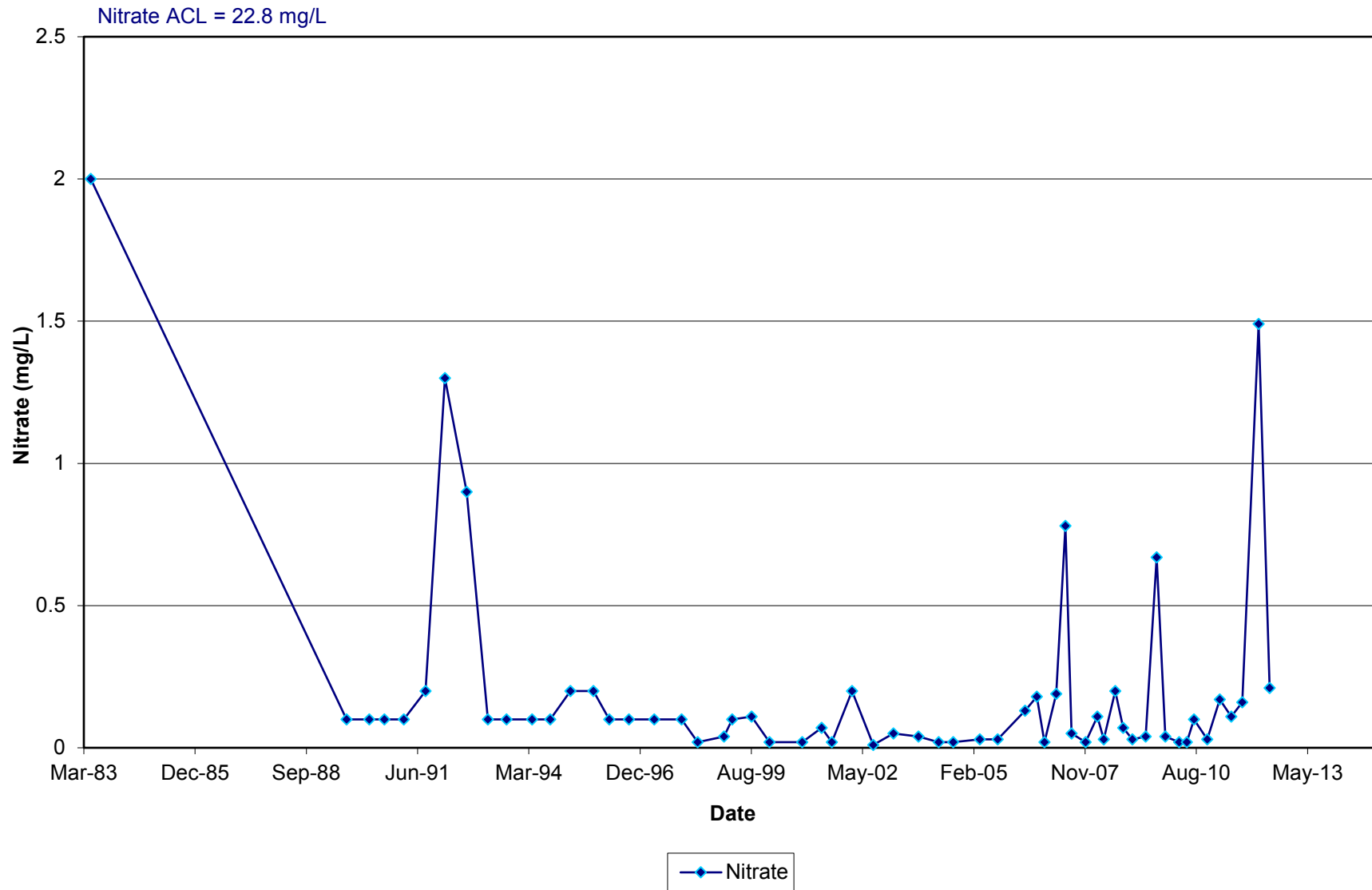
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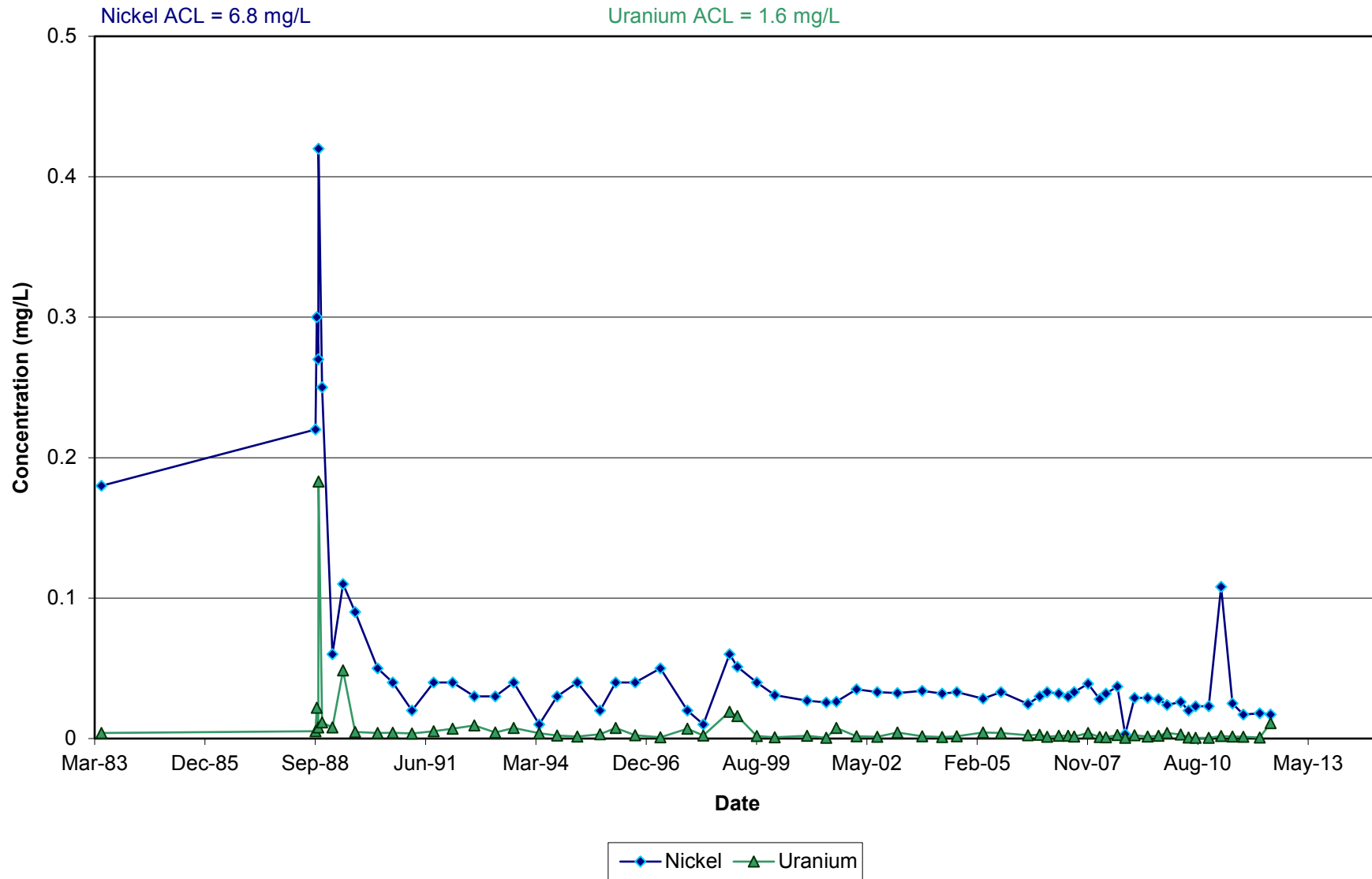
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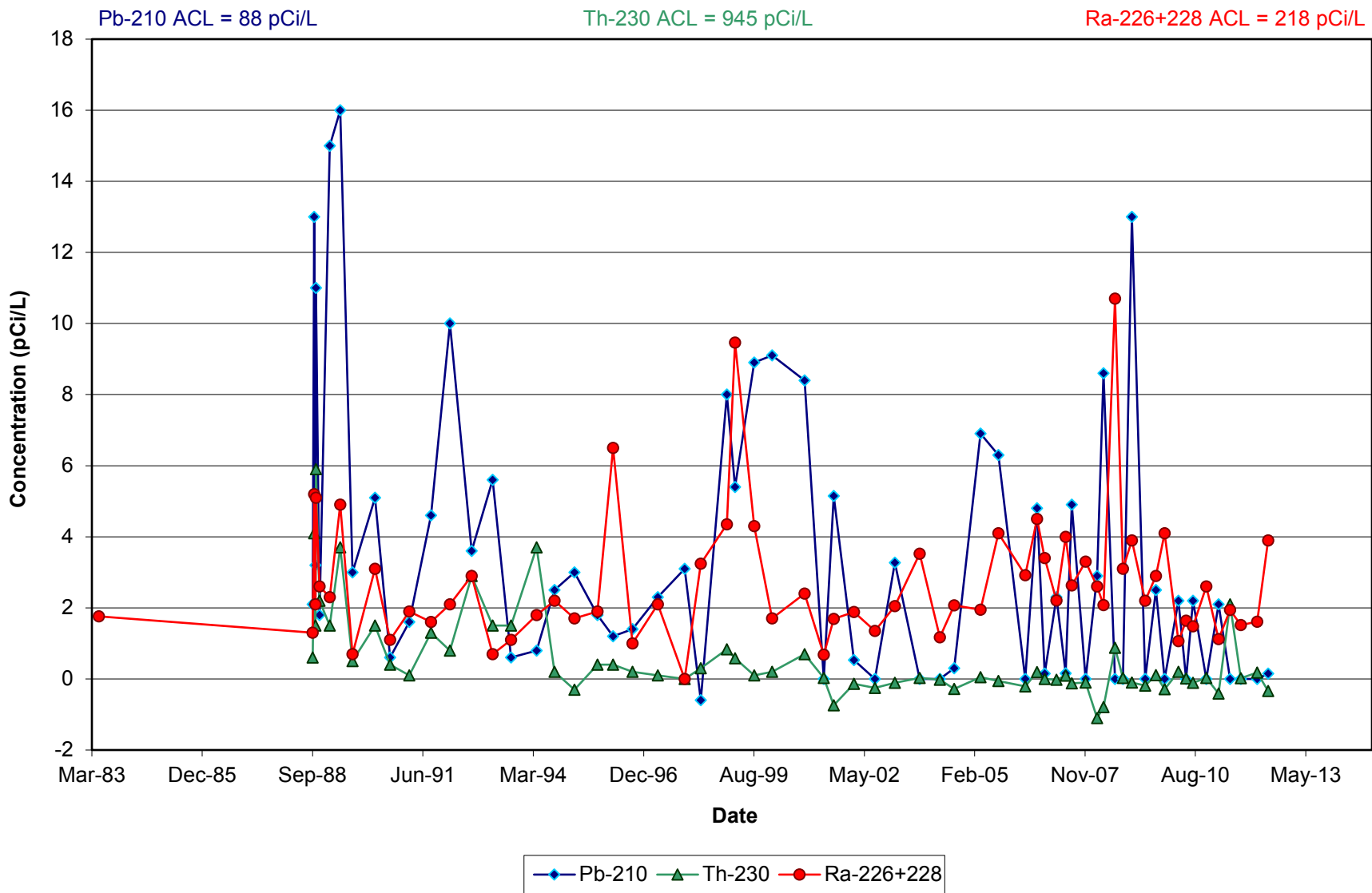
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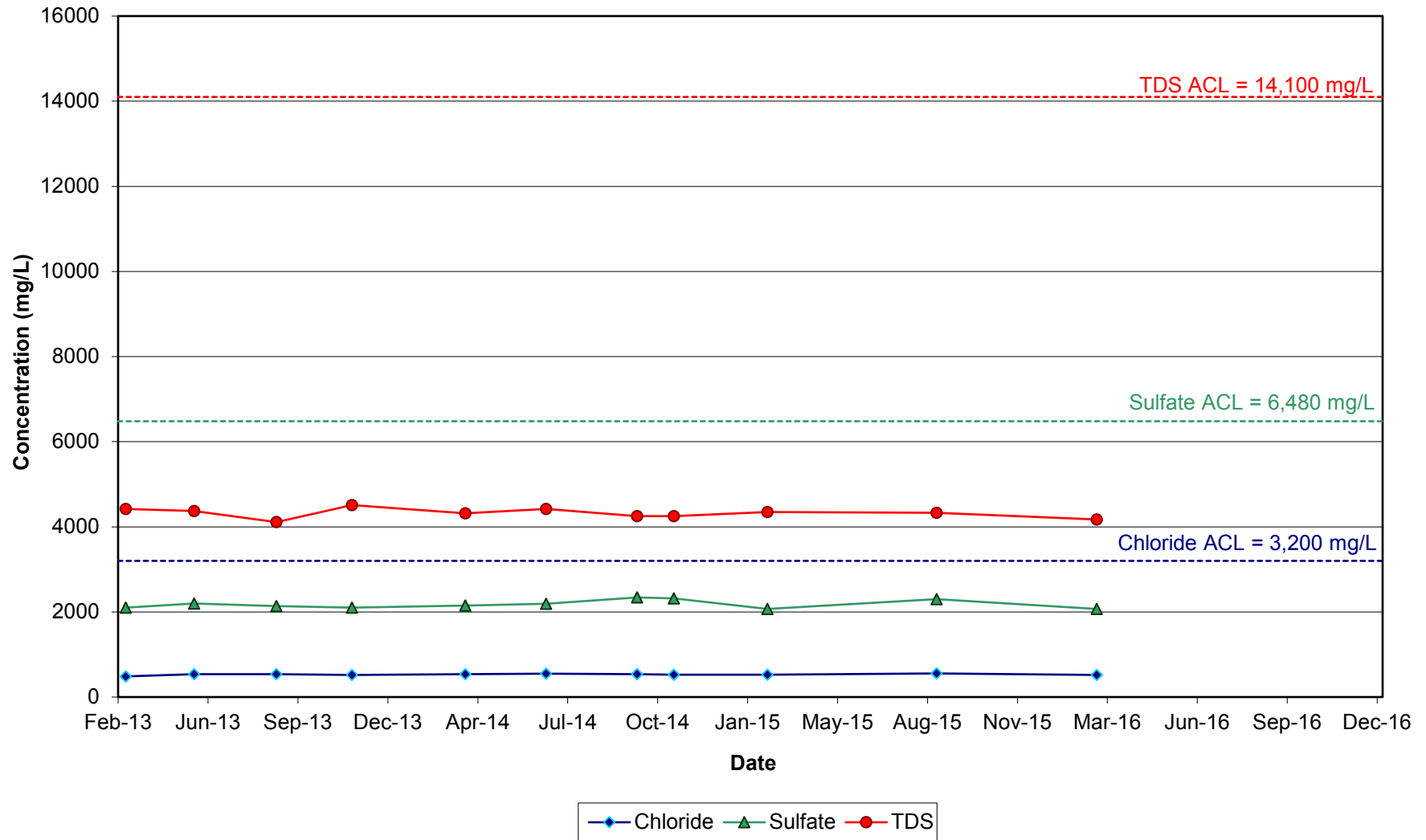
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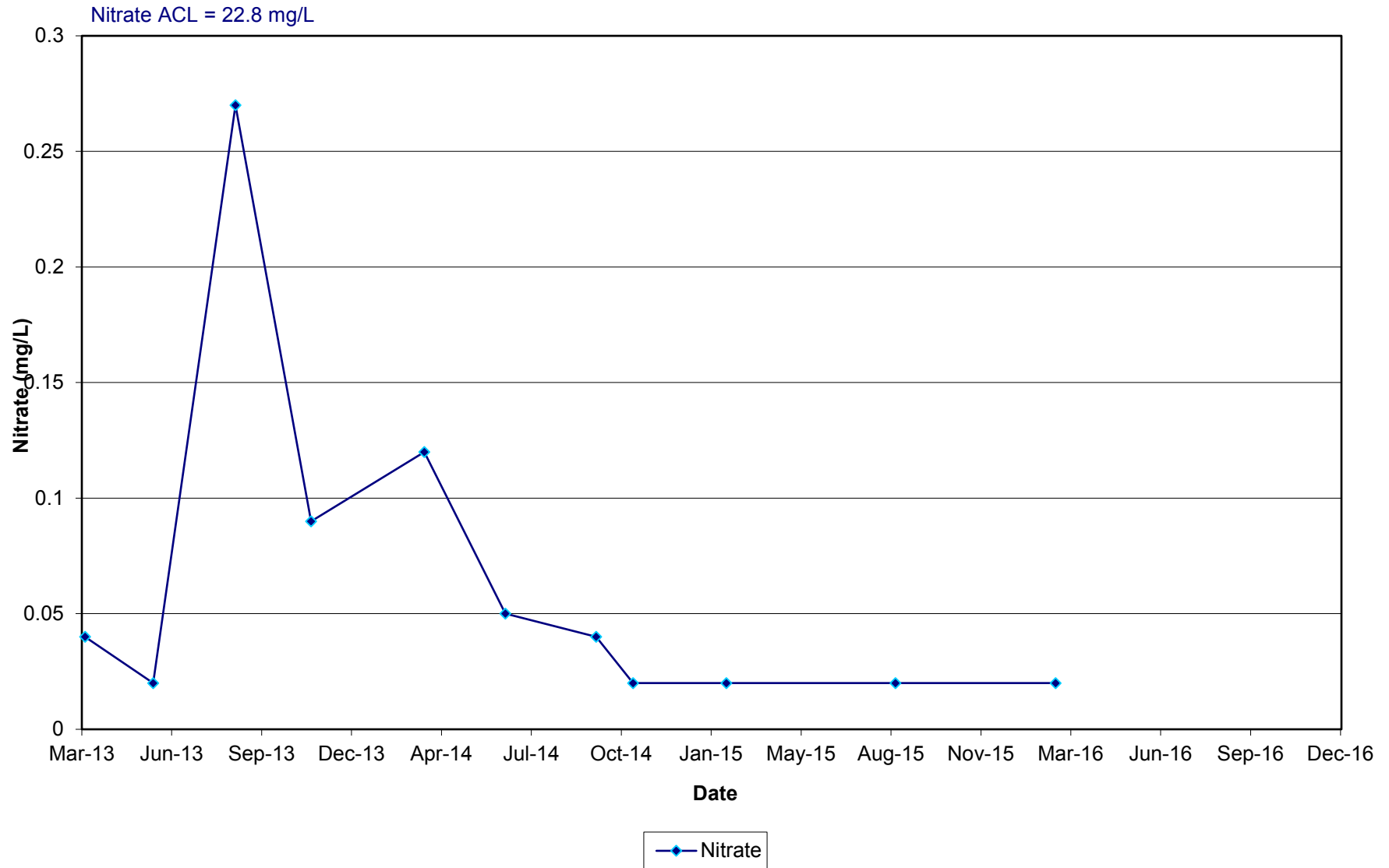
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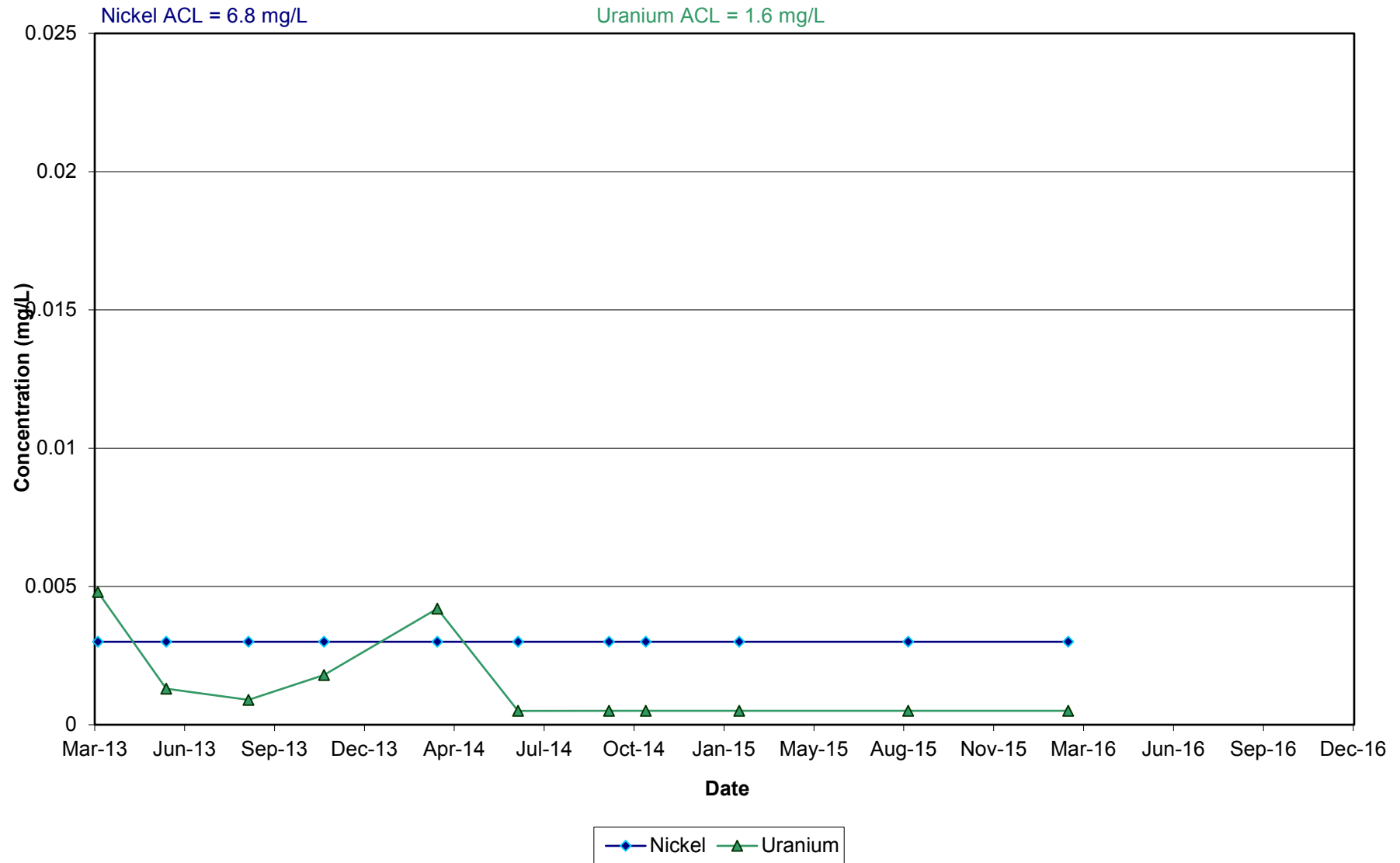
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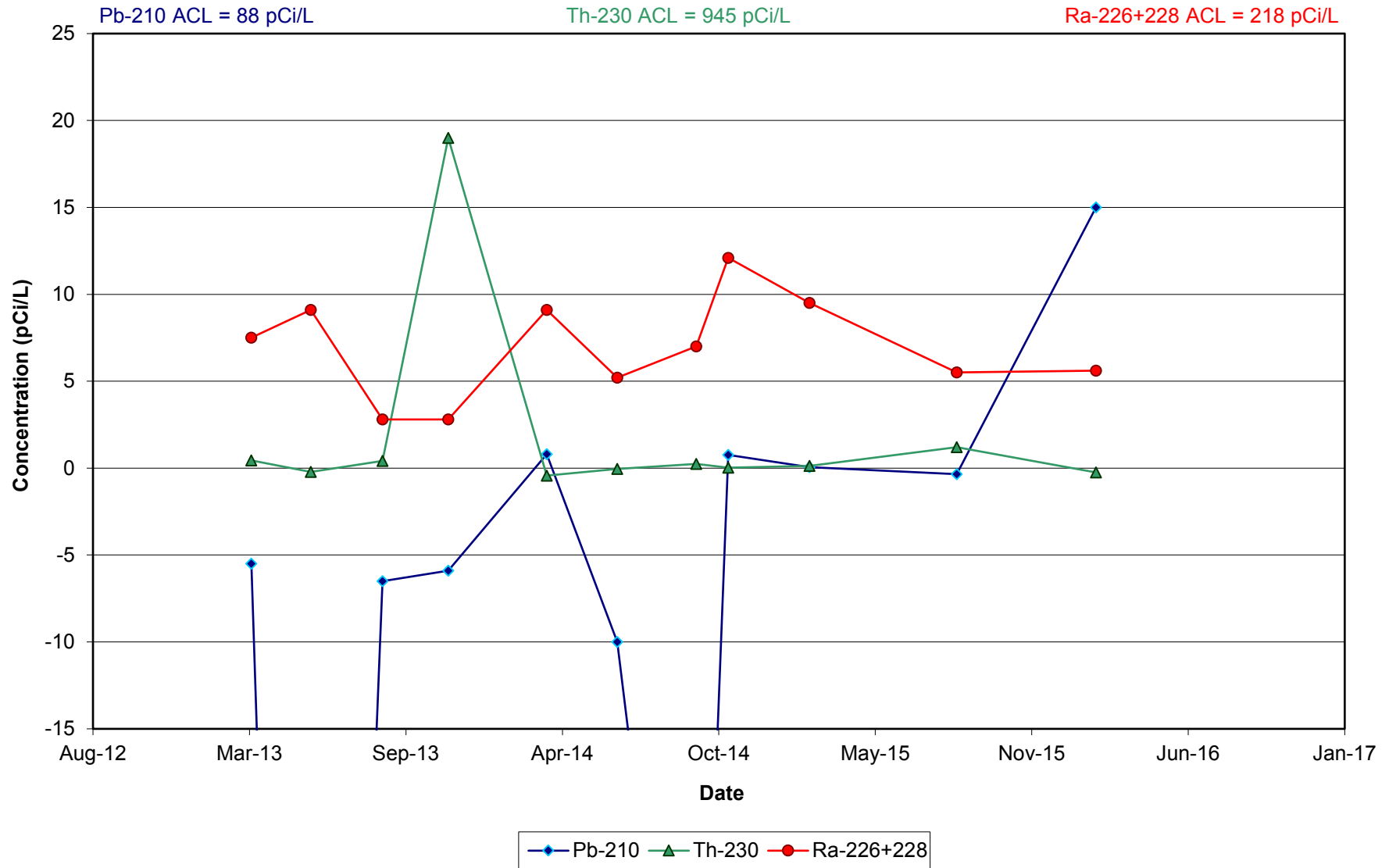
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(replaced 12/5/2012)**



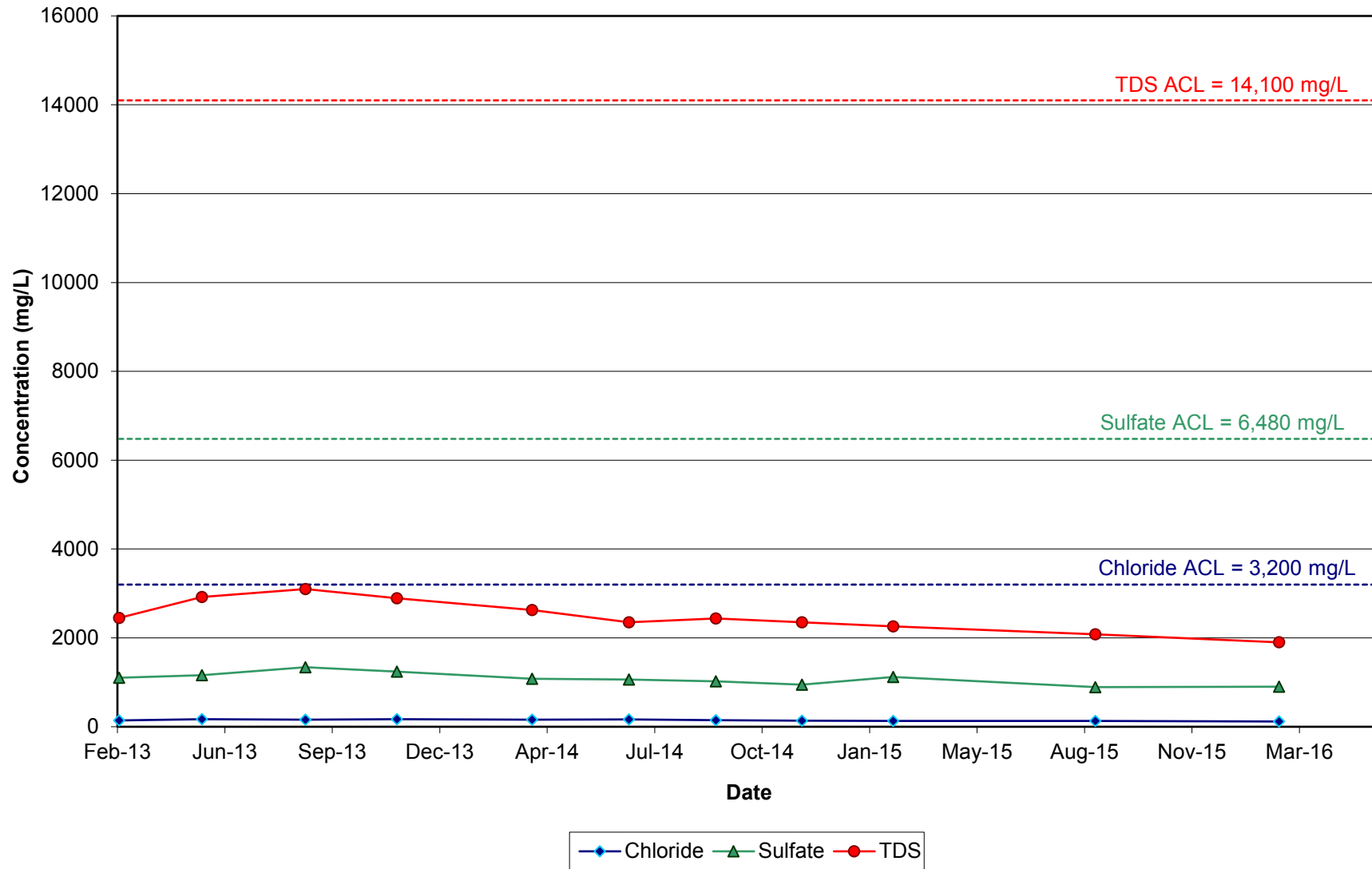
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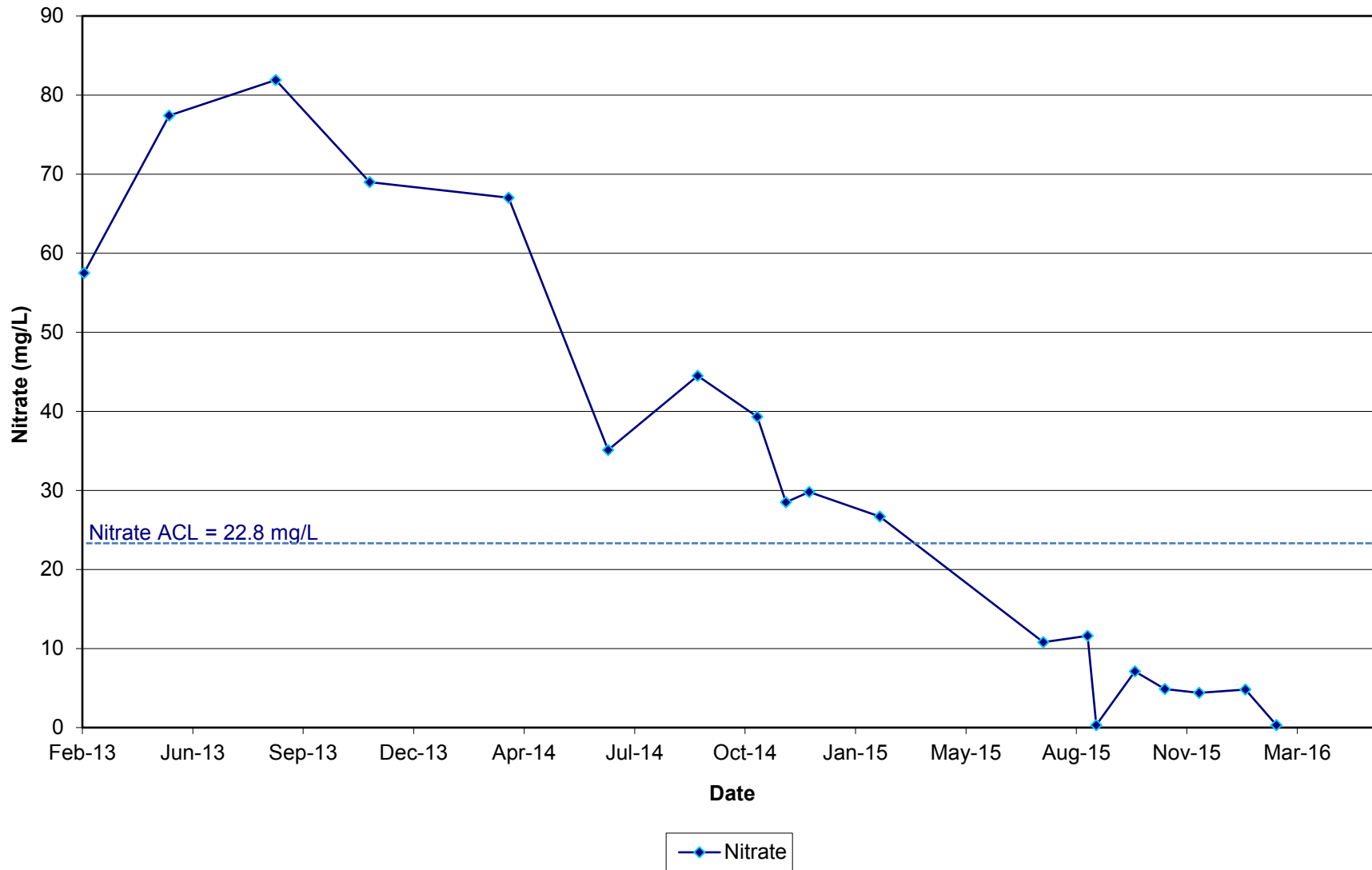
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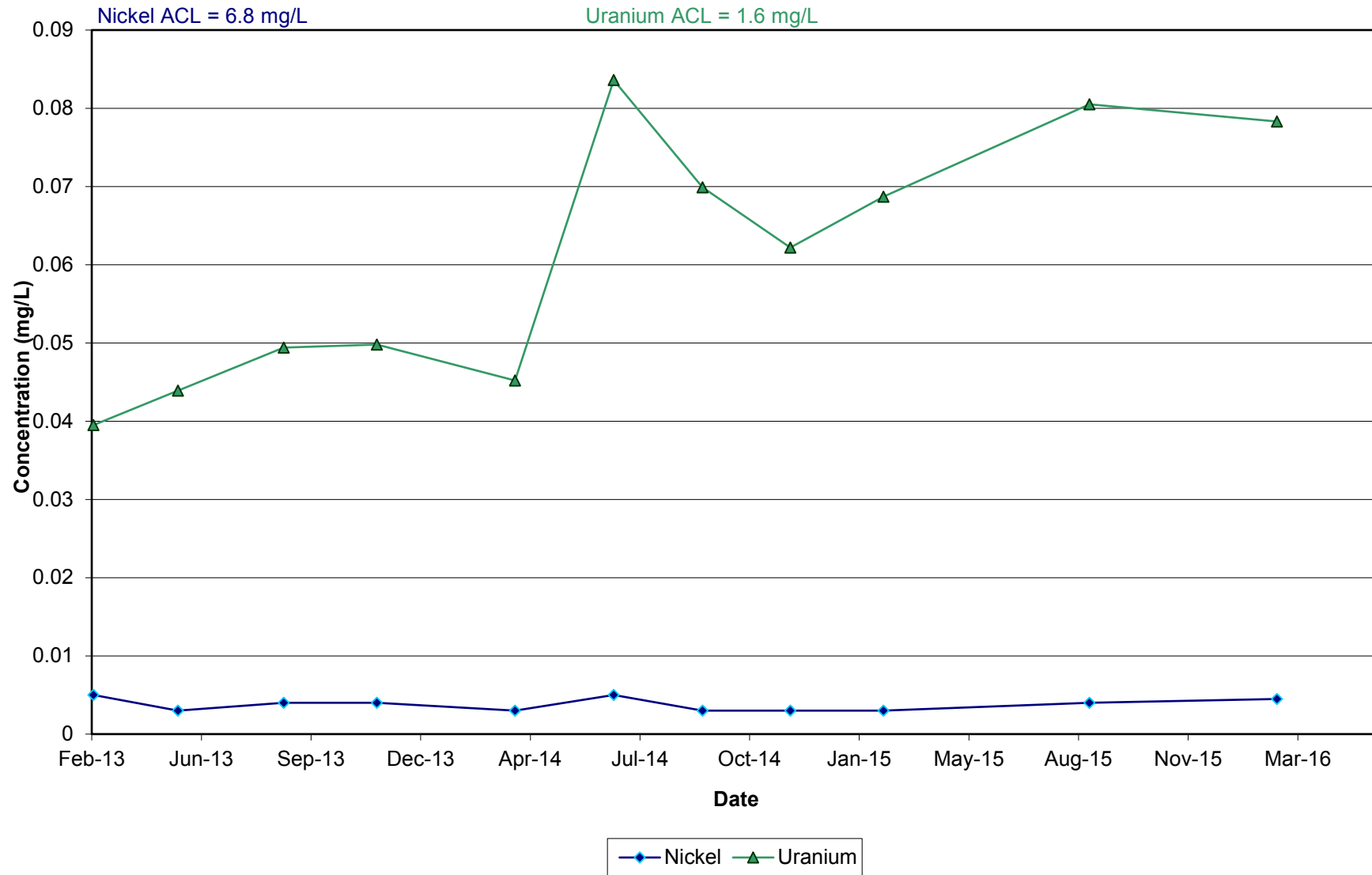
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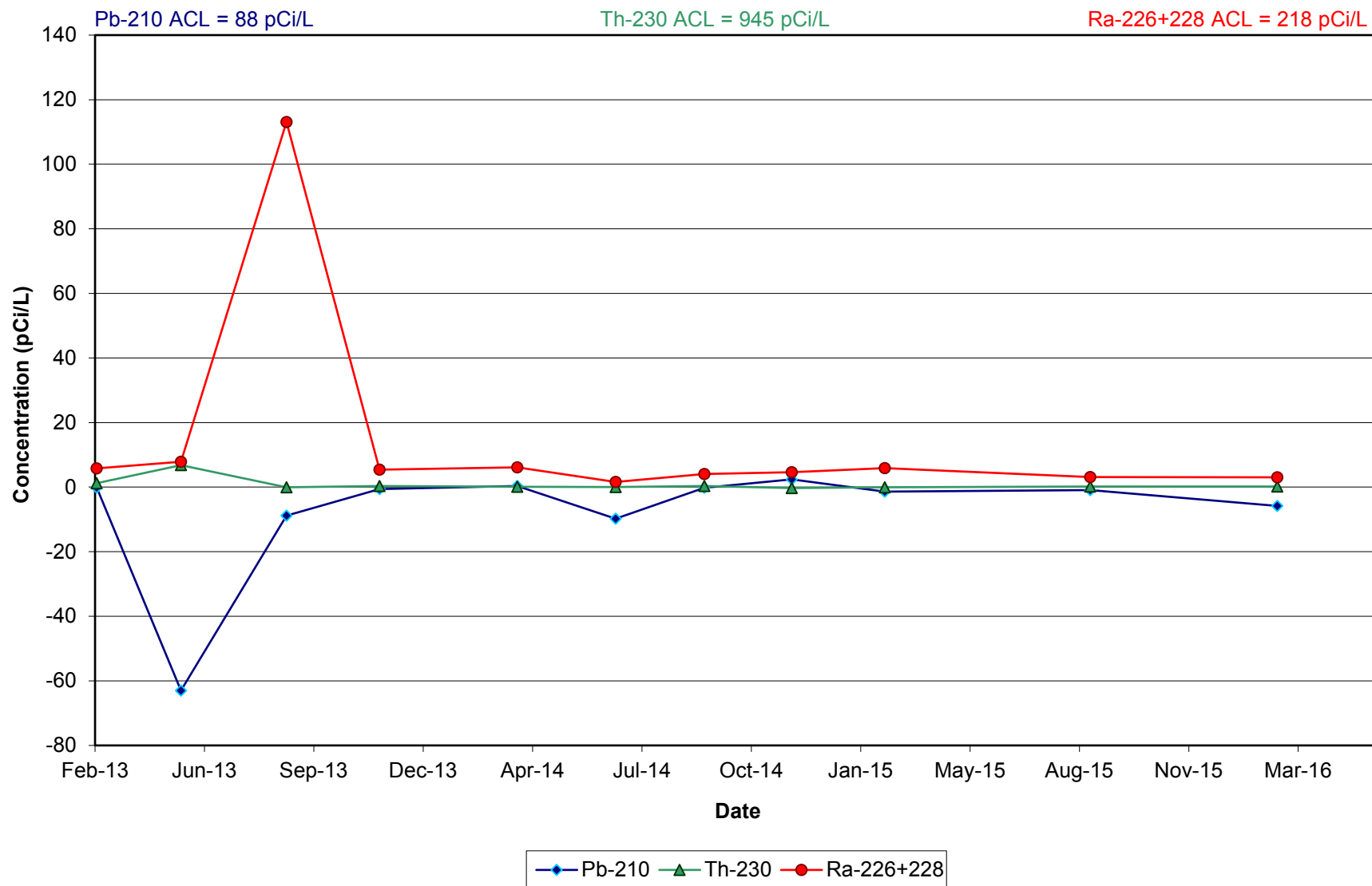
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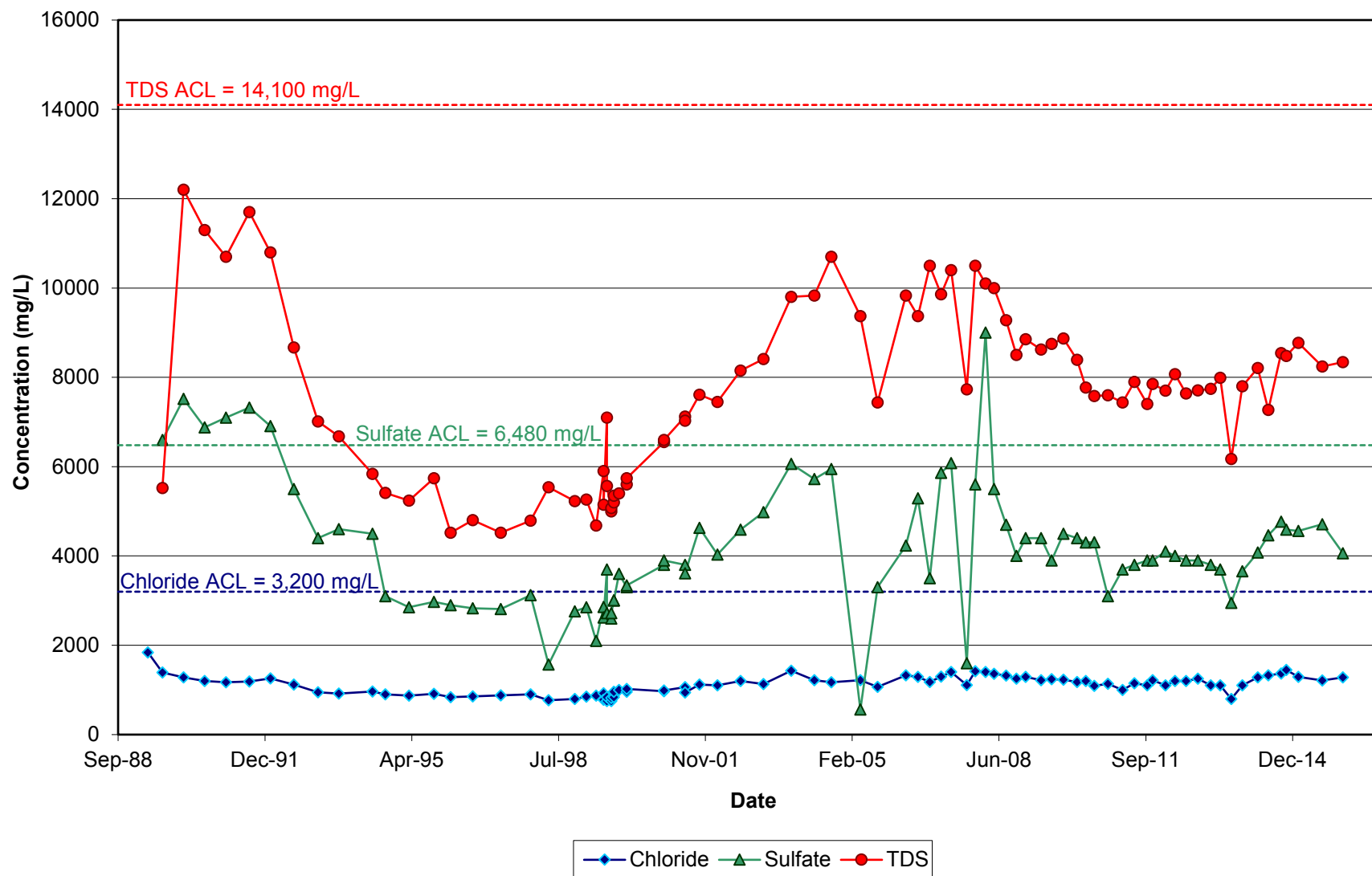
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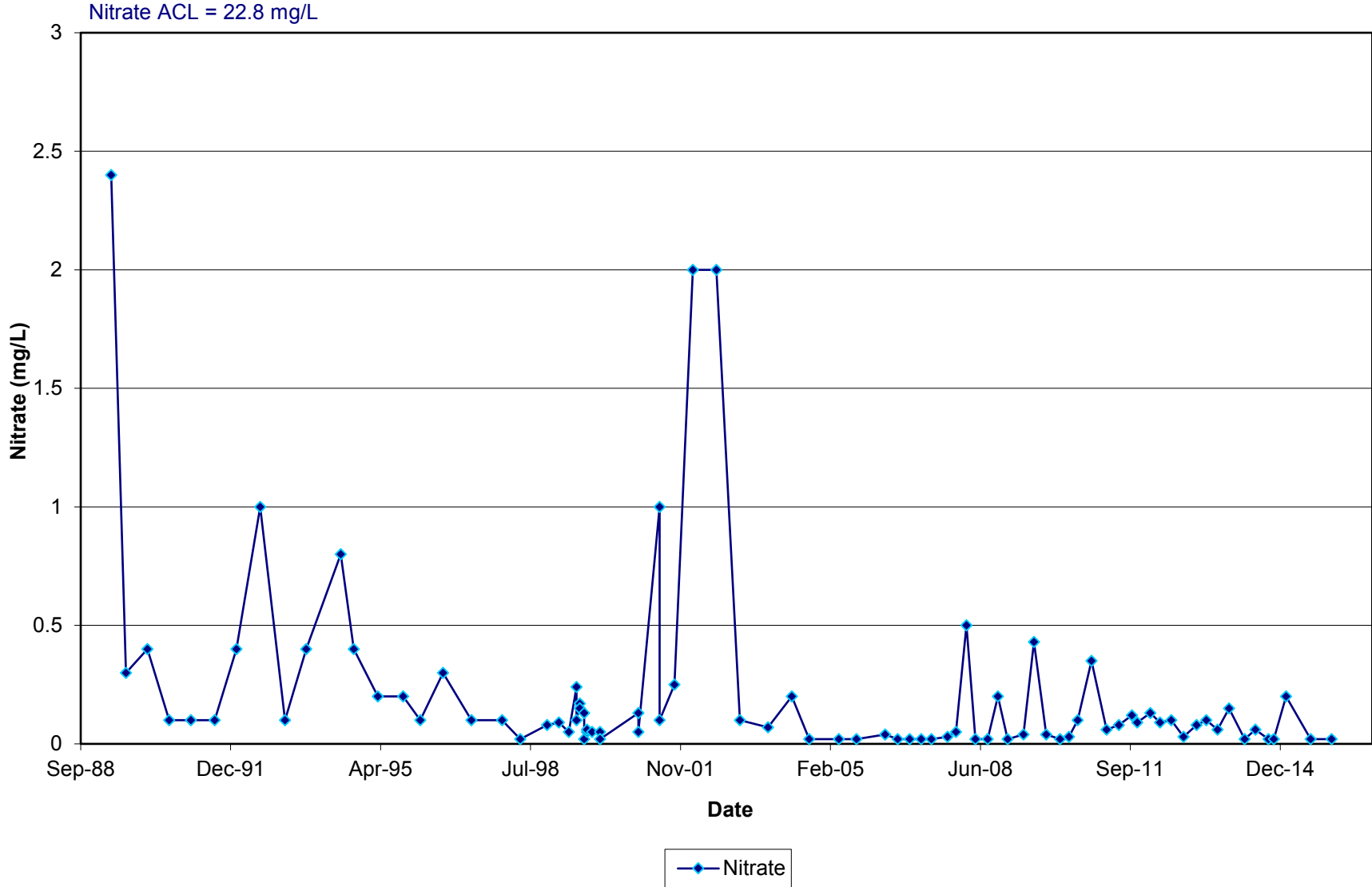
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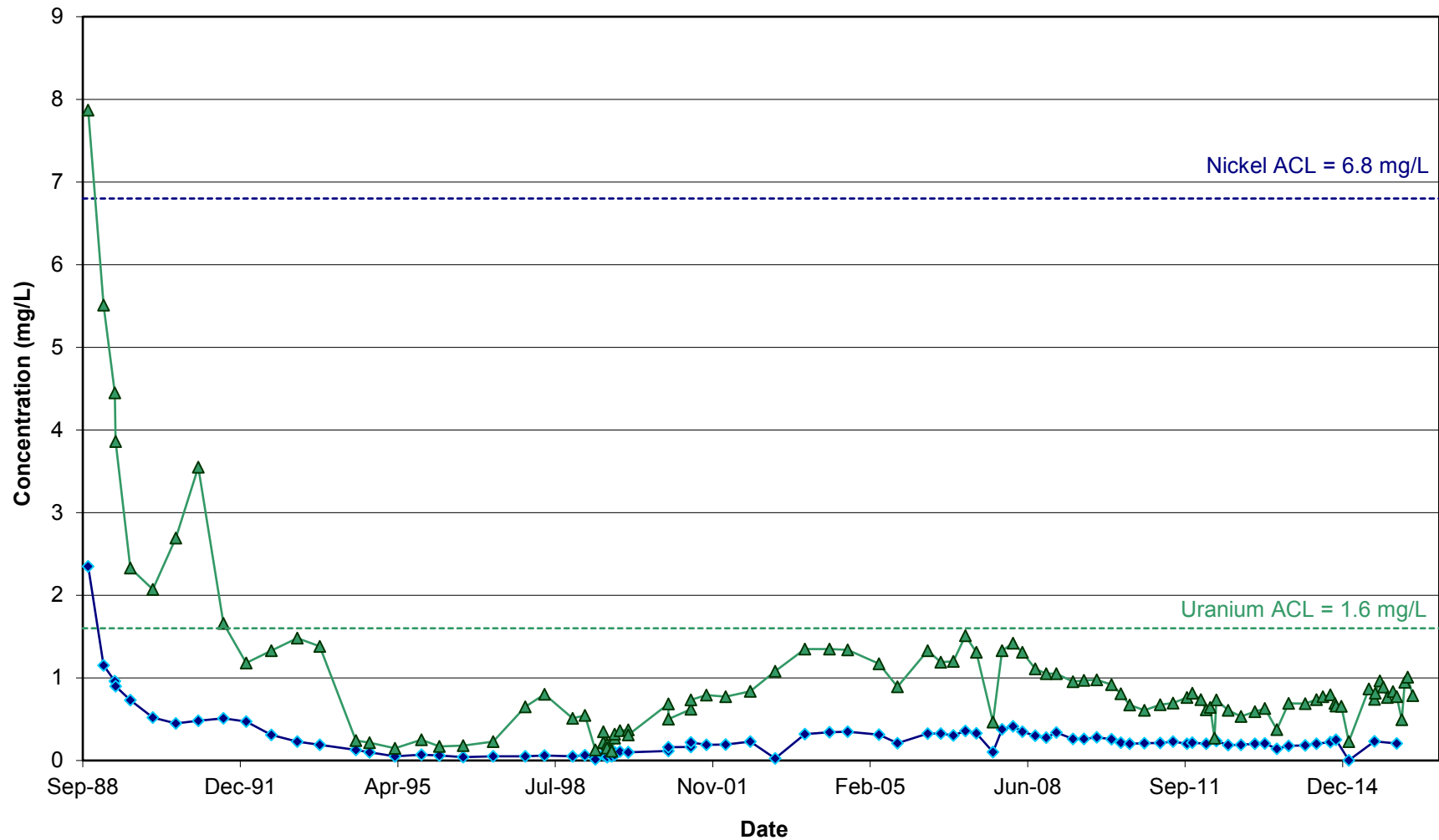
Anions and TDS Well 36-06 KD



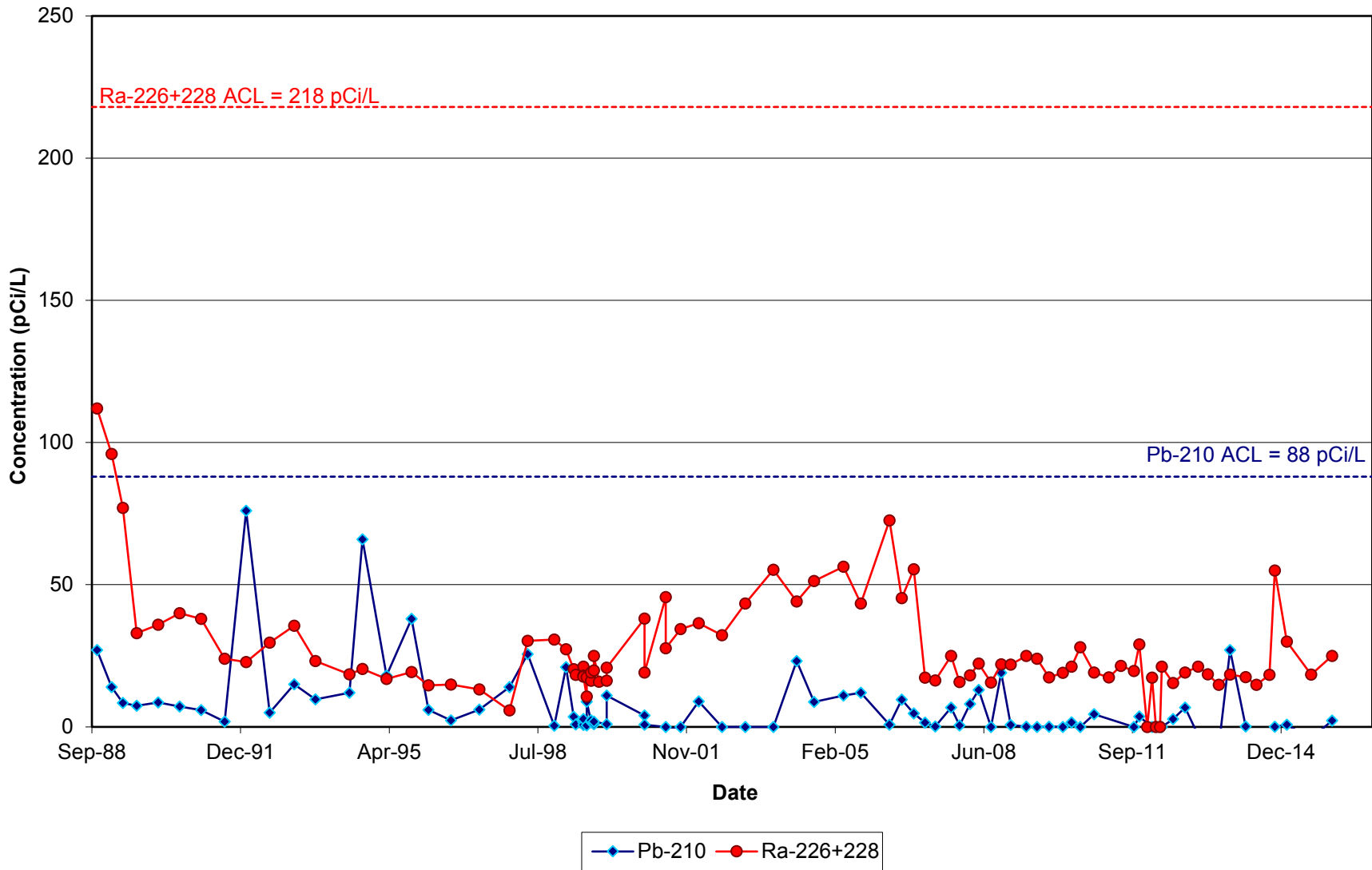
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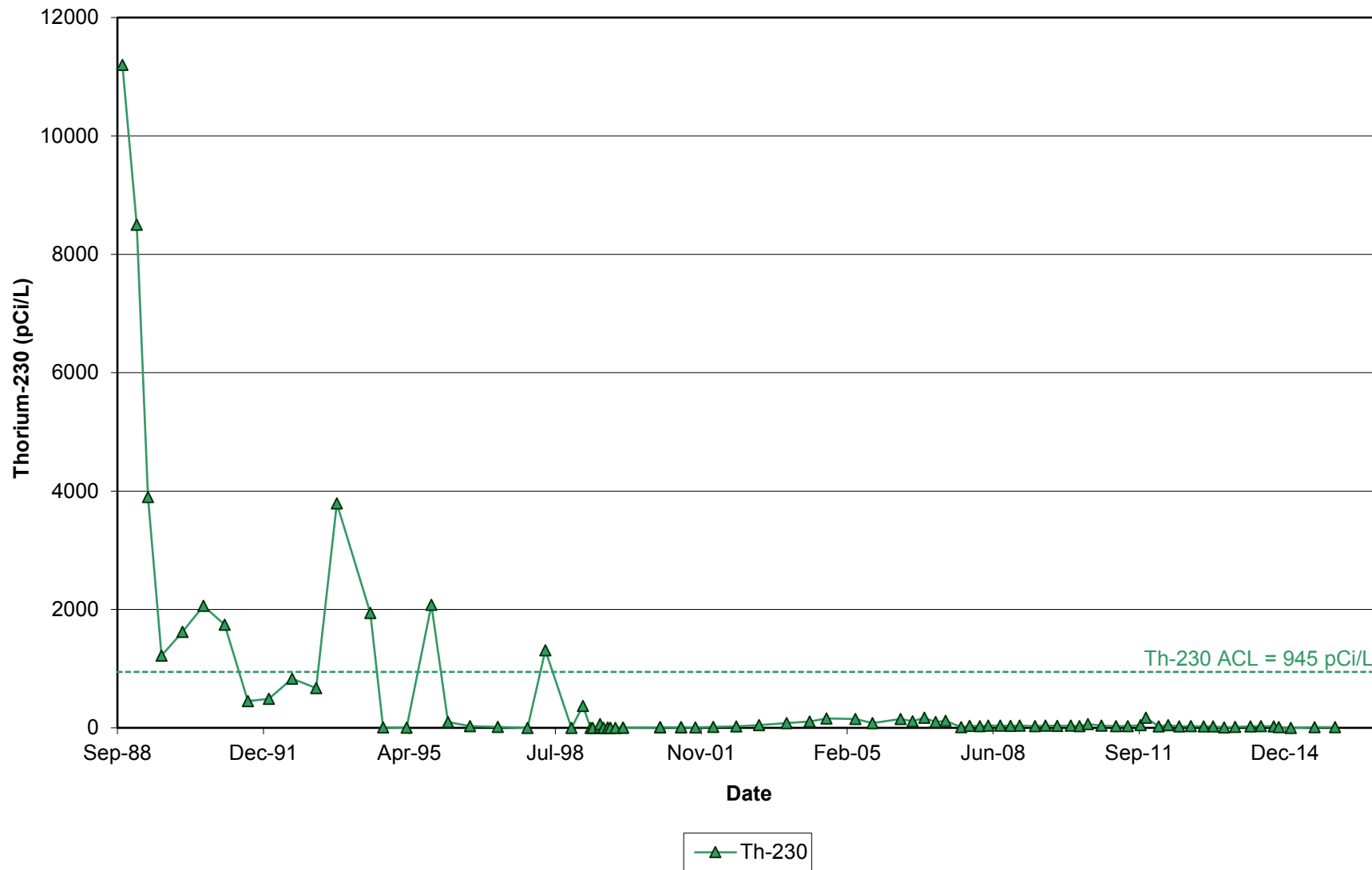
Metals in Monitoring Well 36-06 KD



Radionuclides in Monitoring Well 36-06 KD

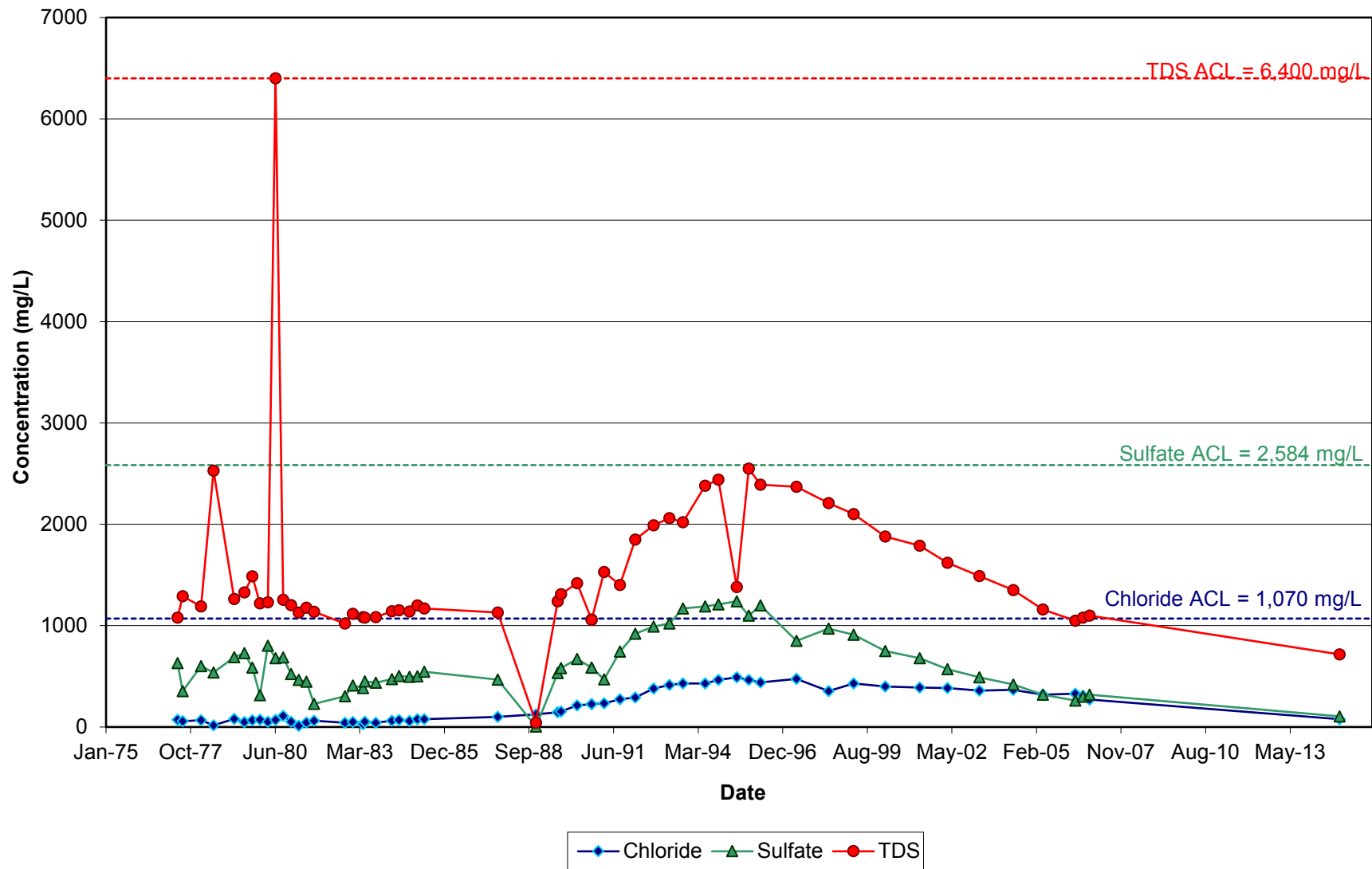


Thorium-230 in Monitoring Well 36-06 KD

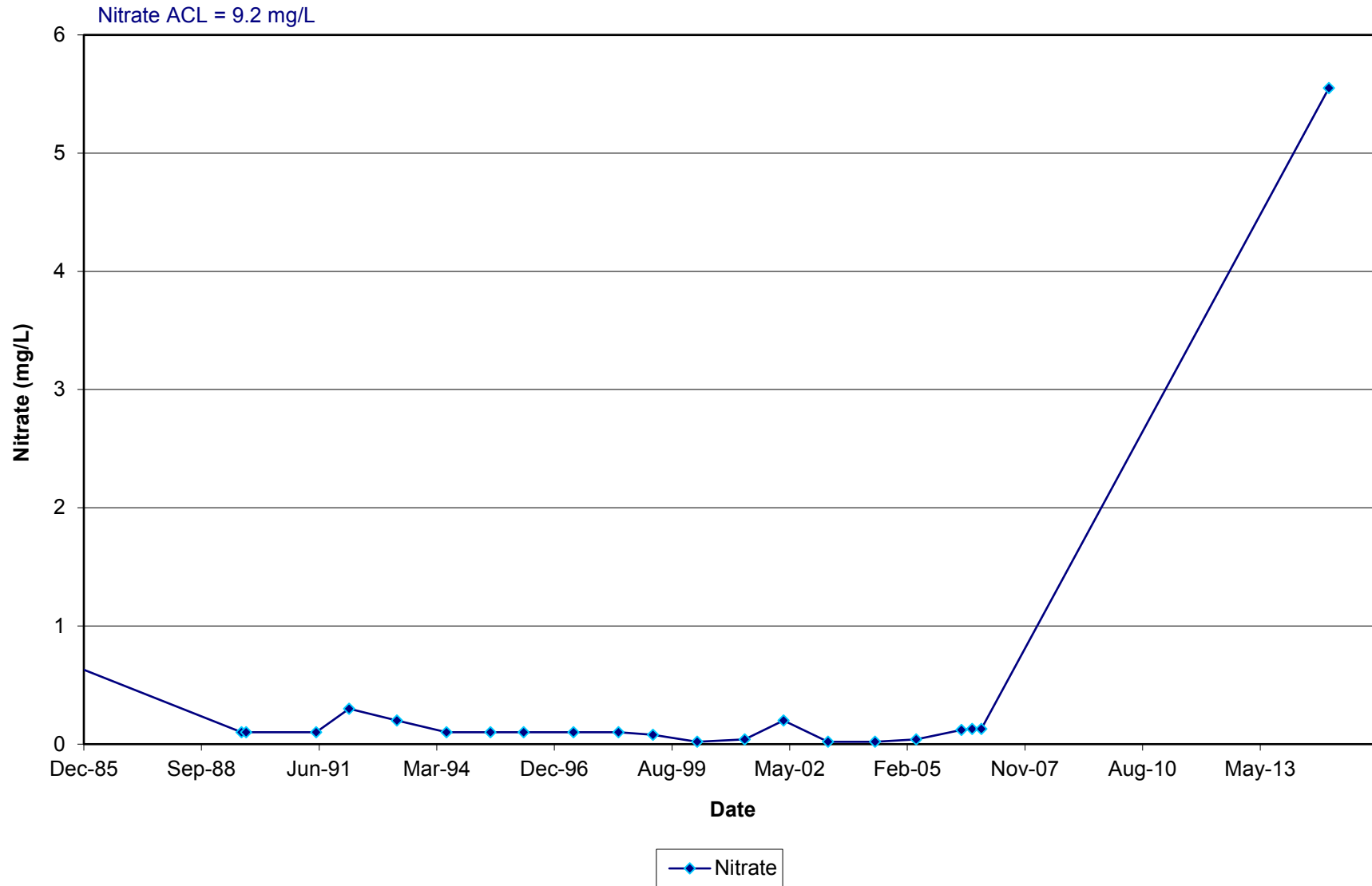


Stability Monitoring Plan
Time Versus Concentration Plots
Tres Hermanos A

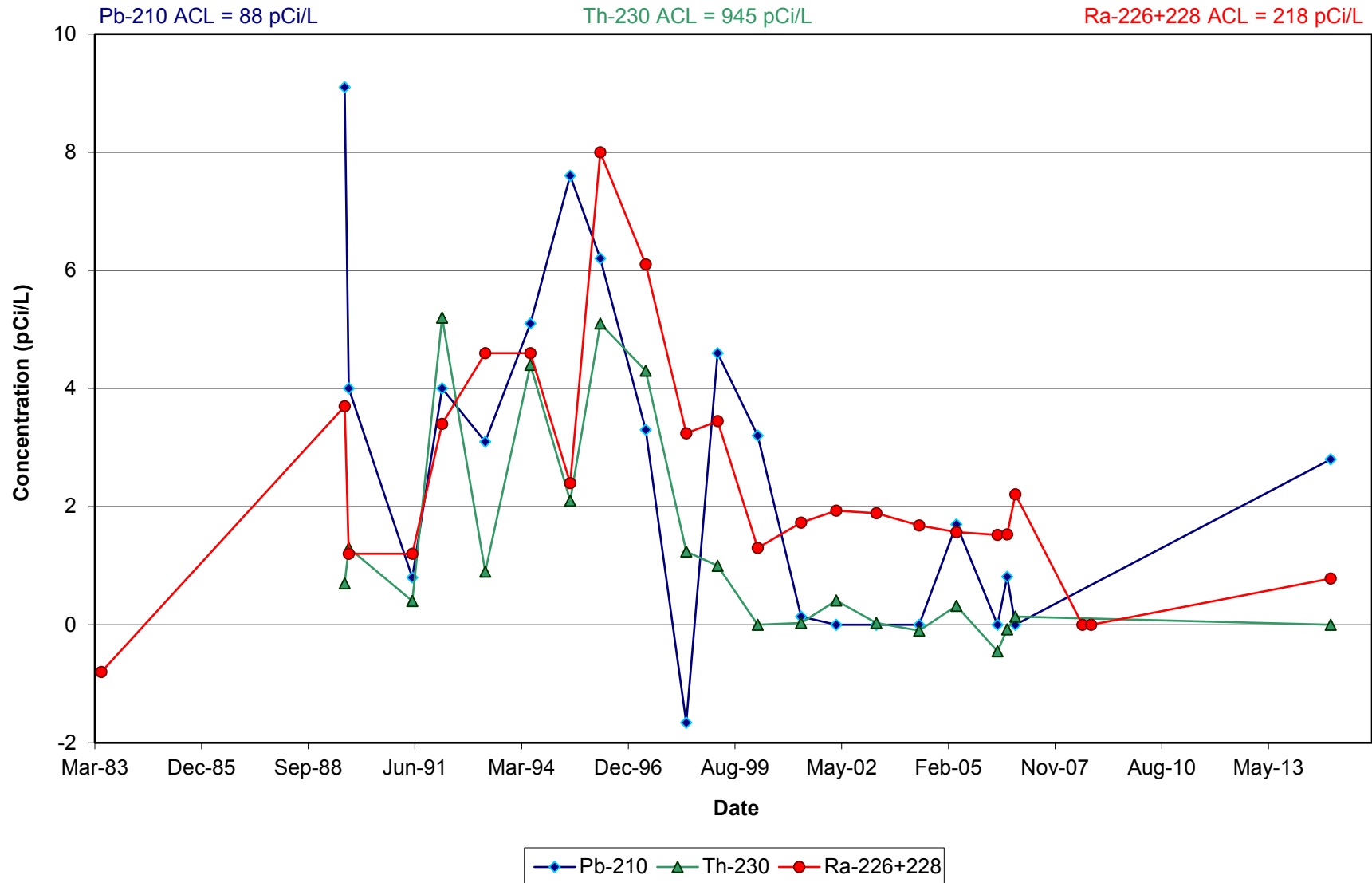
Anions and TDS in Monitoring Well 30-01 TRA



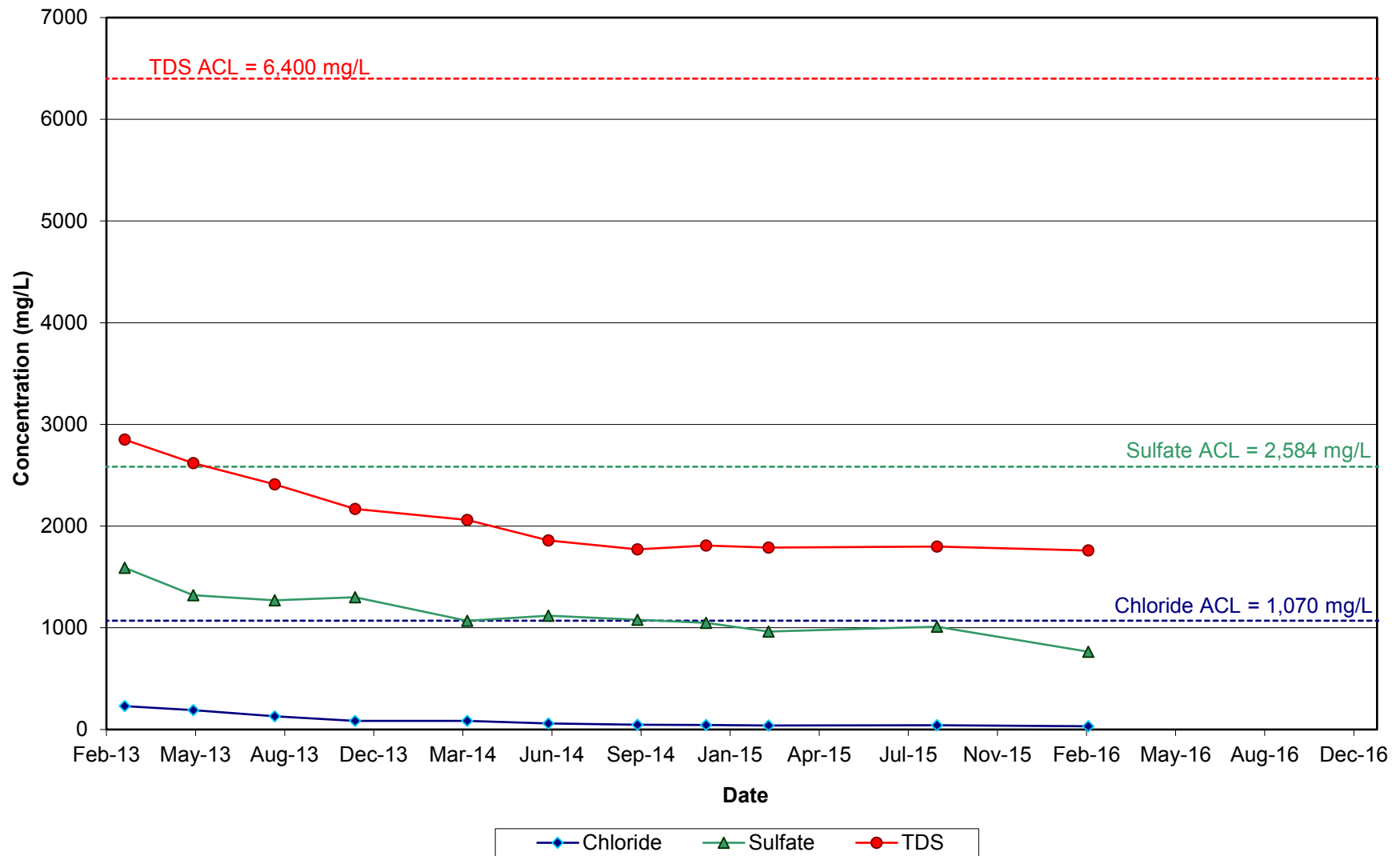
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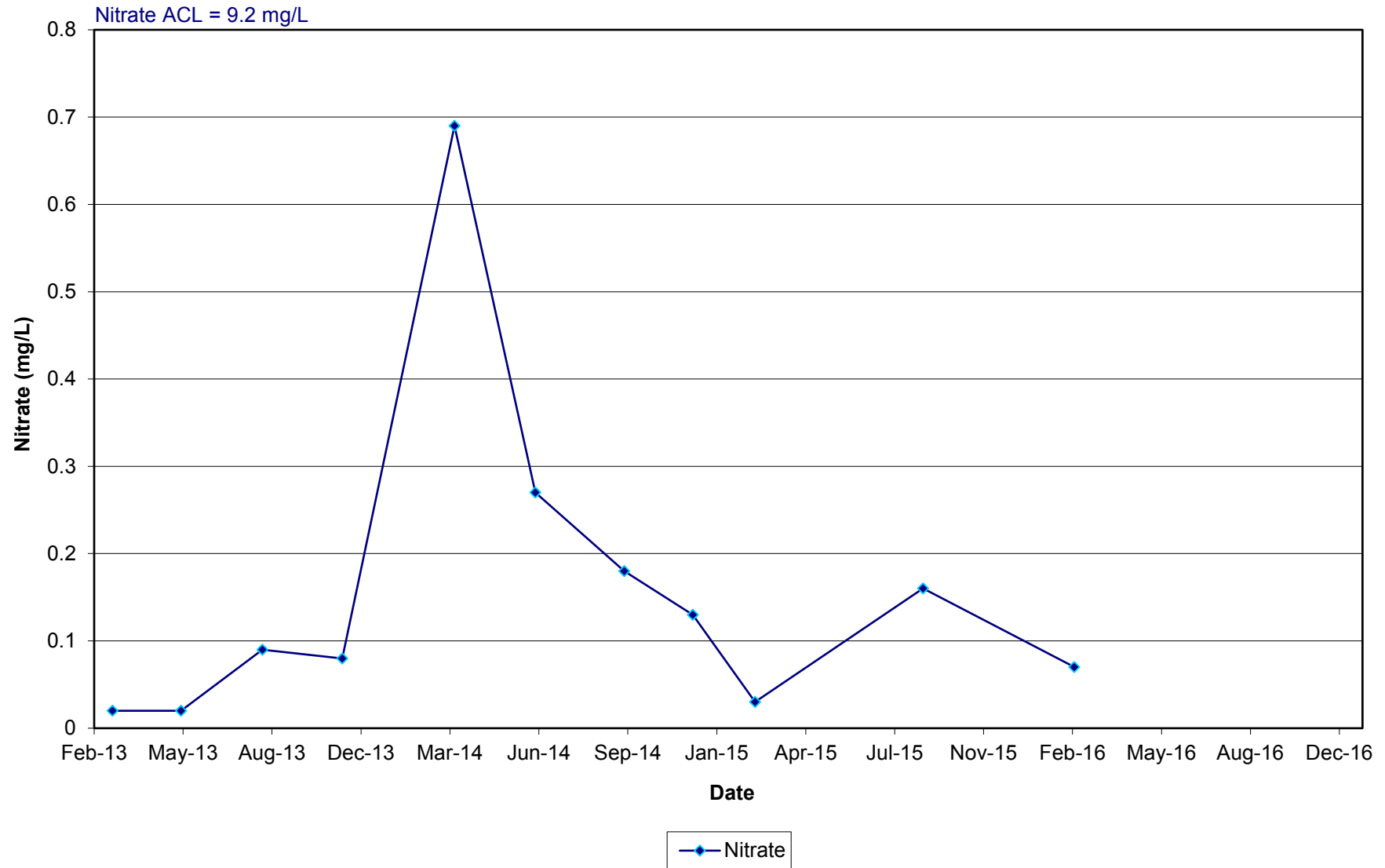
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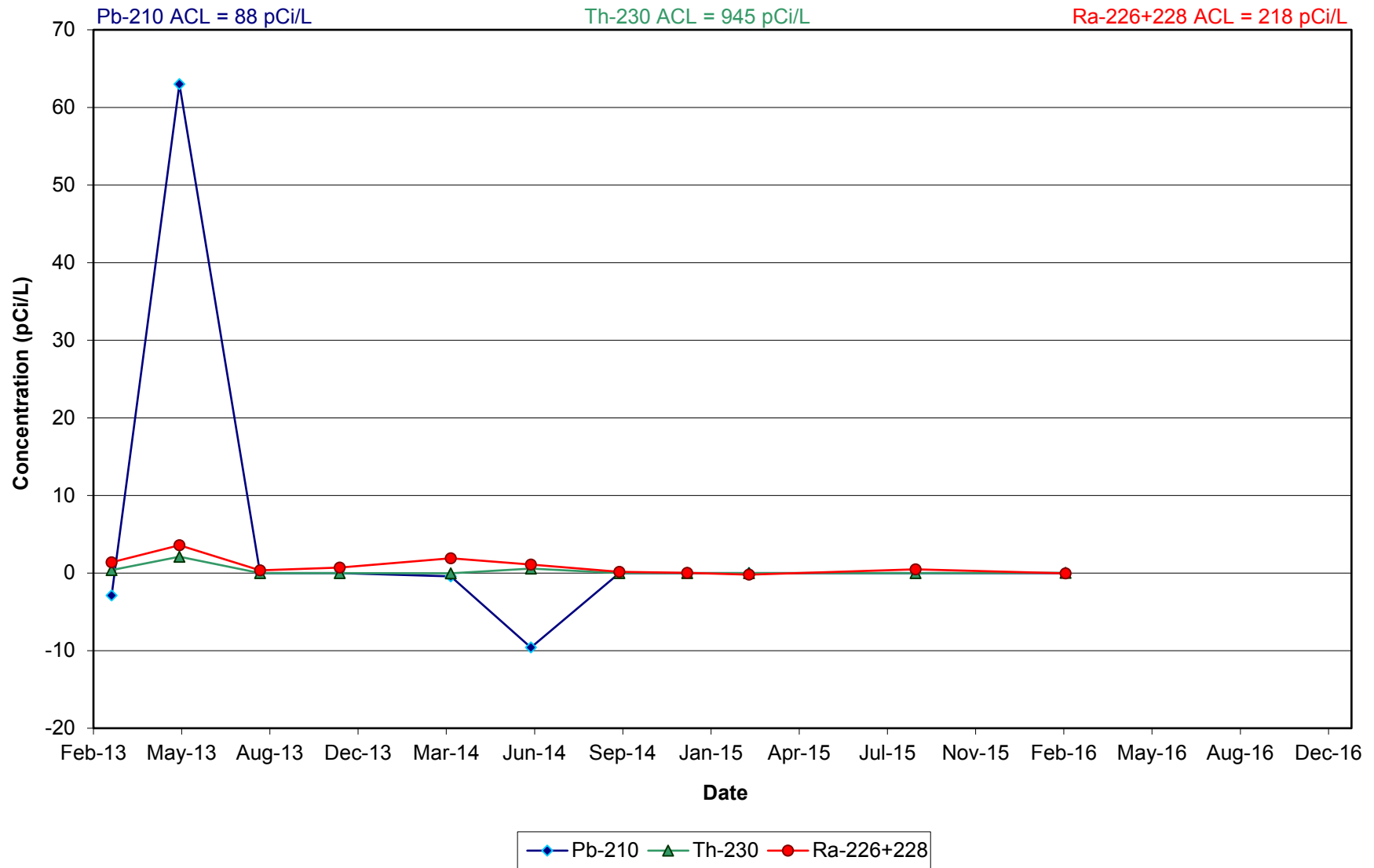
**Anions and TDS in Monitoring Well 31-01TRA-R
(replaced 12/12/2012)**



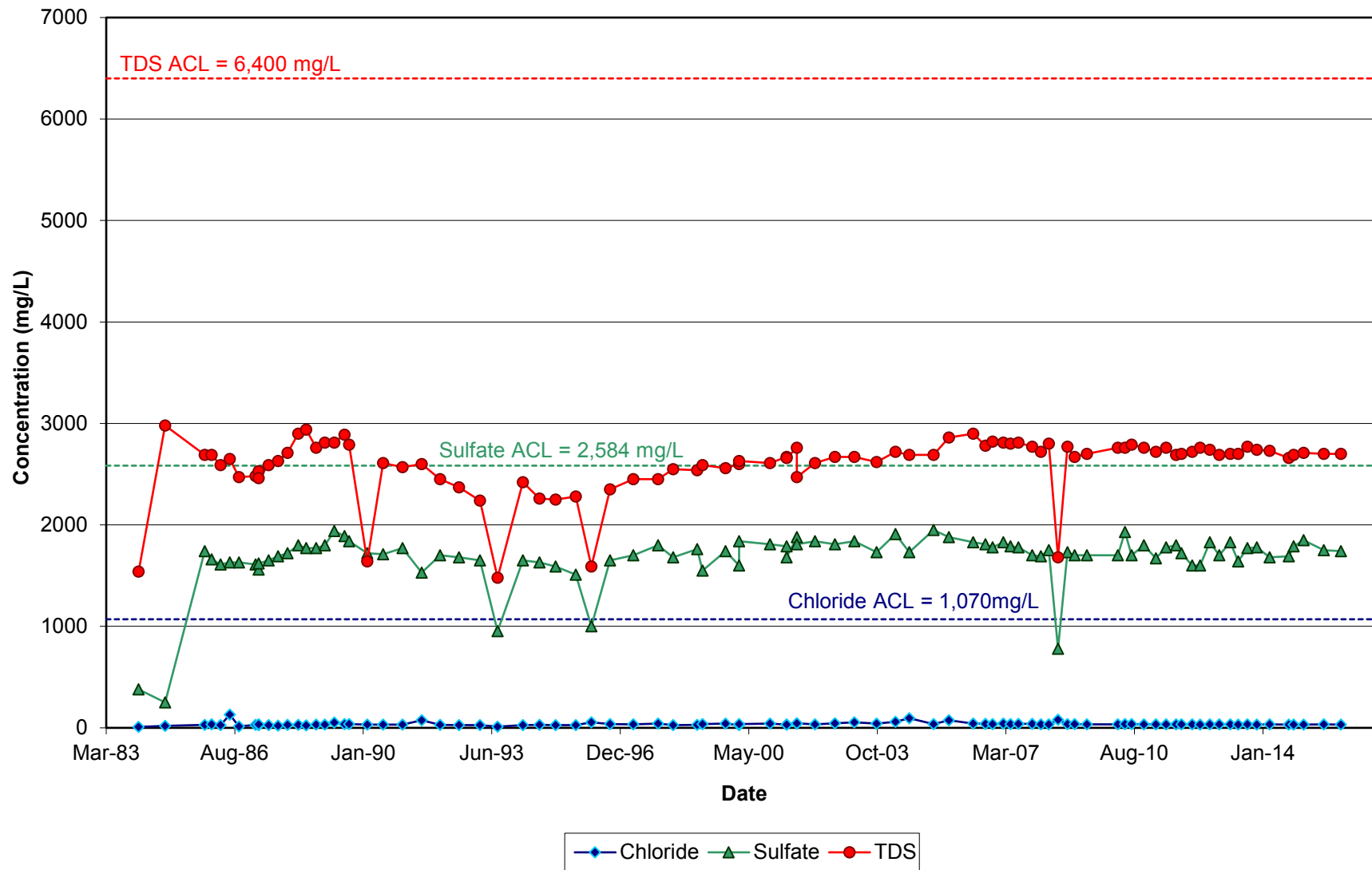
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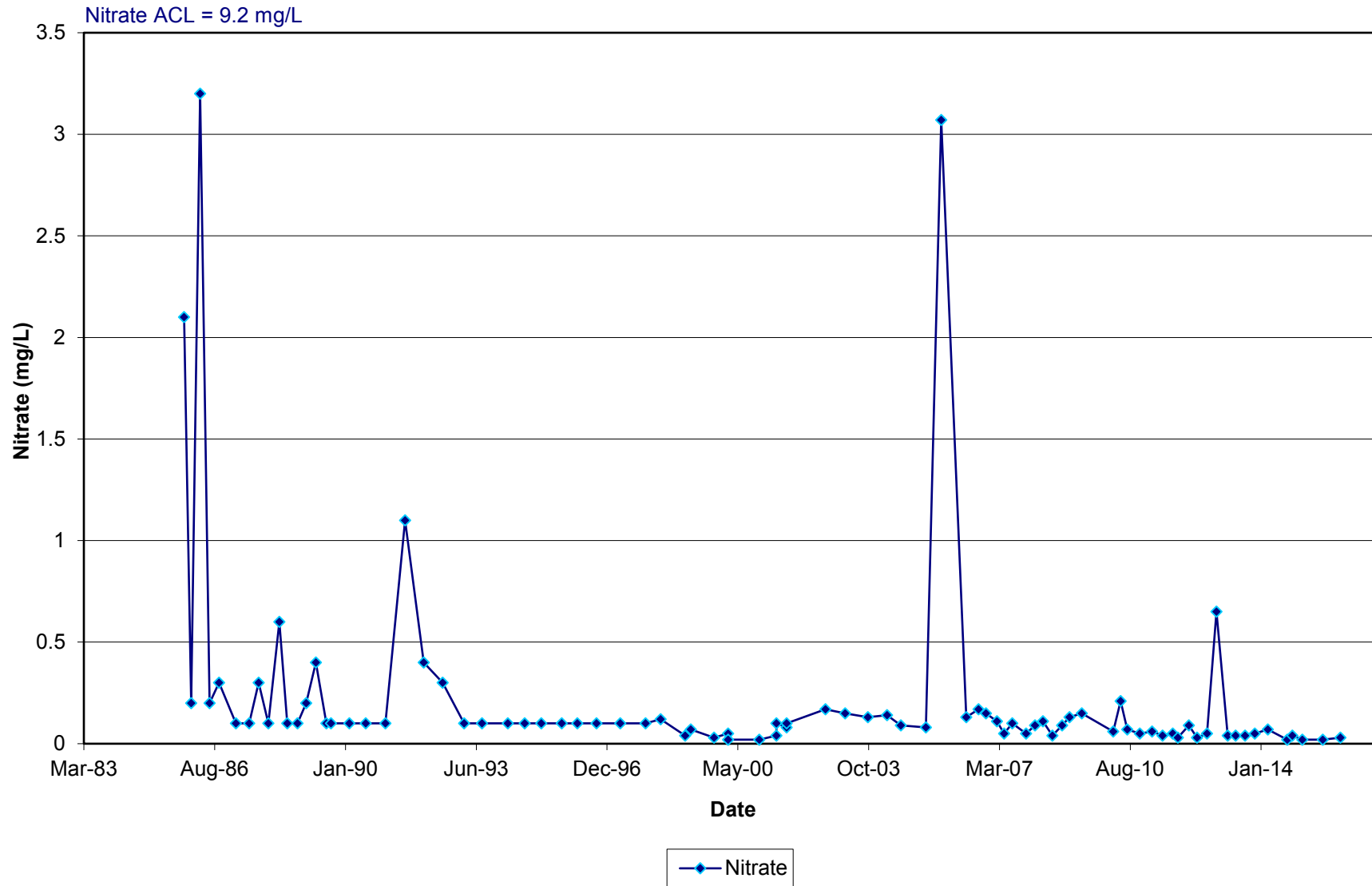
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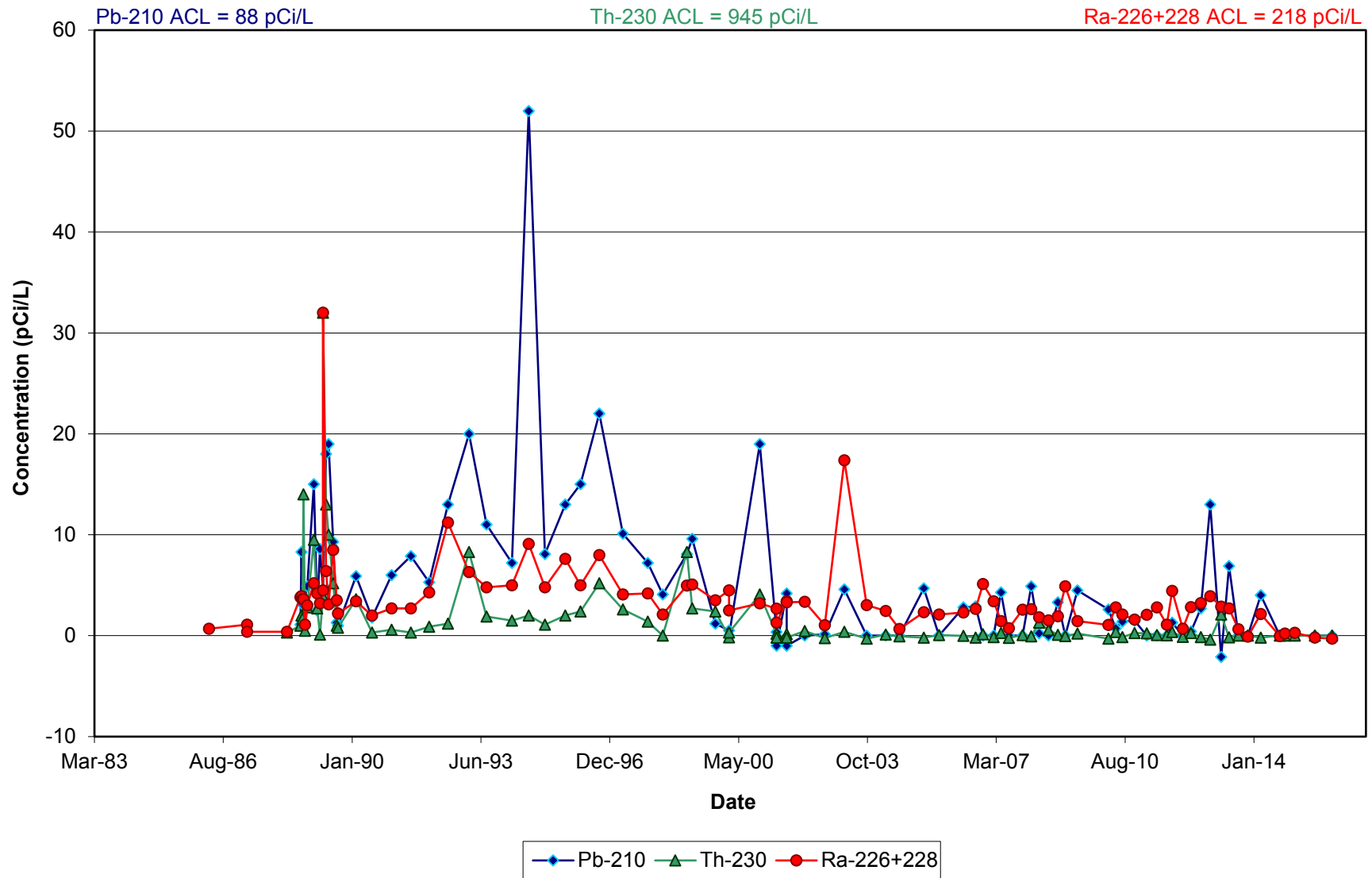
Anions and TDS in Monitoring Well 33-01 TRA



Nitrate in Monitoring Well 33-01 TRA

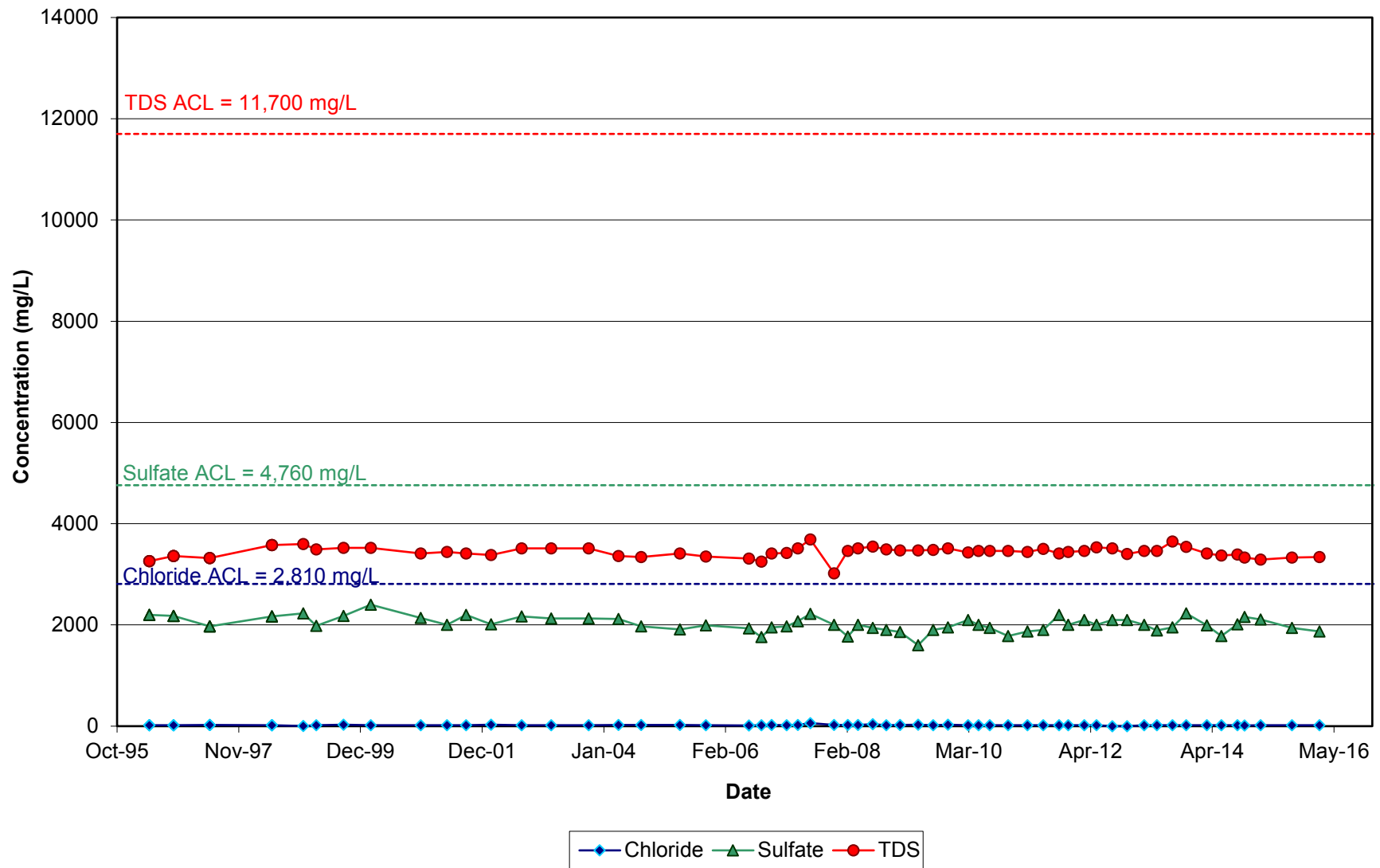


Radionuclides in Monitoring Well 33-01 TRA

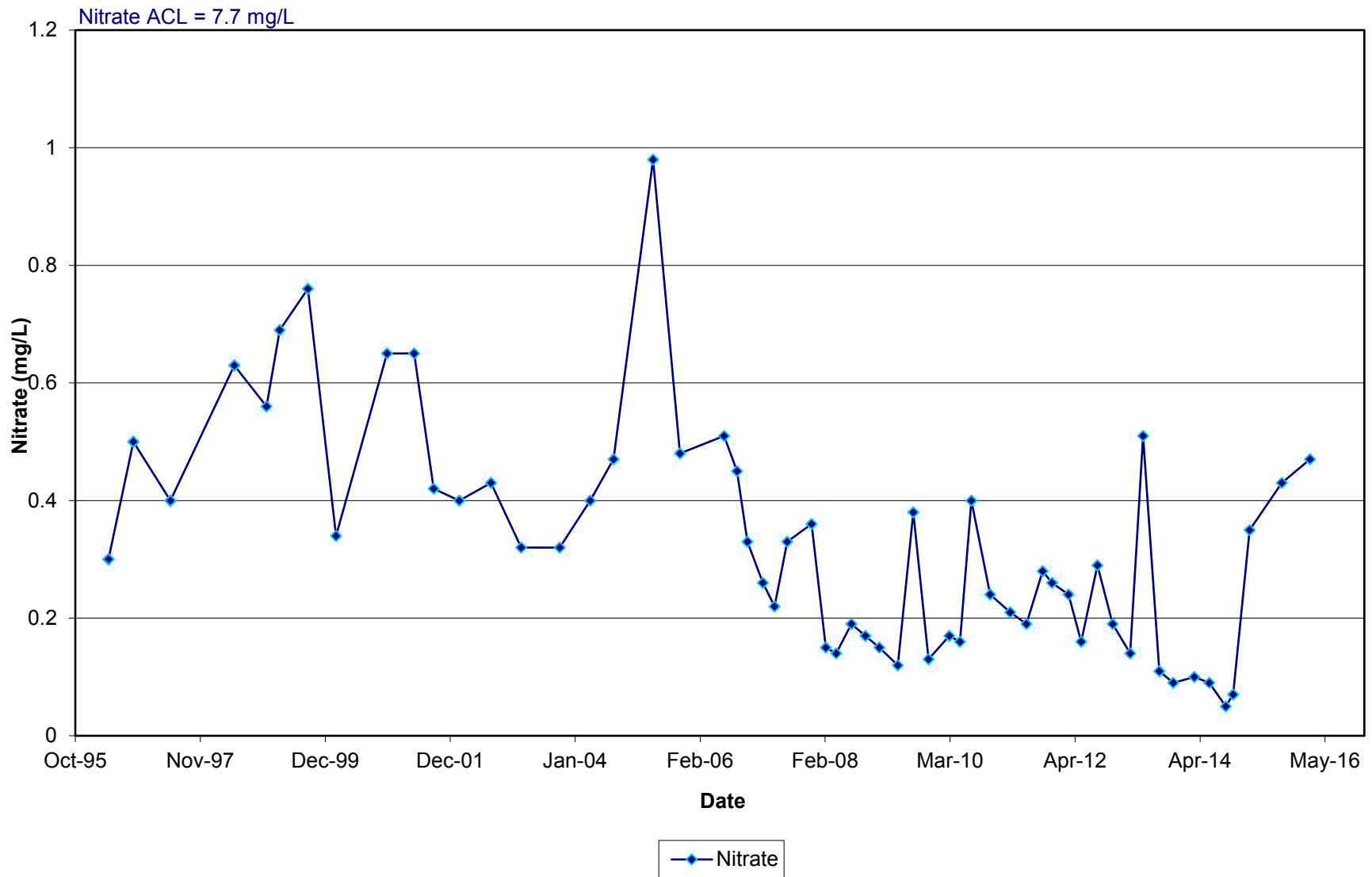


Stability Monitoring Plan
Time Versus Concentration Plots
Tres Hermanos B

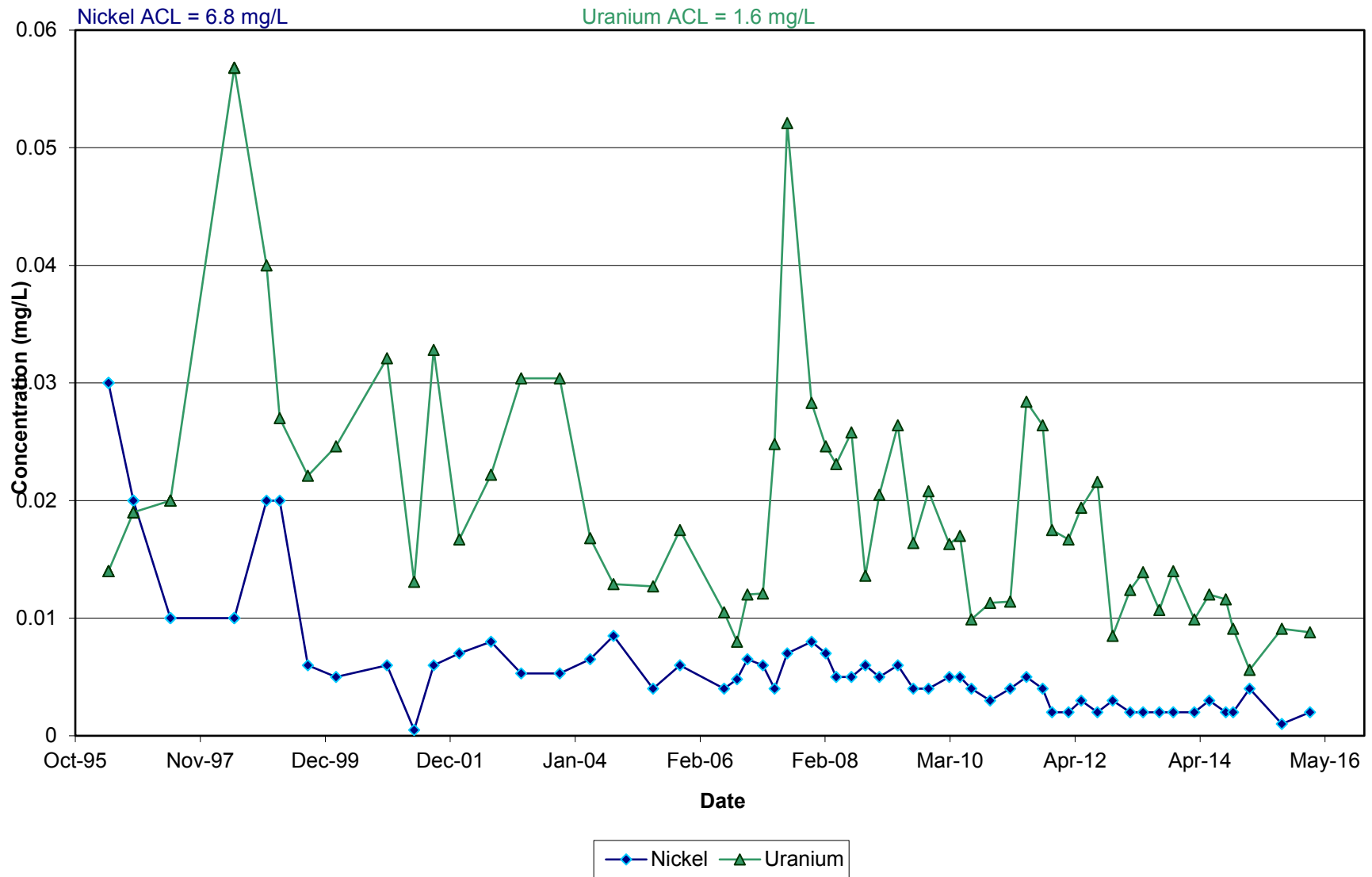
Anions and TDS in Monitoring Well 19-77 TRB



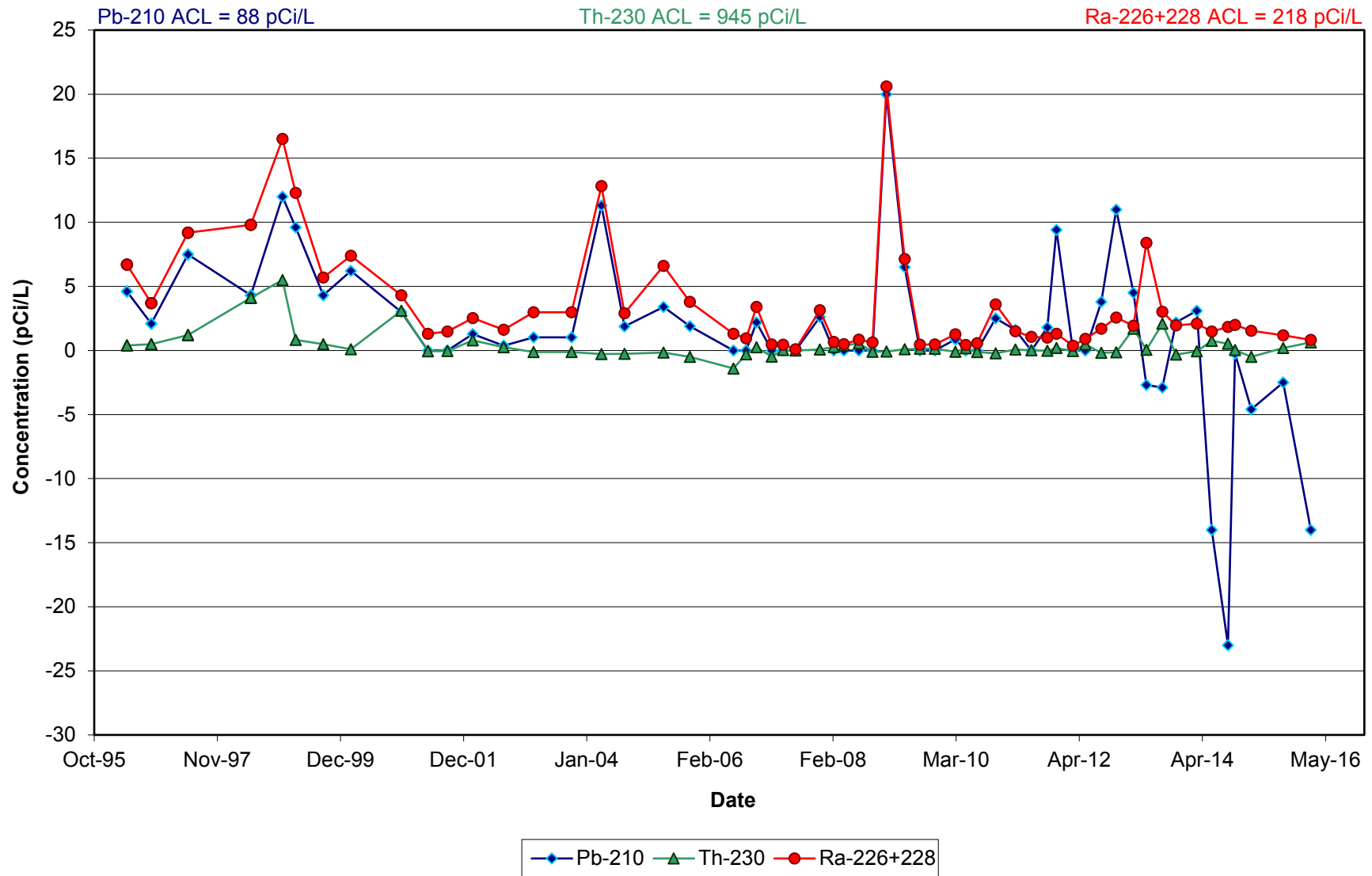
Nitrate in Monitoring Well 19-77 TRB



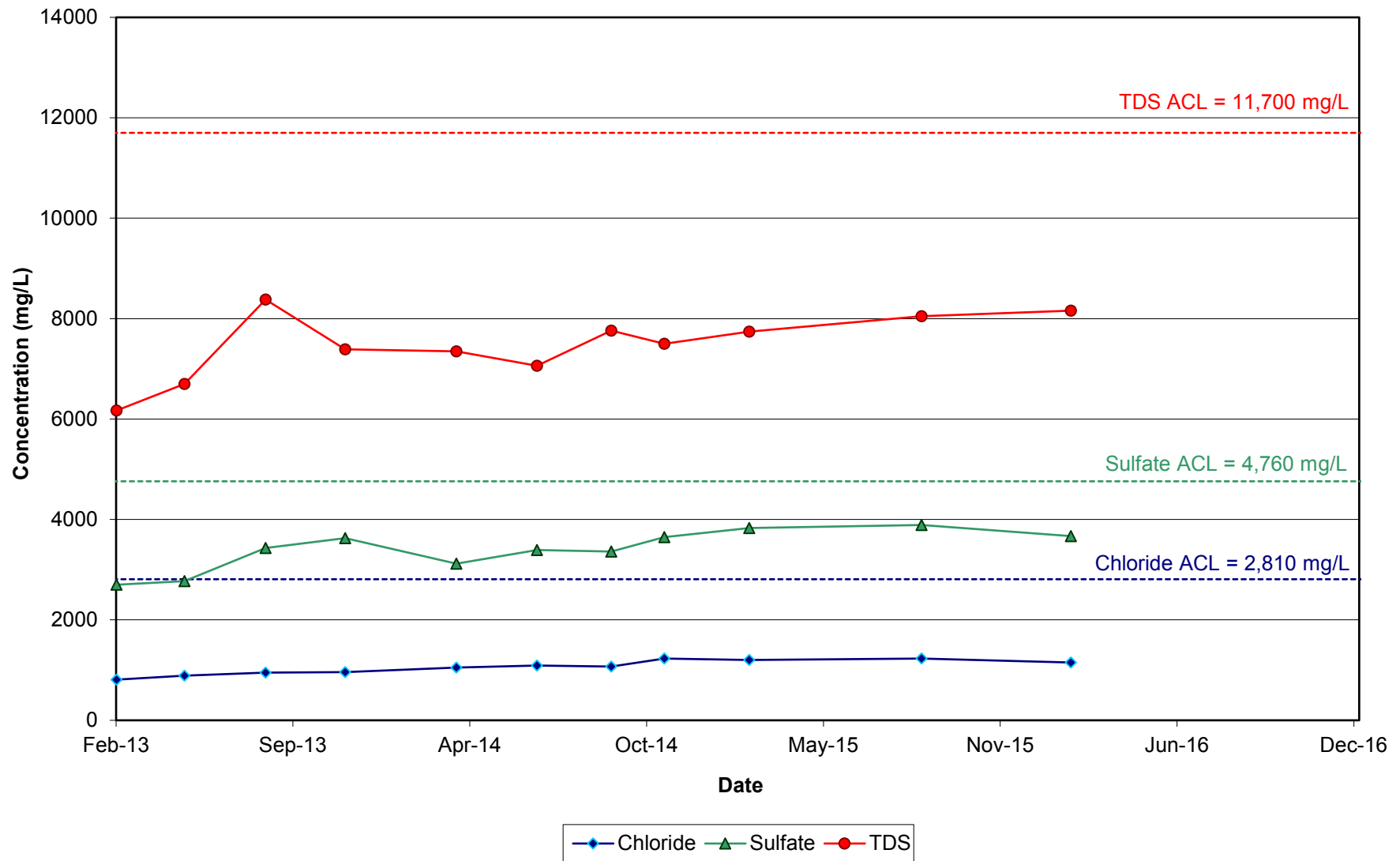
Metals in Monitoring Well 19-77 TRB



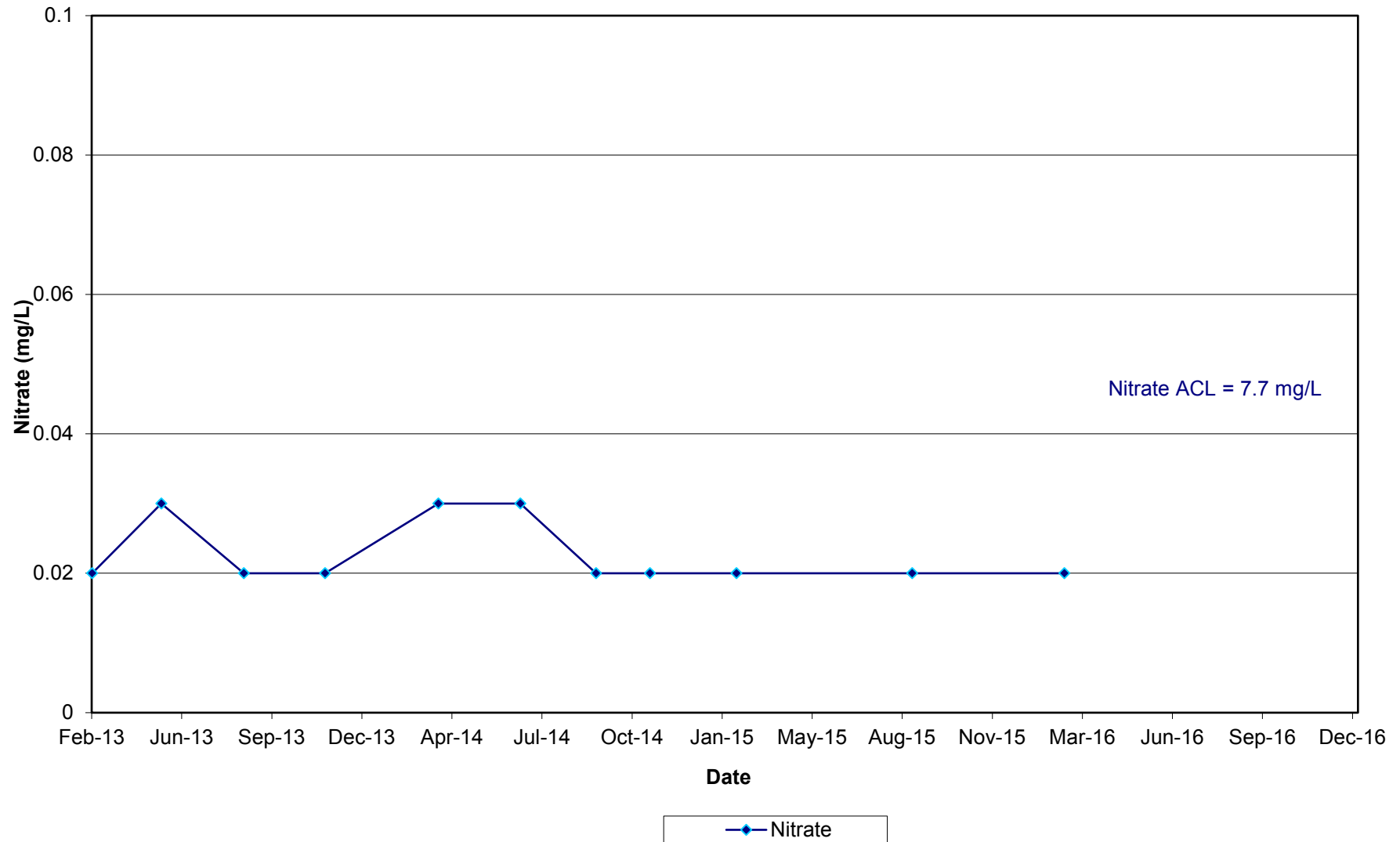
Radionuclides in Monitoring Well 19-77 TRB



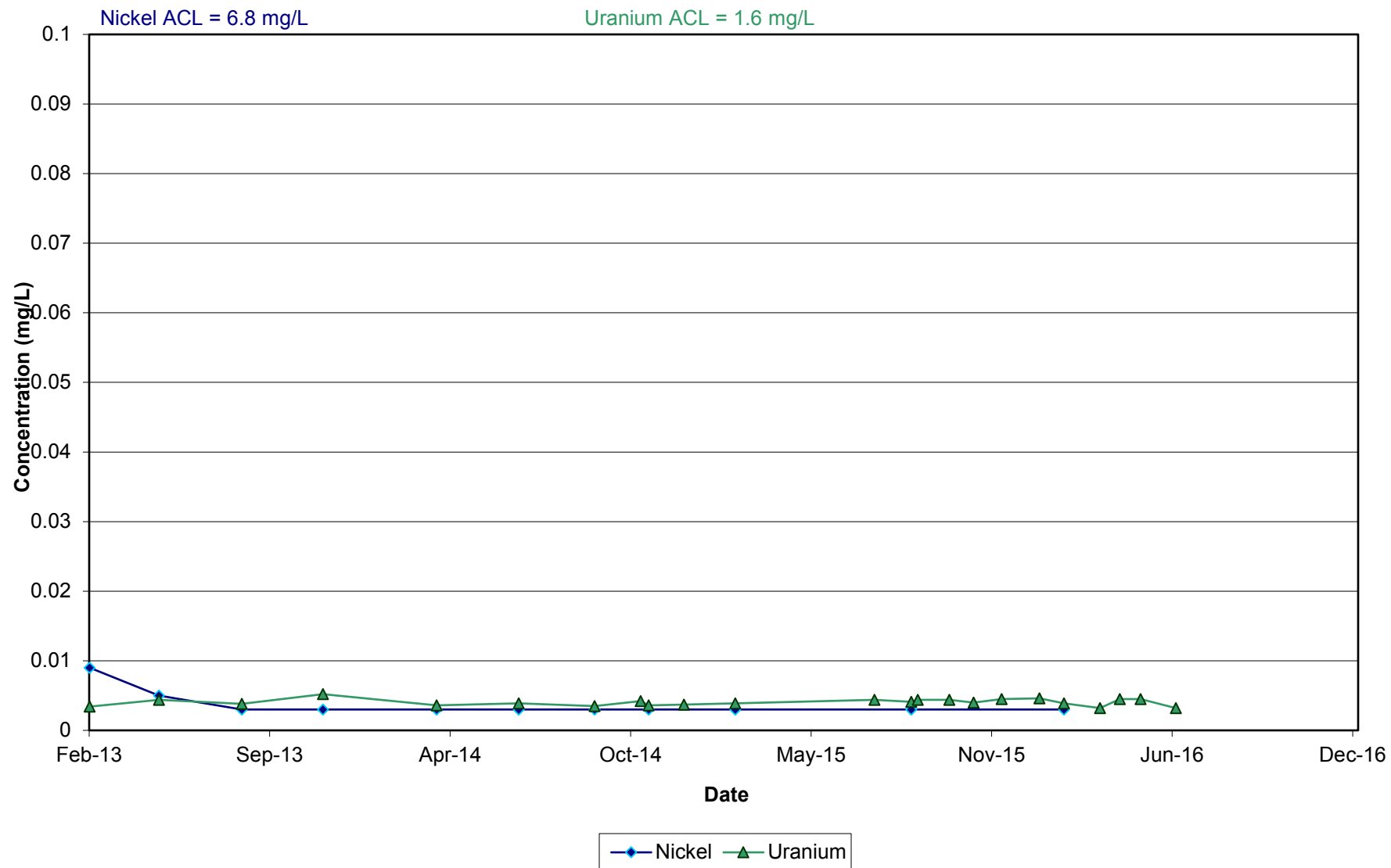
**Anions and TDS in Monitoring Well 31-02 TRB-R
(replaced 12/14/2012)**



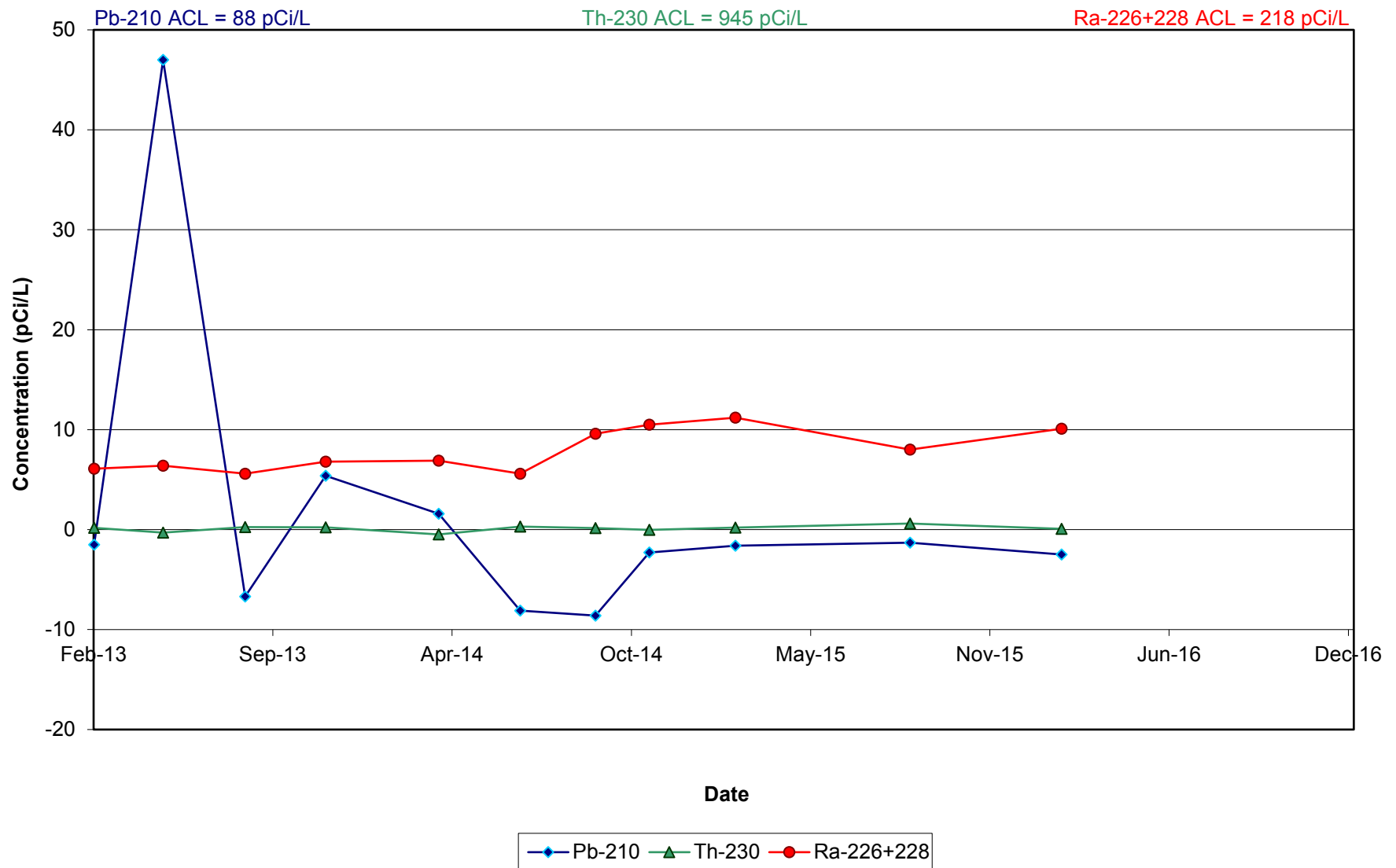
**Nitrate in Monitoring Well 31-02 TRB-R
(replaced 12/14/2012)**



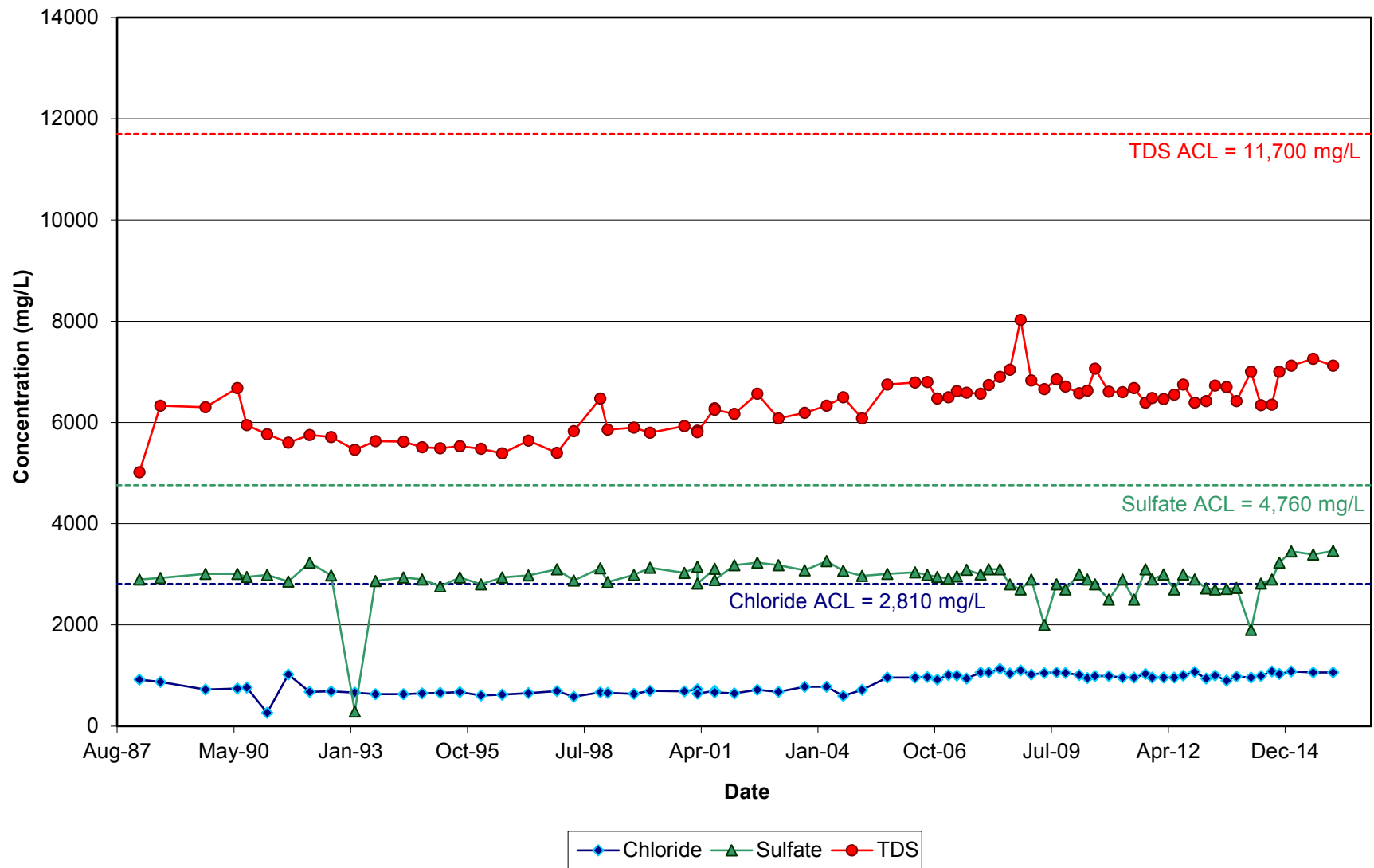
Metals in Monitoring Well 31-02 TRB-R (replaced 12/14/2012)



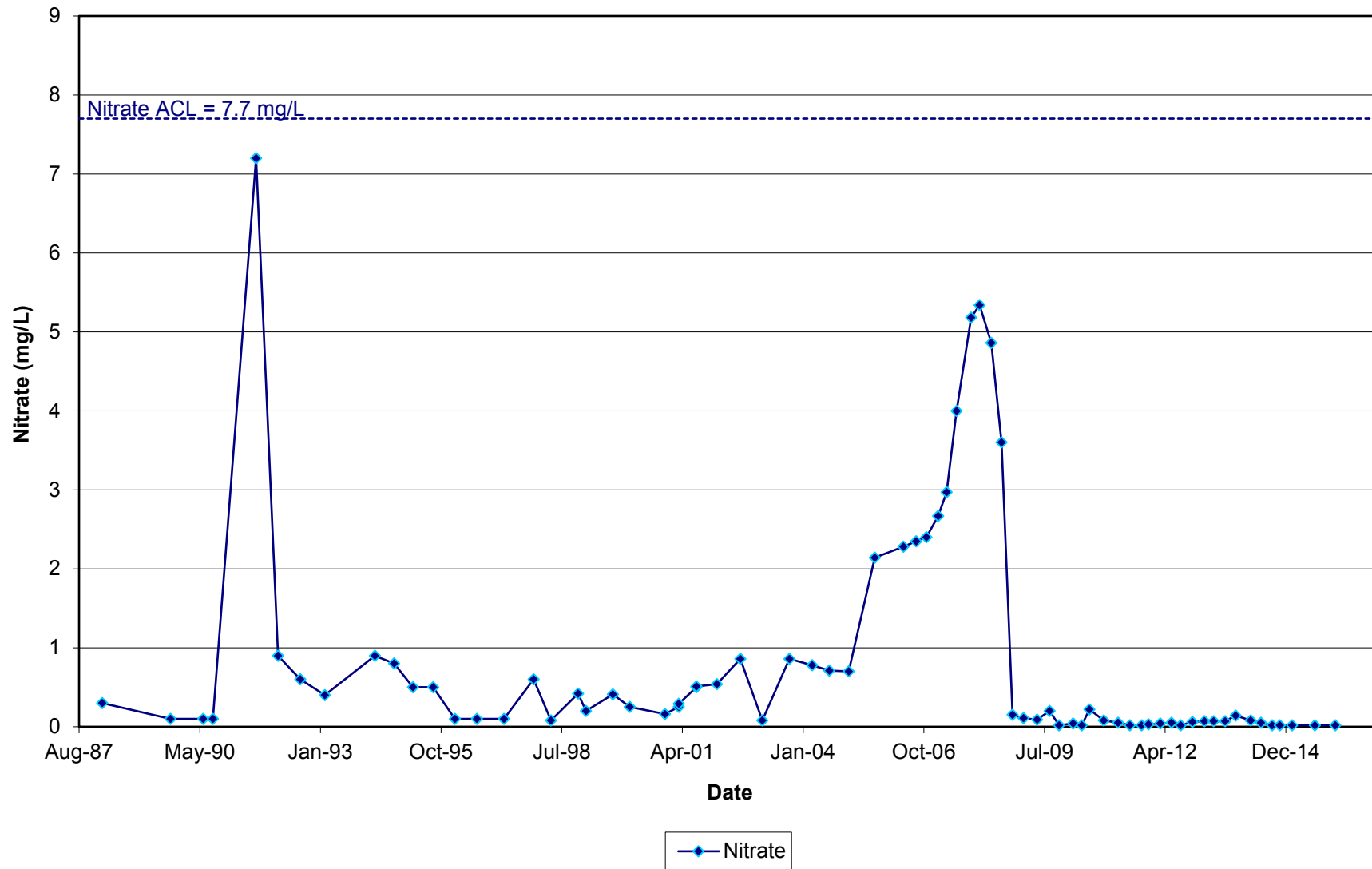
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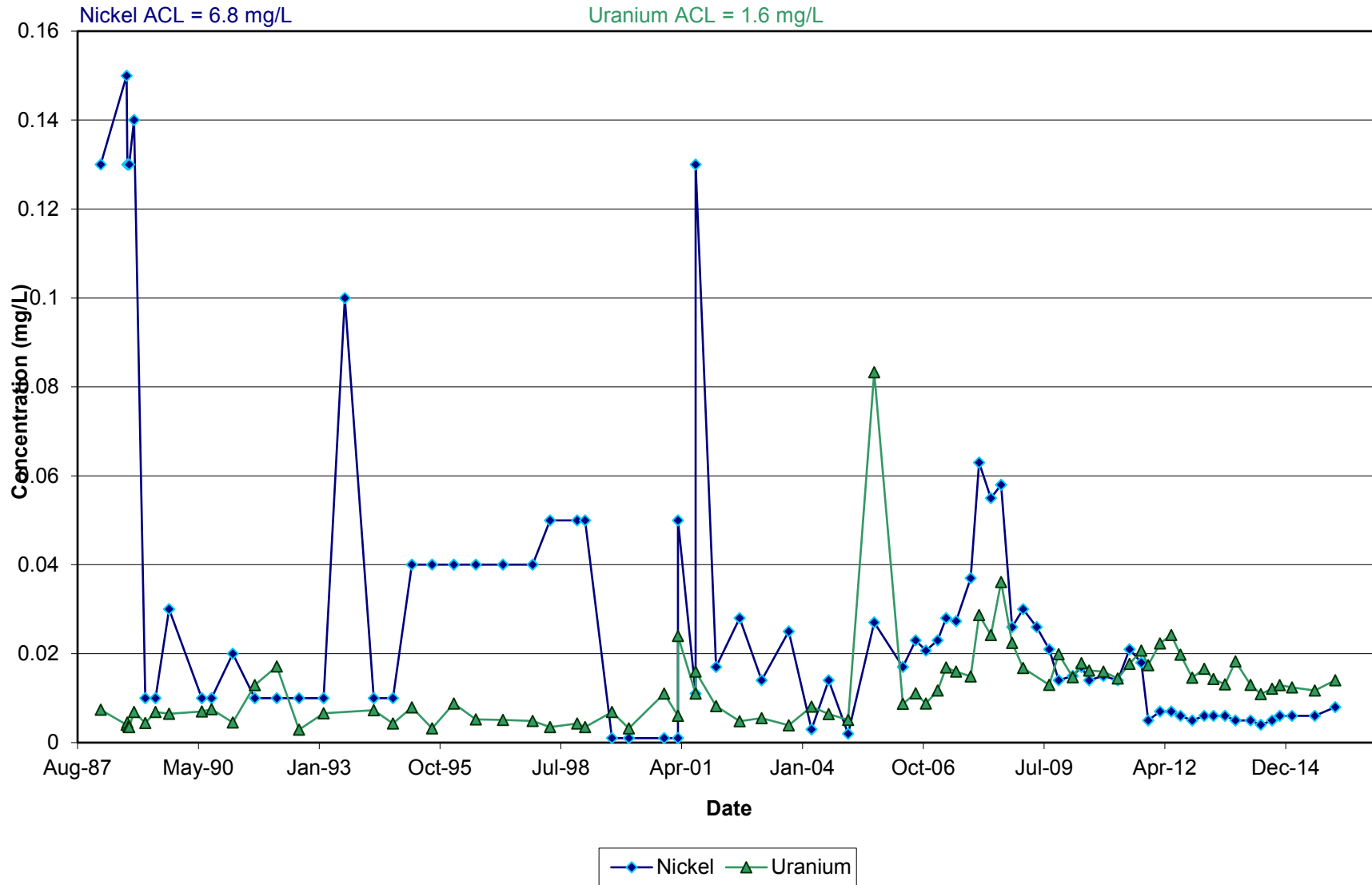
Anions and TDS in Monitoring Well 31-67 TRB



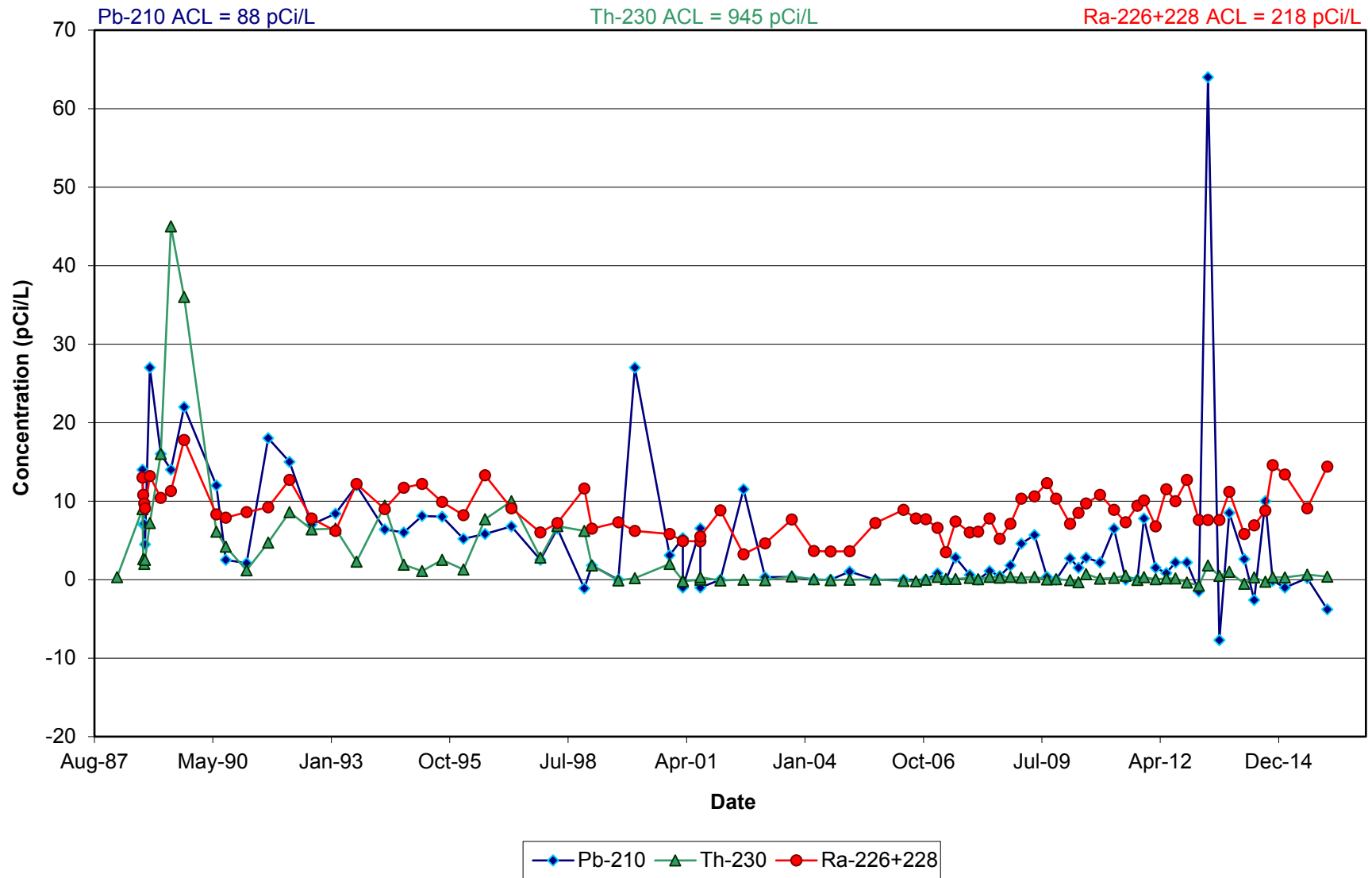
Nitrate in Monitoring Well 31-67 TRB



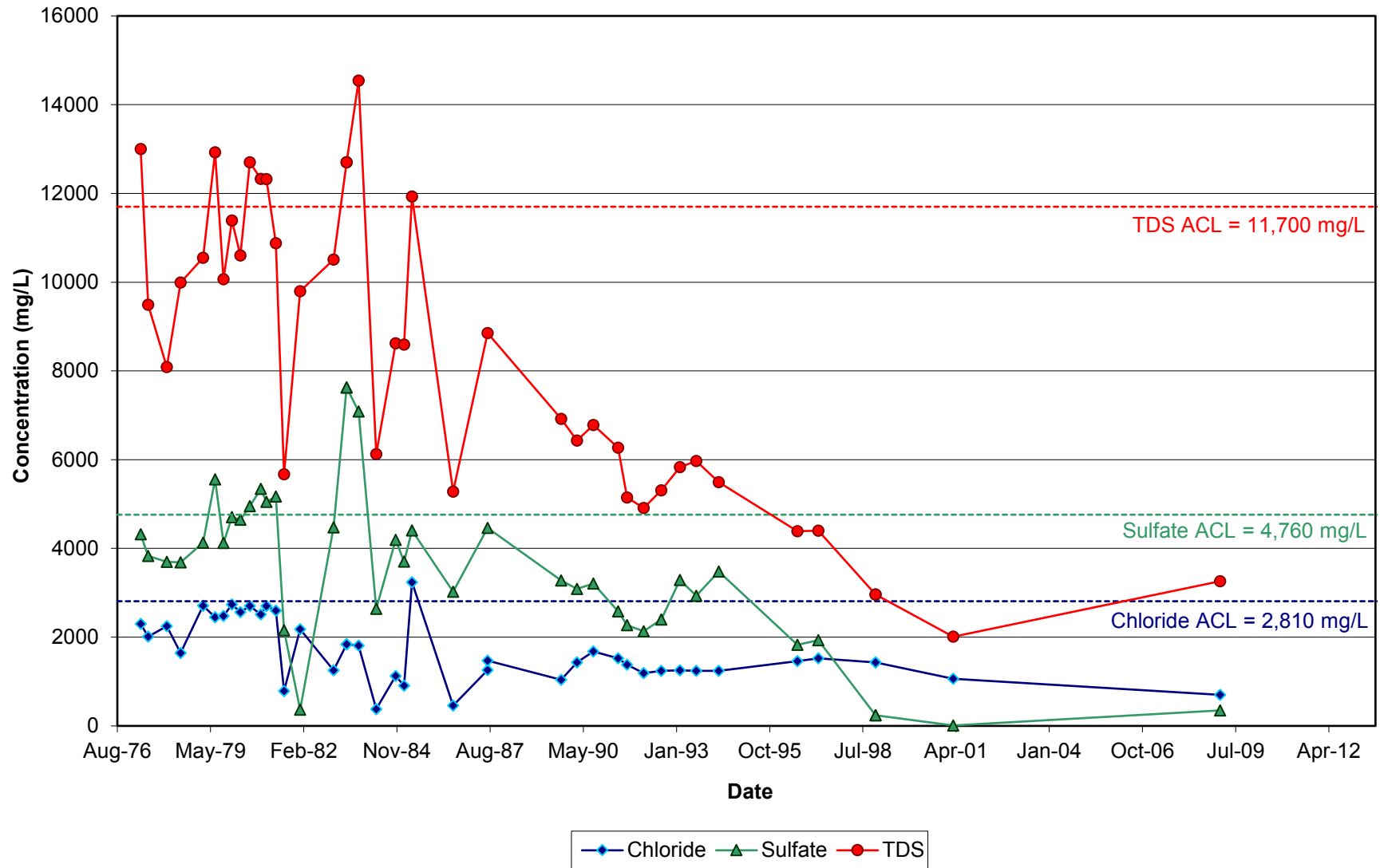
Metals in Monitoring Well 31-67 TRB



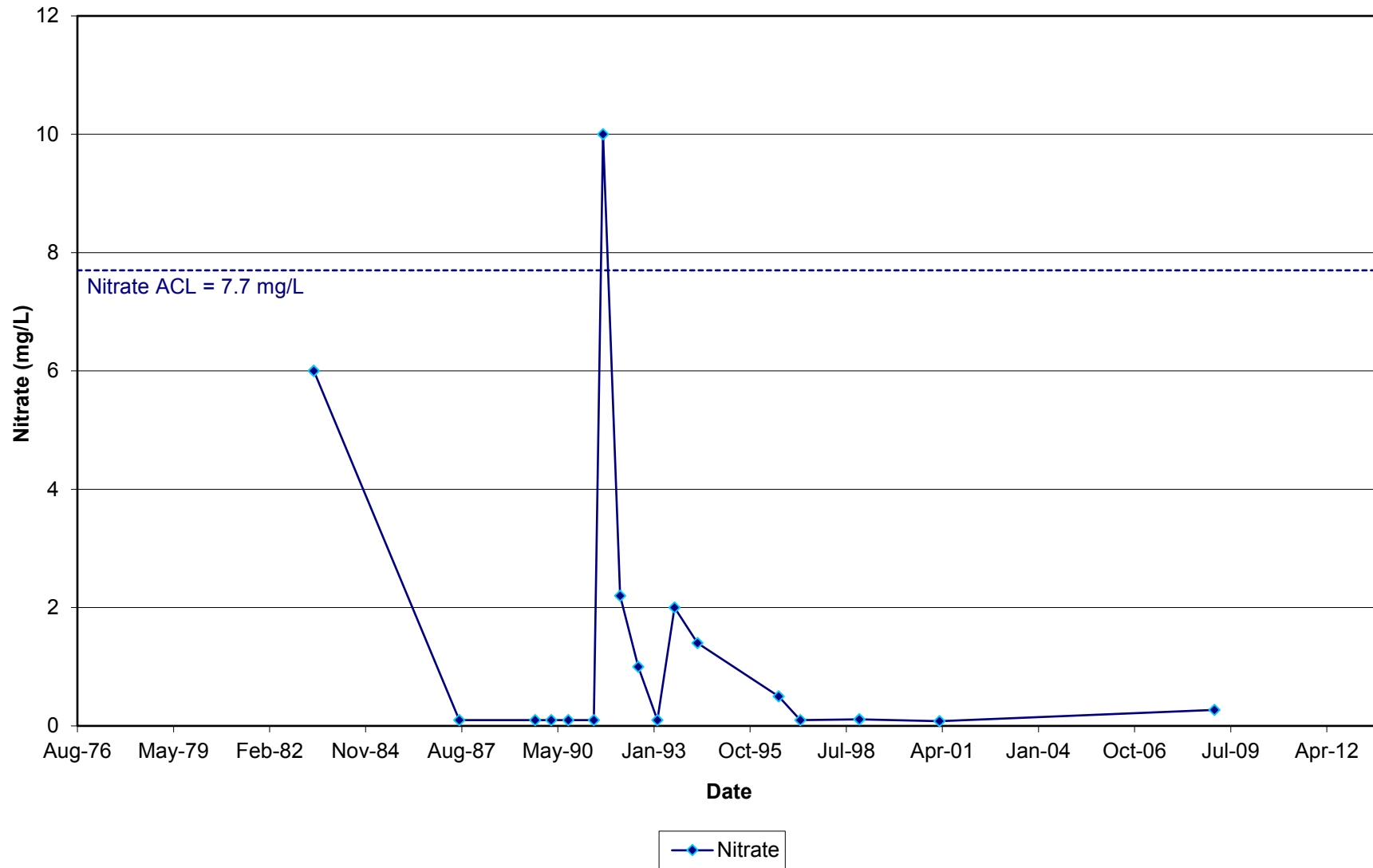
Radionuclides in Monitoring Well 31-67 TRB



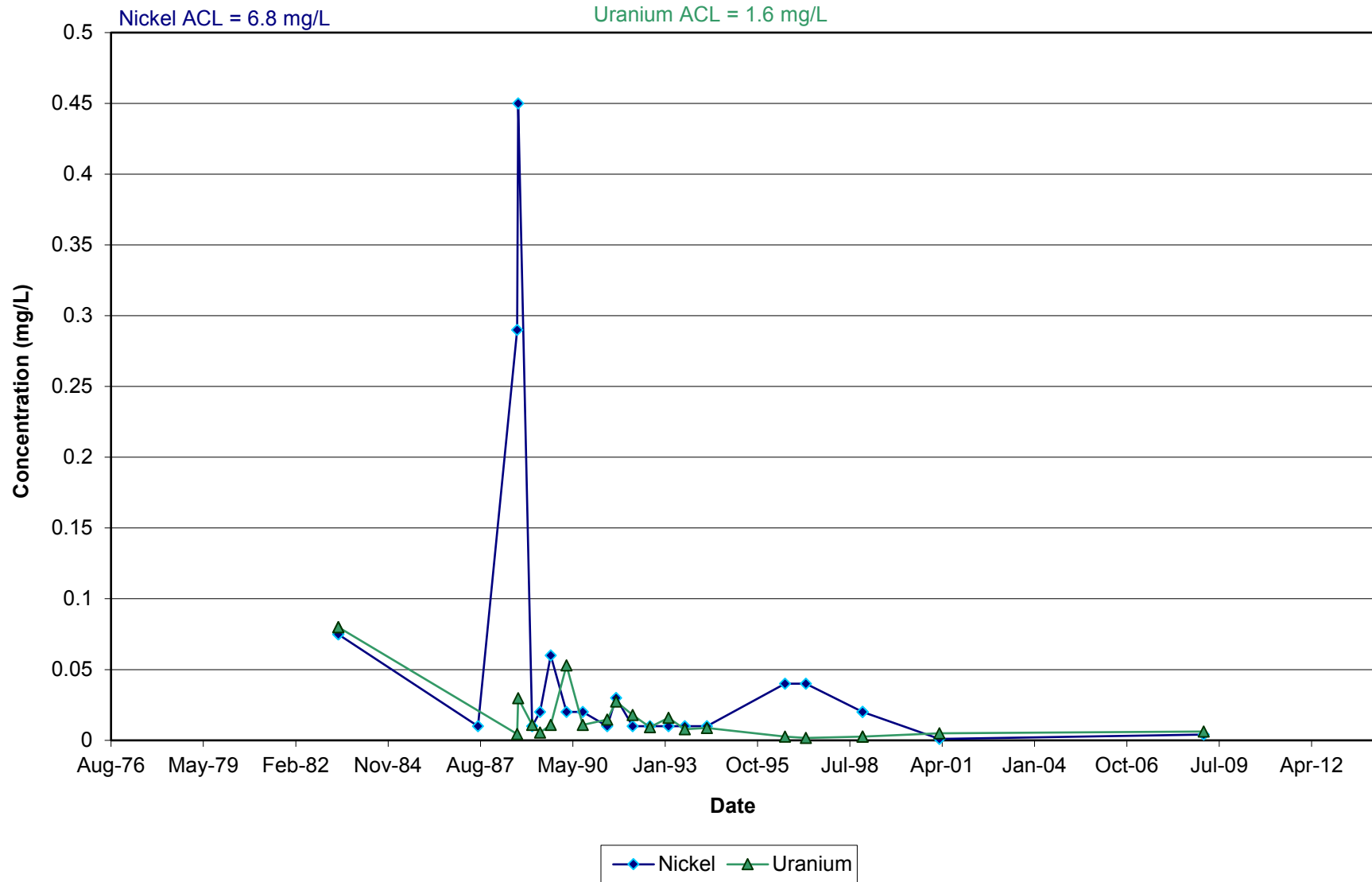
Anions and TDS in Monitoring Well 36-01 TRB



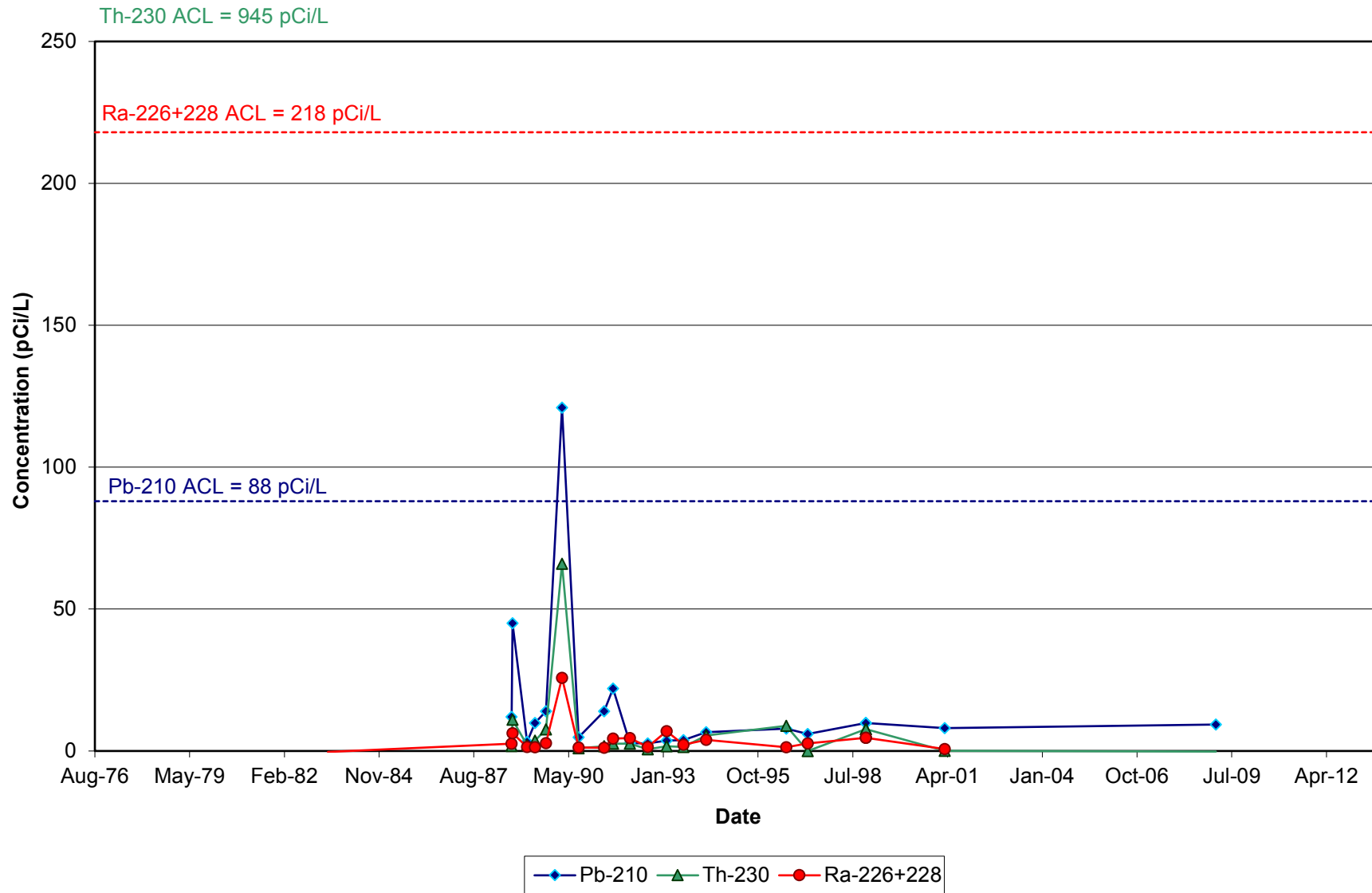
Nitrate in Monitoring Well 36-01 TRB



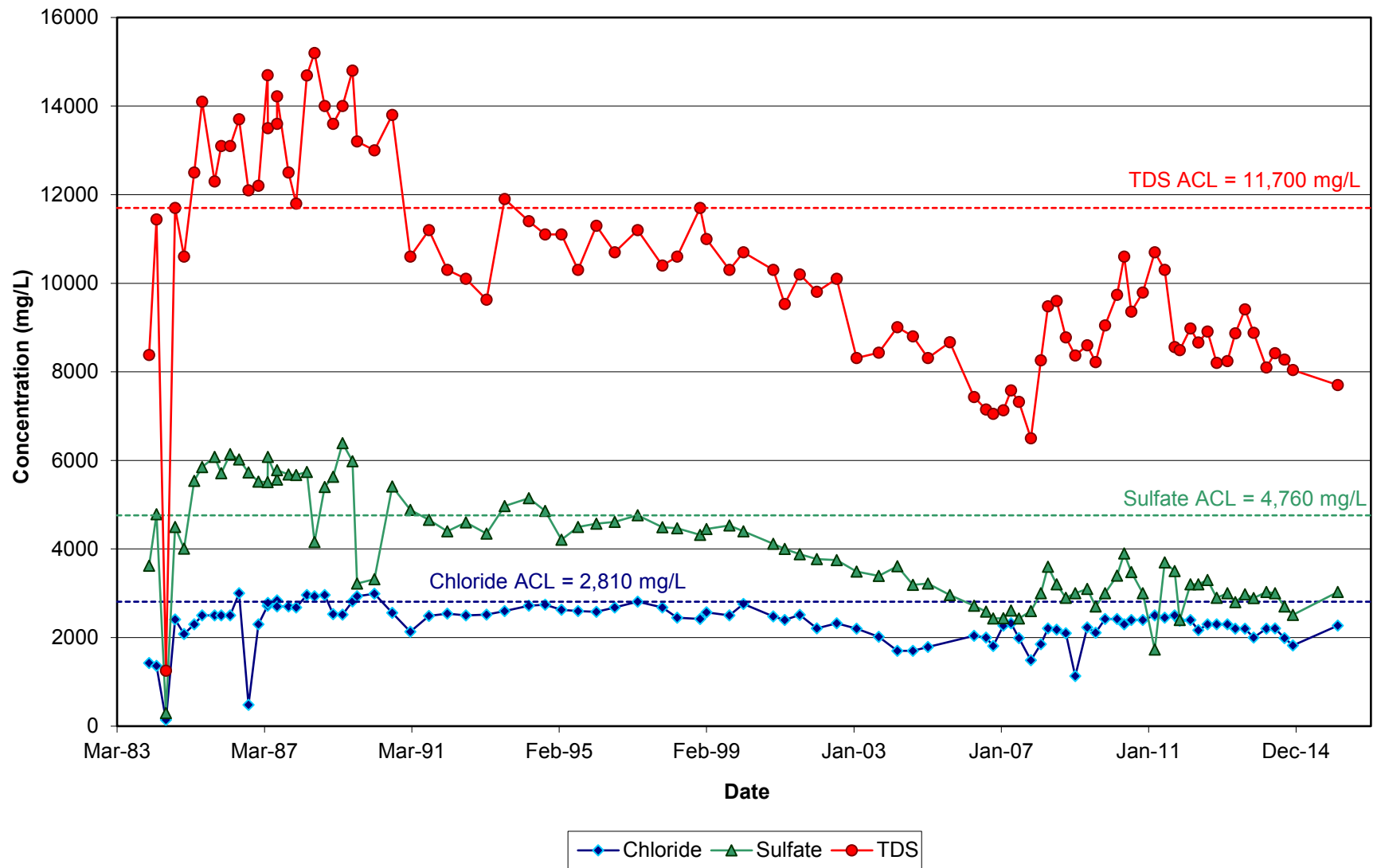
Metals in Monitoring Well 36-01 TRB



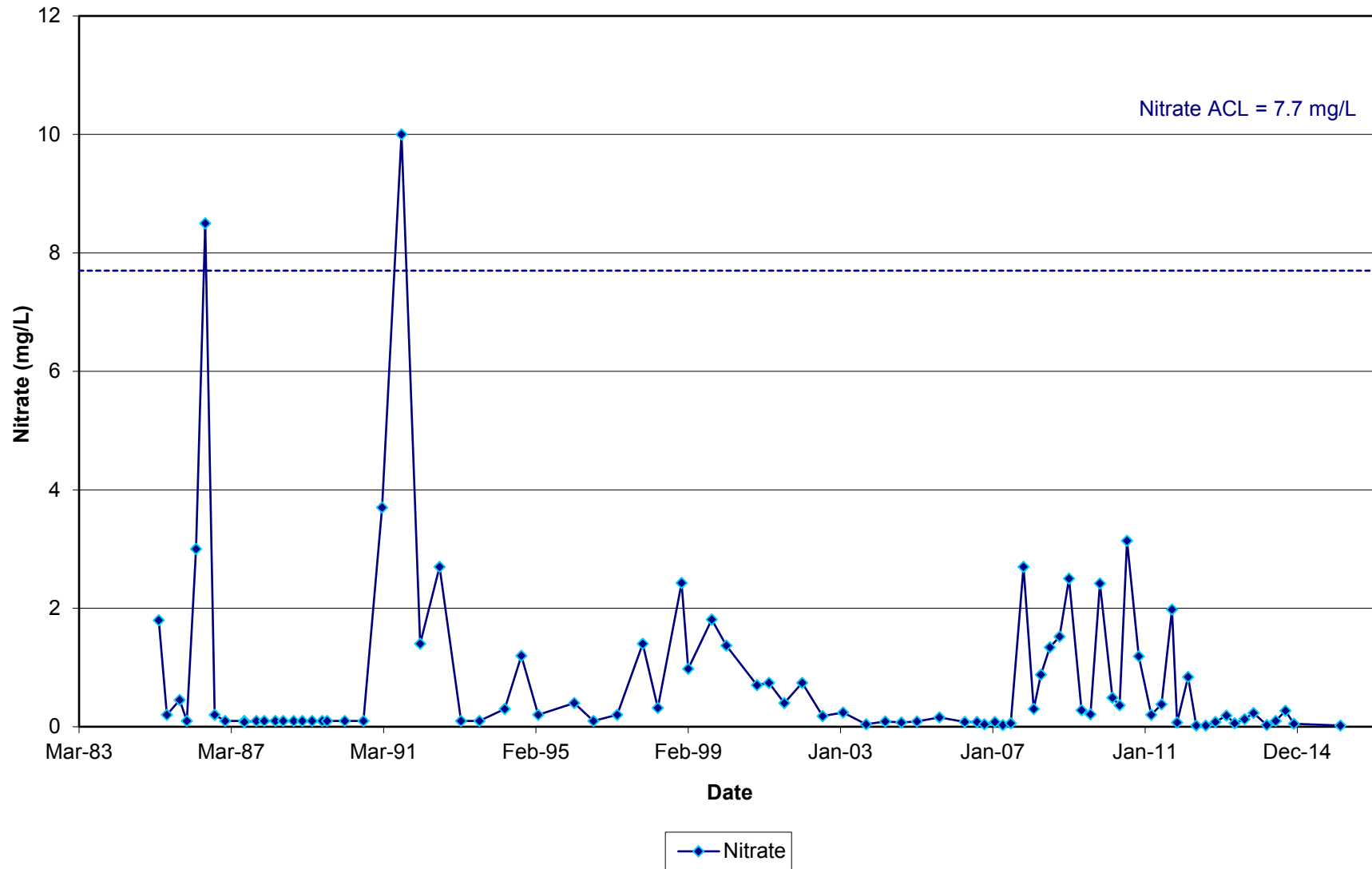
Radionuclides in Monitoring Well 36-01 TRB



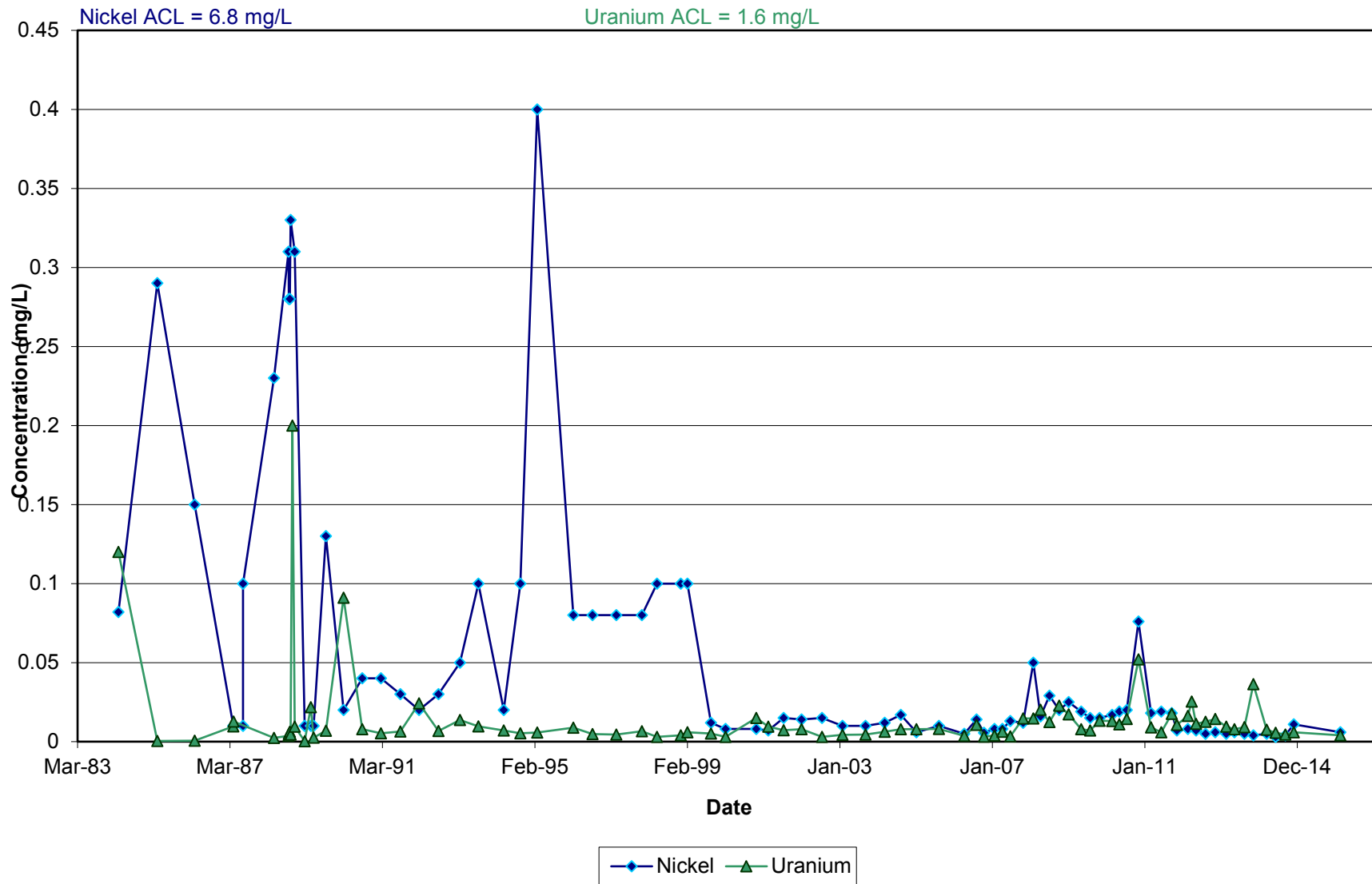
Anions and TDS in Monitoring Well 36-02 TRB



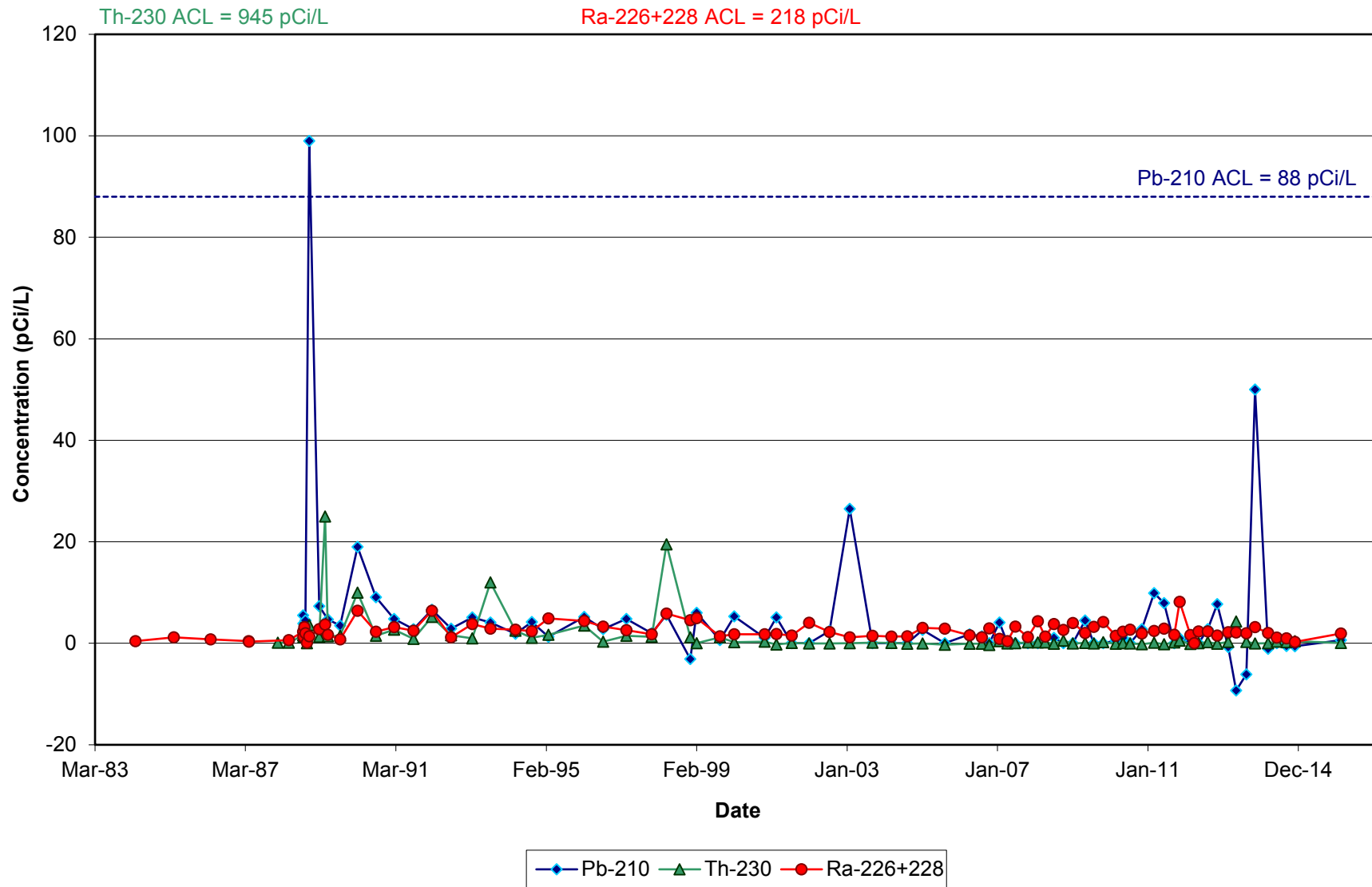
Nitrate in Monitoring Well 36-02 TRB



Metals in Monitoring Well 36-02 TRB



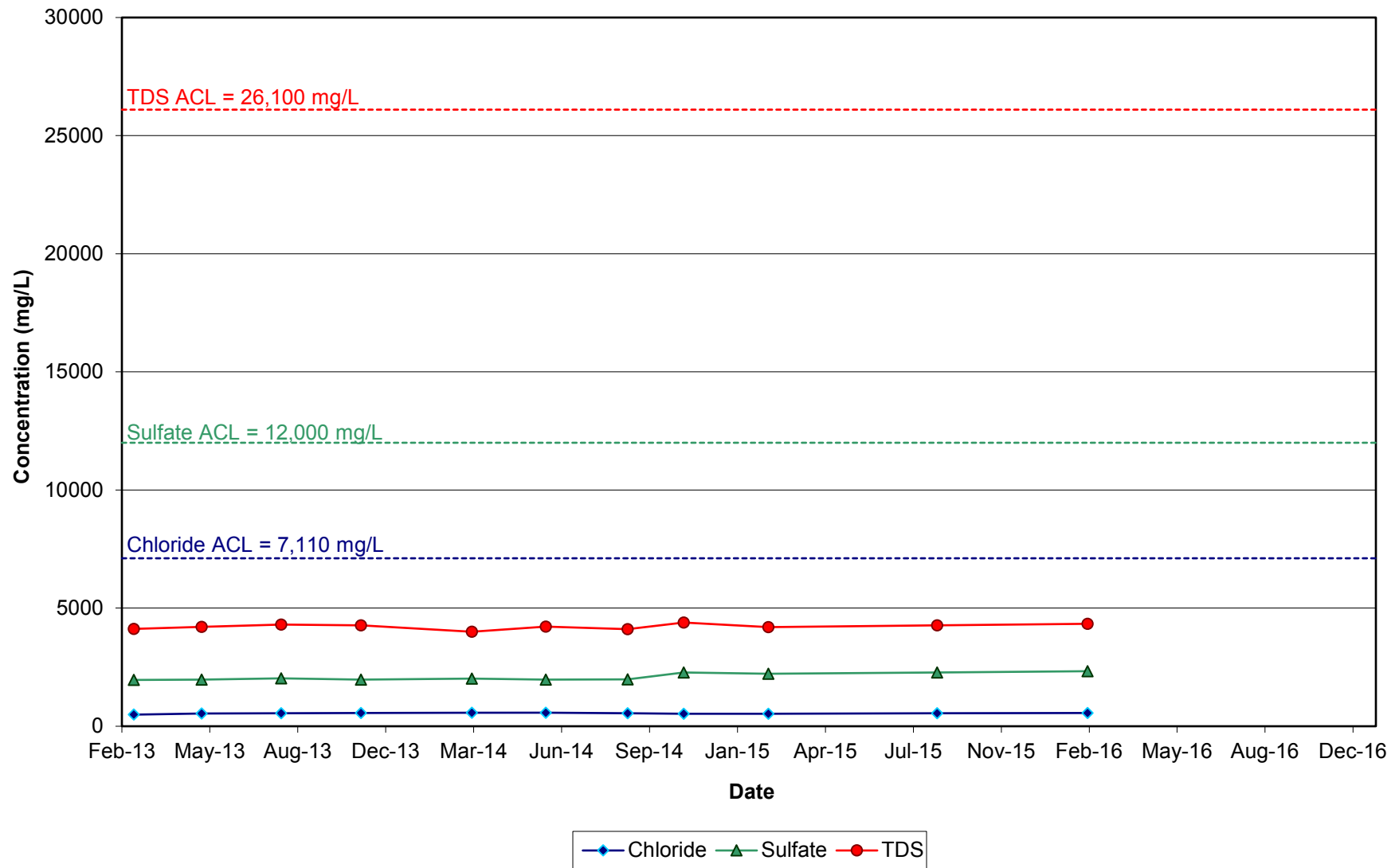
Radionuclides in Monitoring Well 36-02 TRB



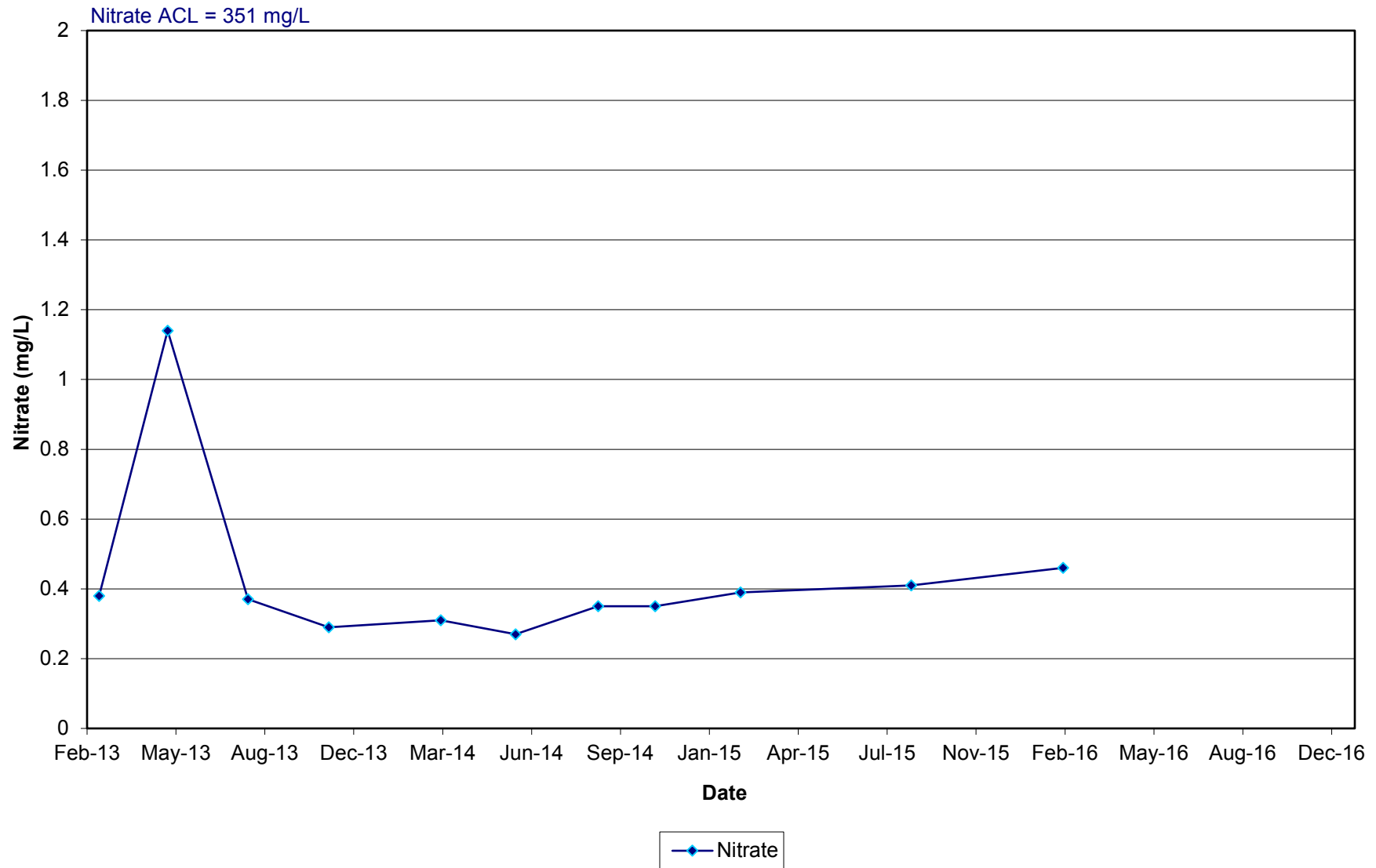
Stability Monitoring Plan
Time Versus Concentration Plots

Alluvium

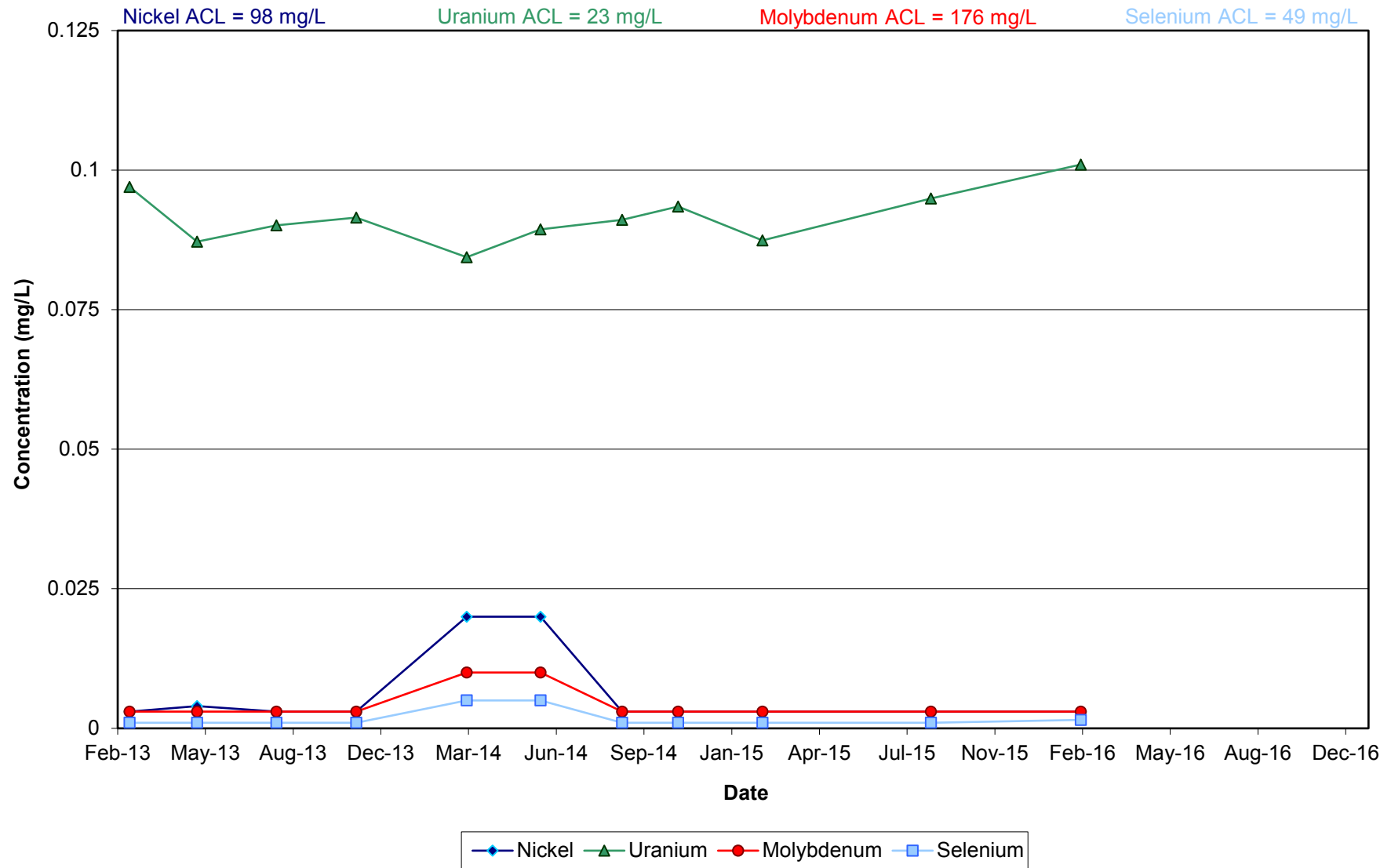
**Anions and TDS in Monitoring Well 5-03 ALL-R
(replaced 11/5/2012)**



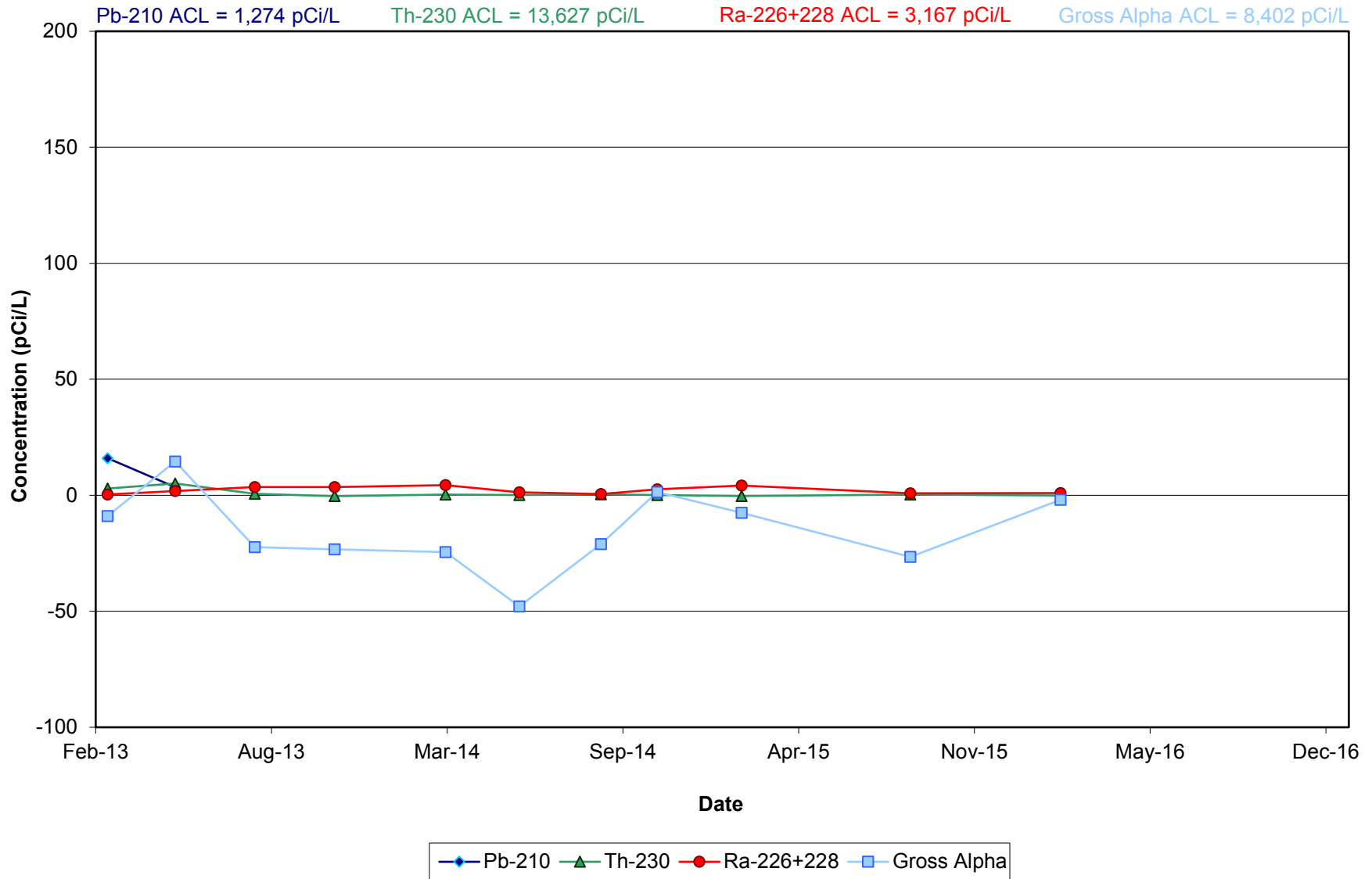
**Nitrate in Monitoring Well 5-03 ALL-R
(replaced 11/5/2012)**



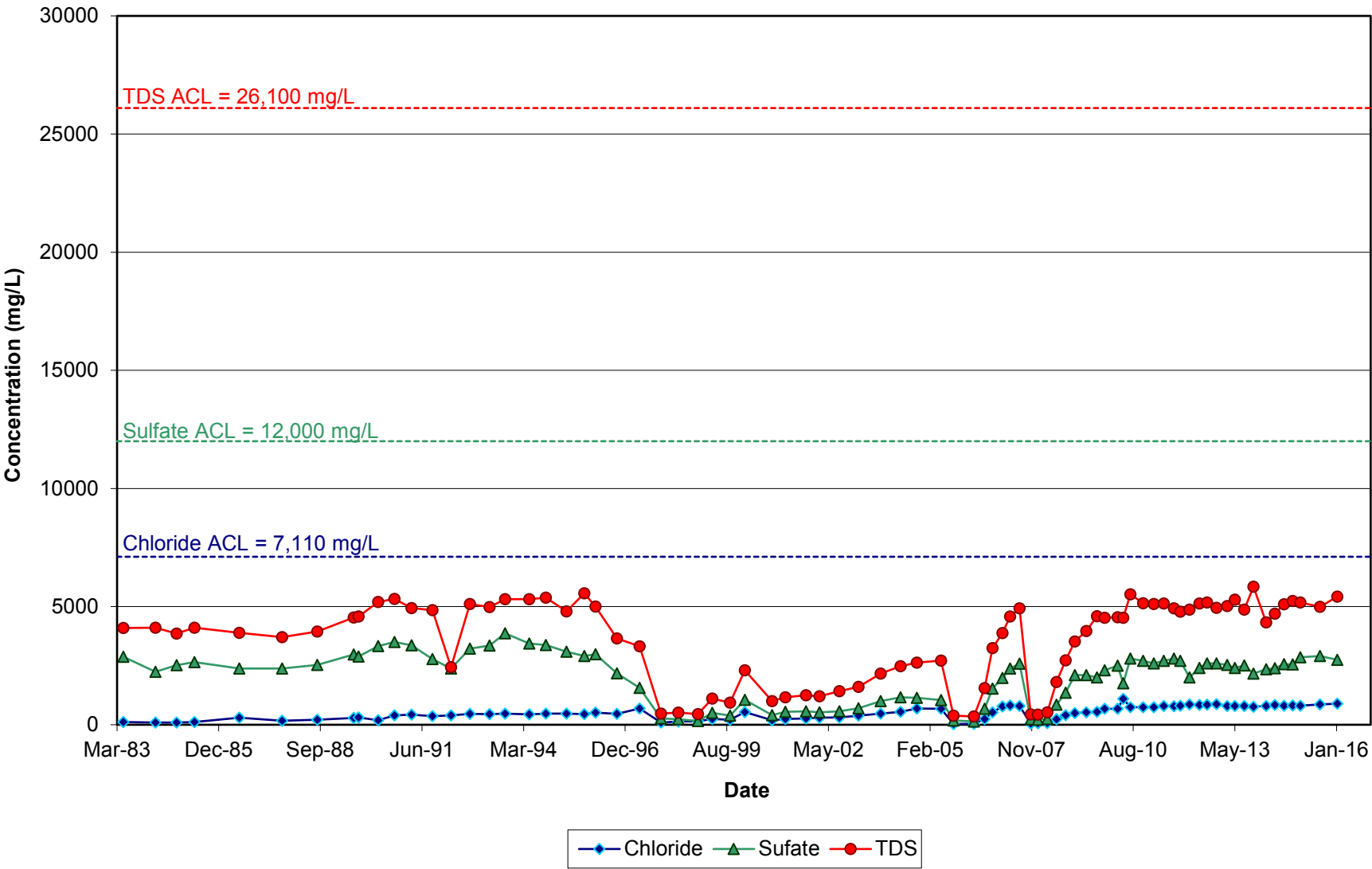
Metals in Monitoring Well 5-03 ALL-R (replaced 11/5/2012)



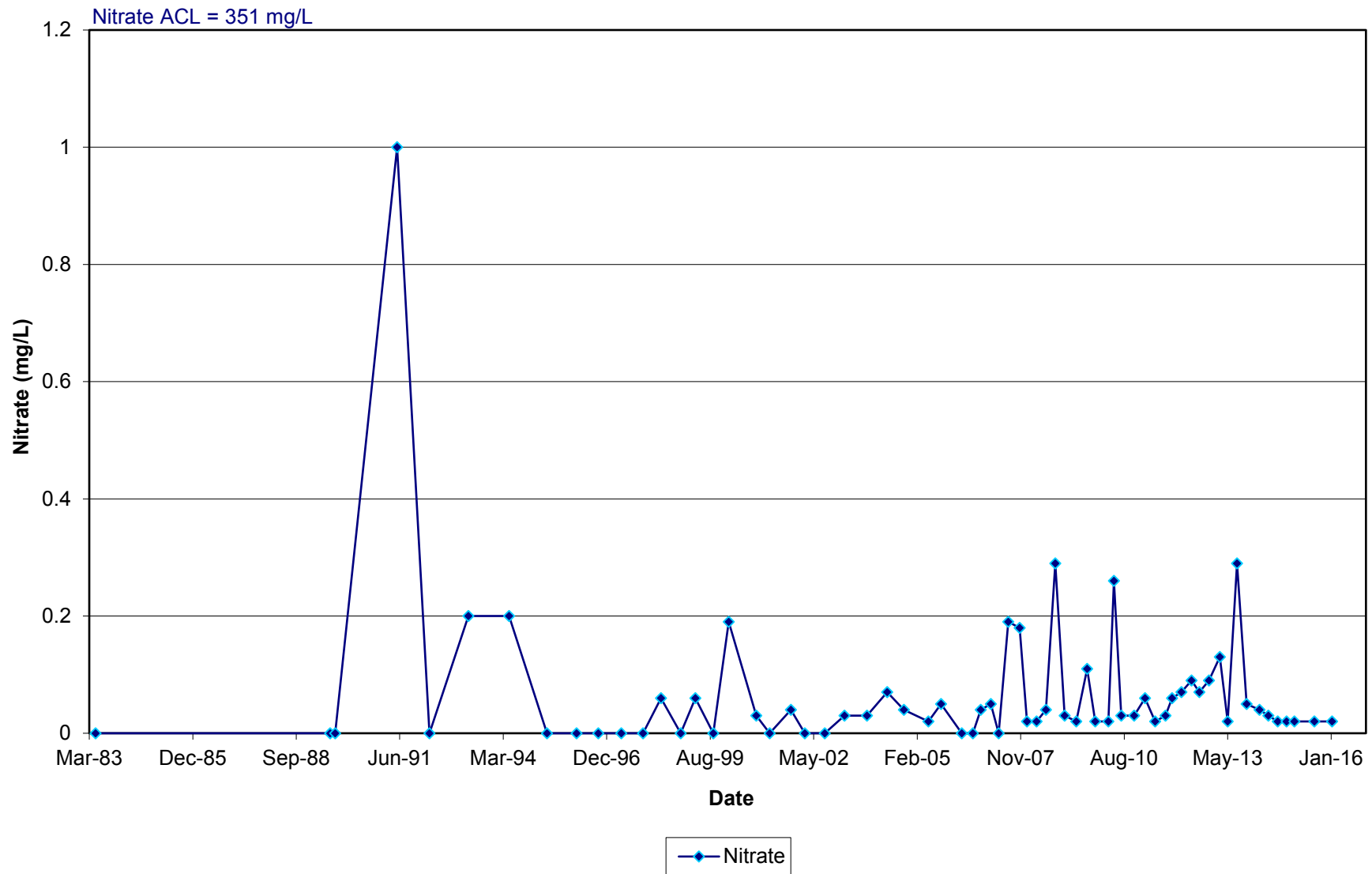
Radionuclides in Monitoring Well 5-03 ALL-R (replaced 11/5/2012)



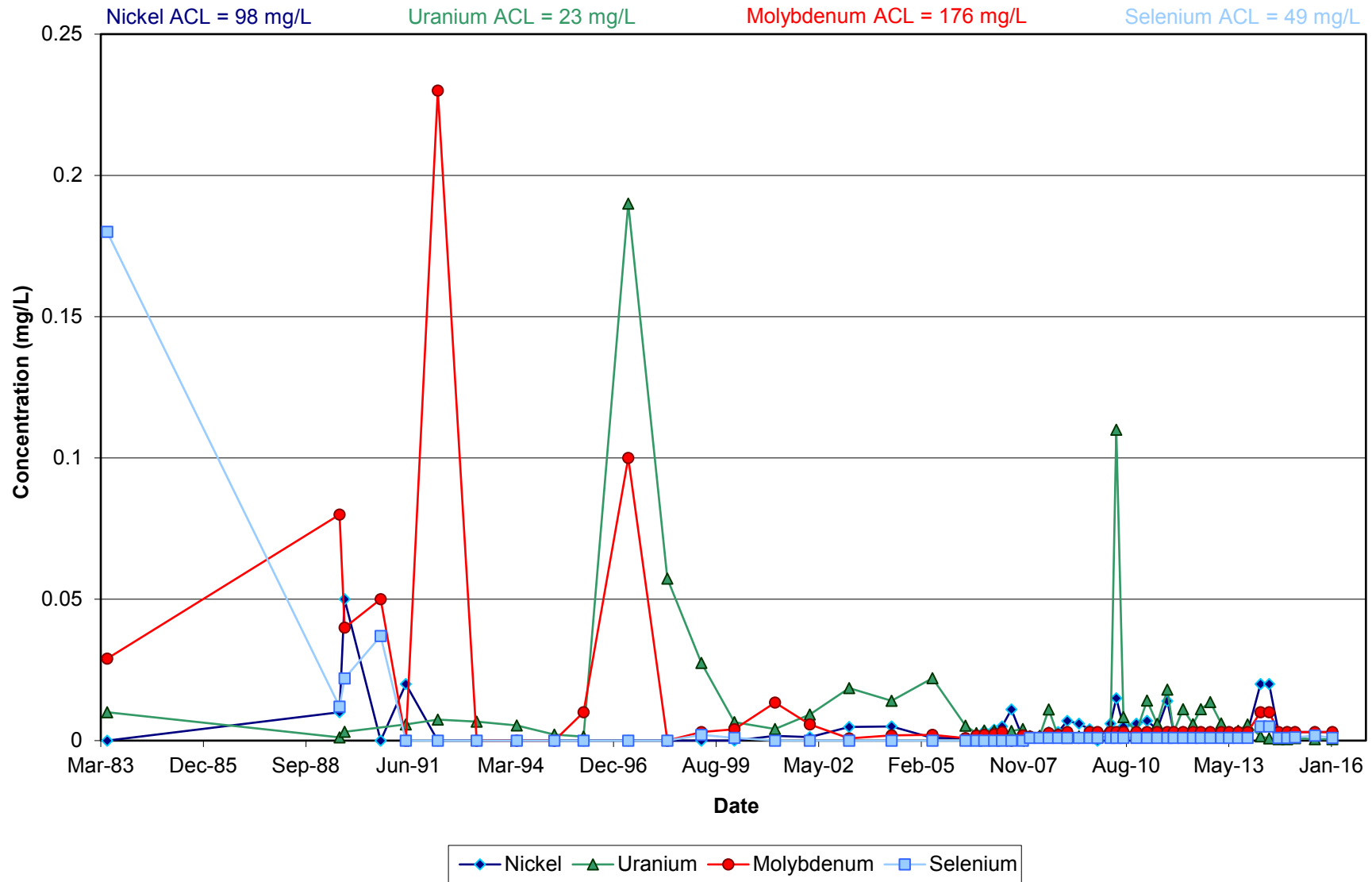
Anions and TDS in Monitoring Well 5-04 ALL



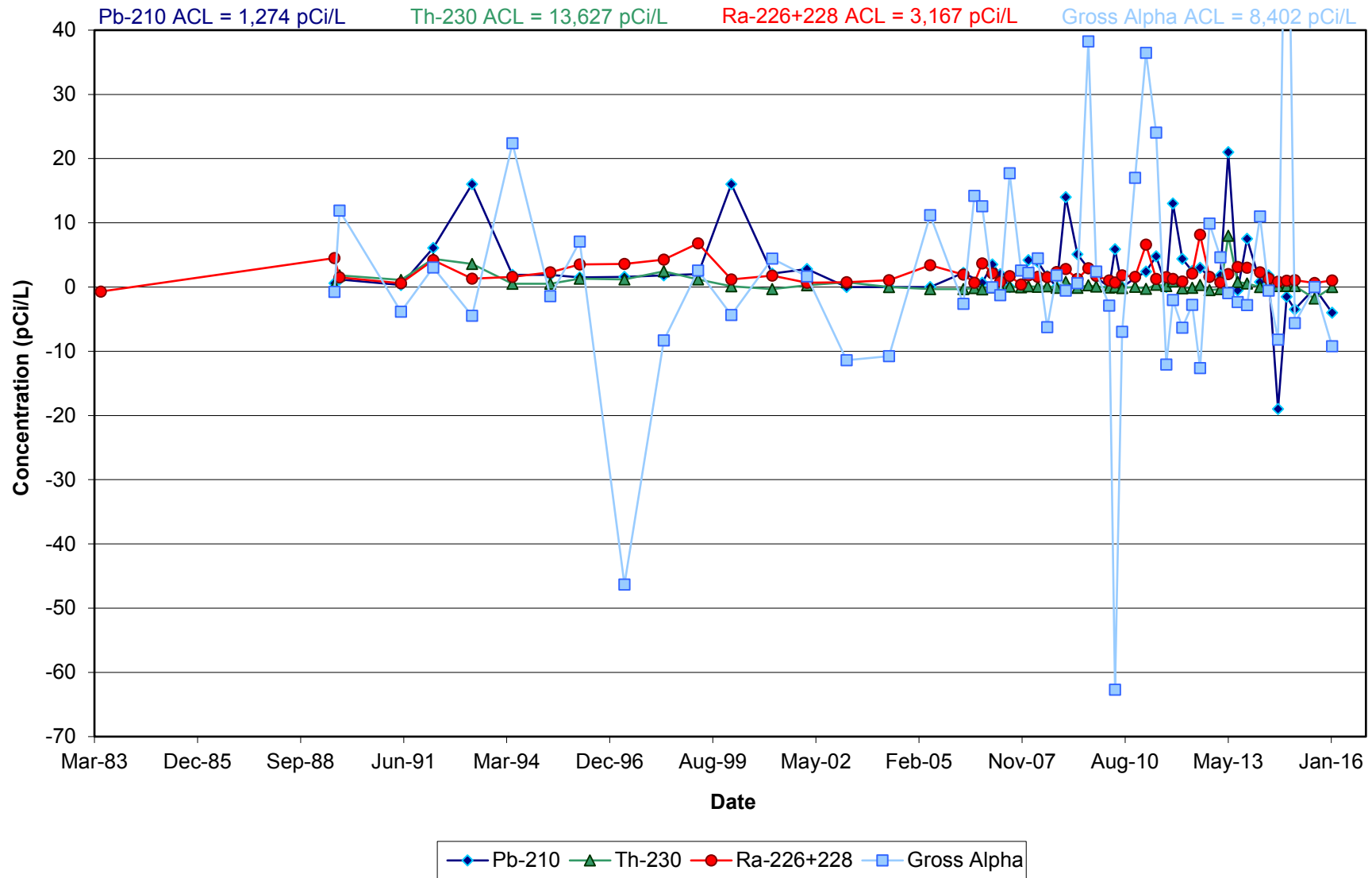
Nitrate in Monitoring Well 5-04 ALL



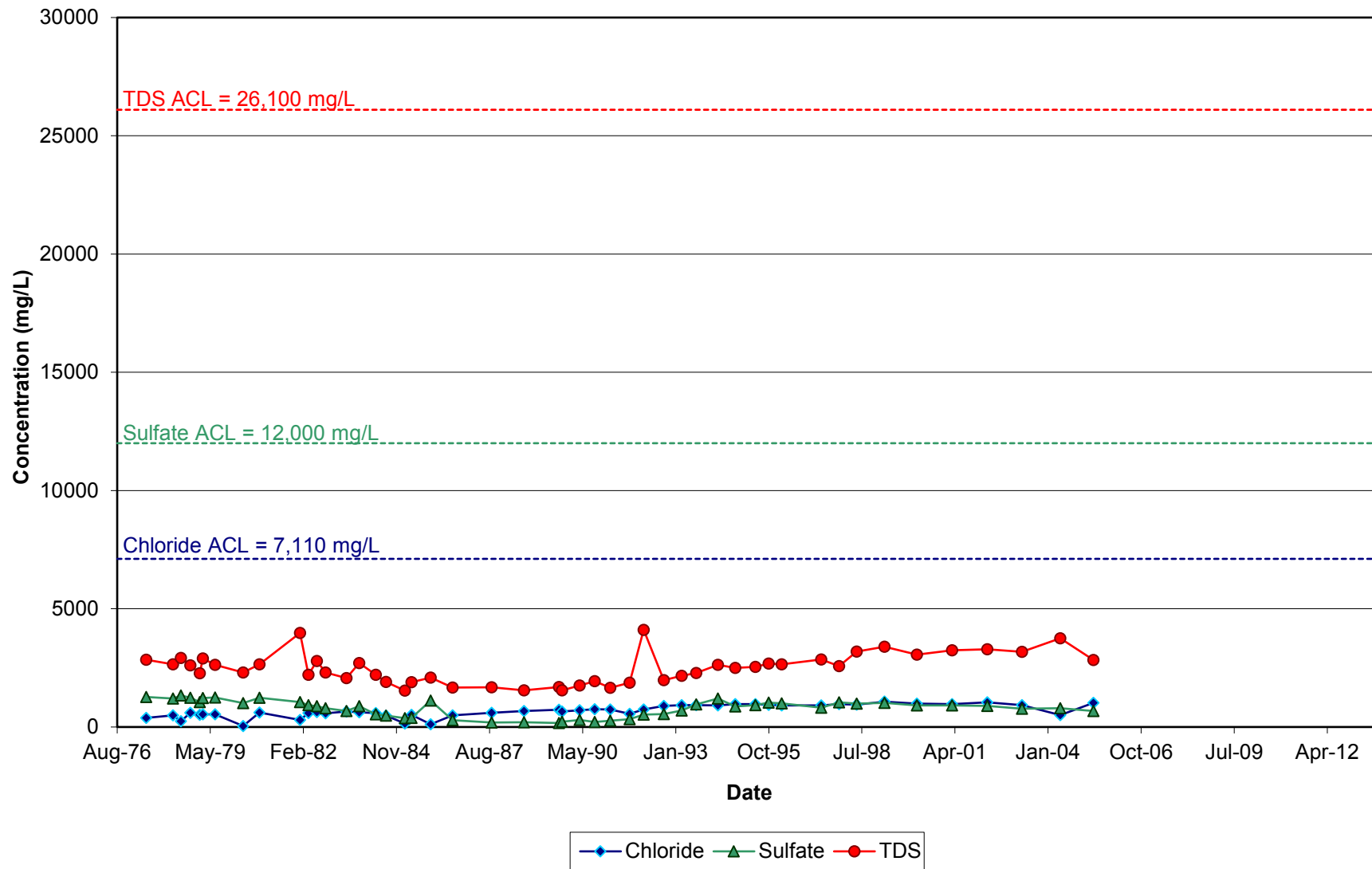
Metals in Monitoring Well 5-04 ALL



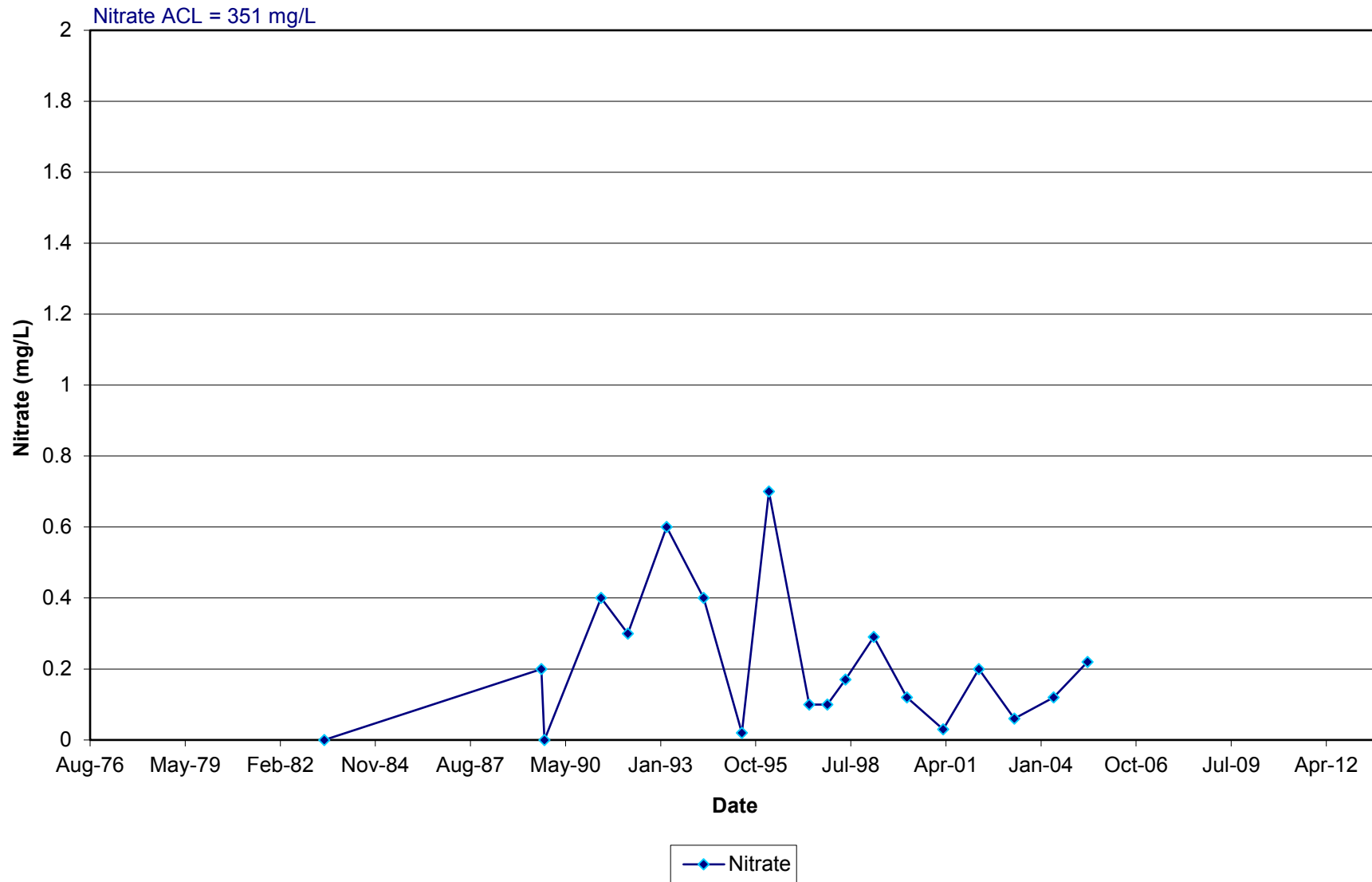
Radionuclides in Monitoring Well 5-04 ALL



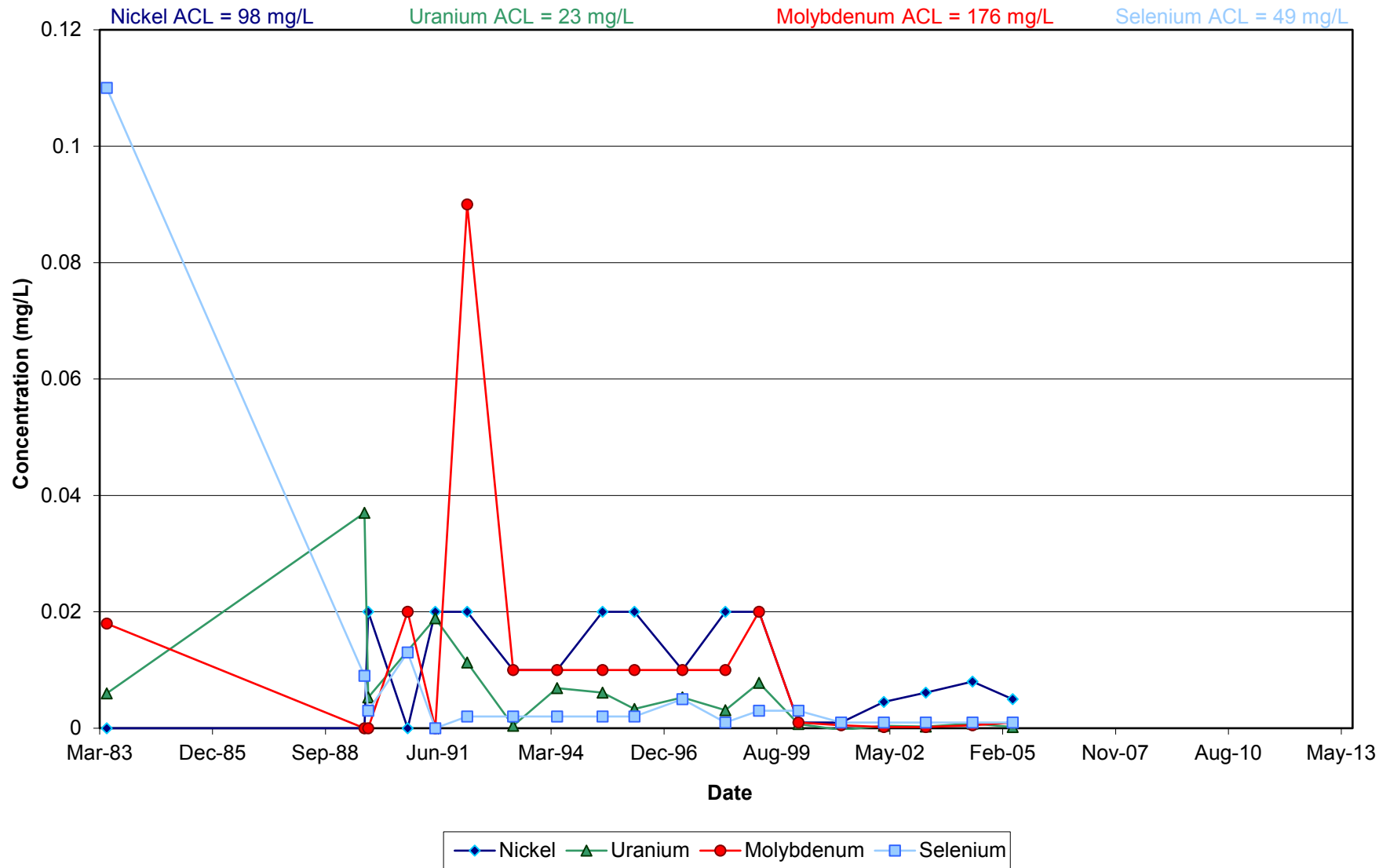
Anions and TDS in Monitoring Well 5-05



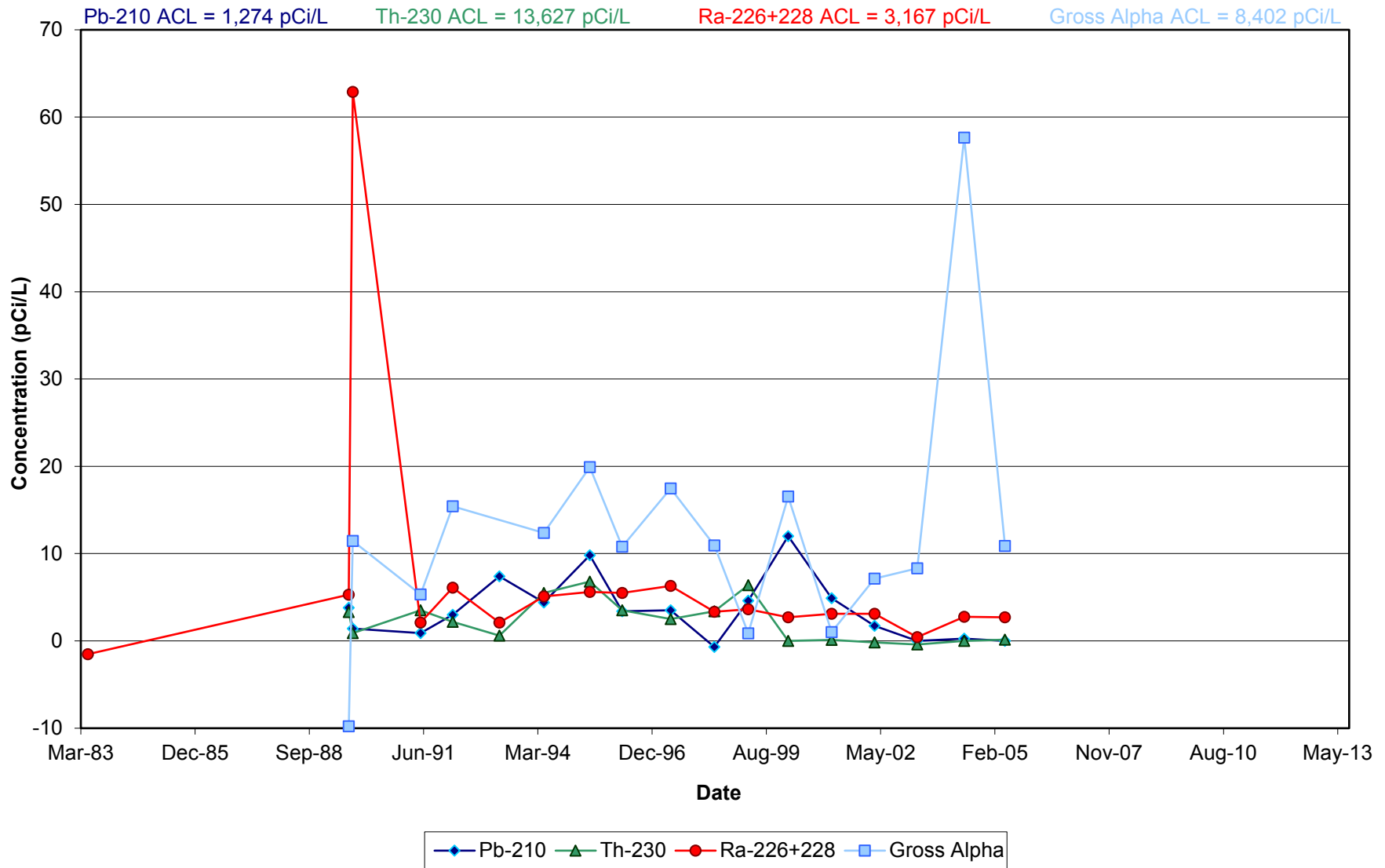
Nitrate in Monitoring Well 5-05



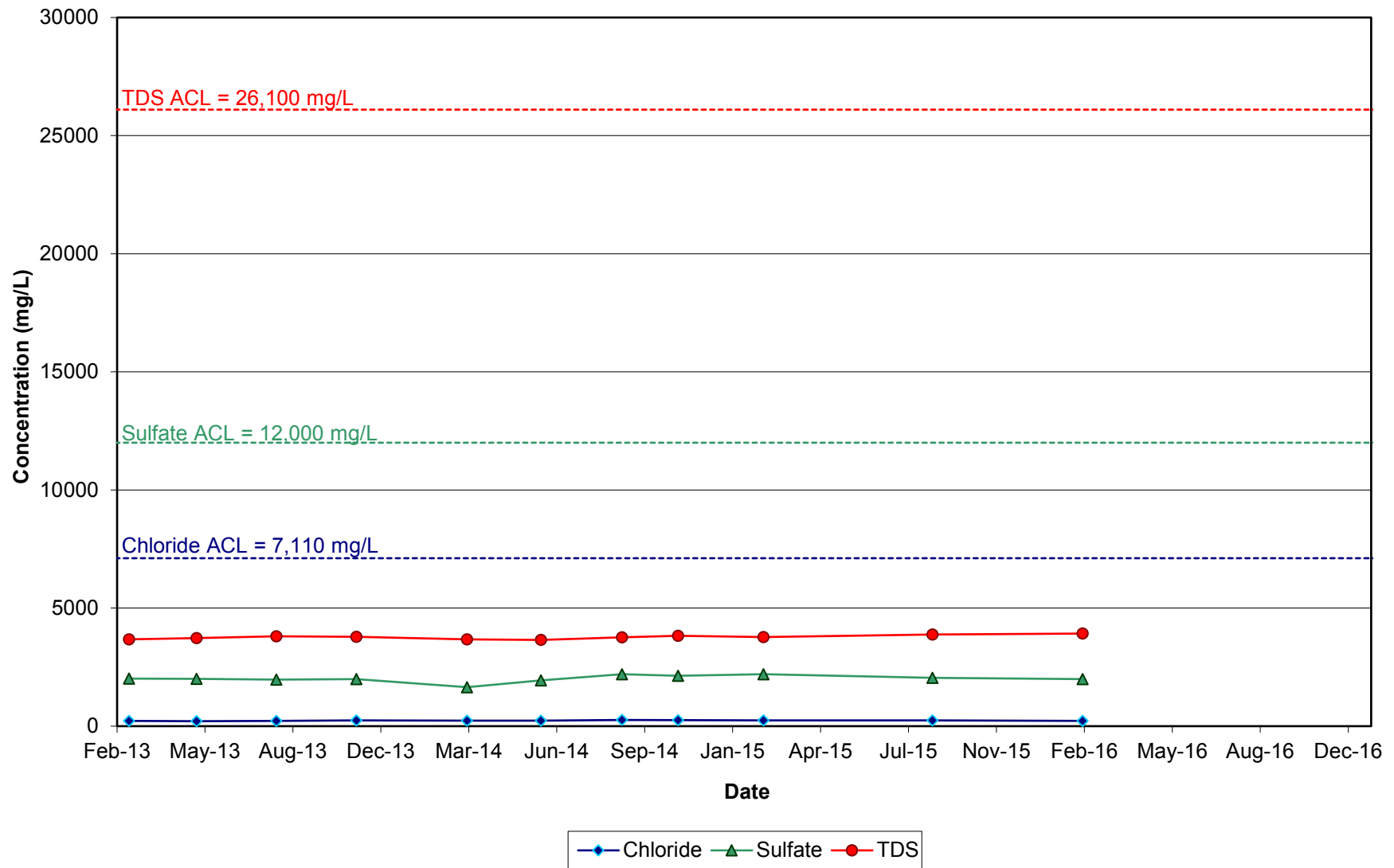
Metals in Monitoring Well 5-05



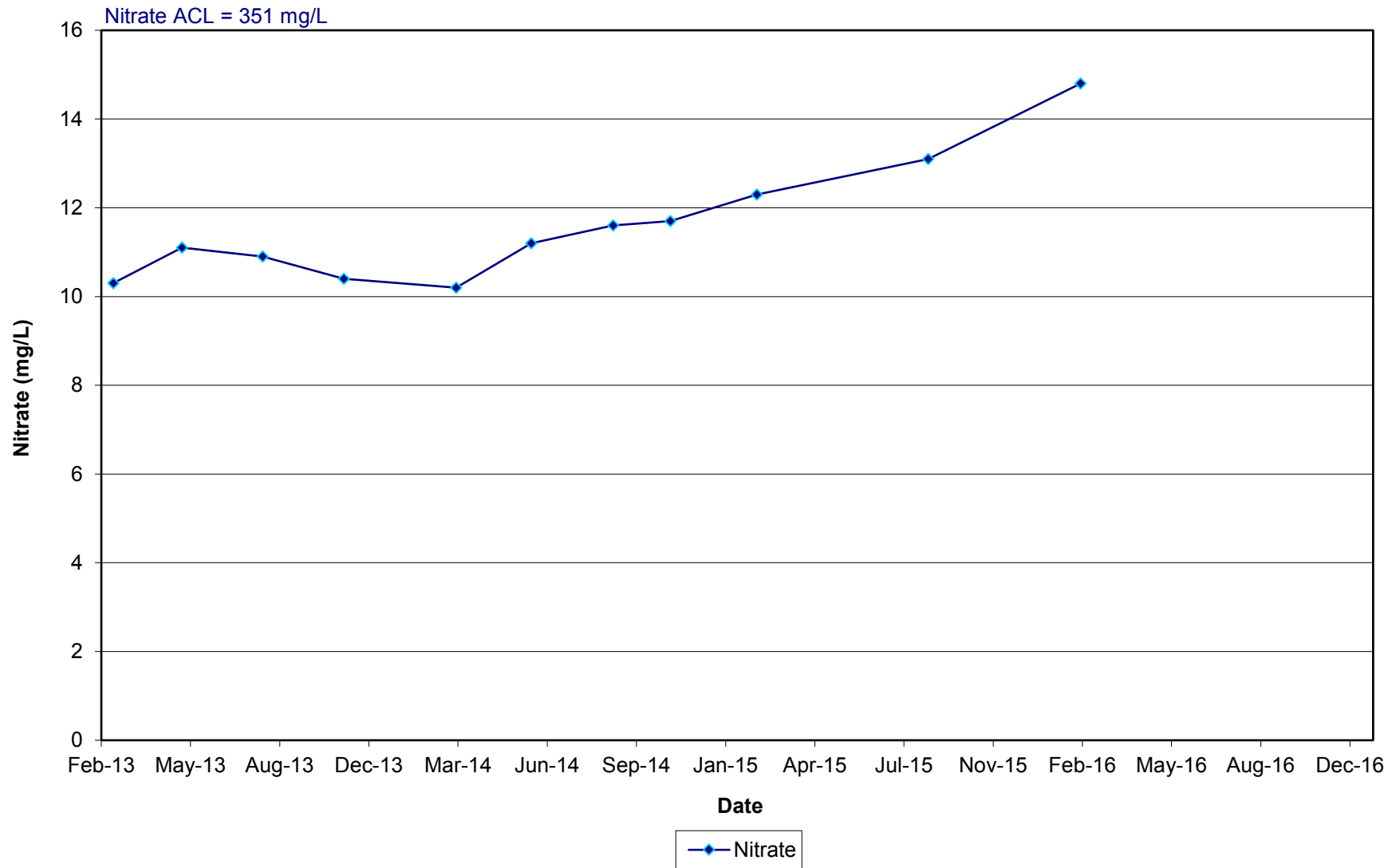
Radionuclides in Monitoring Well 5-05



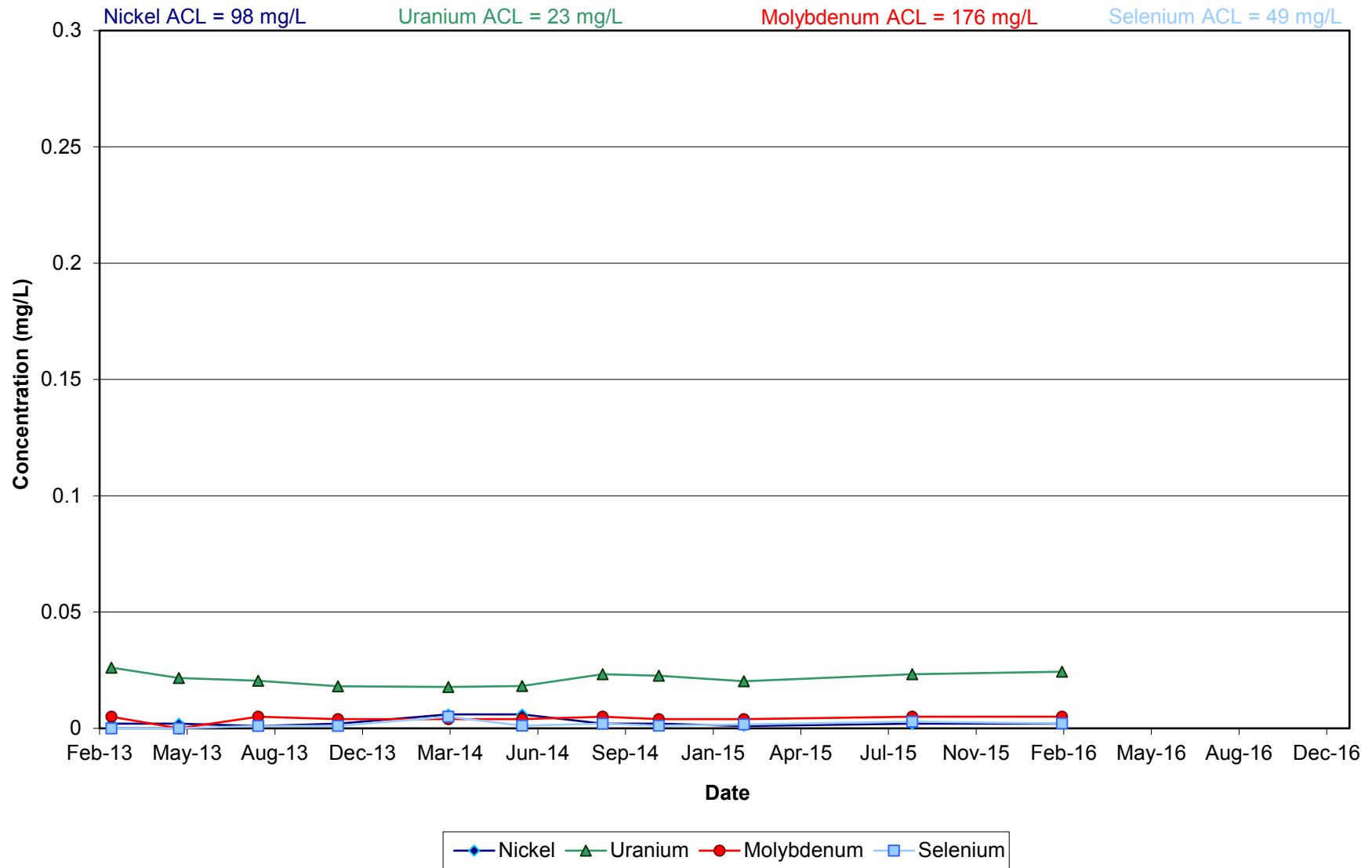
**Anions and TDS in Monitoring Well 5-08 ALL-R
(replaced 11/2/2012)**



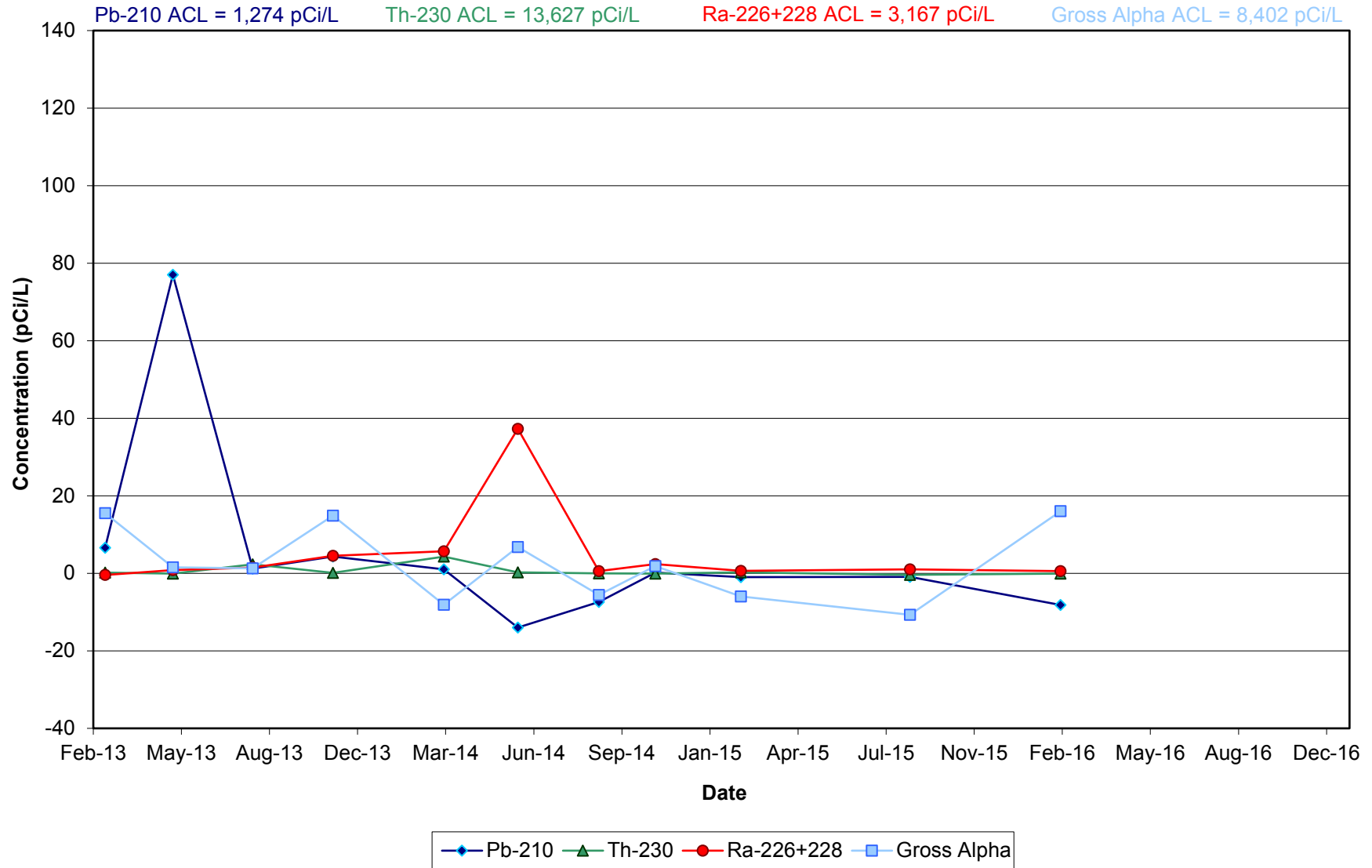
**Nitrate in Monitoring Well 5-08 ALL-R
(replaced 11/2/2012)**



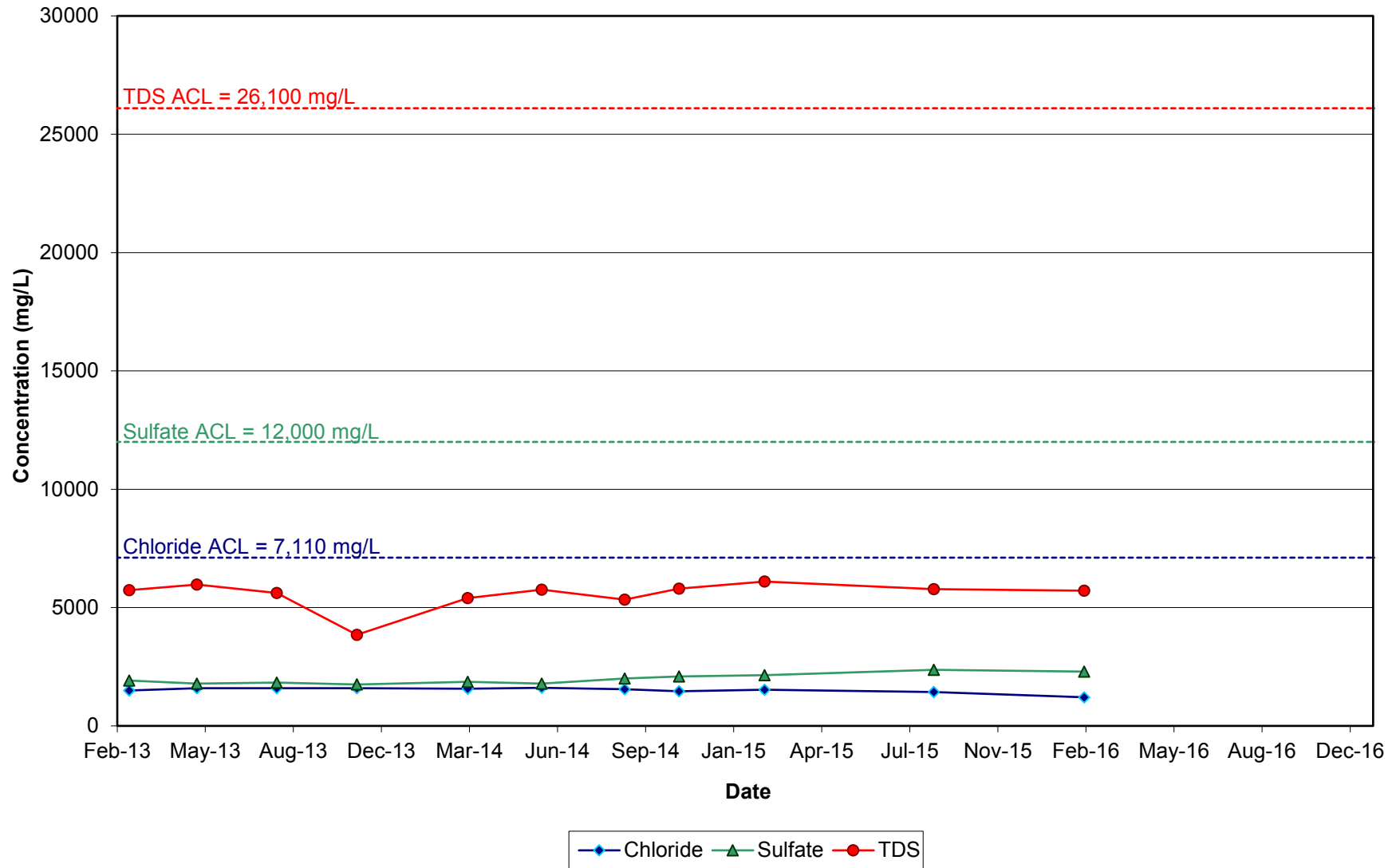
**Metals in Monitoring Well 5-08 ALL-R
(replaced 11/2/2012)**



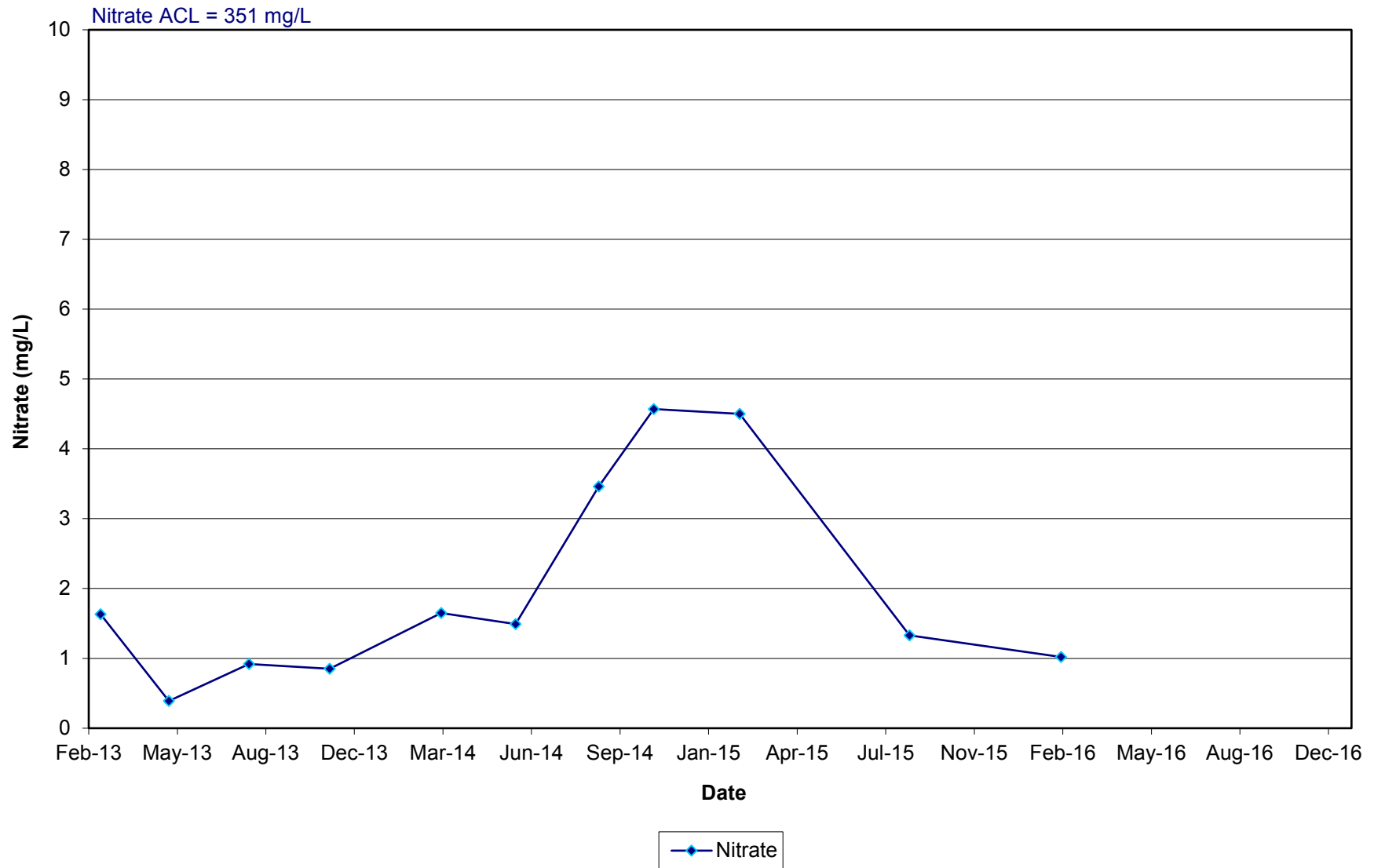
Radionuclides in Monitoring Well 5-08 ALL-R (replaced 11/2/2012)



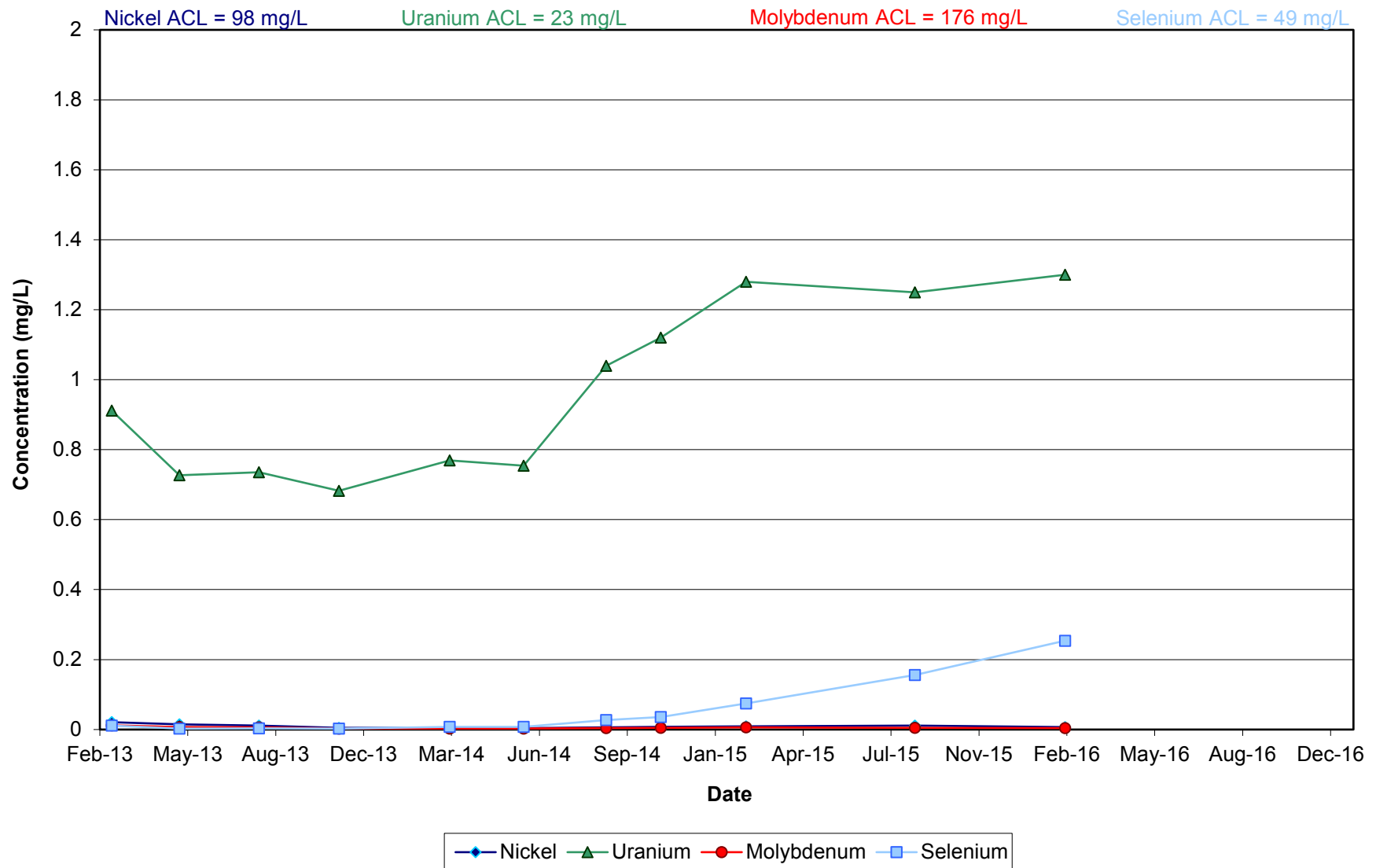
**Anions and TDS in Monitoring Well 5-73 ALL-R
(replaced 11/4/2012)**



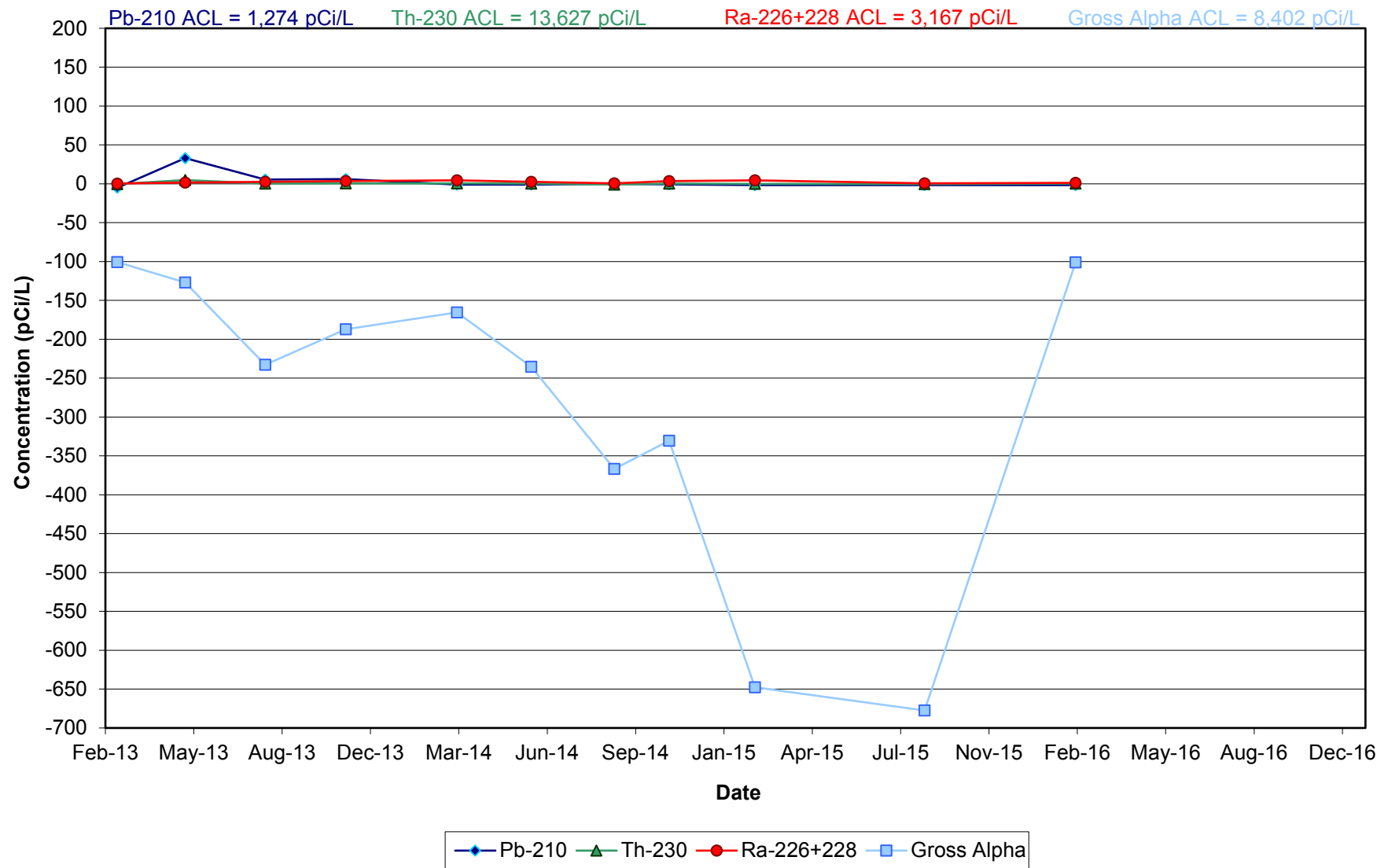
**Nitrate in Monitoring Well 5-73 ALL-R
(replaced 11/4/2012)**



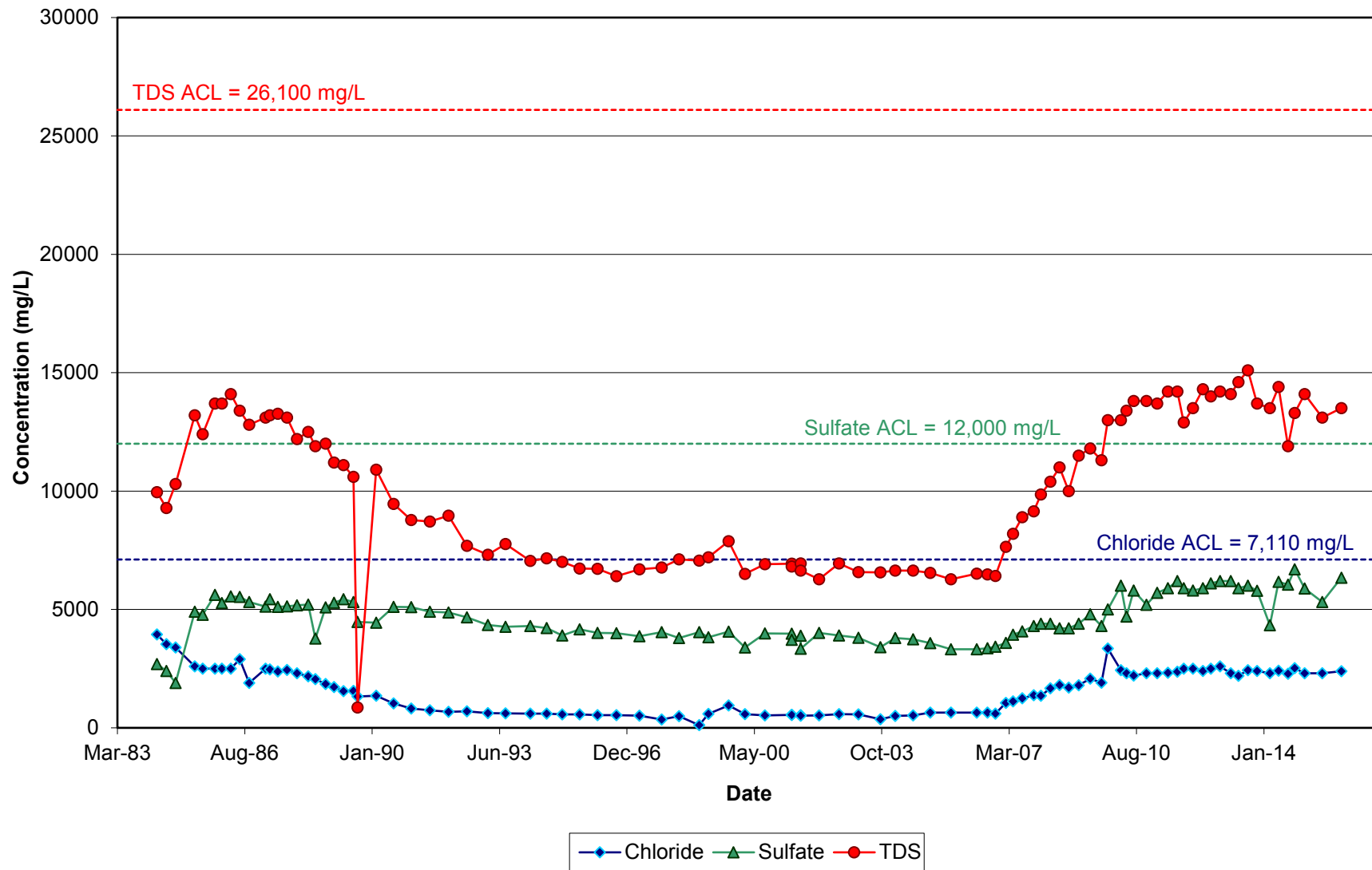
**Metals in Monitoring Well 5-73 ALL-R
(replaced 11/4/2012)**



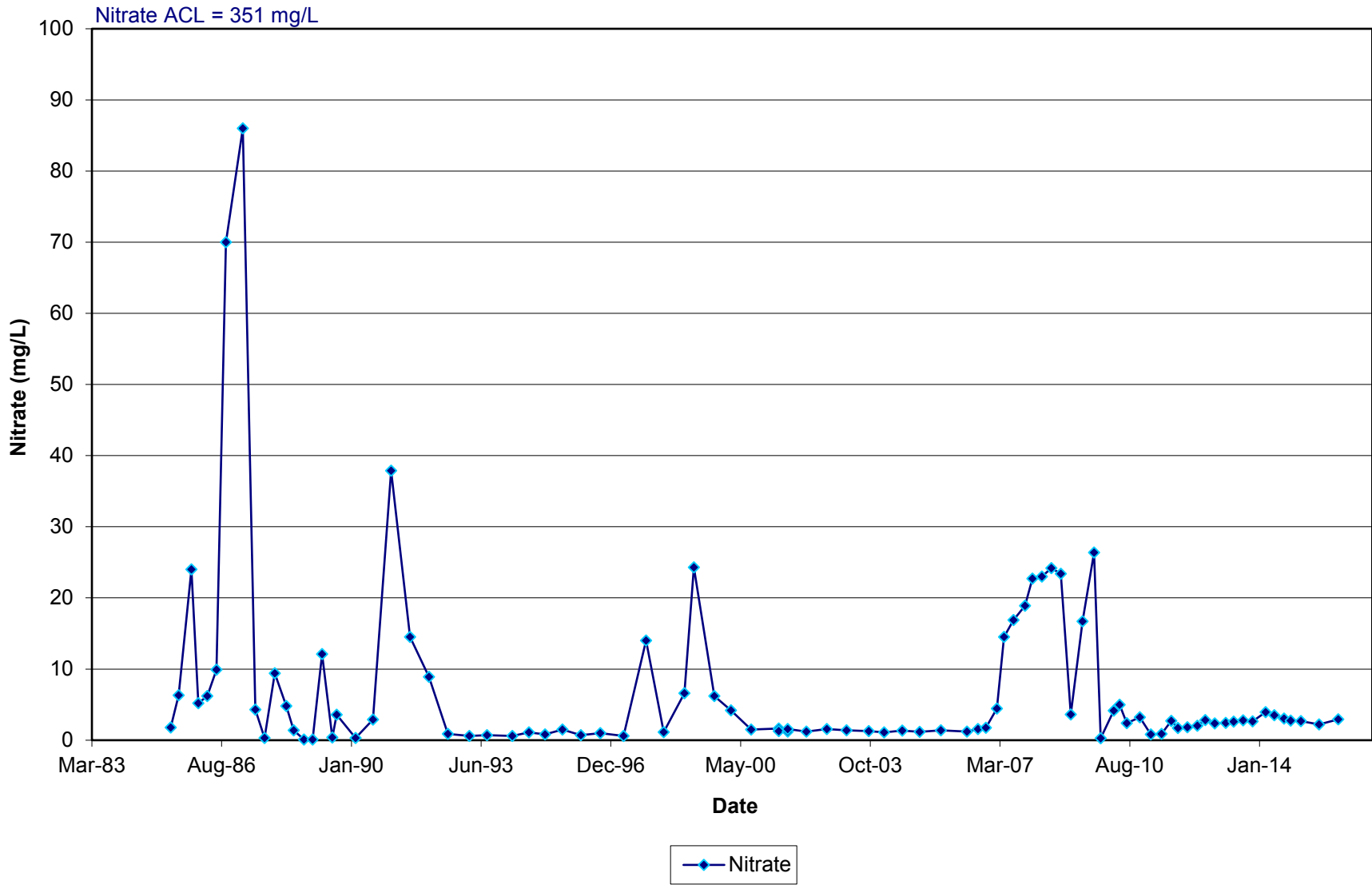
Radionuclides in Monitoring Well 5-73 ALL-R (replaced 11/4/2012)



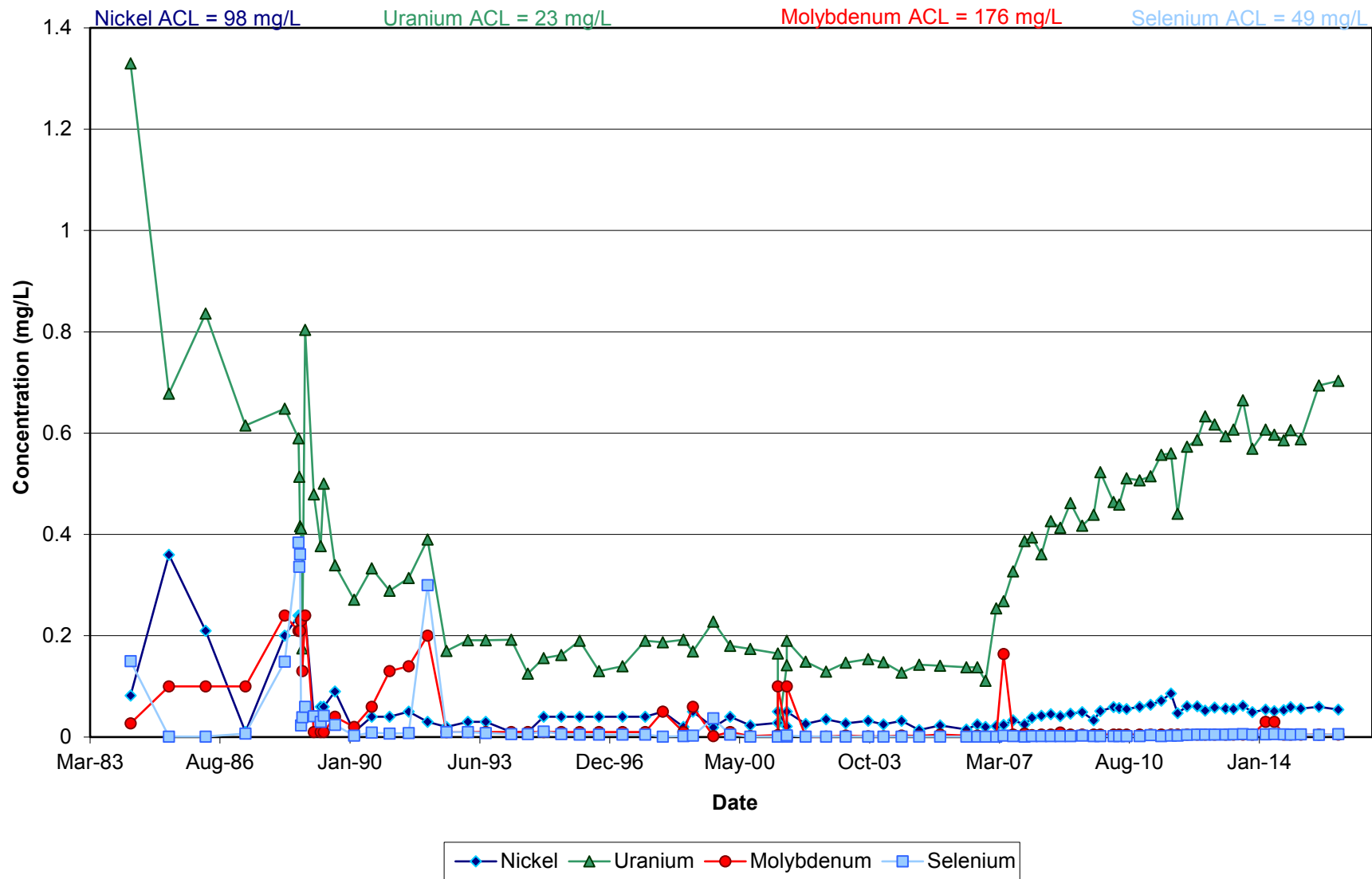
Anions and TDS in Monitoring Well 31-61 ALL



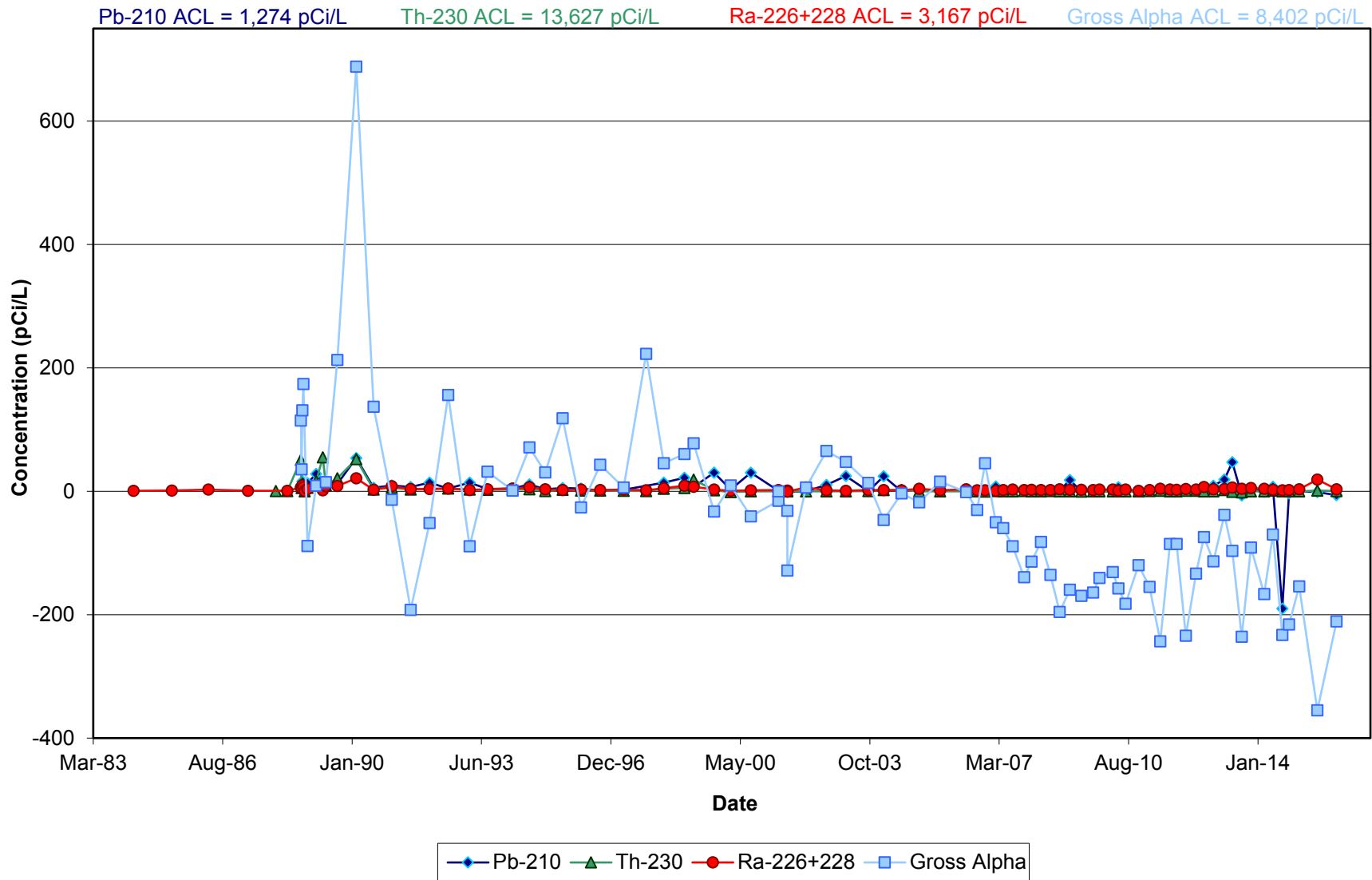
Nitrate in Monitoring Well 31-61 ALL



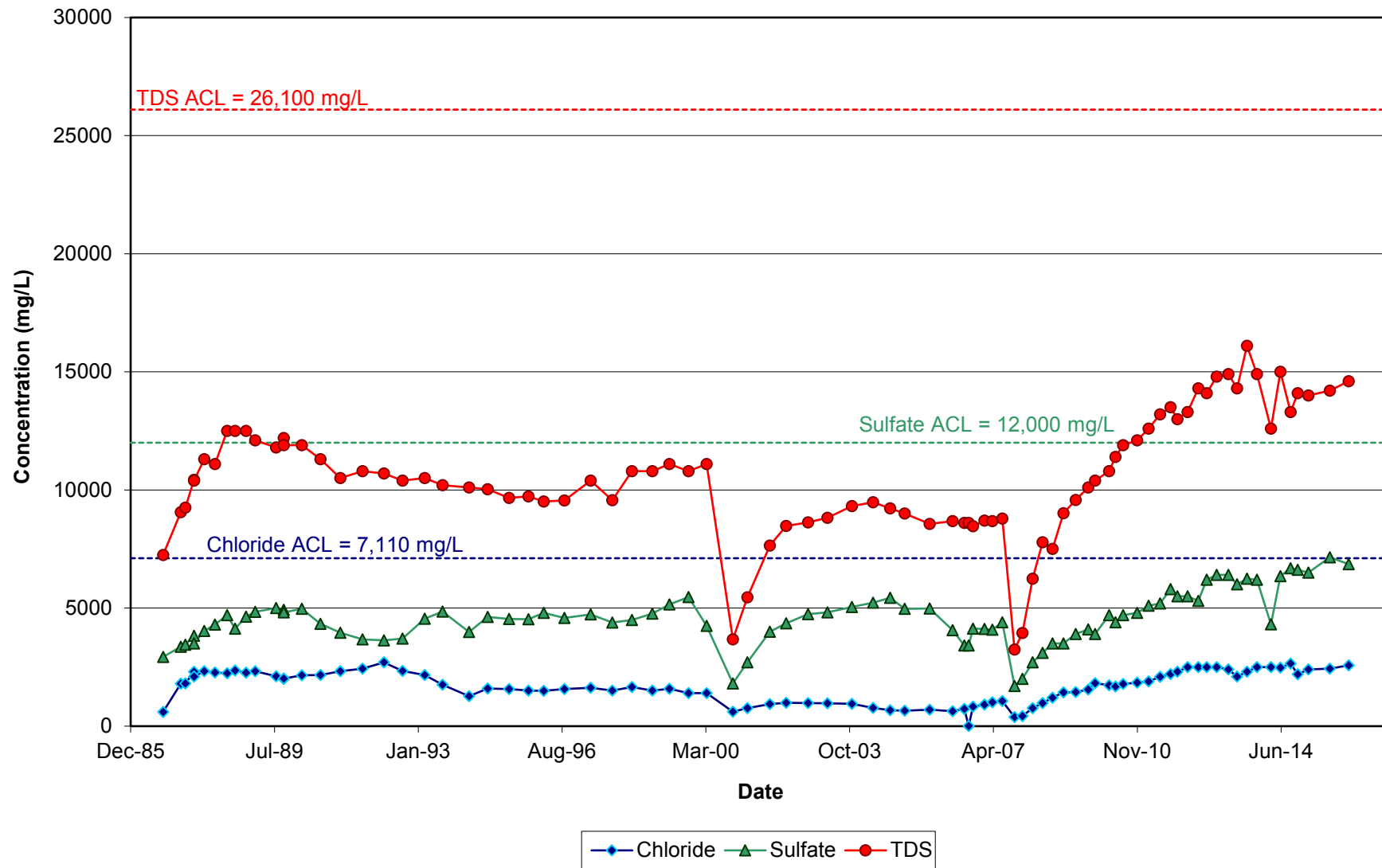
Metals in Monitoring Well 31-61 ALL



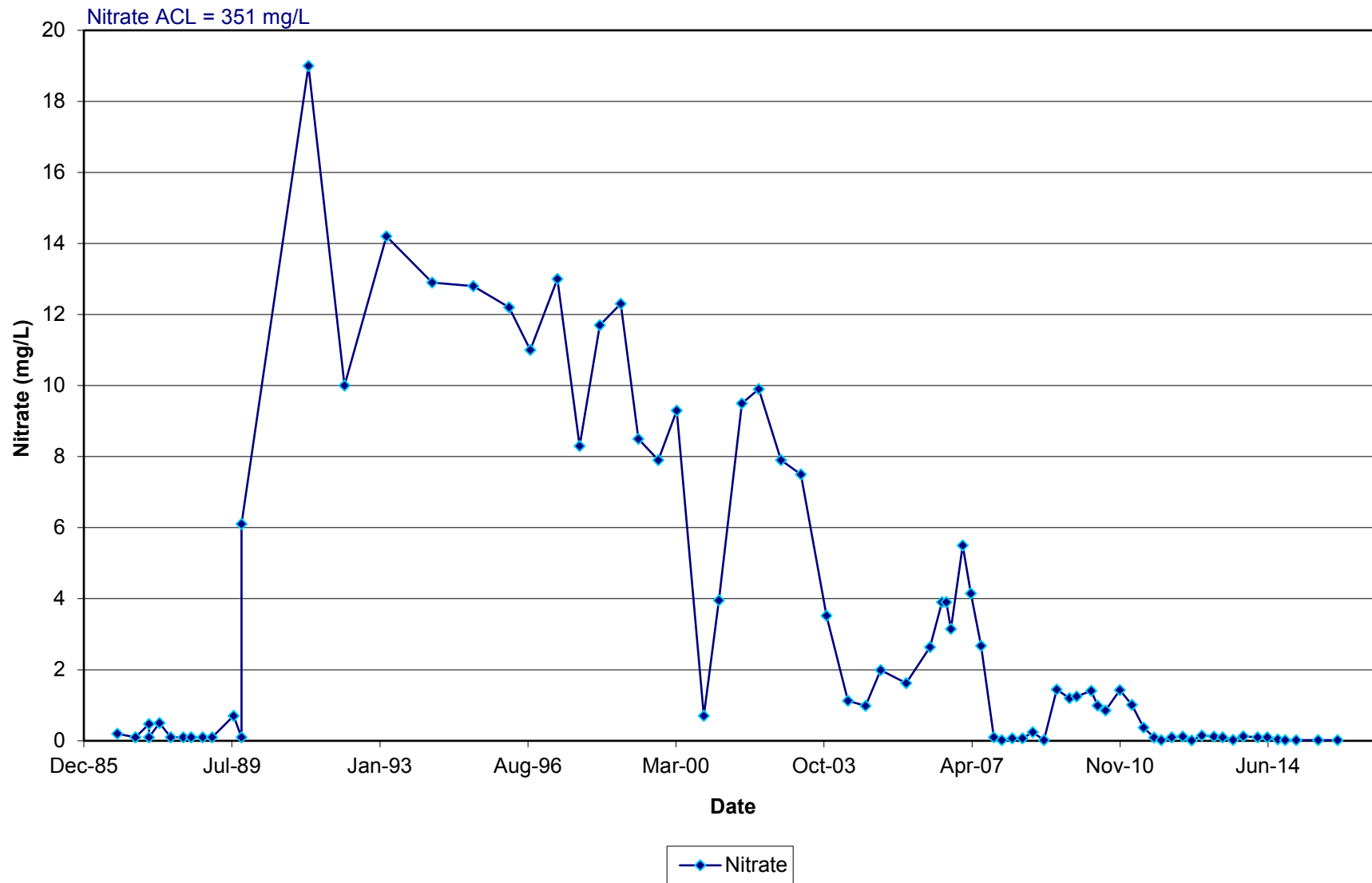
Radionuclides in Monitoring Well 31-61 ALL



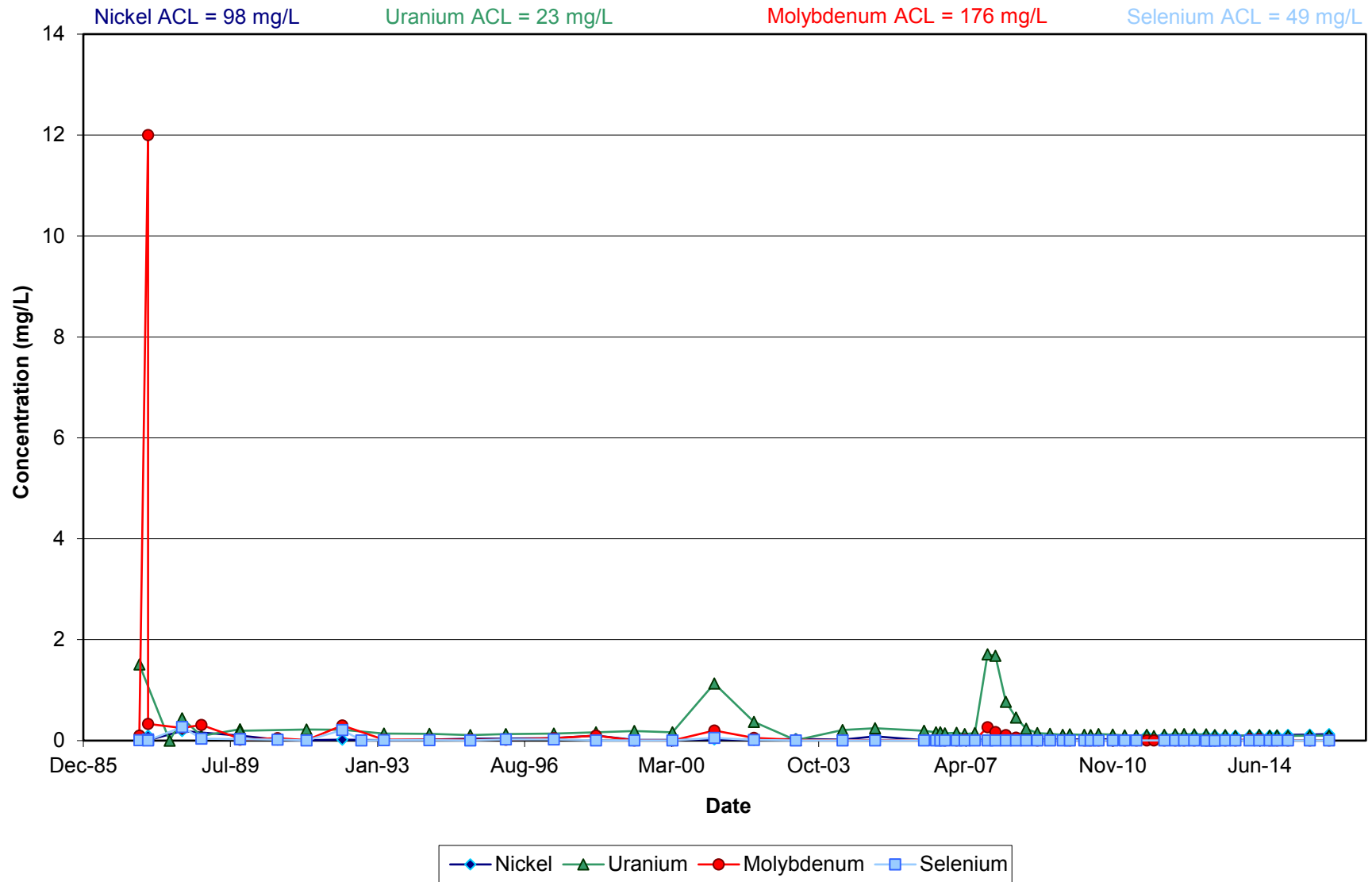
Anions and TDS in Monitoring Well 31-65 ALL



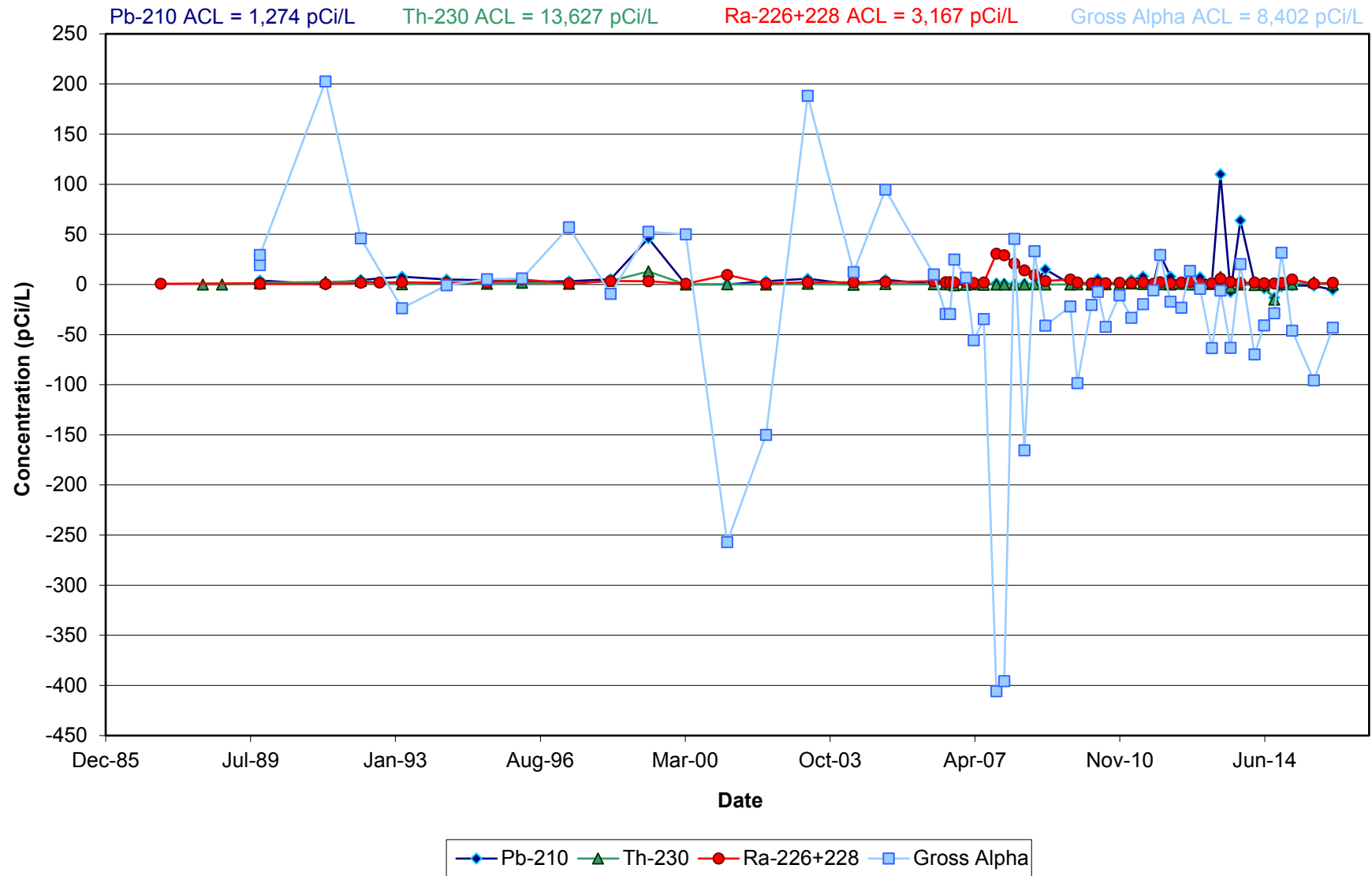
Nitrate in Monitoring Well 31-65 ALL



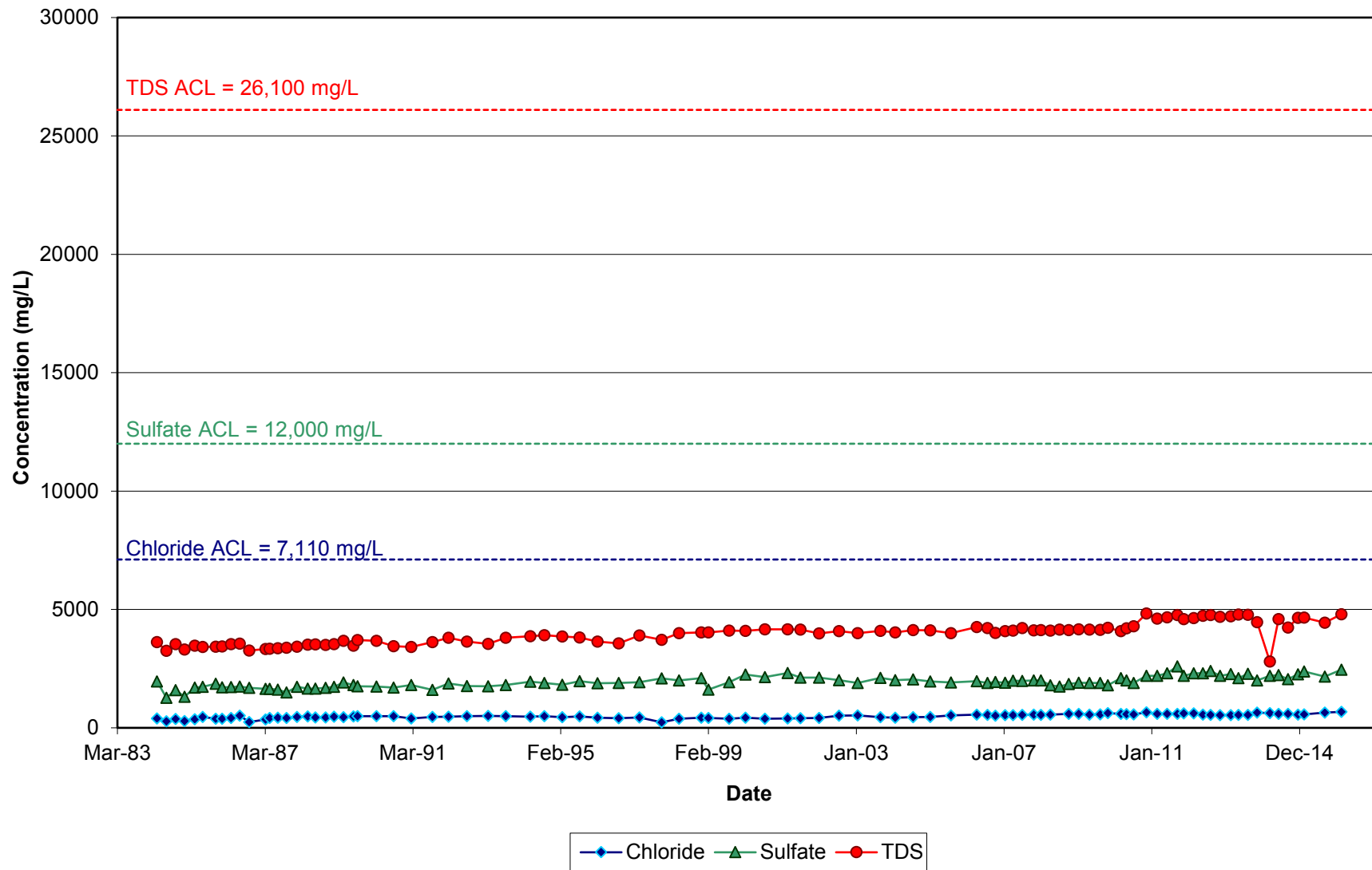
Metals in Monitoring Well 31-65 ALL



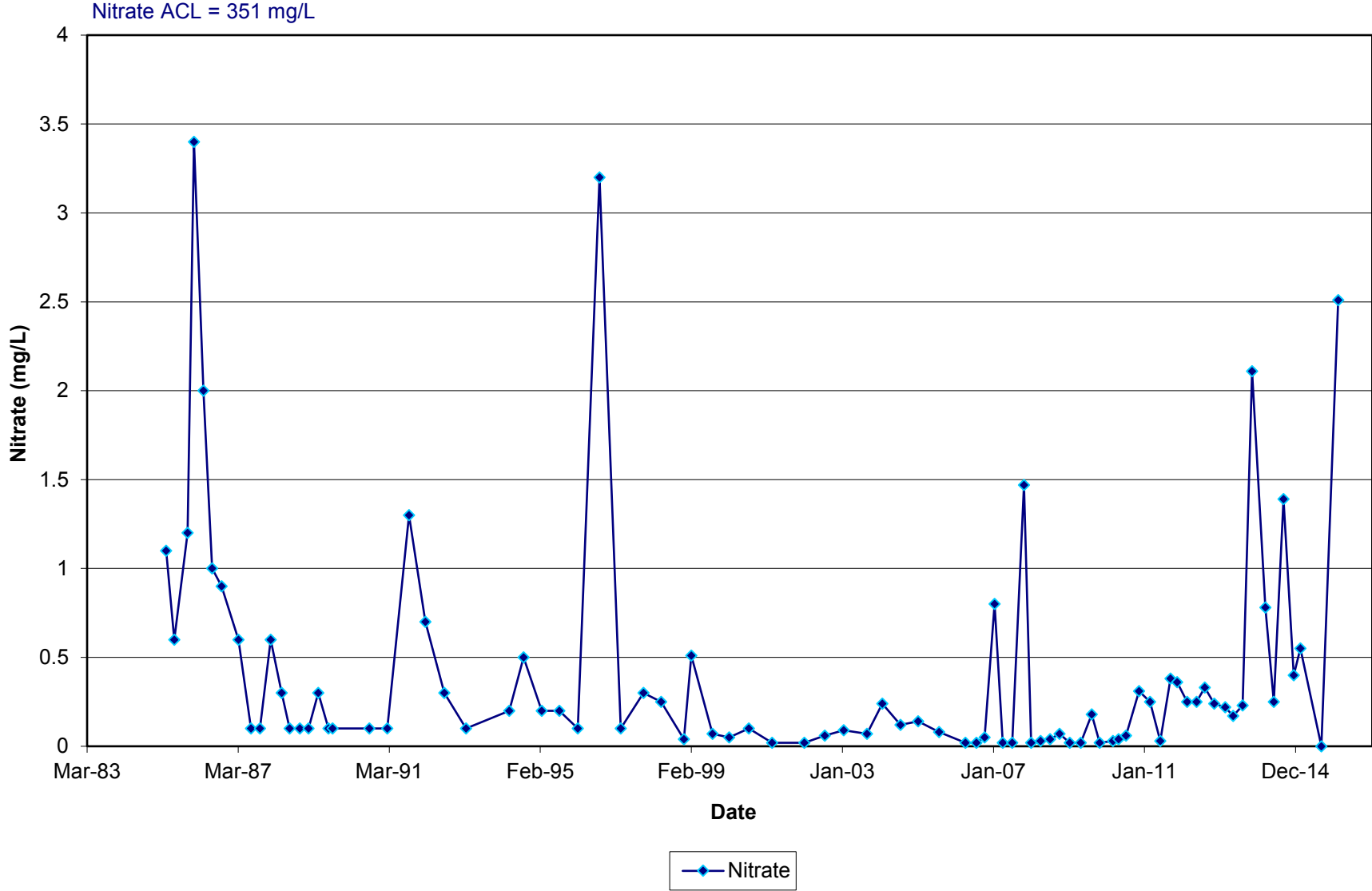
Radionuclides in Monitoring Well 31-65 ALL



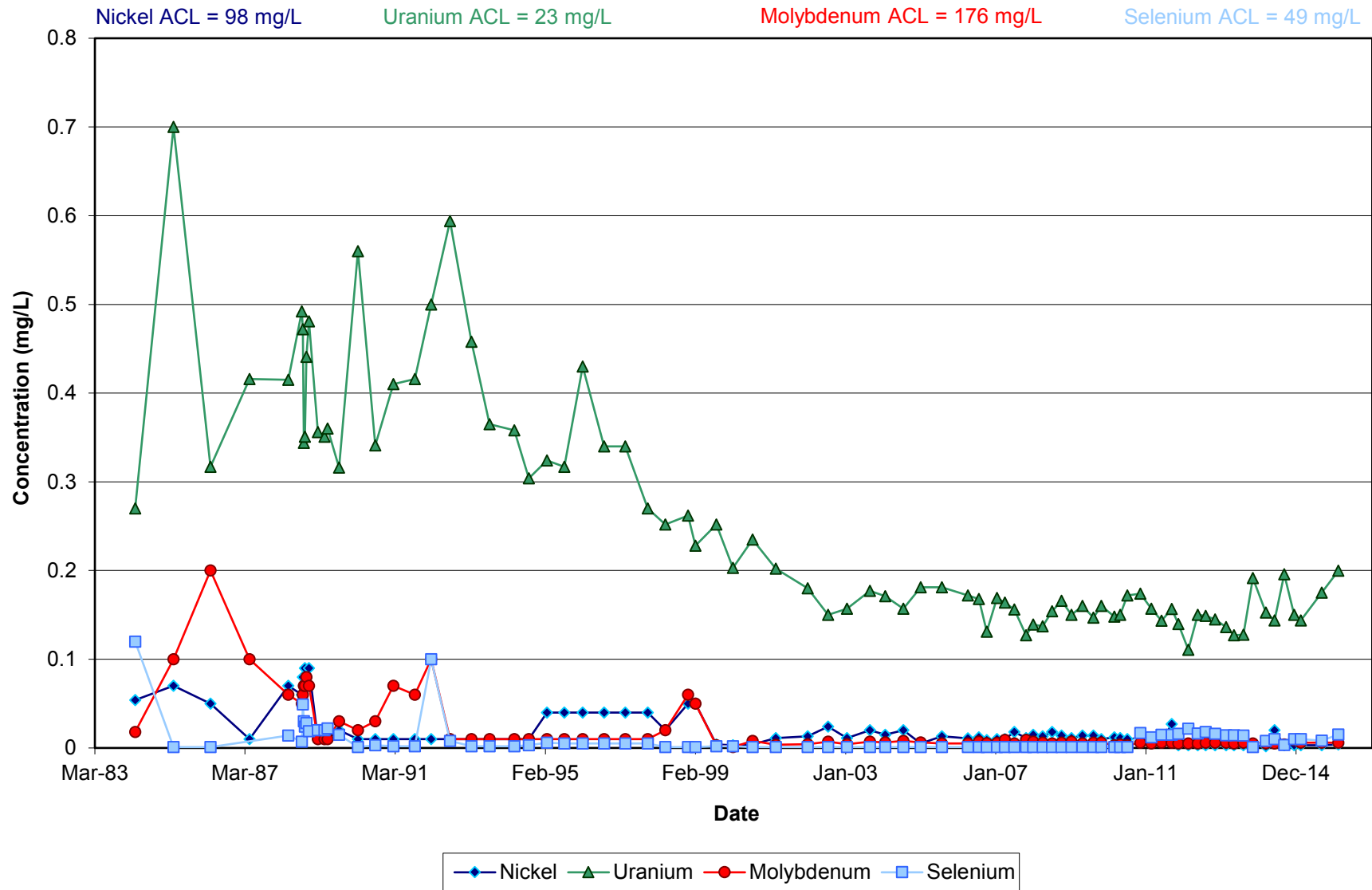
Anions and TDS in Monitoring Well 32-59 ALL



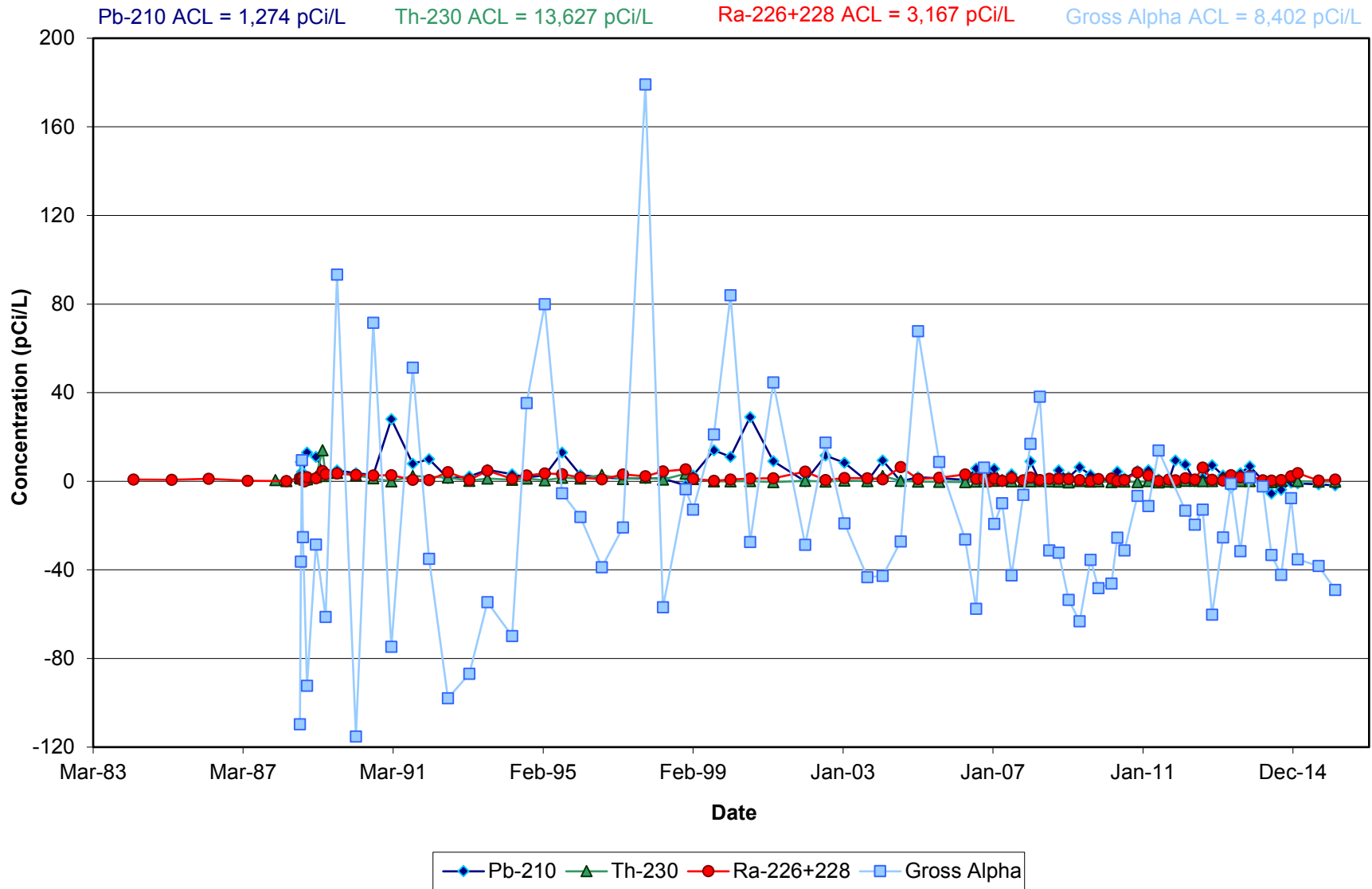
Nitrate in Monitoring Well 32-59 ALL



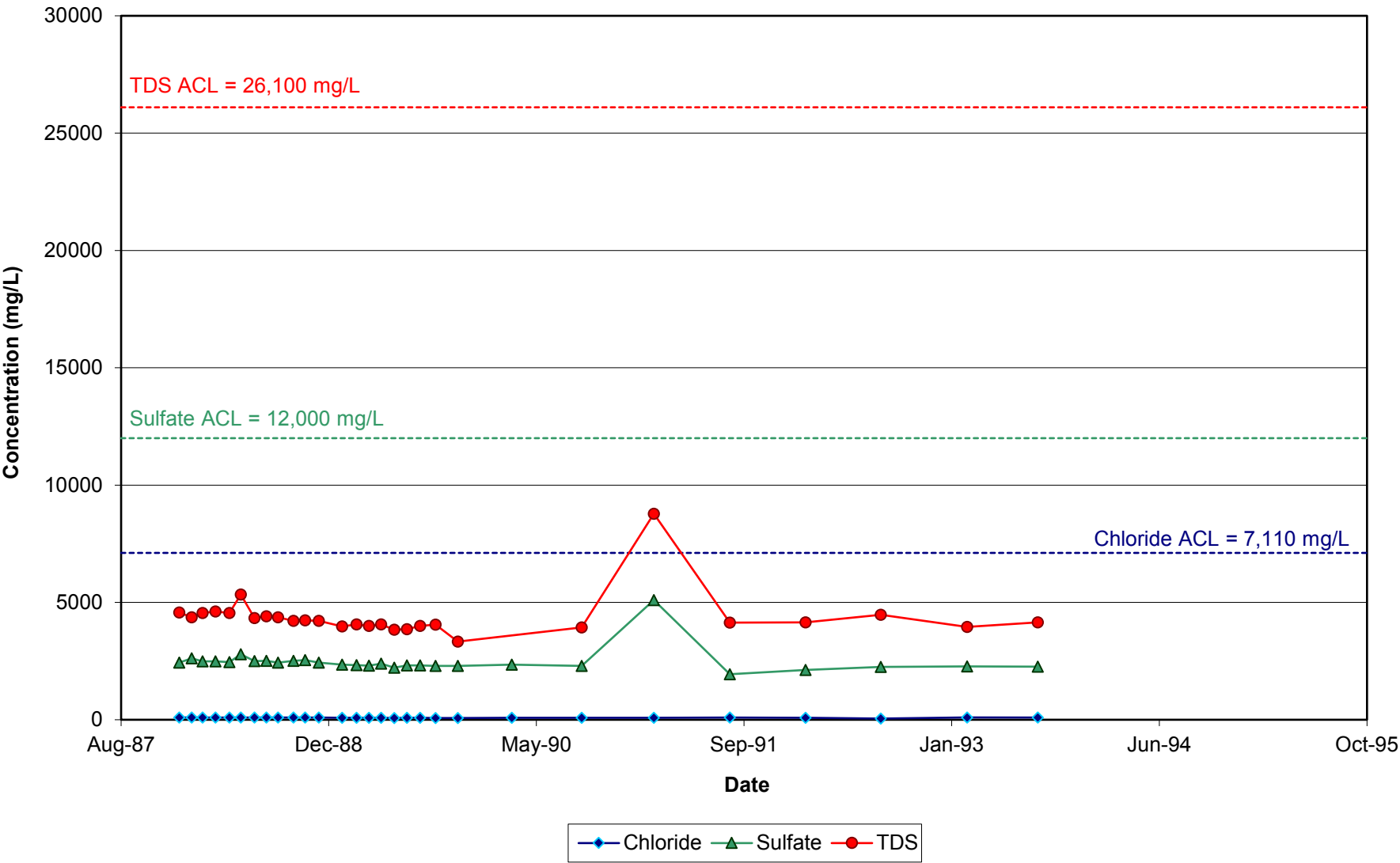
Metals in Monitoring Well 32-59 ALL



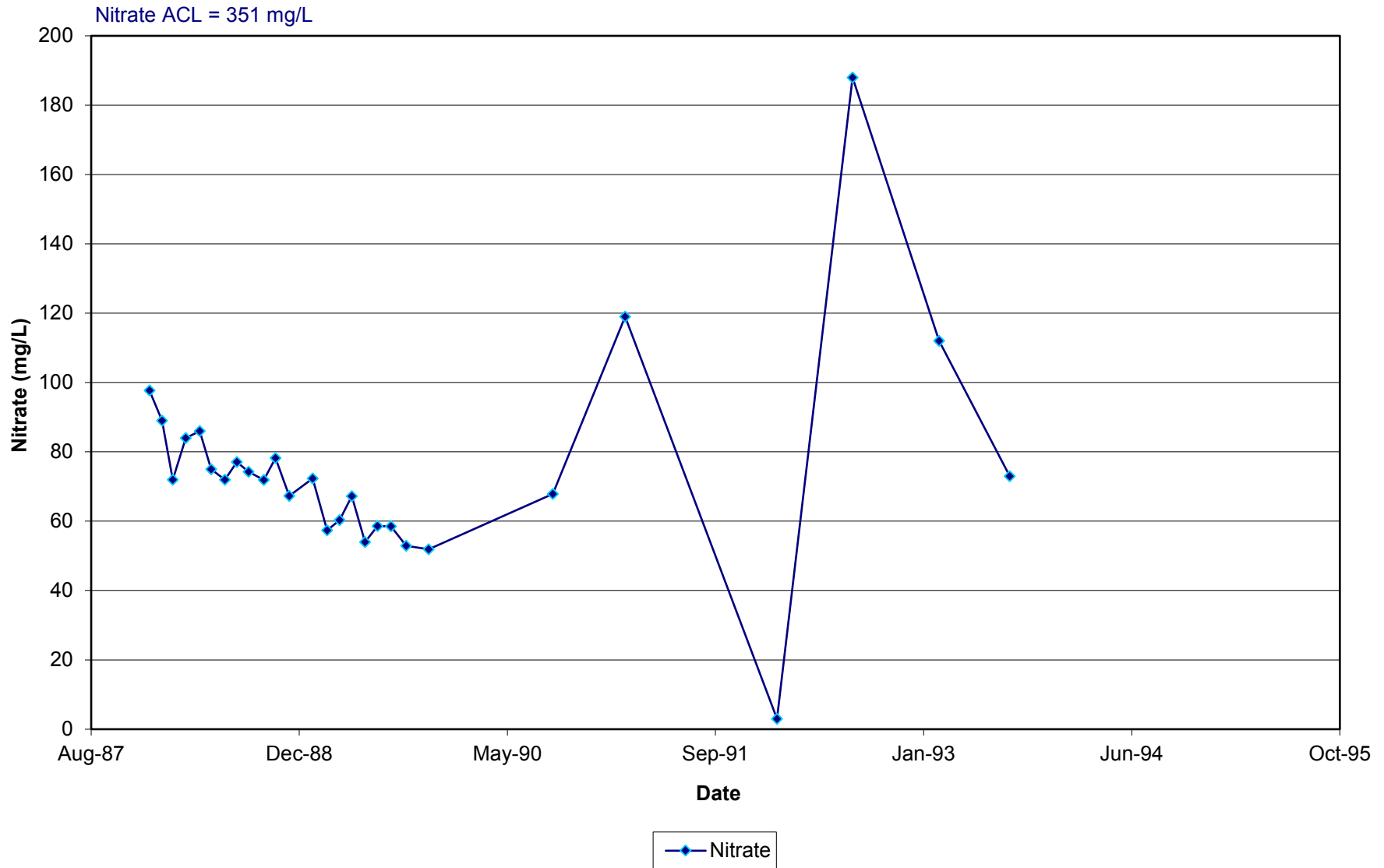
Radionuclides in Monitoring Well 32-59 ALL



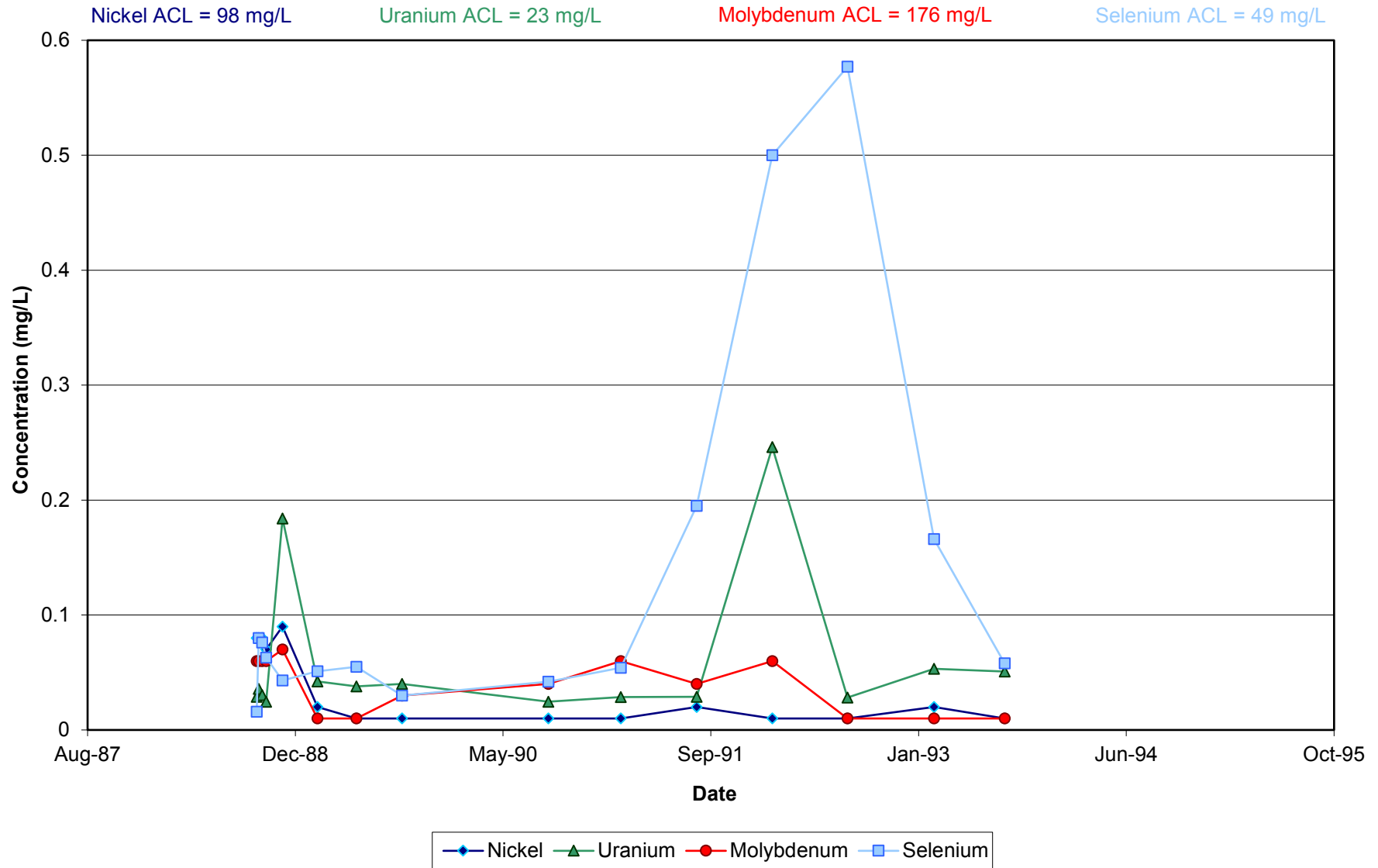
Anions and TDS in Monitoring Well MW-24 ALL



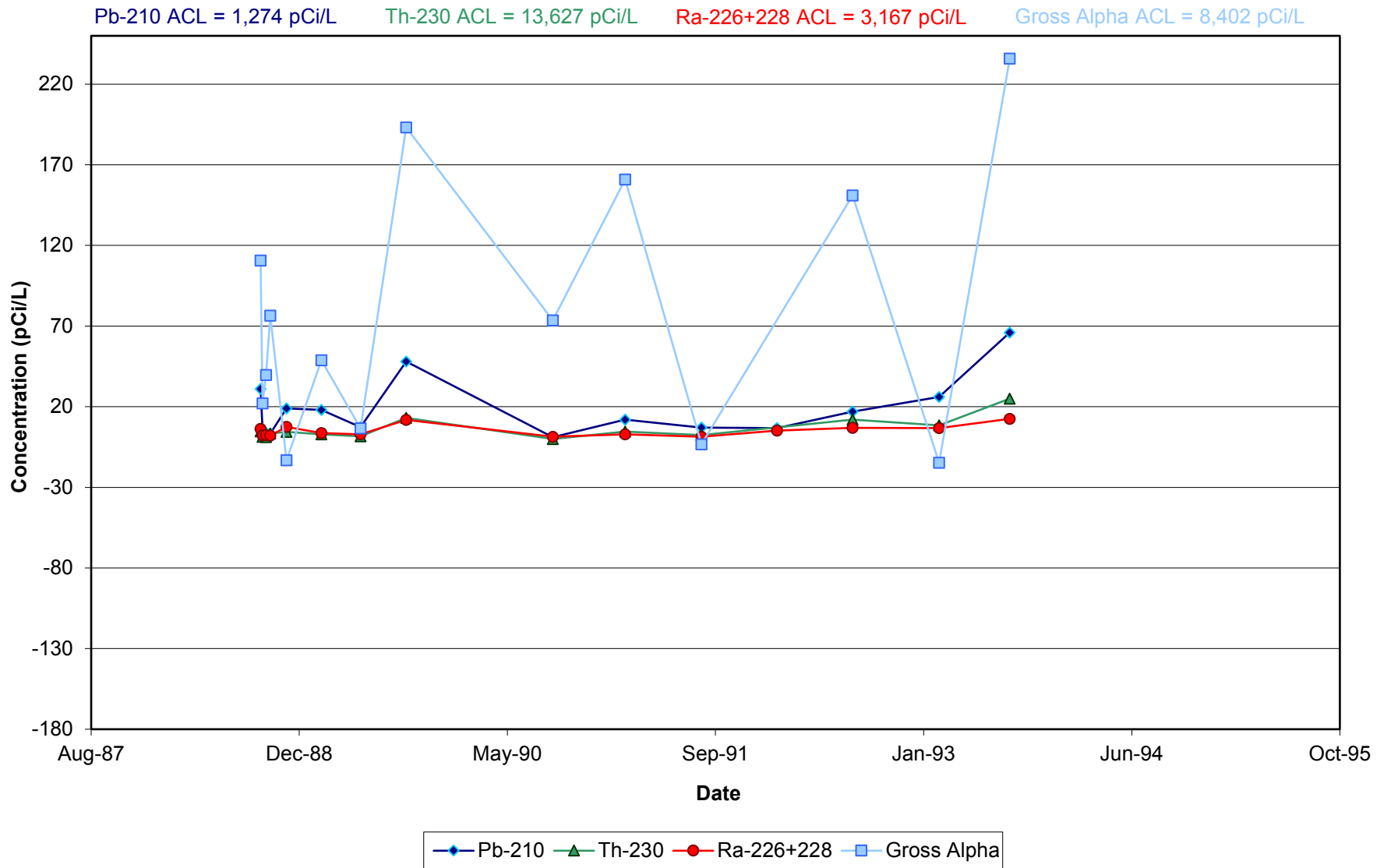
Nitrate in Monitoring Well MW-24 ALL



Metals in Monitoring Well MW-24 ALL



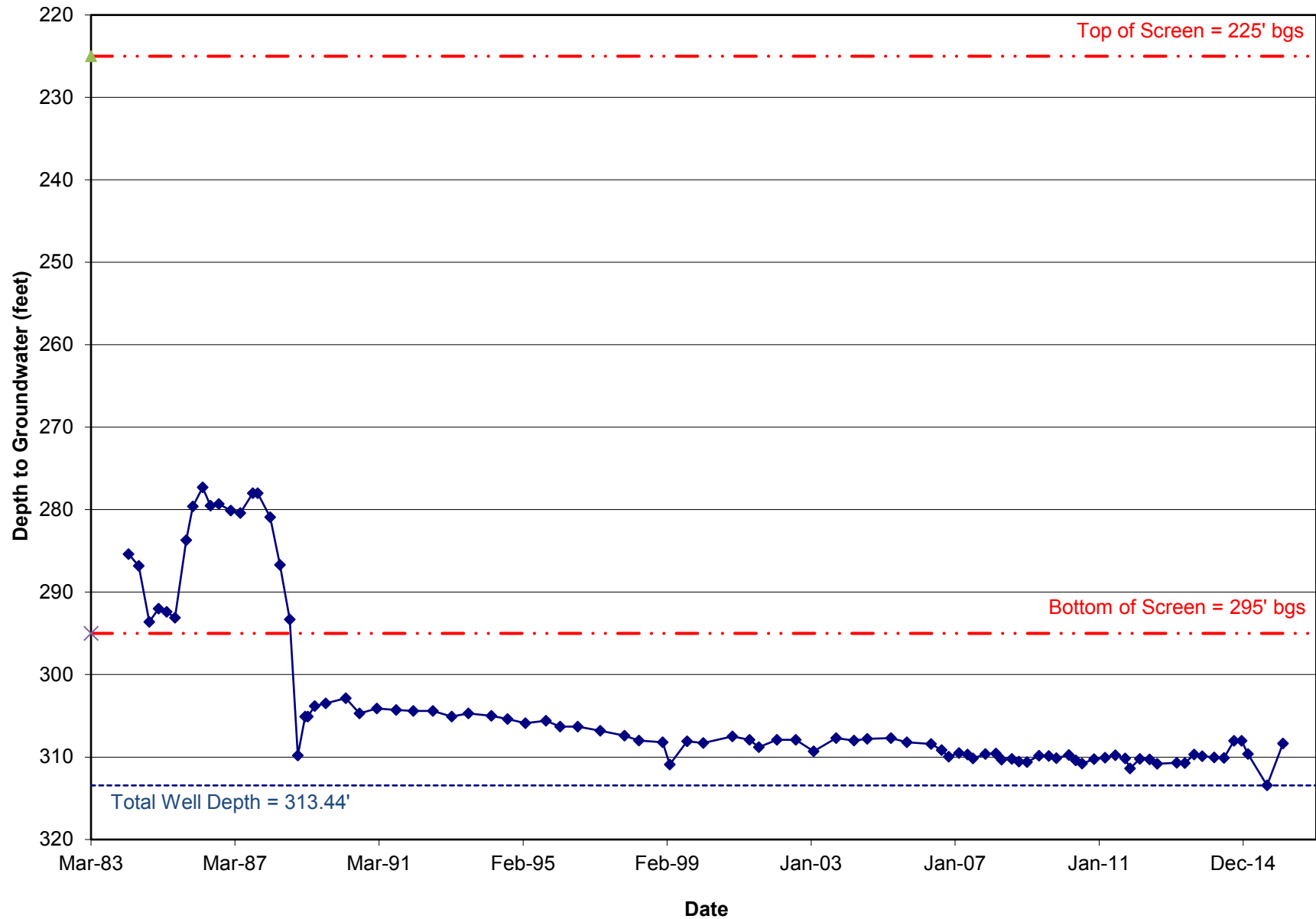
Radionuclides in Monitoring Well MW-24 ALL



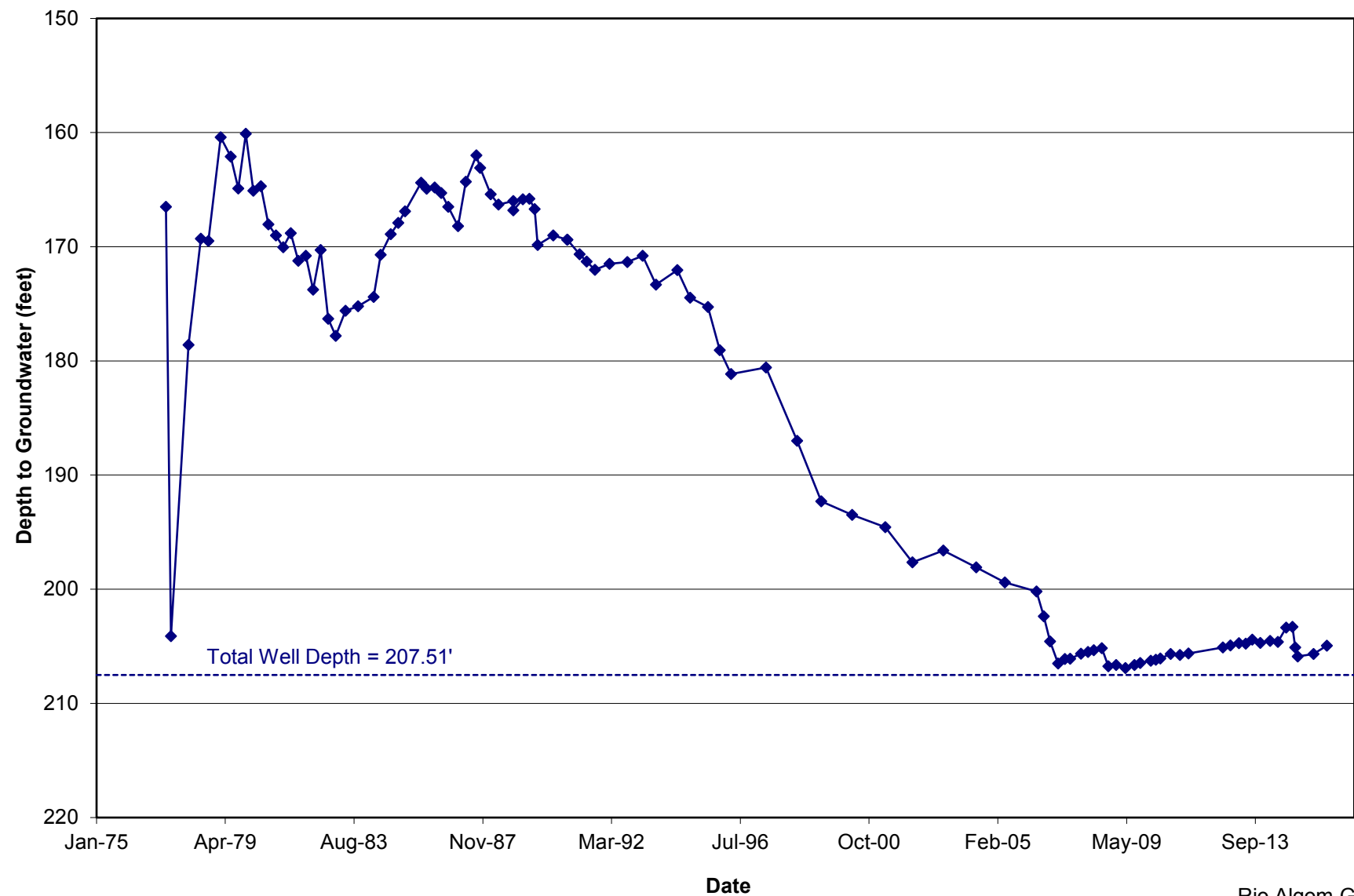
APPENDIX 3

Stability Monitoring Plan
Hydrographs

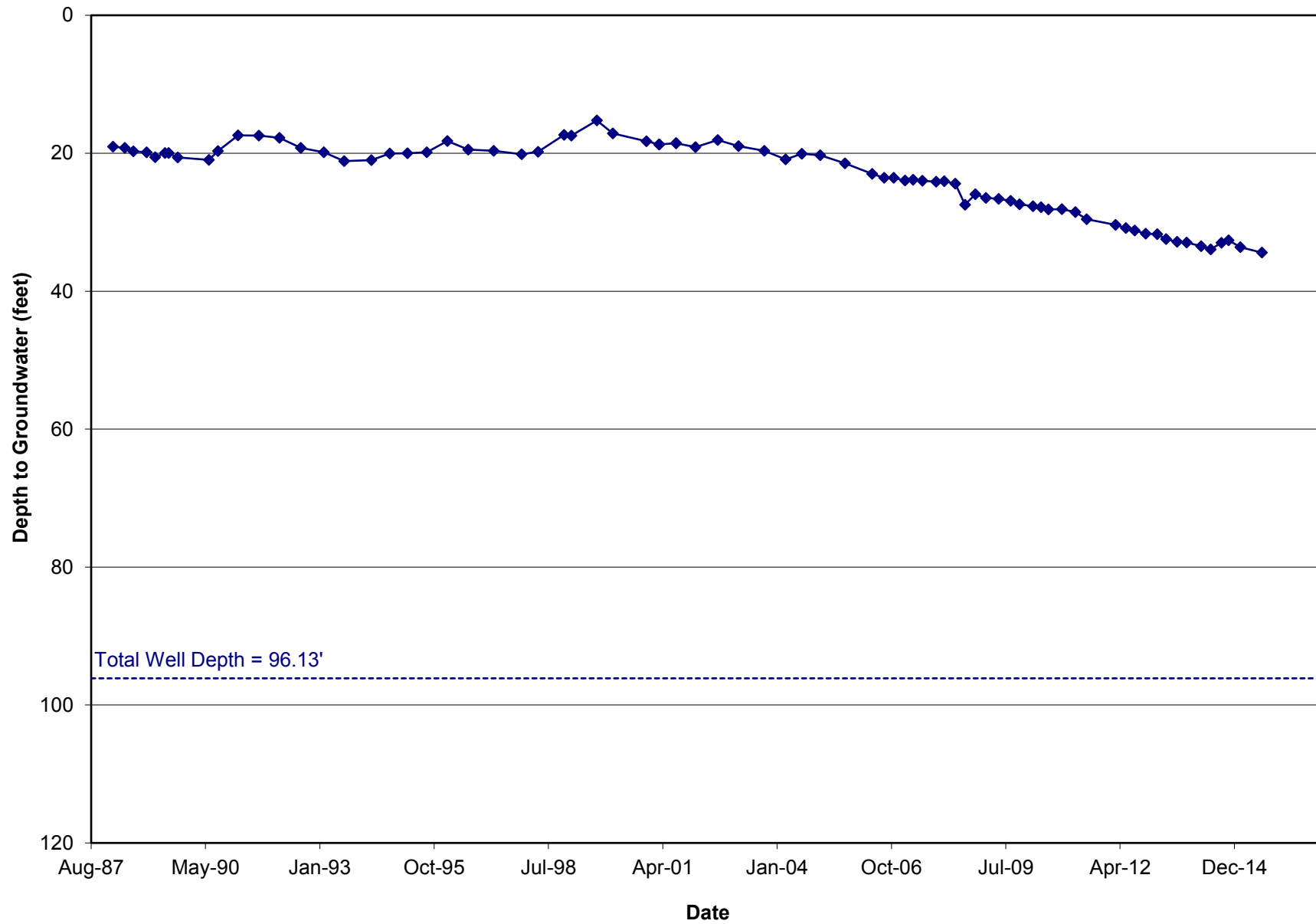
Hydrograph for Dakota Monitoring Well 30-02 KD



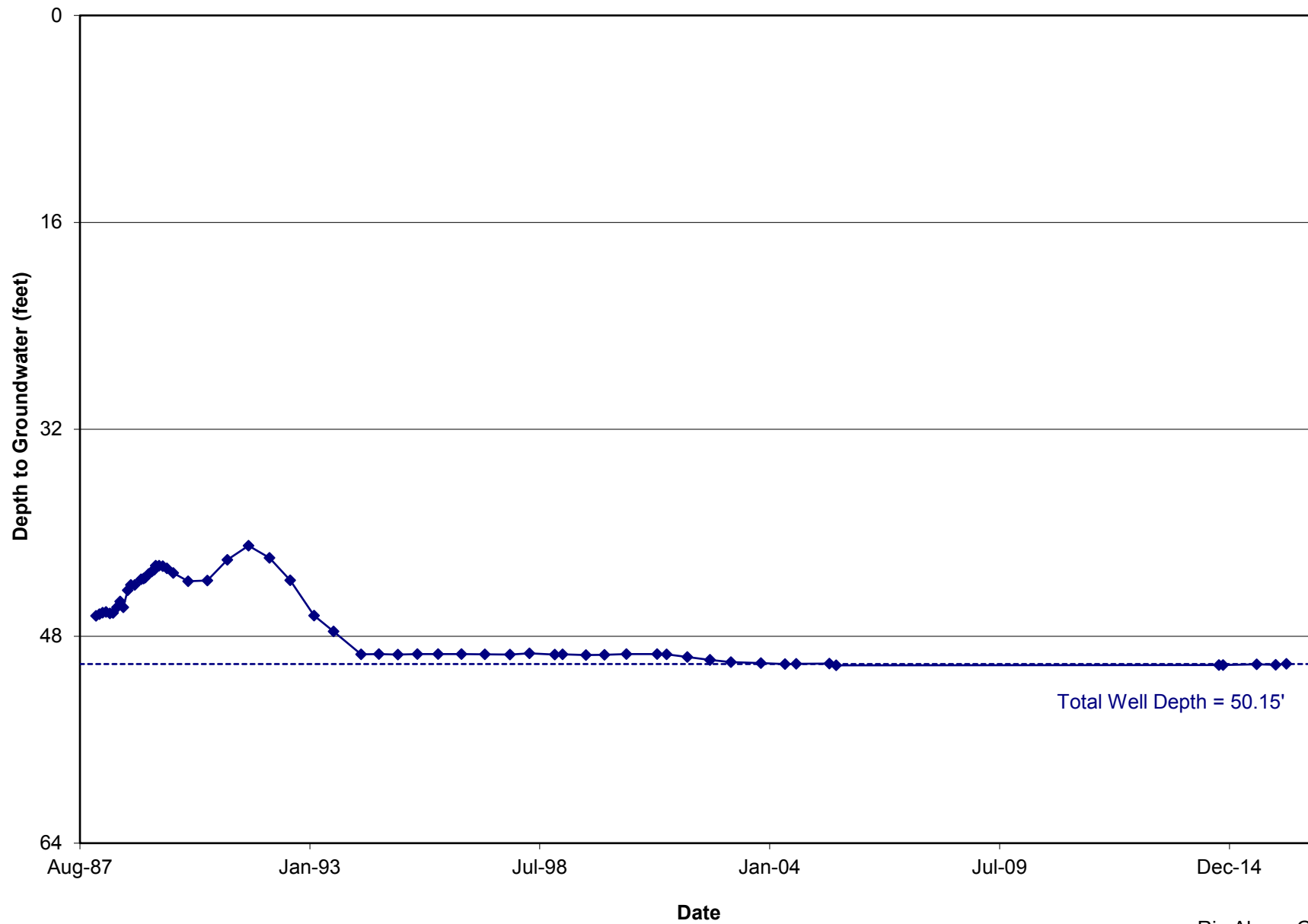
Hydrograph for TRA Monitoring Well 30-01 TRA



Hydrograph for TRB Monitoring Well 31-67 TRB

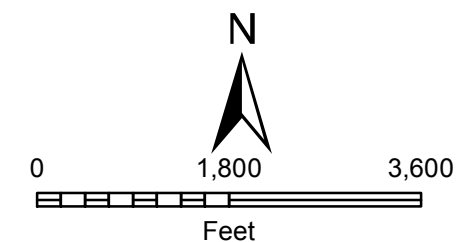


Hydrograph for Alluvial Monitoring Well MW-24 ALL



APPENDIX 4

Stability Monitoring Plan
Potentiometric Surface Maps



Aerial – NAIP imagery, dated 2014

Legend

- Alluvial Monitoring Well Location
 - Alluvial Groundwater Surface Elevation (ft amsl)
 - - - Estimated Boundary of Saturated Alluvium
- Well ID**
- Groundwater Surface Elevation (ft amsl)

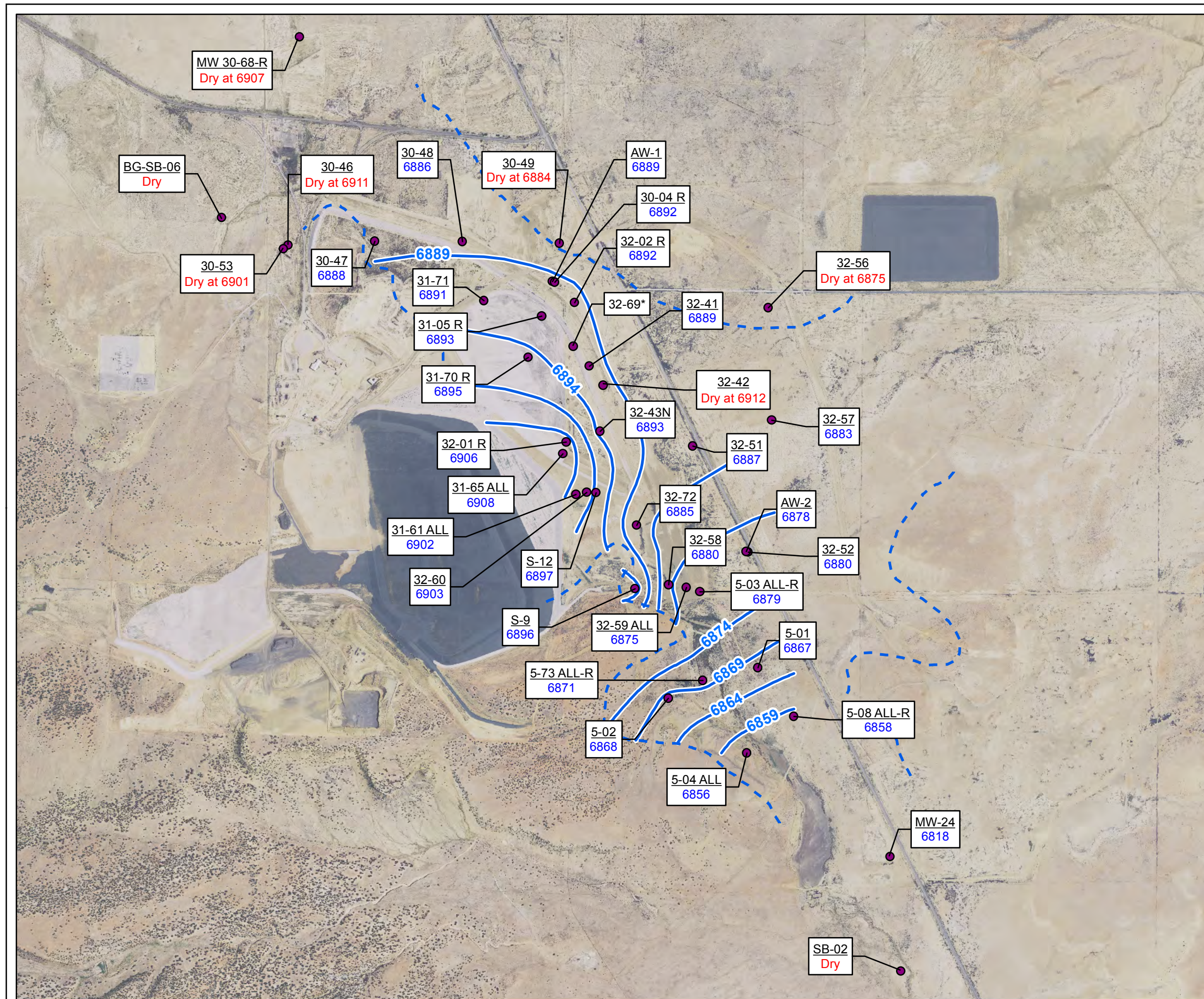
Notes:
All data collected 1st Quarter, 2016.
* = Water level at well not used for contouring due to inaccurate TOC survey.

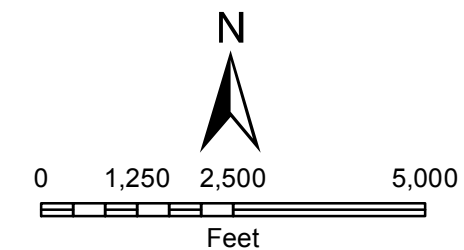
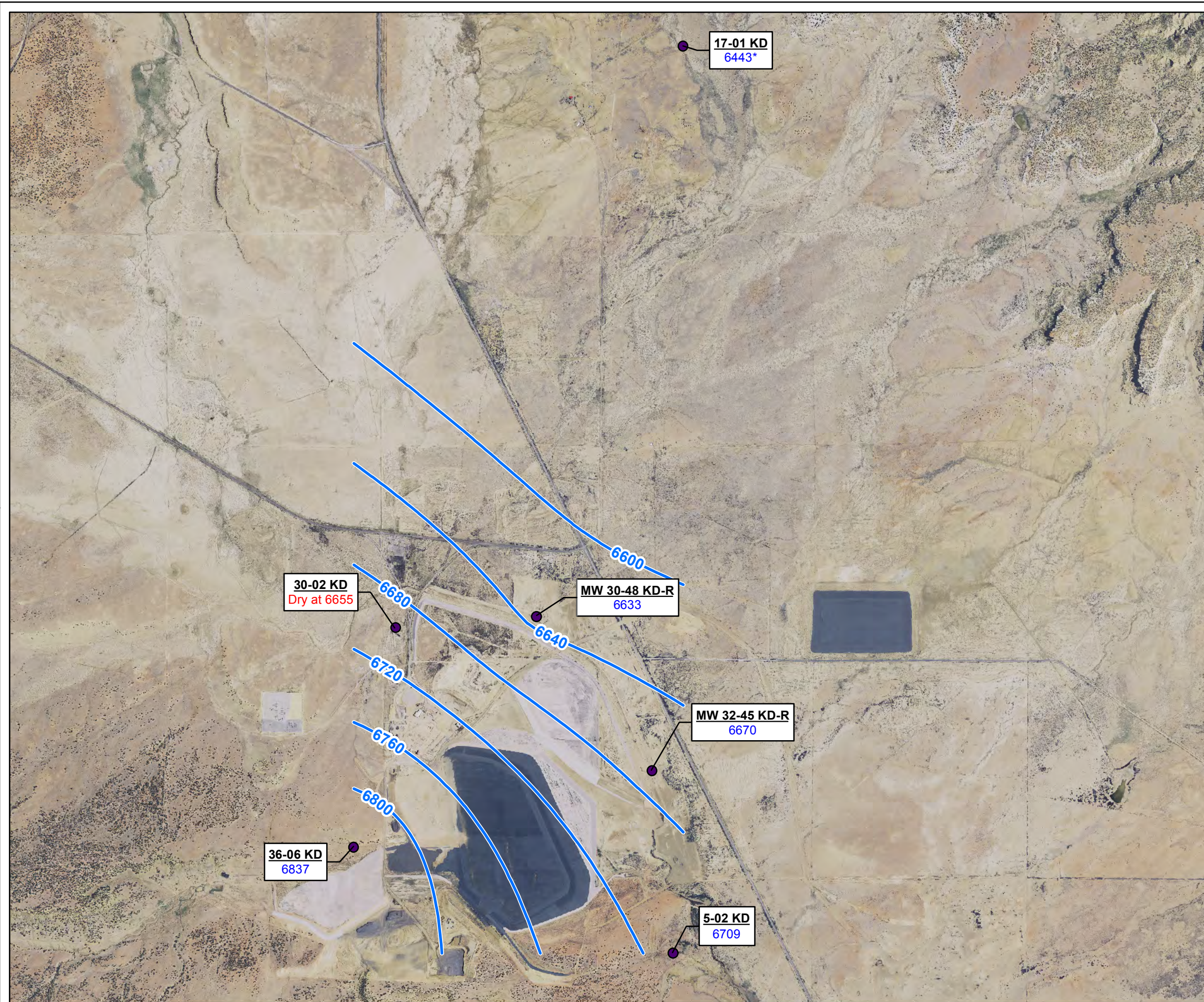
Gradient calculation:

(Difference in Groundwater Elevation Between Point of Compliance Well 31-61 and Trend Well 5-08 ALL-R = 6,902 - 6,858 = 44 feet) Divided by (Distance Along a Flow Path Between Point of Compliance Well 31-61 and Trend Well 5-08 = 5560 feet)

= 0.008 feet per foot

1st Half 2016 Alluvial Groundwater Surface Elevation Iso-Contours
Rio Algom DP-169 ACL
Semi-Annual Report





Aerial – NAIP imagery, dated 2014

Legend

- Dakota Monitoring Well
- Dakota Potentiometric Iso-Contours (ft amsl)

Well ID

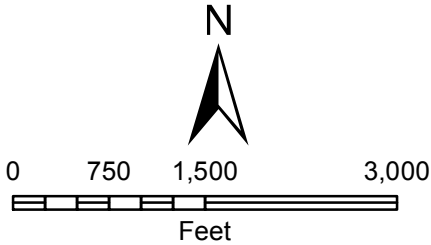
Groundwater Surface Elevation (ft amsl)

* indicates well 17-01 KD reading was taken 9/23/14, prior to pump install

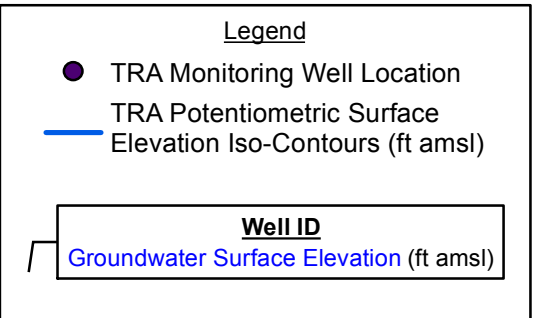
Note: All data collected 1st quarter, 2016 except 17-01 KD

Gradient calculation:
(Difference in Groundwater Elevation Between Point of Compliance Well 36-06 KD and Trend Well 30-48 KD-R = 6,837 - 6,633 = 204 feet) Divided by (Distance Along a Flow Path Between Point of Compliance Well 36-06 KD and Trend Well 30-48 KD-R = 5711 feet)
= 0.036 feet per foot

1st Half 2016 Dakota Potentiometric Surface Elevation Iso-Contours
Rio Algom DP-169 ACL
Semi-Annual Report



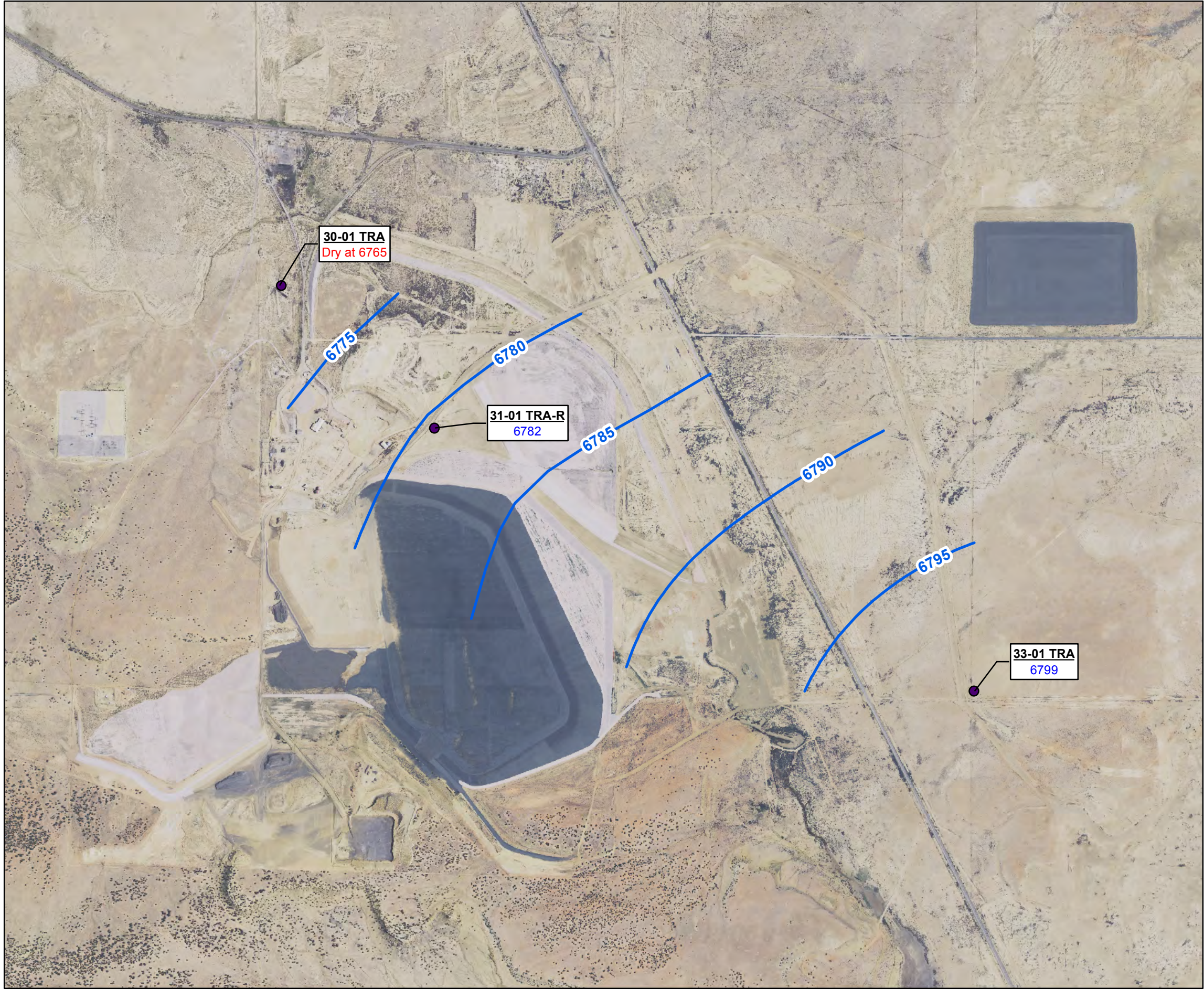
Aerial – NAIP imagery, dated 2014

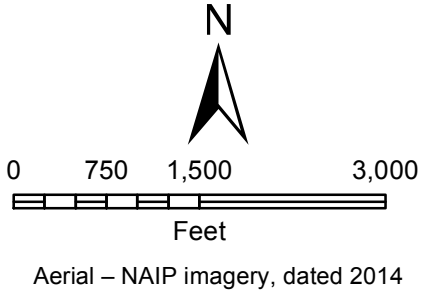


Note: All data collected 1st quarter, 2016

Gradient calculation:
(Difference in Groundwater Elevation Between Point of Compliance Well MW 31-01 TRA-R and Trend Well 33-01 TRA = 6,799 - 6,782 = 17 feet) Divided by (Distance Along a Flow Path Between Point of Compliance Well MW 31-01 TRA-R and Trend Well 33-01 TRA = 8947 feet)
= 0.002 feet per foot

1st Half 2016 TRA Potentiometric Surface Elevation Iso-Contours
Rio Algom DP-169 ACL
Semi-Annual Report





Legend

- TRB Monitoring Well Location
- Trb Potentiometric Surface Elevations (ft amsl)

Well ID

Groundwater Surface Elevation (ft amsl)

* = indicates well 31-67 TRB reading was taken 08/24/2015
Note: All data collected 1st quarter, 2016 except 31-67 TRB

Gradient calculation:
(Difference in Groundwater Elevation Between Point of Compliance Well 31-02 TRB-R and far downgradient Well 19-77 = 6,890 - 6,739 = 151 feet)
Divided by
(Distance Along a Flow Path Between Point of Compliance Well 31-02 TRB-R and far downgradient Well 19-77 = 9,640 feet)
= 0.016 feet per foot

1st Half 2016 TRB Potentiometric Surface Elevation Iso-Contours ACL
Rio Algom DP-169 ACL
Semi-Annual Report

