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Mr. Robert Burgess
Alaska Department of Environmental Conservation
610 University Avenue
Fairbanks, AK 99709

Environment

Subject:

Natural Attenuation and LNAPL Stability Evaluation Memorandum
Union Oil Airport Bulk Fuel Facility 306443
Gate 28, Block 1, Lot 8, West Ramp,
Fairbanks International Airport
Fairbanks, Alaska

Date:
May 28, 2015

Contact:
Greg Montgomery

Phone:
206.726.4742

Email:
Gregory.Montgomery@arcadis-us.com

Our ref:
B0045507

Dear Mr. Burgess:

This cover letter summarizes the attached memorandum, *Natural Attenuation and LNAPL Stability Evaluation Memorandum*. The memorandum responds to a July 23, 2014, Alaska Department of Environmental Conservation (ADEC) email addressing a site Remedial Action Plan submitted July 3, 2014. In the email, ADEC requests the project team provide additional data analysis demonstrating that there is both active biodegradation of hydrocarbon impacted groundwater and LNAPL plume stability occurring at the Fairbanks Airport site.

Briefly, the memo is divided into two principal sections: natural attenuation assessment and LNAPL stability assessment. The natural attenuation assessment is a statistical assessment of all historical groundwater data for selected wells using a Mann-Kendall slope trend test which evaluates trends through time for constituents of concern. The LNAPL stability assessment uses multiple lines of evidence to determine LNAPL mobility and the potential for future LNAPL migration.

In summary, the Mann-Kendall analysis demonstrates an overall stable-to-decreasing dissolved-phase petroleum hydrocarbon plume. Also, groundwater geochemical parameters support strongly-reducing conditions near the plume interior, which are indicative of degrading petroleum hydrocarbons. The LNAPL stability assessment demonstrates that LNAPL at the site is locally mobile within the interior of the LNAPL plume; however, the LNAPL plume is stable and is not expected to expand beyond the currently defined footprint. Finally, natural processes are actively depleting LNAPL mass through source-zone depletion.

Should you have any questions regarding the attached memorandum, please contact Greg Montgomery, ARCADIS project manager at 206.726.4742 or via email at Gregory.Montgomery@arcadis-us.com. Thank you.

Sincerely,

ARCADIS

Greg Montgomery
Senior Project Manager

Attachment:

Natural Attenuation and LNAPL Stability Evaluation Memorandum

Copies:

Dan Carrier, Chevron
Rebekah Wenger, ADOT& PF, Fairbanks International Airport
Mr. Shannon Thrun, ERA Alaska
File

MEMO

To:
Gregory Montgomery

Copies:

From:
Elizabeth Cohen
Ashley Nagle

Date:
March 20, 2015

ARCADIS Project No.:
B0045507.0016

Subject:
Natural Attenuation and LNAPL Stability Evaluation Memorandum
Chevron Facility No. 306443
Gate 28, Blk 1, Lot 8, West Ramp
Fairbanks, Alaska

Introduction and Site Background

This Natural Attenuation Evaluation and Light Non-aqueous Phase Liquid (LNAPL) Stability Memorandum presents an evaluation of the natural attenuation of dissolved phase and LNAPL petroleum hydrocarbons in groundwater at Chevron Facility No. 36443, located in Fairbanks Alaska (Site). The memorandum was prepared to address comments in an Alaska Department of Environmental Conservation (ADEC) email dated July 23, 2014 regarding the Remedial Action Plan dated July 3, 2014. The ADEC email is presented in Appendix A.

Natural attenuation is the reliance on natural physical, chemical, and/or biological processes to achieve site-specific remediation objectives (United States Environmental Protection Agency [USEPA] 1999).

The Site is a former Union Oil Fuel Distribution Facility located at Fairbanks International Airport. In 1991, four 10,000-gallon underground storage tanks (USTs), two pump islands, and associated piping were removed from the Site. The UST excavation was approximately 65 feet by 40 feet and averaged 10 feet in depth. No free product was encountered during the excavation. Approximately 1,200 cubic yards of soil were removed during the excavation; however, soil suspected of containing hydrocarbons was placed back into the excavation, a layer of visqueen was placed over the impacted soil, and clean imported fill was used to restore the excavation to the original grade. Site conditions are described in section 6 of the Remedial Action Plan (RAP; ARCADIS 2014). The hydrogeology of the site is described in Section 3 of the RAP. Groundwater monitoring wells were installed as part of historical site characterization activities, and LNAPL has been detected at monitoring wells at the Site. During groundwater monitoring activities conducted in 2011 and 2012, efforts were made to remove LNAPL from monitoring wells, where present, via peristaltic pumping. No additional remedial actions have been conducted, the extent of the LNAPL has been delineated, the LNAPL body is within the property boundaries, and is not migrating.

Natural Attenuation Assessment

Stable or decreasing trends in the concentrations of petroleum hydrocarbon constituents represent the primary line of evidence for natural attenuation of petroleum hydrocarbons in groundwater. Geochemical indicator parameters provide an additional line of evidence to document favorable groundwater conditions for ongoing natural attenuation processes.

To verify that the overall groundwater plume is stable or shrinking, ARCADIS evaluated the trends through time of concentrations of dissolved-phase petroleum hydrocarbon constituents in groundwater at the Site. The assessment utilized statistical analysis to provide evidence that the overall groundwater plume is stable or shrinking. Changes over time in concentrations of dissolved-phase constituents of concern (COCs), including benzene, gasoline-range organic (GRO) constituents, diesel-range organic (DRO) constituents, and residual-range organic (RRO) constituents, were evaluated for key locations where concentrations remain in excess of the ADEC Groundwater Cleanup Levels (GCLs). ARCADIS evaluated all available historic data (dating from 2004) collected at the Site from a subset of wells that met the screening criteria for statistical analysis. The results from these statistical analyses were used to assess the stability of the existing dissolved-phase plume at the Site.

Groundwater Hydrocarbon Constituent Concentration Trends

To evaluate the concentration trends for individual COCs at the Site and provide data representative of current conditions at the Site, a statistical analysis using the Mann-Kendall slope trend test was performed at selected monitoring wells, for the entire historical dataset. Trends were evaluated for monitoring locations where concentrations of hydrocarbons exceeded applicable screening levels. The ADEC GCLs were used as the screening levels (screening levels) for this assessment. The relevant screening levels for these analyses were 5 micrograms per liter (µg/L) for benzene, 2,200 µg/L for GRO, 1,500 µg/L for DRO, and 1,100 µg/L for RRO.

Trends were not evaluated at monitoring locations where any of the following criteria applied:

- Insufficient data were available (less than four data points)
- Constituent concentrations have never exceeded their respective GCL

- Greater than 50 percent of the results were below detection limits

Monitoring wells where LNAPL have been historically measured are typically not used for statistical analysis. However, dissolved-phase COCs in groundwater are below screening levels or are non-detect at a large majority of monitoring wells where LNAPL has not been detected. Because of the limited amount of wells available to perform statistical analysis where LNAPL was not measured, for the purposes of this statistical analysis, all monitoring wells were evaluated whether or not LNAPL was measured.

Based on the selection criteria above, the following monitoring wells and COCs at the Site were identified for statistical analysis:

- Benzene: GEI-1, GEI-4, GEI-6, GEI-7, GEI-9, MW-1, and MW-9
- GRO: GEI-1, GEI-4, GEI-6, GEI-7, GEI-9, MW-1, MW-5, and RW-1
- DRO: GEI-1, GEI-2, GEI-3, GEI-4, GEI-6, GEI-7, GEI-8, GEI-9, MW-1, MW-3, MW-5, MW-9, and RW-1
- RRO: MW-6 and MW-7

Among the wells that met the selection criteria, only monitoring wells MW-5, MW-6, MW-7, and MW-9 have never historically had LNAPL detected. Monitoring wells MW-3 and RW-1 have occasionally have globules of LNAPL detected. The remaining monitoring wells (GEI-1, GEI-2, GEI-3, GEI-4, GEI-6, GEI-7, GEI-8, GEI-9, and MW-1) have consistently had LNAPL present in the wells throughout the historical monitoring period.

The Mann-Kendall trend test is a non-parametric test that calculates trends based on ranked data, which can be useful where large variations in the magnitude of concentrations may be present and may otherwise influence a time-series trend analysis. The basic Mann-Kendall trend test involves listing the concentrations in temporal order and computing all differences that may be formed between a given measurement and earlier measurements (Gilbert 1987). The test statistic (sum of trend (S)) is the difference between the number of strictly positive differences and the number of strictly negative differences. If there is an underlying increasing trend, then these differences will tend to be positive, indicated by a sufficiently large positive value of the test statistic. The p-value of the correlation provides a measure of the level of significance of the statistical test. Correlations were accepted as significant for p-values less than or equal to 0.1 (90 percent confidence level). Pursuant to USEPA (2009) guidance, non-detect results may be used in the Mann-Kendall analysis and treated by assigning them a common value that is lower than any of the detected concentrations for each individual well/constituent. For this analysis, the non-detects were substituted with a value equal to 95 percent of the lowest reported detected concentration per individual well/constituent. Results of the Mann-Kendall analyses are presented in Table 1 and Appendix B and detailed below.

Benzene

Historical groundwater data for seven monitoring locations at the Site met the above stated screening criteria for performing trend analysis: GEI-1, GEI-4, GEI-6, GEI-7, GEI-9, MW-1, and MW-9. LNAPL has been historically detected in all of these monitoring wells with the exception of monitoring well MW-9. Results of the statistical analyses are summarized in Table 1. All other monitoring wells at the Site had benzene groundwater concentrations below the screening level, less than four data points, or greater than 50 percent of the data points were non-detect.

Results from the statistical analysis indicated that concentrations of benzene in groundwater are statistically significantly decreasing at MW-9. The results from the statistical analyses at the other six wells, all of which have historically had LNAPL, all indicated that there was no significant trend. The sum of the trends (S values) for these analyses were negative (indicating an overall decreasing tend) for monitoring wells GEI-4, GEI-6, GEI-7, GEI-9, and MW-1, and the S value was equal to zero at monitoring well GEI-1 (no trend). These results suggest that the dissolved-phase concentrations of benzene are stable to decreasing at the Site.

GRO

Seven monitoring locations at the Site met the above stated screening criteria for performing trend analysis: GEI-1, GEI-4, GEI-6, GEI-7, GEI-9, MW-1, MW-5, and RW-1. LNAPL has been historically detected in all of these monitoring wells with the exception of monitoring well MW-5. The results of the Mann-Kendall trend test indicate that none of these monitoring wells exhibit a statistically significant trend in GRO concentrations in groundwater. The S values for these analyses were negative for monitoring wells GEI-1, GEI-4, GEI-6, GEI-7, GEI-9, MW-1, and MW-5, indicating that GRO concentrations are decreasing at these six monitoring wells. At monitoring location RW-1, the S value is positive, indicating an increasing trend in GRO concentrations at this well, however, the most recent analytical results for GRO is below the historical maximum concentration. These results suggest that the dissolved-phase concentrations for GRO are generally stable to decreasing at the Site.

DRO

Historical groundwater data for 13 monitoring locations at the Site met the above stated screening criteria for performing trend analysis: GEI-1, GEI-2, GEI-3, GEI-4, GEI-6, GEI-7, GEI-8, GEI-9, MW-1, MW-3, MW-5, MW-9, and RW-1. LNAPL has been historically detected in all of these monitoring wells with the exception of monitoring well MW-5 and MW-9. The results of the Mann-Kendall trend test indicate that none of these monitoring wells exhibit a statistically significant trend in DRO concentrations. The S values for these analyses were negative for monitoring wells GEI-2, GEI-4, GEI-8, and MW-9 indicating overall decreasing trends. The S value was equal to zero at GEI-1 and RW-1, suggesting stable trends. The S value was positive GEI-3, GEI-6, GEI-7, GEI-9, MW-1, MW-3, and MW-5, however, the most recent analytical results for these monitoring wells are below the historical maximum concentration. While there are some apparent increasing trends at 7 out of the 13 monitoring wells at the Site, this is likely due to the presence of LNAPL and overall, the dissolved-phase concentrations for DRO generally appear stable at the plume fringes.

RRO

Two monitoring locations at the Site met the above stated screening criteria for performing trend analysis: MW-6 and MW-7. Neither of these wells has had any historical measurements of LNAPL. The results of the Mann-Kendall trend test indicate that neither of these monitoring wells exhibits a statistically significant trend in RRO concentrations in groundwater. However, the S values for both of these analyses were negative, indicating that dissolved-phase RRO concentrations are decreasing at monitoring wells MW-6 and MW-7. These results suggest that the dissolved-phase concentrations for RRO are generally stable to decreasing at the Site.

Groundwater Geochemical Data

While decreasing dissolved-phase concentration trends represent the primary line of evidence for natural attenuation of the dissolved-phase petroleum hydrocarbons and overall plume stability, geochemical indicator parameters can provide an additional line of evidence to document favorable groundwater conditions for biodegradation processes that may be occurring.

Hydrocarbon compounds can serve as sources of carbon and/or energy for naturally occurring bacteria, and biodegradation of these compounds occurs by both aerobic and anaerobic microbial processes. Bacteria obtain energy by facilitating reduction-oxidation (redox) reactions involving the transfer of electrons from electron donors (e.g., benzene) to available electron acceptors.

In aerobic environments, dissolved oxygen (DO) serves as the electron acceptor and becomes reduced while the primary substrate is oxidized. Oxidation of the primary substrate results in its degradation to harmless byproducts (carbon dioxide and water). Under anaerobic conditions, other inorganic compounds act as electron acceptors (e.g., nitrate, ferric iron, sulfate, and carbon dioxide) and become reduced while the primary substrate is oxidized. Anaerobic oxidation processes consume these alternate electron acceptors in the following order of preference: nitrate (nitrate reduction), manganese (manganese (IV) reduction), ferric iron (ferric iron reduction), sulfate (sulfate reduction), and carbon dioxide (methanogenesis).

To evaluate for such potential biodegradation processes within petroleum-affected groundwater beneath the Site, groundwater samples were collected during the April 2009 and June 2012 sampling events for analysis of select geochemical parameters at MW-1, MW-2, MW-3, MW-4, MW-5, MW-7, MW-10, GEI-4, and GEI-8. These individual parameters and results are provided below.

Dissolved Oxygen and Oxygen Reduction Potential

While field-measured DO and ORP data can be variable, they indicate whether groundwater conditions are likely to be favorable for aerobic biodegradation processes (available DO, positive ORP) or anaerobic biodegradation processes (low DO, negative ORP). Aerobic respiration tends to be the dominant process where DO concentrations are greater than 1 mg/L. Subsequently, the primary indicator of aerobic respiration is depressed DO concentrations in the area(s) where petroleum hydrocarbons are present.

DO concentrations at the Site ranged from 0.31 milligrams per liter (mg/L) at monitoring well MW-5 to 1.07 mg/L at MW-3. Field-measured ORP ranged from -108 millivolts (mV; MW-1 and MW-3) to -80.6 mV (GEI-4). No DO concentrations are available from upgradient monitoring locations (e.g. MW-10). However, DO concentrations are sufficiently depressed within, and immediately downgradient from petroleum hydrocarbon affected groundwater, indicating biological degradation of petroleum hydrocarbons in this area of the Site. These results indicate that aerobic oxidation is contributing to the degradation of petroleum hydrocarbons in Site groundwater.

Nitrate

As DO concentrations decrease, nitrate reduction is the first anaerobic degradation pathway if sufficient concentrations of this nitrate are available in the subsurface (more than 0.5 mg/L). During the nitrate reduction process, bacteria reduce nitrate to nitrite and petroleum hydrocarbons are oxidized to carbon dioxide and water.

Nitrate was not detected (less than 0.20 mg/L and less than 0.25 mg/L) in most of groundwater samples collected from the Site. Only one sample collected from cross-gradient monitoring well MW-2 had a detectable nitrate concentration of 1.2 mg/L. The generally low nitrate concentrations observed at the Site suggest that denitrification may be occurring to support biodegradation of petroleum hydrocarbons in groundwater.

Iron

Iron reduction is an anaerobic redox reaction in which bacteria use ferric iron as an electron acceptor to facilitate biodegradation of organic compounds. When ferric iron is used as an electron acceptor, it is reduced to soluble ferrous iron, resulting in increased concentrations of dissolved iron.

Ferrous iron concentrations were measured in April 2009 using a field HACH kit, and ranged from 4.0 mg/L (GEI-4) to 6.2 mg/L at GEI-8. Based on the presence of dissolved iron in the groundwater, iron reduction is likely occurring. Concentrations of dissolved iron measured at wells within the hydrocarbon-affected area were relatively low; however, it is likely that iron-reducing microbes are active in this area, and that ferrous iron is reacting with sulfide based on the presence of sulfate-reducing conditions (described below).

Sulfate

Sulfate reduction takes place after ferrous iron concentrations in the subsurface have been depleted, at which point anaerobic bacteria use sulfate as an electron acceptor. During this process, biological breakdown of petroleum hydrocarbons into carbon dioxide results in the reduction of sulfate to sulfide.

Sulfate concentrations in site groundwater range from non-detect (<0.40 mg/L) at MW-1 to 28.4 mg/L at up-gradient monitoring location MW-10. These data indicate that sulfate reduction is occurring to a limited extent within the hydrocarbon plume under anaerobic conditions.

Methane

Methanogenesis is an anaerobic redox reaction in which bacteria use carbon dioxide as an electron acceptor in the biodegradation of organic compounds, producing methane as a byproduct.

Methane concentrations ranged from 0.011 mg/L at downgradient monitoring well MW-4 to 16.5 mg/L at cross-gradient monitoring well MW-1. Methane was detected at all nine monitoring locations (i.e., MW-1, MW-2, MW-3, MW-4, MW-5, MW-7, MW-10, GEI-4, and GEI-8), Elevated methane concentrations within monitoring wells close to the plume interior (GEI-4, MW-1, MW-3, and MW-5) suggest relatively strongly reducing, methanogenic conditions near these monitoring locations. These results indicate that methanogenesis is contributing to the degradation of petroleum hydrocarbons in Site groundwater.

Summary

The Mann-Kendall analysis of dissolved-phase COC groundwater concentration trends with time demonstrate an overall stable-to-decreasing dissolved-phase petroleum hydrocarbon plume. Additionally, the geochemical parameter data are supportive of strongly-reducing conditions present near the plume interior, which are supportive of degradation of petroleum hydrocarbons in Site groundwater.

LNAPL Stability Demonstration

A LNAPL stability assessment uses multiple lines of evidence to determine LNAPL mobility and the potential for future LNAPL migration. Immobile LNAPL is functionally locked in pore spaces, while mobile LNAPL is capable of moving laterally and vertically within the existing LNAPL body footprint. Migrating LNAPL moves beyond the existing boundaries of the LNAPL body footprint, thereby causing expansion of the footprint. The following lines of evidence were used to assess mobility and the potential for migration at the Site:

- Age of LNAPL release
- No ongoing source

- LNAPL presence in monitoring wells
- Dissolved-phase plume stability
- Natural source zone depletion (NSZD)

LNAPL Source

The source of the LNAPL was four 10,000-gallon underground storage tanks (USTs) and associated piping. In October 1991, Dames & Moore observed and monitored the removal of the four 10,000-gallon USTs, two pump islands, and associated piping, as reported in the Site Assessment Report for Underground Storage Tanks Closure (Geoengineers 2003). The excavation removed the source of the LNAPL; therefore, there is no longer an ongoing release of LNAPL.

The potential for mobility of LNAPL reduces significantly over time once the source is terminated. The source of the LNAPL was removed in 1991, therefore the LNAPL body was exposed to over twenty years of LNAPL smearing in the soil matrix due to groundwater fluctuations and mass depletion through dissolution, biodegradation, and volatilization that reduced the potential for mobility. Based on the age of release, the LNAPL body is likely stable.

LNAPL Presence in Monitoring Wells

Hydrographs of corrected groundwater elevation and measured LNAPL thickness were compiled for monitoring wells with historically observed LNAPL. The graphs were visually examined for trends in groundwater elevation and LNAPL thickness. The lines of evidence for potentially migrating LNAPL include when temporal fluid level gauging indicates the following:

- A clear trend of increasing thickness of LNAPL in monitoring wells through time that is not attributable to water-table changes.
- Observation of LNAPL in a portion of the monitoring well network where it was previously not observed and there are no other lines of evidence for LNAPL presence, suggesting that the LNAPL zone may be expanding (migrating) in that area.

LNAPL accumulations have been historically observed in twelve wells at the Site: GEI-1, GEI-2, GEI-3, GEI-4, GEI-5, GEI-6, GEI-7, GEI-8, GEI-9, MW-1, MW-8, and RW-1. During the annual monitoring event in July 2014, LNAPL was measured in only two monitoring wells, GEI-5 and GEI-6, at 0.19 feet and 0.01 feet, respectively. Generally, increased measured LNAPL thicknesses in wells coincided with lower groundwater elevations at the Site. In an unconfined groundwater system, an inverse relationship between the groundwater potentiometric surface elevation and LNAPL thickness is expected (e.g., LNAPL thickness decreases as groundwater levels rise). Common unconfined groundwater behavior between groundwater elevation and LNAPL thickness is demonstrated in the hydrographs on Figures 1 through 12 for the monitoring wells. Generally, LNAPL thicknesses in monitoring wells within the LNAPL body footprint at the Site have remained within historical ranges or have decreased since monitoring events began in 2003.

The stable LNAPL accumulations in monitoring wells within the footprint of the plume is a line of evidence indicating that the historical plume is stable and not migrating. The lack of LNAPL accumulation in downgradient wells further demonstrates that the LNAPL is not migrating.

LNAPL Dissolved-Phase Stability

Stable or decreasing groundwater concentrations of dissolved LNAPL compounds indicate that the LNAPL body is stable or decreasing in size, while increasing groundwater concentrations indicate that LNAPL may be migrating at the LNAPL-body scale.

As discussed above, dissolved-phased concentrations of petroleum hydrocarbon COCs are stable or decreasing, indicating the LNAPL body is also stable.

Natural Source Zone Depletion

Natural source zone depletion (NSZD) is a combination of natural processes that reduce the mass of LNAPL in the subsurface over time. NSZD occurs when processes act to physically redistribute LNAPL components to the aqueous phase via dissolution or to the gaseous phase via volatilization. In turn, dissolved or volatilized LNAPL constituents can be biologically degraded by microbial and/or enzymatic activity. These processes explain why LNAPL plumes stabilize even though LNAPL is measured in monitoring well. Further, the natural processes continue to deplete the LNAPL mass and further reduce mobility.

As described above, the presence of methane in groundwater in the vicinity of the LNAPL body indicates NSZD is occurring through methanogenic degradation of the petroleum hydrocarbons in the source area. Based on recent published literature (Lundegard and Johnson 2006; Sihota et al. 2011; McCoy et al. 2012) and ARCADIS' experience, hydrocarbon LNAPL losses due to NSZD generally fall within the range of hundreds to thousands of gallons per acre per year.

Summary

Multiple lines of evidence demonstrate that the LNAPL body at this Site is mature, mitigated, and naturally controlled. These lines of evidence include:

- release terminated over 20 years ago
- stable accumulations of LNAPL in monitoring wells
- stable dissolved-phase plume

- natural source zone depletion continues to deplete the LNAPL source

Results of the LNAPL stability assessment demonstrate that LNAPL at the Site is mobile within the interior of the LNAPL plume; however, it is not migrating outside the footprint of the LNAPL plume. LNAPL that is mobile is capable of moving laterally and vertically at the soil media pore scale, meaning that the LNAPL can enter a well, but has insufficient mobility at the pore scale to cause expansion of the plume footprint. The LNAPL plume is stable and is not expected to expand beyond the currently defined footprint and natural processes are actively depleting LNAPL mass through NSZD.

Conclusions

Data from the Site indicates a stable dissolved phase plume, along with a stable LNAPL plume. There is evidence of natural attenuation of dissolved phase petroleum hydrocarbon related COCs and it is likely NSZD of LNAPL is also occurring. Given the age of the historical release, and the decreasing to stable concentration trends observed at the Site is unlikely that the plume will expand beyond its current boundaries.

Tables

Table 1 Mann-Kendall Analysis Summary

Figures

LNAPL Hydrographs

Appendices

Appendix A – July 23, 2014 ADEC Email

Appendix B - ADEC Mann-Kendall Results Summary

References

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Tables

Table 1
Mann Kendall Analysis Summary
Chevron Facility No. 306443
Gate 28, Blk 1, Lot 8, West Ramp
Fairbanks, Alaska

Well ID	Analyte	Number of Samples	Sum of Trend	p-Value[a]	Mann-Kendall Trend Direction	Notes
GEI-1	GRO	4	-4	0.167	No Significant Trend	LNAPL present 2007 through 2012 and in 2014
GEI-4		14	-17	0.191	No Significant Trend	LNAPL present 2010 through 2012 and in 2014
GEI-6		6	-7	0.136	No Significant Trend	LNAPL frequently present 2006 through 2014
GEI-7		13	-18	0.150	No Significant Trend	LNAPL present 2009 through 2012
GEI-9		9	-6	0.306	No Significant Trend	LNAPL present 2009 through 2012 and in 2014
MW-1		9	-10	0.179	No Significant Trend	LNAPL present in 2010 and 2012
MW-5		10	-12	0.159	No Significant Trend	No historical LNAPL
RW-1		5	6	0.117	No Significant Trend	LNAPL globules in 2011, 2012, and 2014
GEI-1	DRO	4	0	0.625	No Significant Trend	LNAPL present 2007 through 2012, and in 2014
GEI-2		9	-4	0.381	No Significant Trend	LNAPL Present once in 2010 and in 2014
GEI-3		10	5	0.364	No Significant Trend	LNAPL intermittently present
GEI-4		14	-7	0.371	No Significant Trend	LNAPL present 2010 through 2012, and in 2014
GEI-6		6	5	0.235	No Significant Trend	LNAPL frequently present 2006 through 2014
GEI-7		13	14	0.214	No Significant Trend	LNAPL present 2009 through 2012
GEI-8		18	-16	0.285	No Significant Trend	LNAPL present once in 2008
GEI-9		9	8	0.238	No Significant Trend	LNAPL present 2009 through 2012, and in 2014
MW-1		7	3	0.386	No Significant Trend	LNAPL present in 2010 and 2012
MW-3		9	8	0.238	No Significant Trend	LNAPL Globules present in 2012
MW-5		10	7	0.300	No Significant Trend	No historical LNAPL
MW-9		4	-4	0.167	No Significant Trend	No historical LNAPL
RW-1		5	0	0.592	No Significant Trend	LNAPL globules in 2011, 2012, and 2014
MW-6	RRO	6	-8	0.102	No Significant Trend	No historical LNAPL
MW-7		6	-6	0.186	No Significant Trend	No historical LNAPL
GEI-1	Benzene	4	0	0.625	No Significant Trend	LNAPL present 2007 through 2012, and in 2014
GEI-4		14	-12	0.273	No Significant Trend	LNAPL present 2010 through 2012, and in 2014
GEI-6		6	-3	0.360	No Significant Trend	LNAPL frequently present 2006 through 2014
GEI-7		13	-10	0.295	No Significant Trend	LNAPL present 2009 through 2012
GEI-9		9	-12	0.130	No Significant Trend	LNAPL present 2009 through 2012, and in 2014
MW-1		9	-8	0.238	No Significant Trend	LNAPL present in 2010 and 2012
MW-9		4	-6	0.042	Decreasing Trend	No historical LNAPL

Notes:
[a] A p-value <0.10 indicates a statistically significant trend (90% confidence level)
DRO = total petroleum hydrocarbons - diesel range organics
GRO = total petroleum hydrocarbons - gasoline range organics
NC = Sen's slope value not calculated
LNAPL = light non-aqueous phase liquid
RRO = total petroleum hydrocarbons - residual range organics

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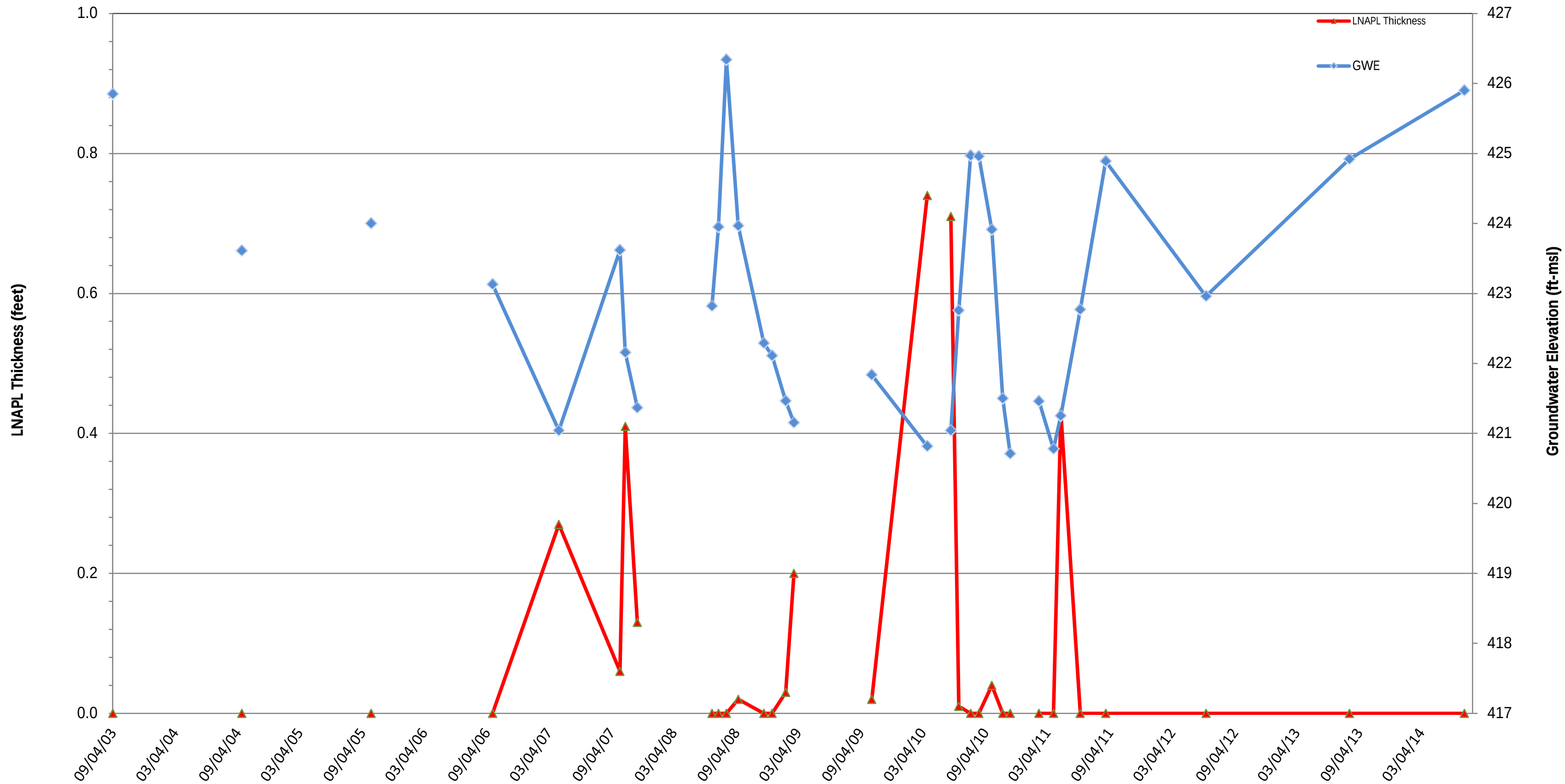
Figures



LEGEND:

- GWE = Groundwater elevation
- LNAPL = Light non-aqueous phase liquid
- ft-msl = Feet above mean sea level
- Data gaps = wells were inaccessible and not gauged

CHEVRON #306443 (FORMER UNOCAL BULK PLANT)
GATE 28, WEST RAMP, FAIRBANKS AIRPORT, FAIRBANKS, AK
ANNUAL 2014 GROUNDWATER MONITORING REPORT

Monitoring Well GEI-1 Historical Groundwater Elevation and LNAPL Thickness

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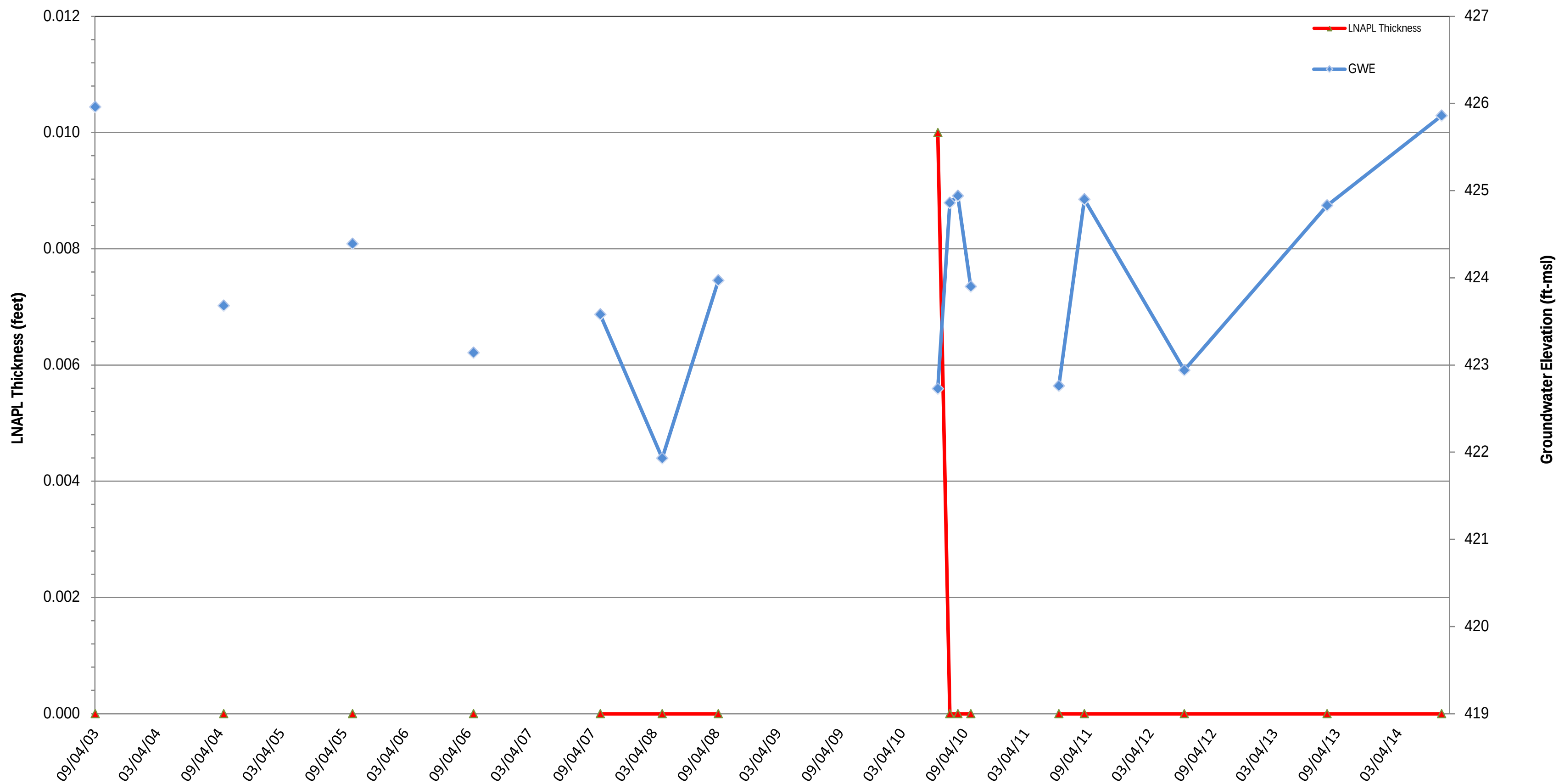
FIGURE
5



LEGEND:

GWE = Groundwater elevation
LNAPL = Light non-aqueous phase liquid
ft-msl = Feet above mean sea level
Data gaps = wells were inaccessible and not gauged

CHEVRON #306443 (FORMER UNOCAL BULK PLANT)
GATE 28, WEST RAMP, FAIRBANKS AIRPORT, FAIRBANKS, AK
ANNUAL 2014 GROUNDWATER MONITORING REPORT

Monitoring Well GEI-2 Historical Groundwater Elevation and LNAPL Thickness

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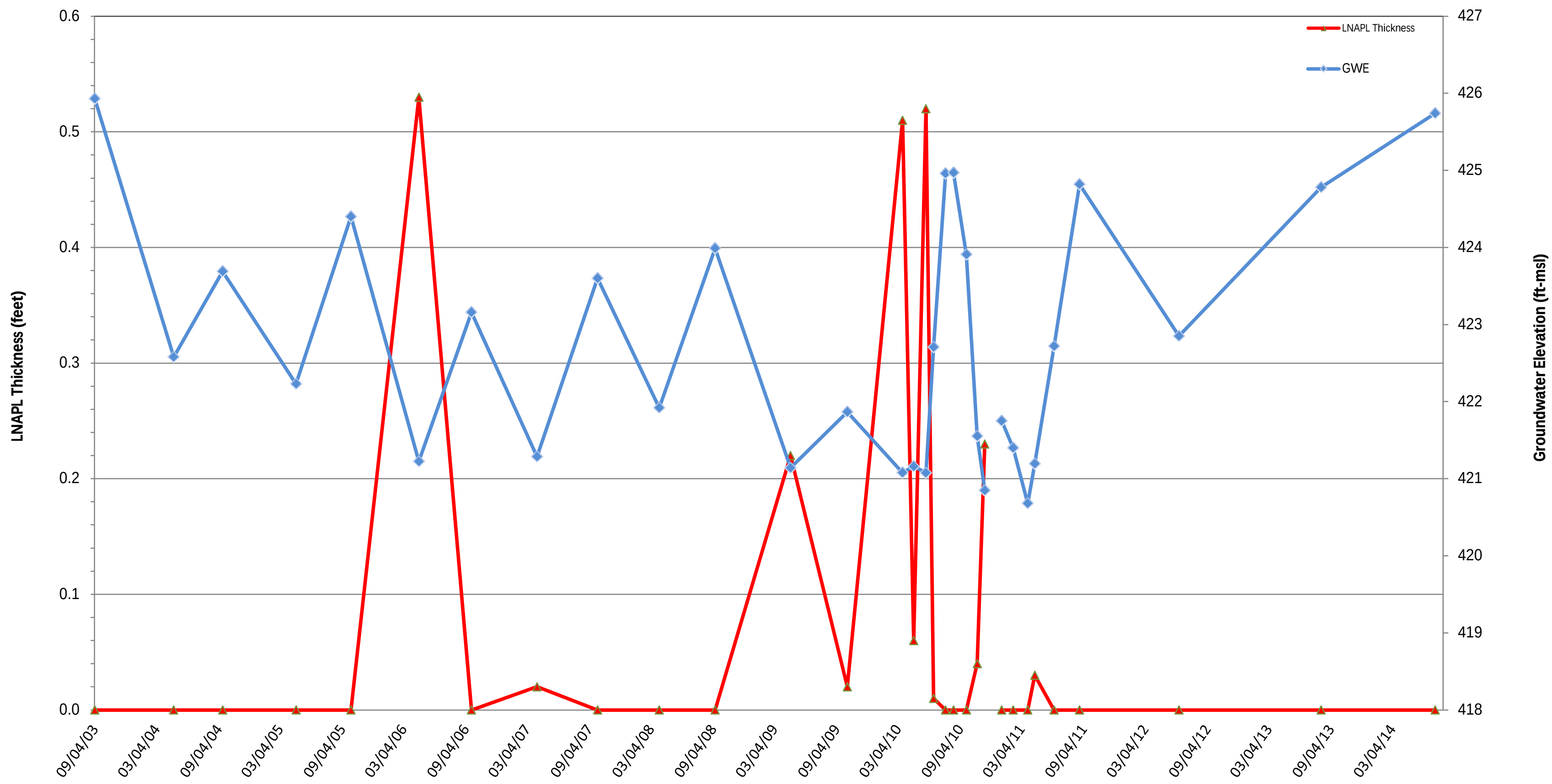
FIGURE
6



LEGEND:
GWE = Groundwater elevation
LNAPL = Light non-aqueous phase liquid
ft-msl = Feet above mean sea level
Data gaps = wells were inaccessible and not gauged

CHEVRON #306443 (FORMER UNOCAL BULK PLANT)
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ANNUAL 2014 GROUNDWATER MONITORING REPORT

Monitoring Well GEI-3 Historical Groundwater Elevation and LNAPL Thickness

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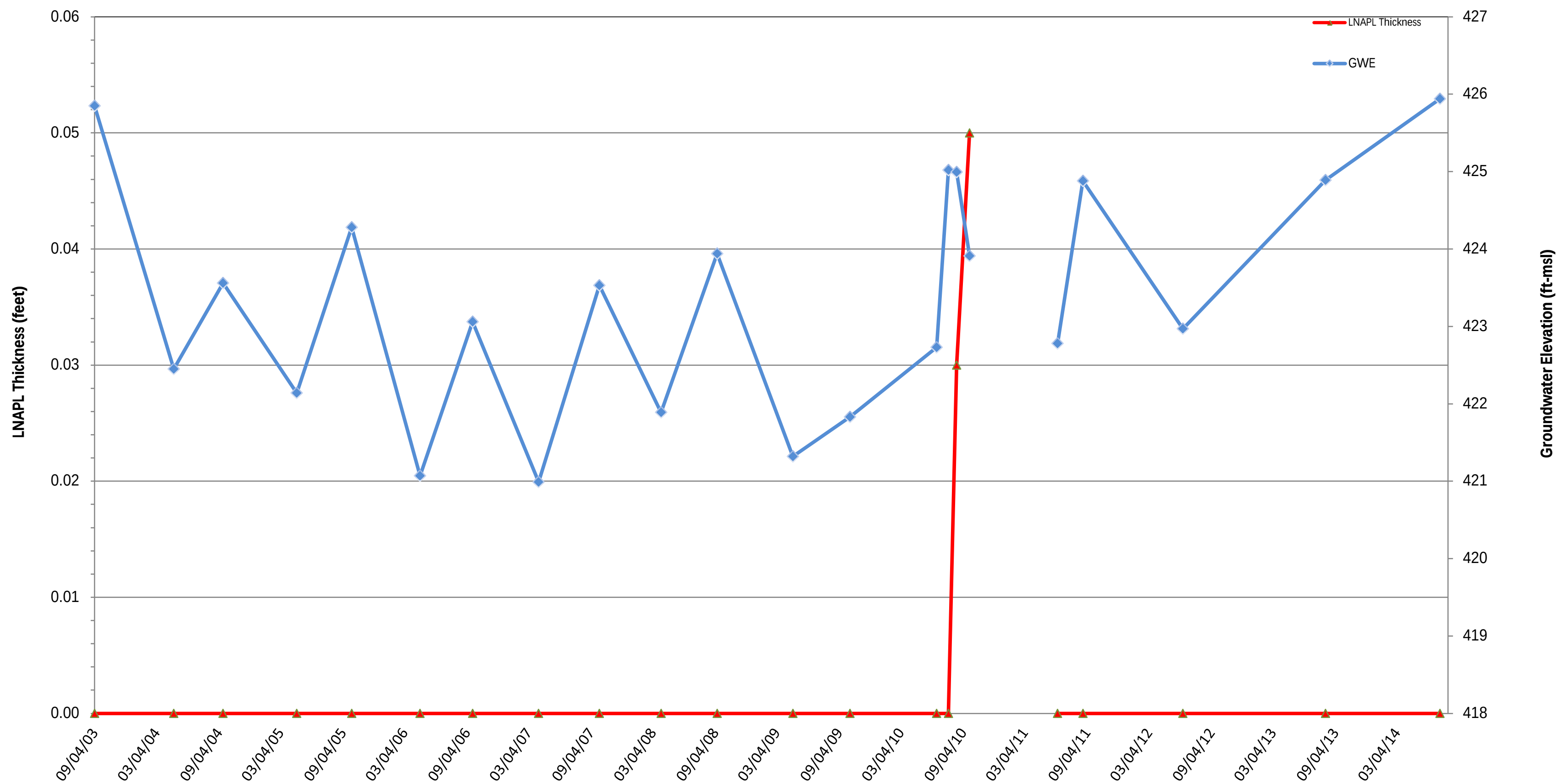
FIGURE
7



LEGEND:

GWE = Groundwater elevation
LNAPL = Light non-aqueous phase liquid
ft-msl = Feet above mean sea level
Data gaps = wells were inaccessible and not gauged

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Monitoring Well GEI-4 Historical Groundwater Elevation and LNAPL Thickness

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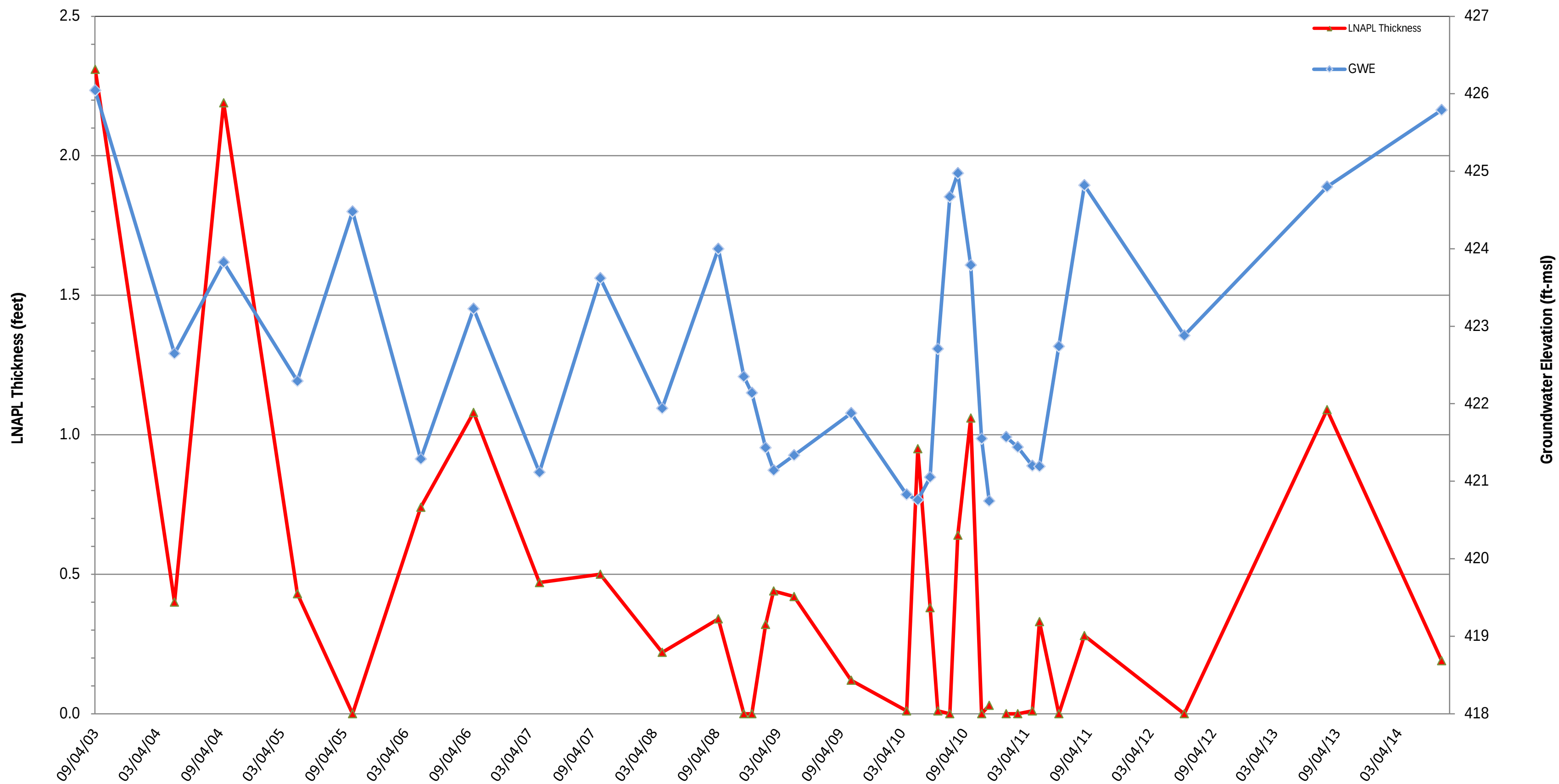
FIGURE 8



LEGEND:
- GWE = Groundwater elevation
- LNAPL = Light non-aqueous phase liquid
- ft-msl = Feet above mean sea level
- Data gaps = wells were inaccessible and not gauged

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Monitoring Well GEI-5 Historical Groundwater Elevation and LNAPL Thickness

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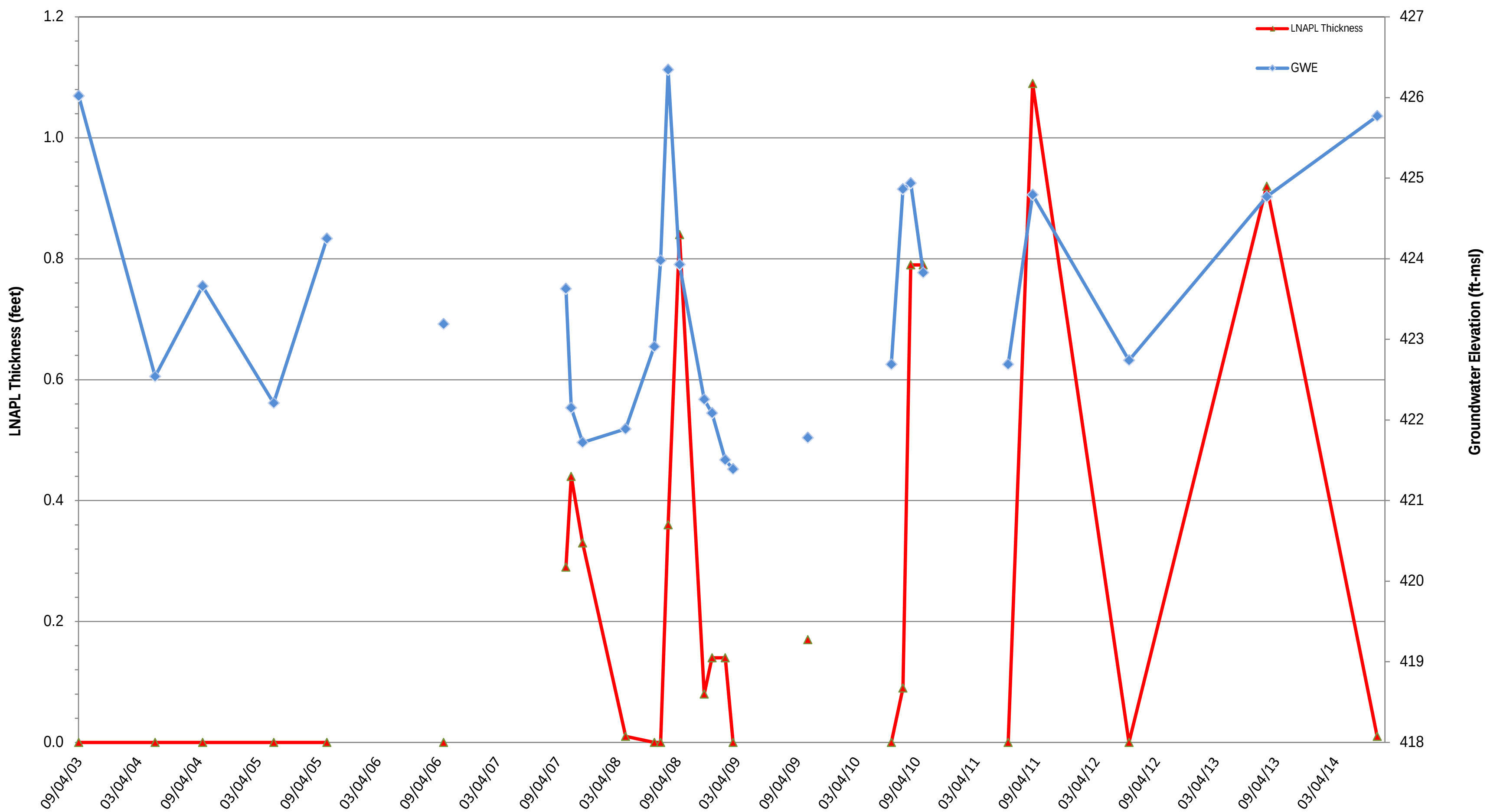
FIGURE
9



LEGEND:

GWE = Groundwater elevation
LNAPL = Light non-aqueous phase liquid
ft-msl = Feet above mean sea level
Data gaps = wells were inaccessible and not gauged

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Monitoring Well GEI-6 Historical Groundwater Elevation and LNAPL Thickness

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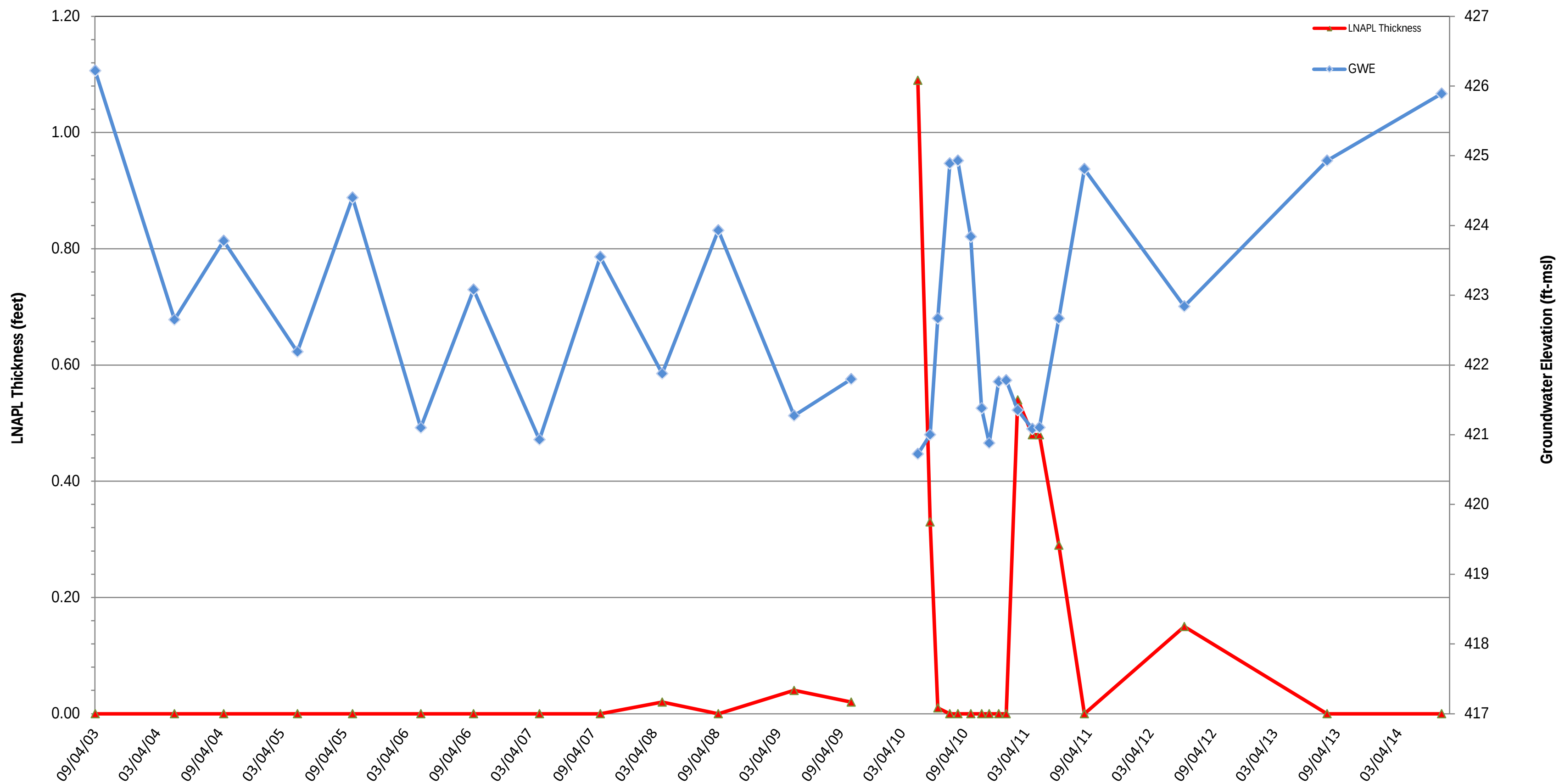
FIGURE 10



LEGEND:
GWE = Groundwater elevation
LNAPL = Light non-aqueous phase liquid
ft-msl = Feet above mean sea level
Data gaps = wells were inaccessible and not gauged

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Monitoring Well GEI-7 Historical Groundwater Elevation and LNAPL Thickness

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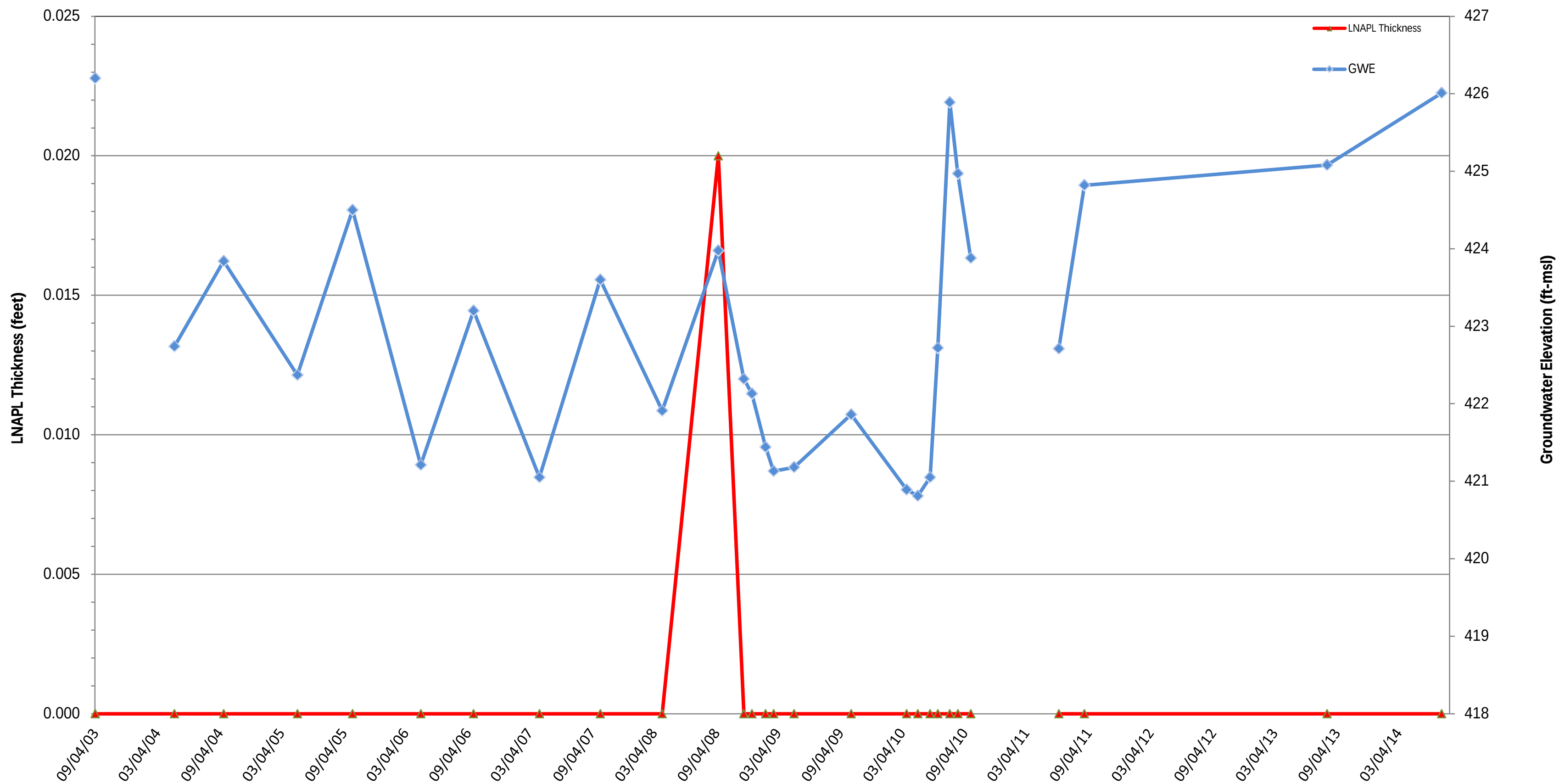
FIGURE
11



LEGEND:

GWE = Groundwater elevation
LNAPL = Light non-aqueous phase liquid
ft-msl = Feet above mean sea level
Data gaps = wells were inaccessible and not gauged, including First Semi-Annual 2012

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Monitoring Well GEI-8 Historical Groundwater Elevation and LNAPL Thickness

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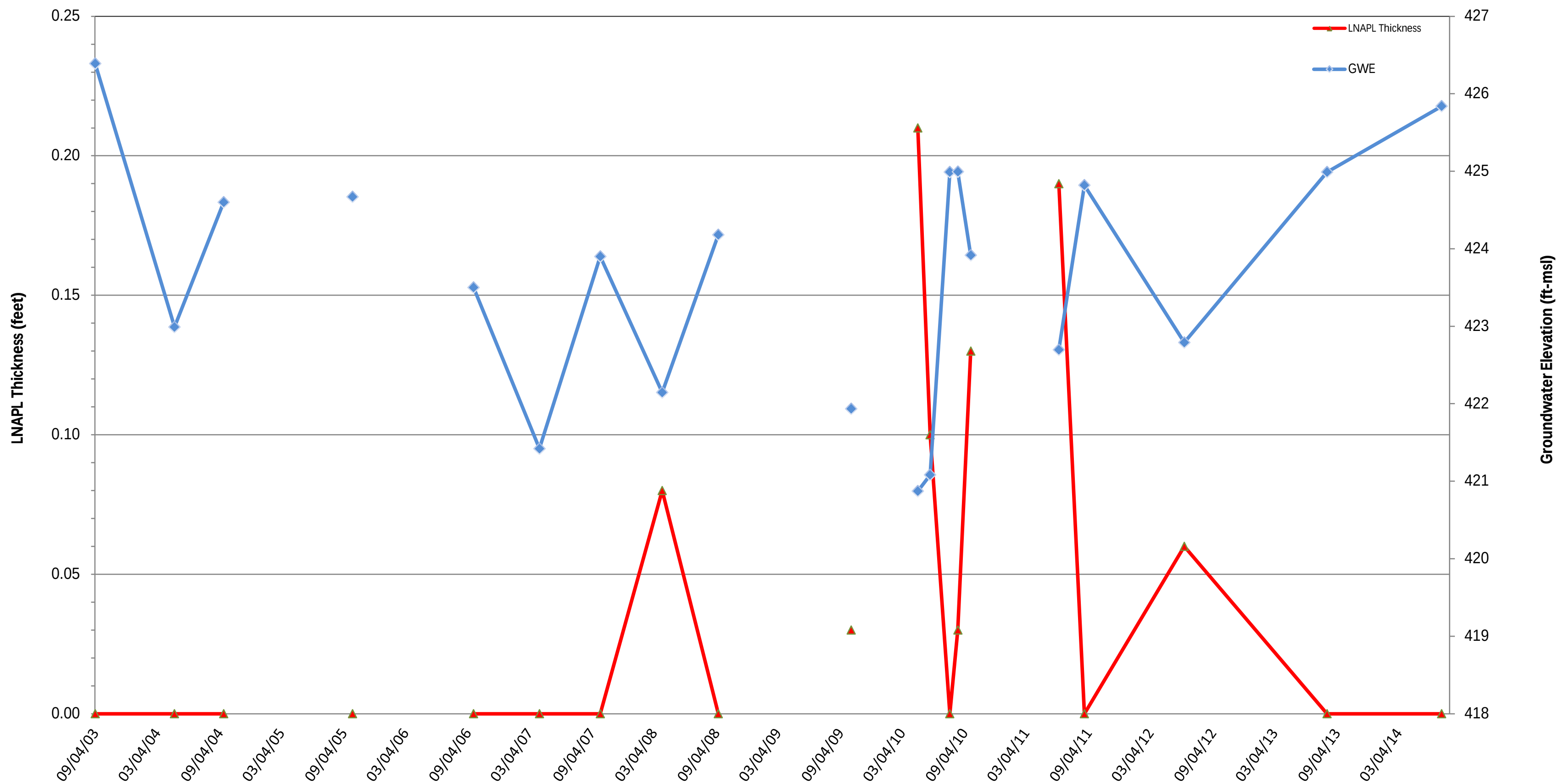
FIGURE
12



LEGEND:

GWE = Groundwater elevation
LNAPL = Light non-aqueous phase liquid
ft-msl = Feet above mean sea level
Data gaps = wells were inaccessible and not gauged

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Monitoring Well GEI-9 Historical Groundwater Elevation and LNAPL Thickness

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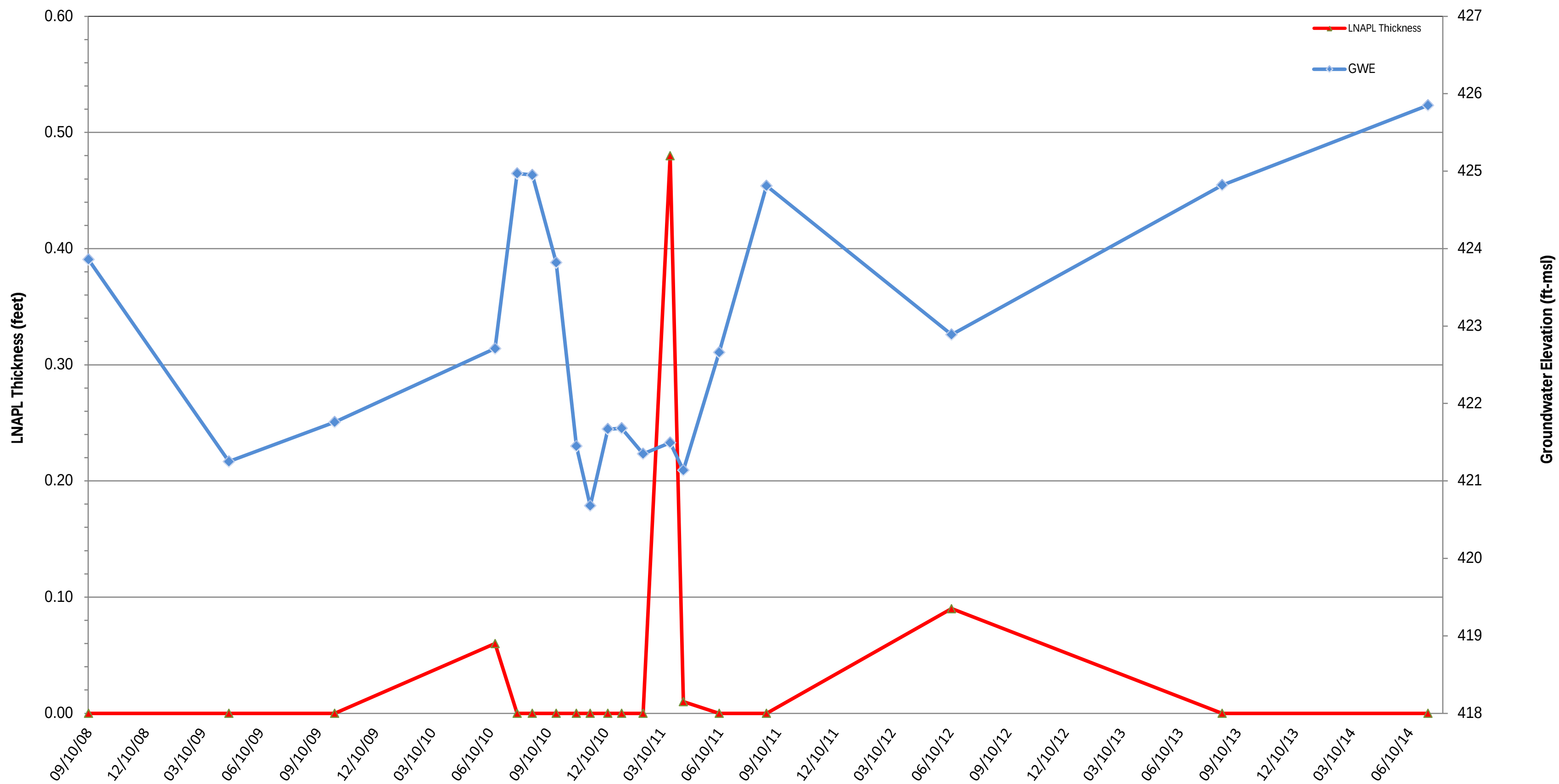
FIGURE
13



LEGEND:

GWE = Groundwater elevation

LNAPL = Light non-aqueous phase liquid

ft-msl = Feet above mean sea level

Data gaps = wells were inaccessible and not gauged

CHEVRON #306443 (FORMER UNOCAL BULK PLANT)

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ANNUAL 2014 GROUNDWATER MONITORING REPORT

Monitoring Well MW-1 Historical Groundwater Elevation and LNAPL Thickness

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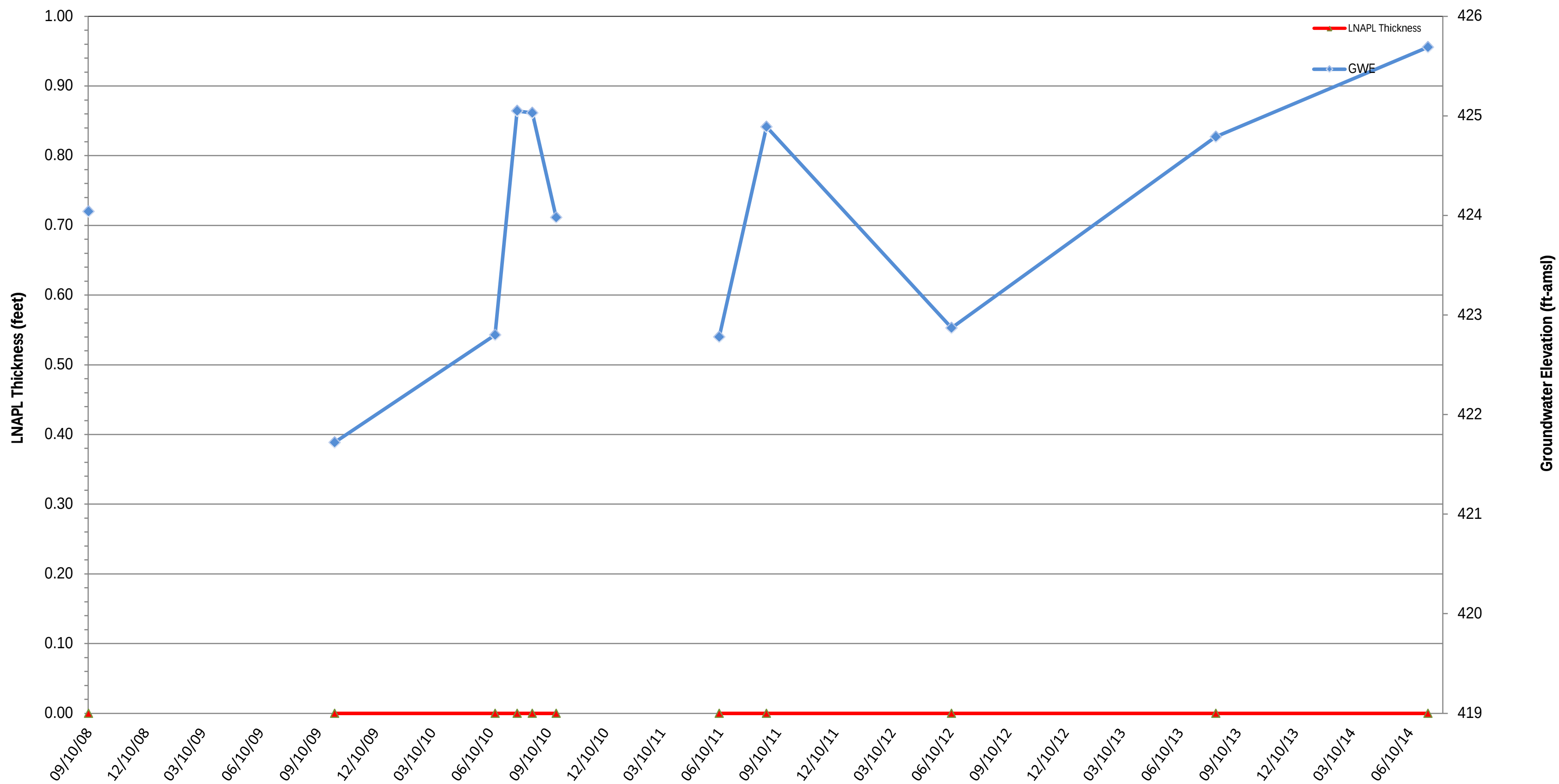
FIGURE 14



LEGEND:
- GWE = Groundwater elevation
- LNAPL = Light non-aqueous phase liquid
- ft-msl = Feet mean sea level
- Data gaps = wells were inaccessible and not gauged

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ANNUAL 2014 GROUNDWATER MONITORING REPORT

Monitoring Well MW-4 Historical Groundwater Elevation and LNAPL Thickness

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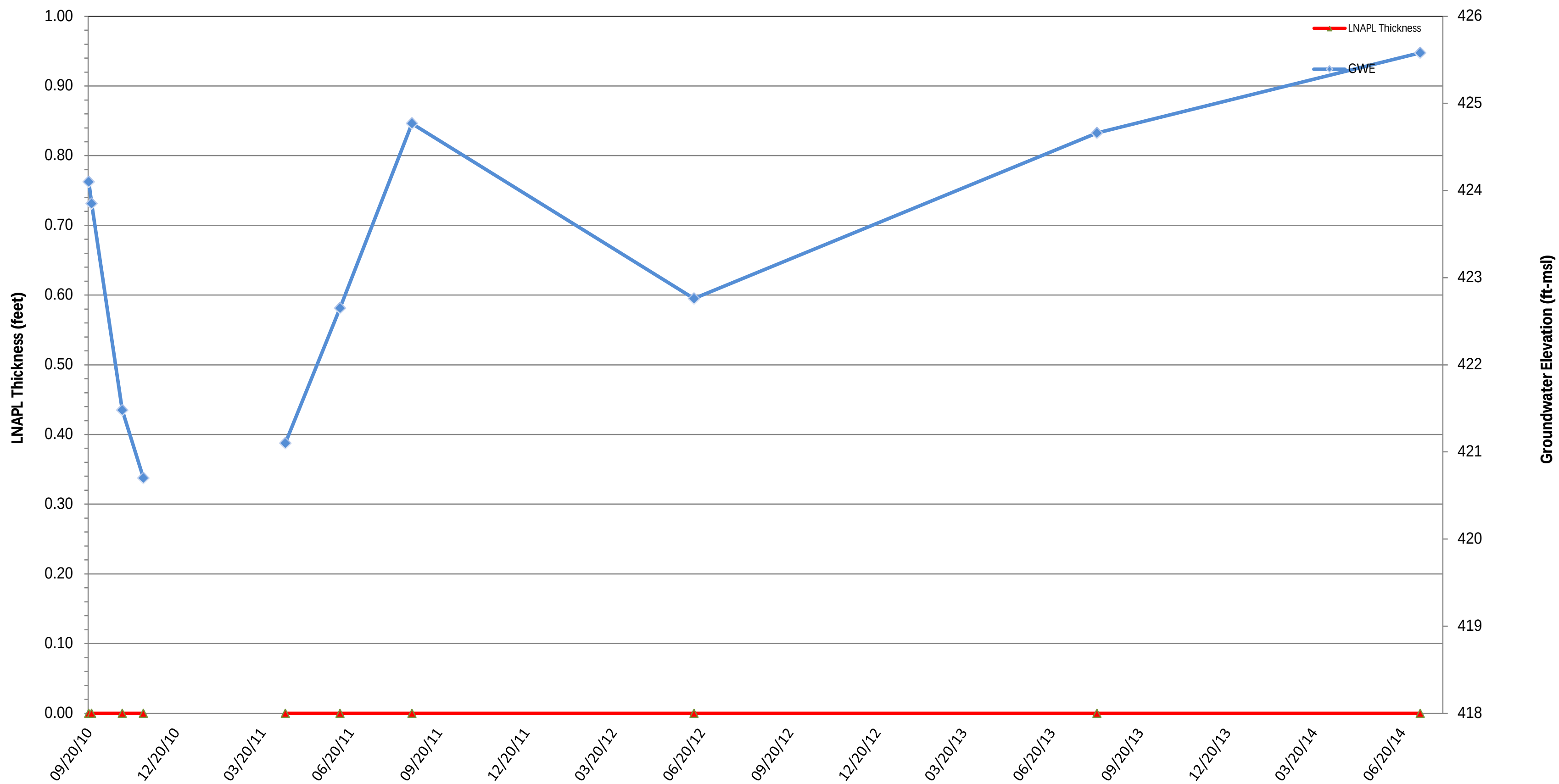
FIGURE 15



LEGEND:
- GWE = Groundwater elevation
- LNAPL = Light non-aqueous phase liquid
- ft-msl = Feet above mean sea level
- Data gaps = wells were inaccessible and not gauged

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Monitoring Well MW-7 Historical Groundwater Elevation and LNAPL Thickness

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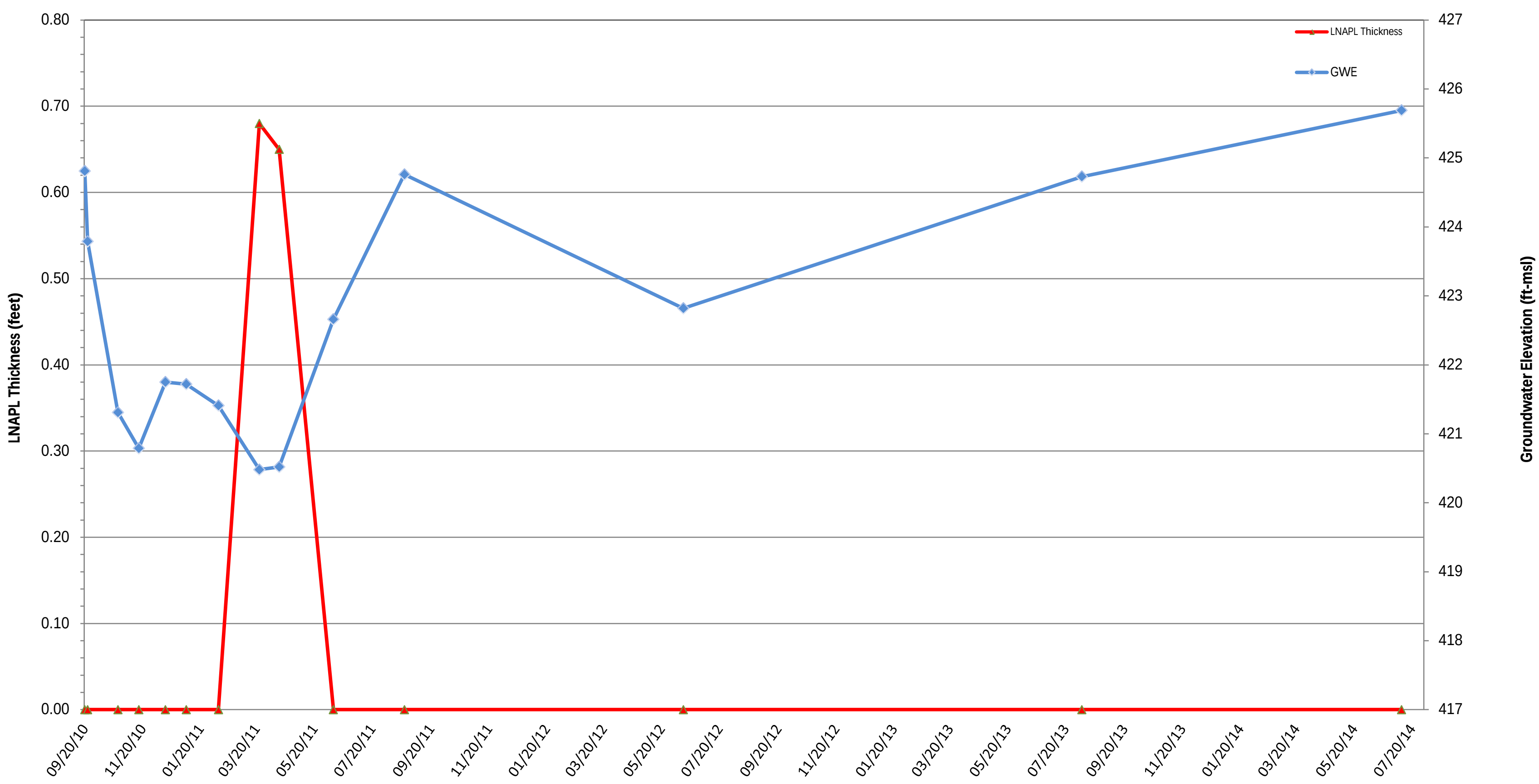
FIGURE
16



LEGEND:

GWE = Groundwater elevation

LNAPL = Light non-aqueous phase liquid

ft-msl = Feet above mean sea level

Data gaps = wells were inaccessible and not gauged

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ANNUAL 2014 GROUNDWATER MONITORING REPORT

Monitoring Well MW-8 Historical Groundwater Elevation and LNAPL Thickness

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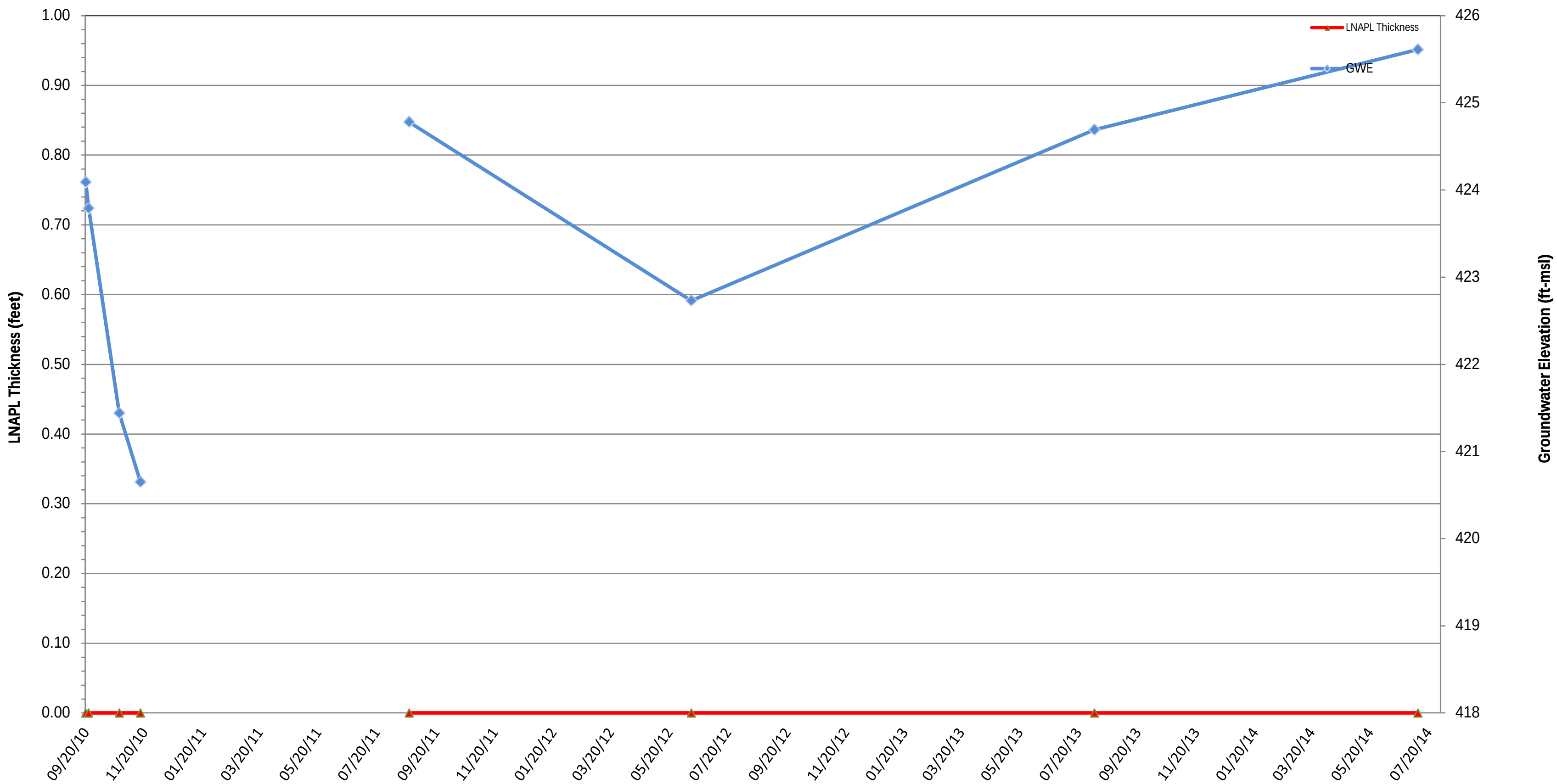
FIGURE
17



LEGEND:

GWE = Groundwater elevation
LNAPL = Light non-aqueous phase liquid
ft-msl = Feet above mean sea level
Data gaps = wells were inaccessible and not gauged

CHEVRON #306443 (FORMER UNOCAL BULK PLANT)
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ANNUAL 2014 GROUNDWATER MONITORING REPORT

Monitoring Well MW-9 Historical Groundwater Elevation and LNAPL Thickness

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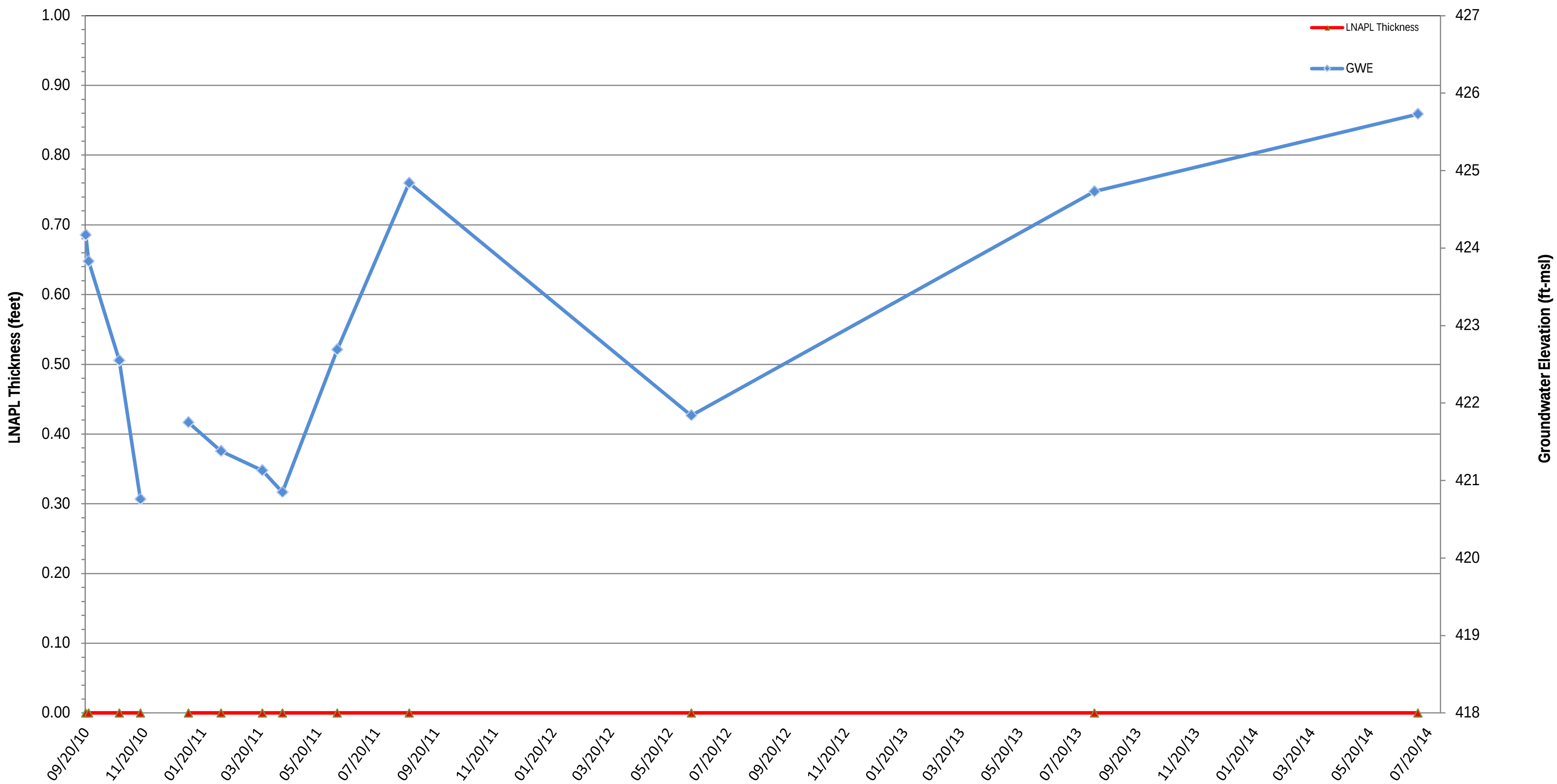
FIGURE 18



LEGEND:

- GWE = Groundwater elevation
- LNAPL = Light non-aqueous phase liquid
- ft-msl = Feet above mean sea level
- Data gaps = wells were inaccessible and not gauged

CHEVRON #306443 (FORMER UNOCAL BULK PLANT)
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Monitoring Well MW-10 Historical Groundwater Elevation and LNAPL Thickness

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FIGURE 19

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Appendix A

July 23, 2014 ADEC Email

From: Burgess, Robert A (DEC)
To: Montgomery, Gregory
Subject: FIA Unocal LNAPL
Date: Wednesday, July 23, 2014 4:27:43 PM

Hi Greg.

To support my efforts in evaluating the request for conditional closure at the FIA Unocal site, could you provide me with a summary of LNAPL recovery efforts and reasoning why it is impracticable to attempt further recovery? In addition, I need to document that there is a stable or decreasing trend in dissolved plume concentration and LNAPL quantity (estimated total volume), if possible. If a formal trend analysis is not the best tool for this, a detailed explanation can sometimes work as well.

Additionally, I want to let you know that current DEC policy suggests that long-term monitoring should not be part of ICs, with the rationale that sites should not be closed if additional monitoring is needed. At this site, due to the LNAPL and high dissolved concentrations, additional monitoring is certainly warranted, but since active remediation may be impracticable it makes sense to me to work towards closure with monitoring as much as possible. We are having ongoing discussions with our management about this issue and there may be room for exceptions applicable to this site. I'm hoping that we can come up with a solution or reasonable compromise for this site.

Let me know if you have any questions.

-Robert

Robert Burgess
Environmental Program Specialist
Contaminated Sites Program
Alaska Department of Environmental Conservation
(907)451-2153

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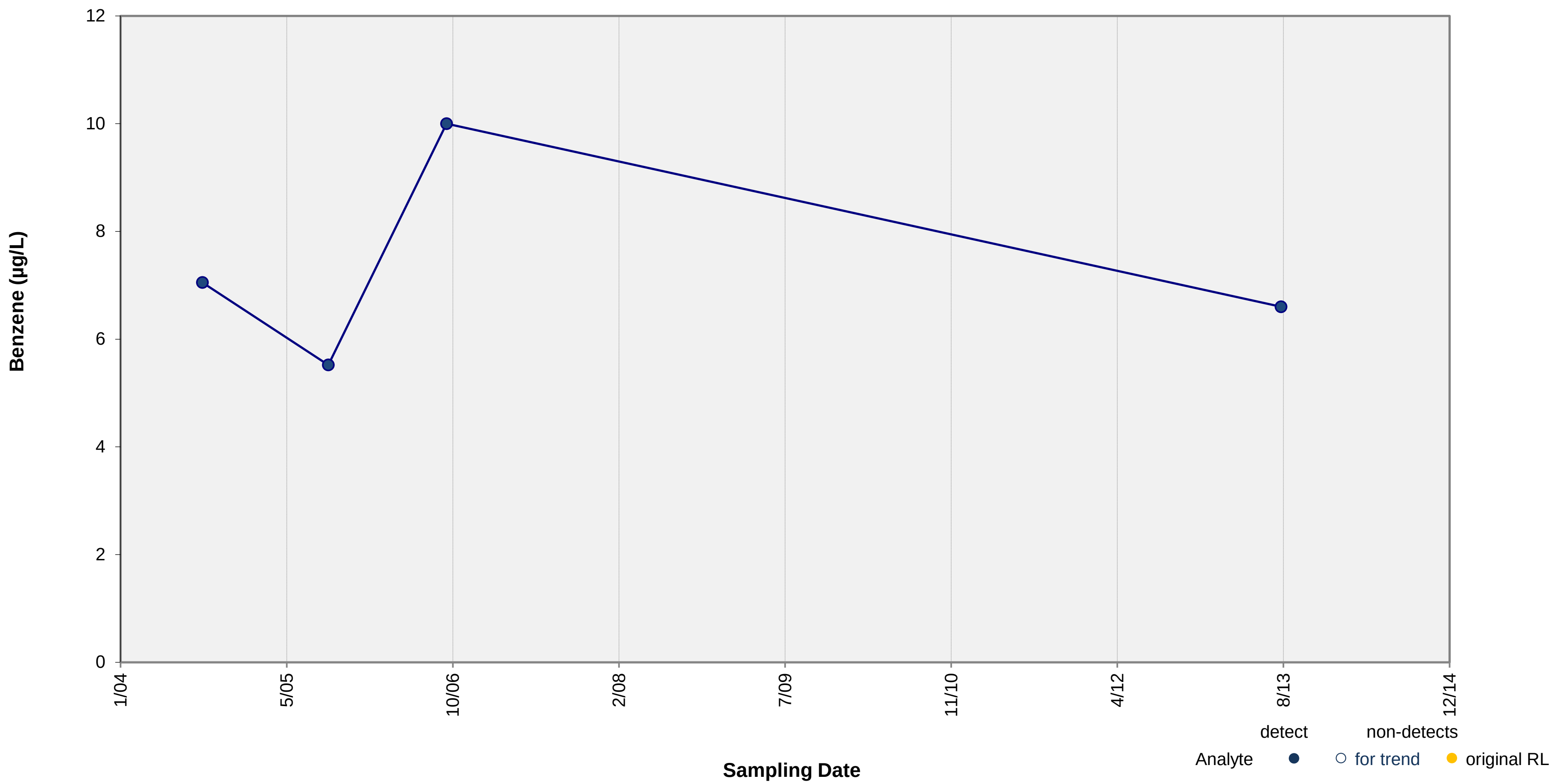
Appendix B

ADEC Mann-Kendall Results Summary



Results of Mann-Kendall Test for Trend: **No Significant Trend**

p value = 0.625 Note: p value < 0.05 indicates a statistically significant trend (95% confidence level).

Results of Sen's Estimator of Slope: **NA**

Median Slope Estimate = NA ug/L Per Day

90% Confidence Interval = NA to NA ug/L Per Day

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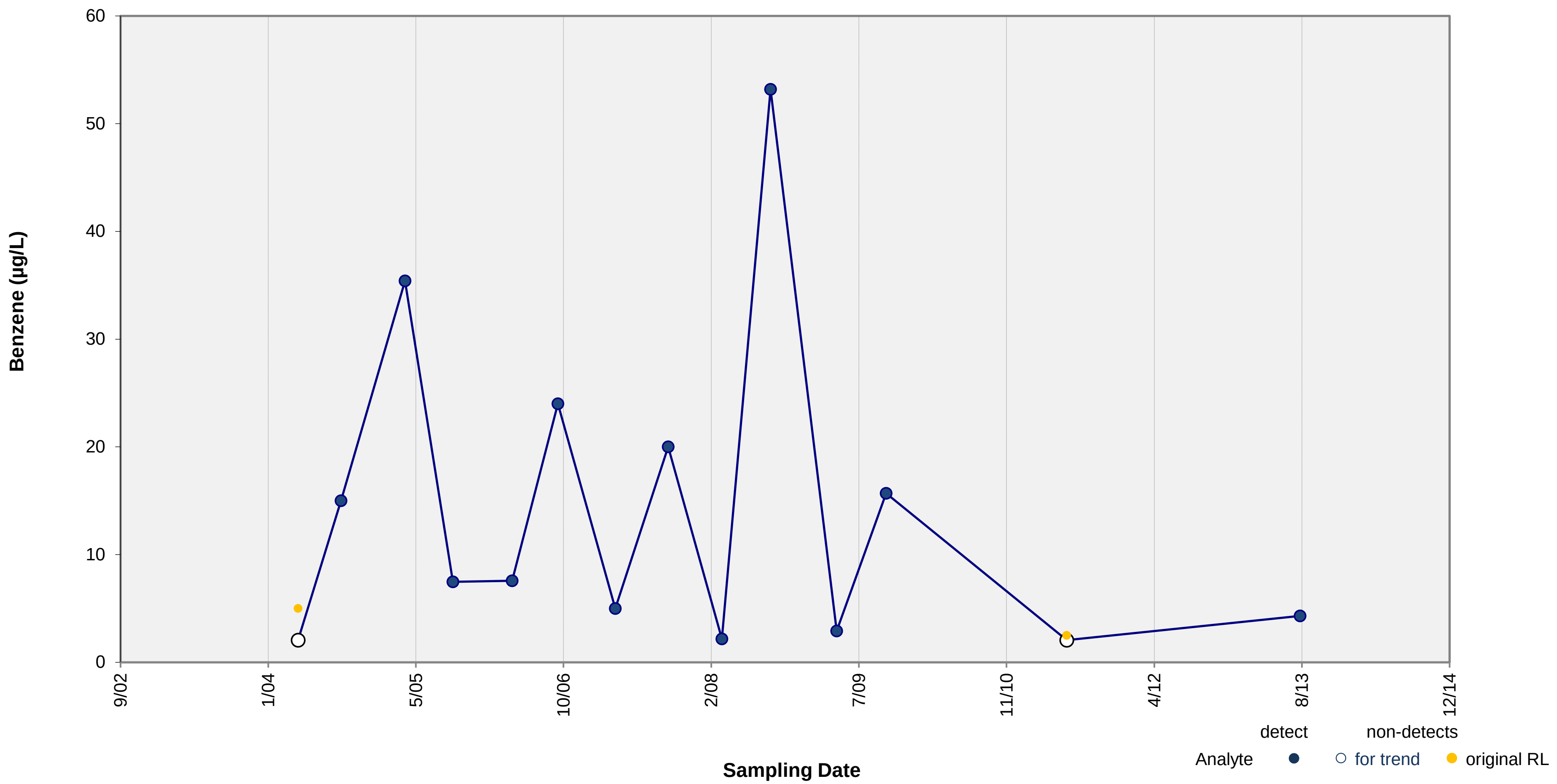
Concentration vs. Time Plot – Benzene in GEI-1

Chevron Facility No. 306443



Results of Mann-Kendall Test for Trend: **No Significant Trend**

p value = 0.273 Note: p value < 0.05 indicates a statistically significant trend (95% confidence level).

Results of Sen's Estimator of Slope: **No Significant Trend**

Median Slope Estimate = -1.9E-03 ug/L Per Day

90% Confidence Interval = -7.7E-03 to 2.3E-03 ug/L Per Day

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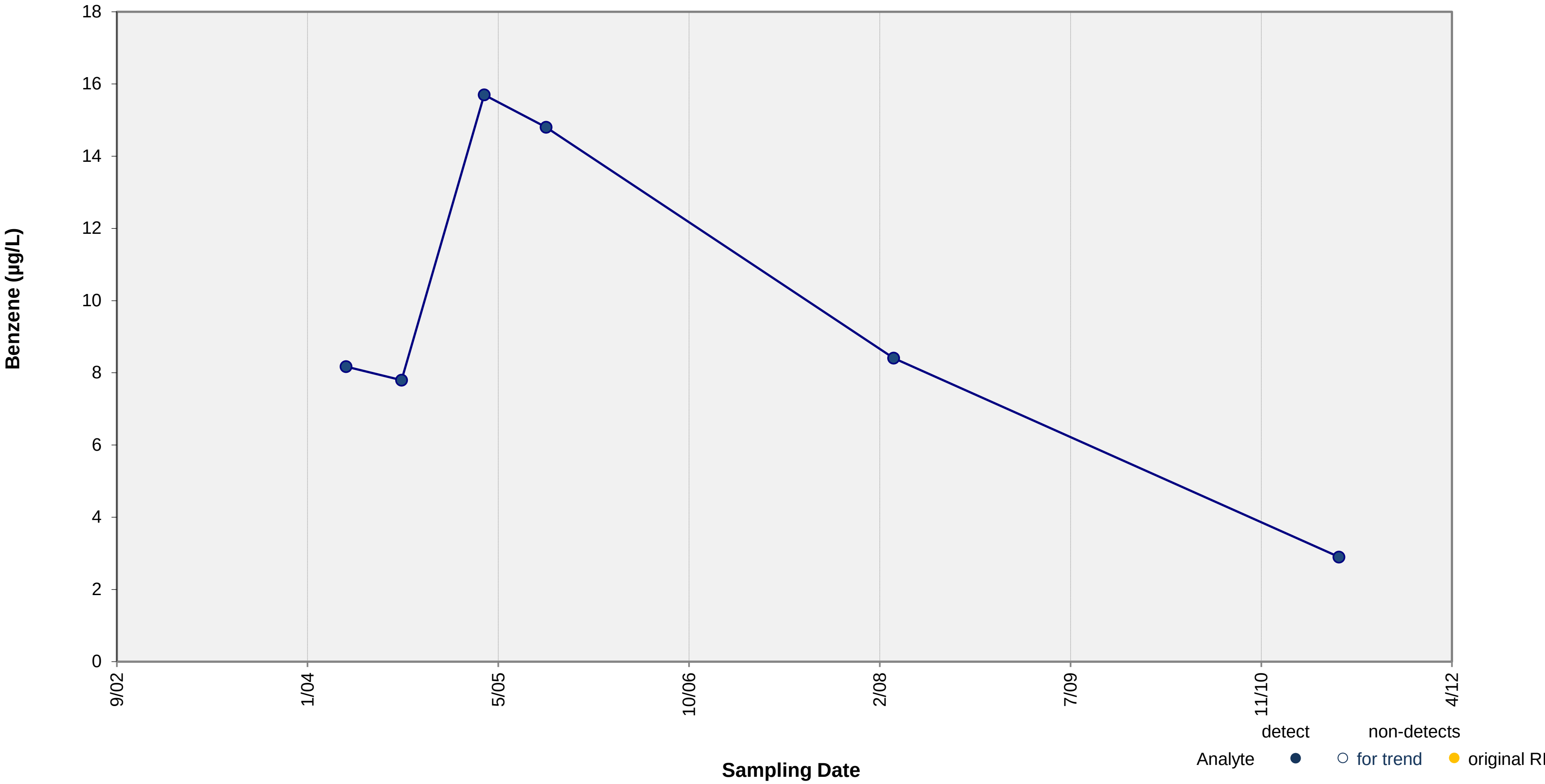
Concentration vs. Time Plot – Benzene in GEI-4

Chevron Facility No. 306443

G:\COMMON\Data\Projects\Chevron\306443 - Fairbanks Int Airport Unocal\2015 MNA Analysis\MK Files\MK_Benzene_GEI-4.xlsx - 5/27/2015



Results of Mann-Kendall Test for Trend: **No Significant Trend**

p value = 0.360 Note: p value < 0.05 indicates a statistically significant trend (95% confidence level).

Results of Sen's Estimator of Slope: **No Significant Trend**

Median Slope Estimate = -2.0E-03 ug/L Per Day

90% Confidence Interval = -5.7E-03 to 1.1E-02 ug/L Per Day

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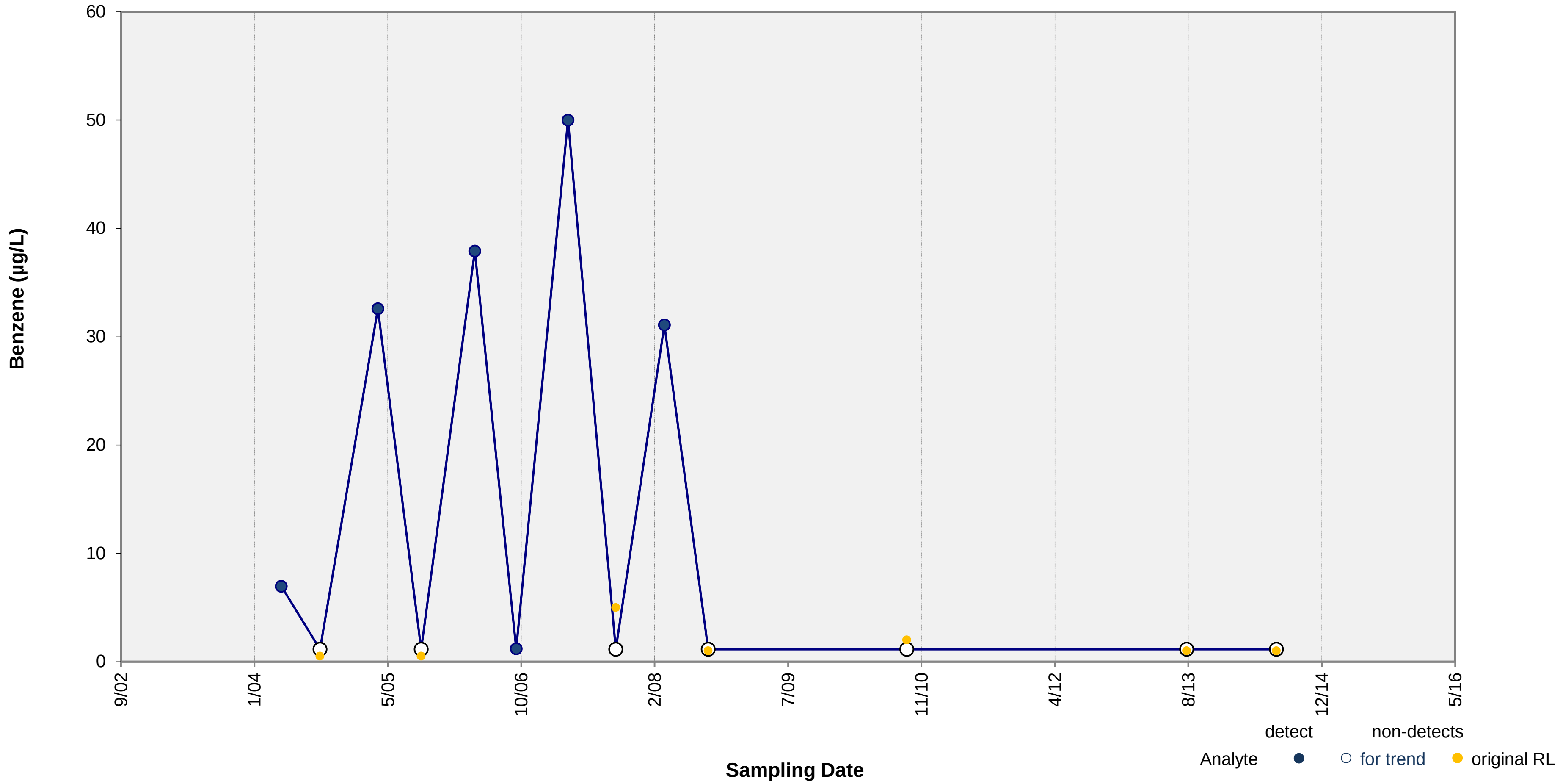
Concentration vs. Time Plot – Benzene in GEI-6

Chevron Facility No. 306443

G:\COMMON\Data\Projects\Chevron\306443 - Fairbanks Int Airport Unocal\2015 MNA Analysis\MK Files\MK_Benzene_GEI-6.xlsx - 5/27/2015



Results of Mann-Kendall Test for Trend: **No Significant Trend**

p value = 0.115 Note: p value < 0.05 indicates a statistically significant trend (95% confidence level).

Results of Sen's Estimator of Slope: **No trend**

Median Slope Estimate = 0.0E+00 ug/L Per Day

90% Confidence Interval = -7.4E-03 to 0.0E+00 ug/L Per Day

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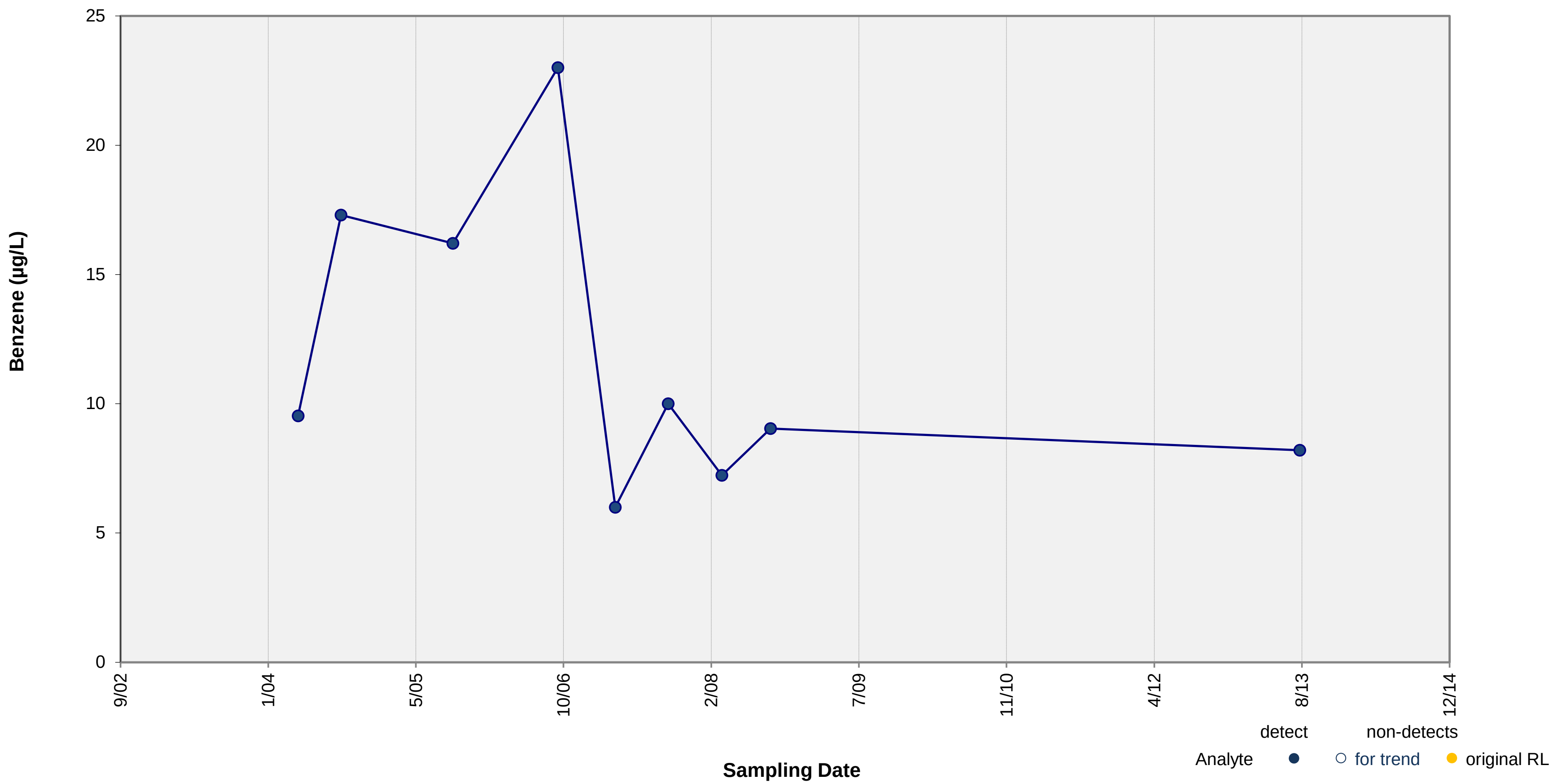
Concentration vs. Time Plot – Benzene in GEI-7

Chevron Facility No. 306443



Results of Mann-Kendall Test for Trend: **No Significant Trend**

p value = 0.130 Note: p value < 0.05 indicates a statistically significant trend (95% confidence level).

Results of Sen's Estimator of Slope: **No Significant Trend**

Median Slope Estimate = -2.8E-03 ug/L Per Day

90% Confidence Interval = -7.7E-03 to 4.8E-04 ug/L Per Day

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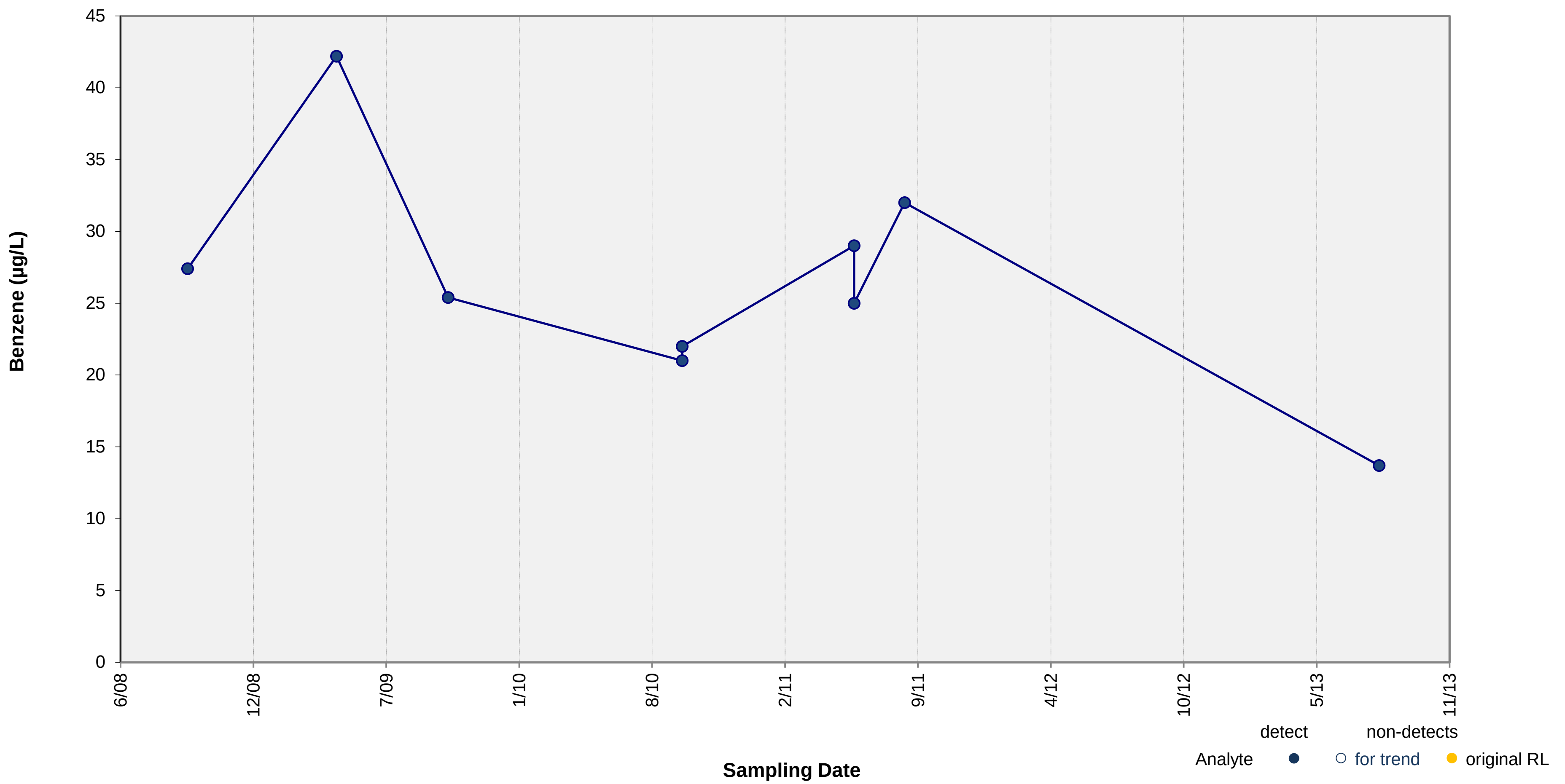
Concentration vs. Time Plot – Benzene in GEI-9

Chevron Facility No. 306443



Results of Mann-Kendall Test for Trend:	**No Significant Trend**			
	p value =	0.238	Note: p value < 0.05 indicates a statistically significant trend (95% confidence level).	
Results of Sen's Estimator of Slope:	**NA**			
	Median Slope Estimate =	NA	ug/L Per Day	
	90% Confidence Interval =	NA	to NA	ug/L Per Day

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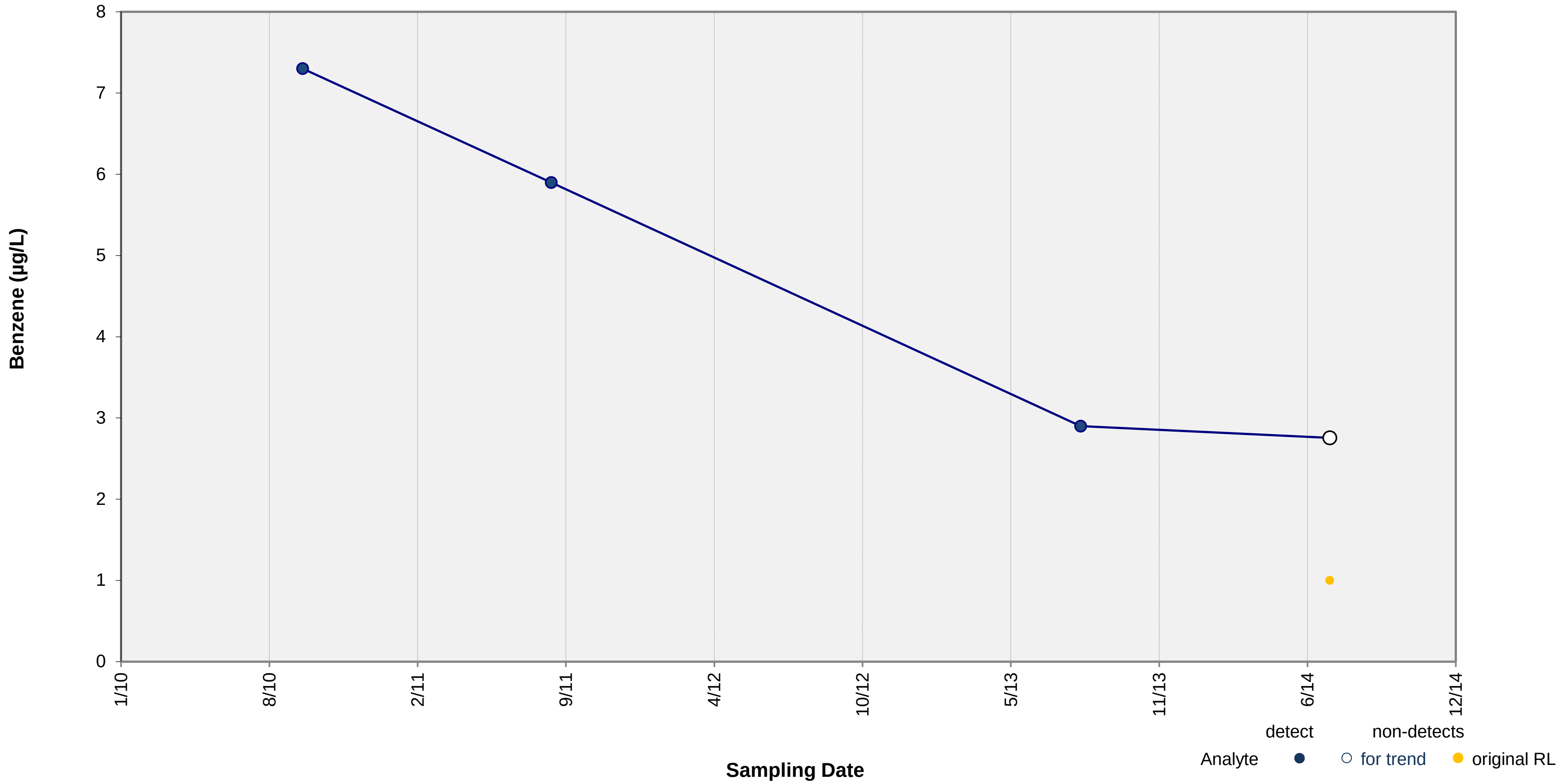
Concentration vs. Time Plot – Benzene in MW-1

Chevron Facility No. 306443



Results of Mann-Kendall Test for Trend:	**DECREASING TREND**			
	p value =	0.042	Note: p value < 0.05 indicates a statistically significant trend (95% confidence level).	
Results of Sen's Estimator of Slope:	**NA**			
	Median Slope Estimate =	NA	ug/L Per Day	
	90% Confidence Interval =	NA	to NA	ug/L Per Day

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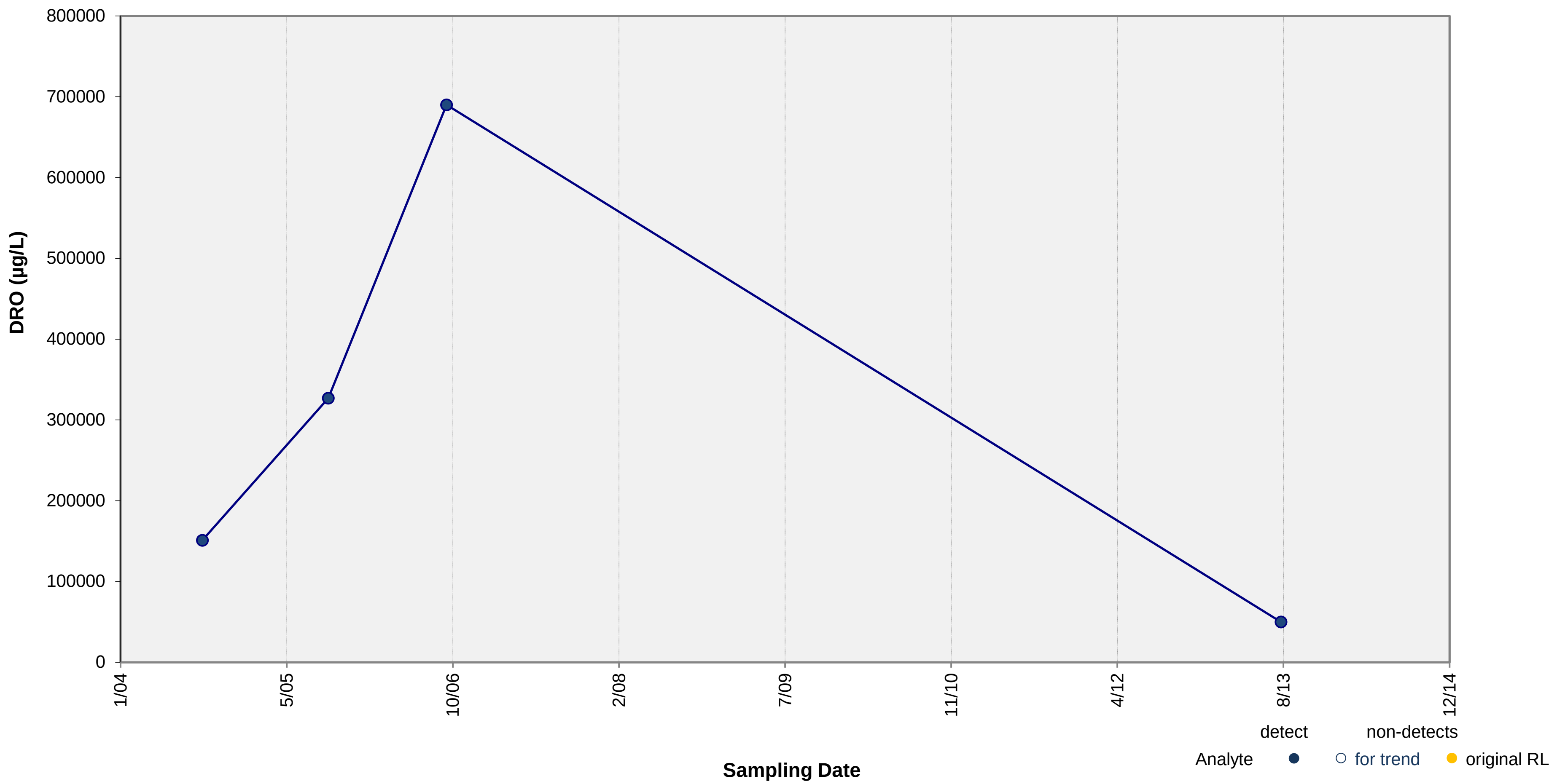
Concentration vs. Time Plot – Benzene in MW-9

Chevron Facility No. 306443

G:\COMMON\Data\Projects\Chevron\306443 - Fairbanks Int Airport Unocal\2015 MNA Analysis\MK Files\MK_Benzene_MW-9.xlsx - 5/27/2015



Results of Mann-Kendall Test for Trend: **No Significant Trend**

p value = 0.625 Note: p value < 0.05 indicates a statistically significant trend (95% confidence level).

Results of Sen's Estimator of Slope: **NA**

Median Slope Estimate = NA ug/L Per Day

90% Confidence Interval = NA to NA ug/L Per Day

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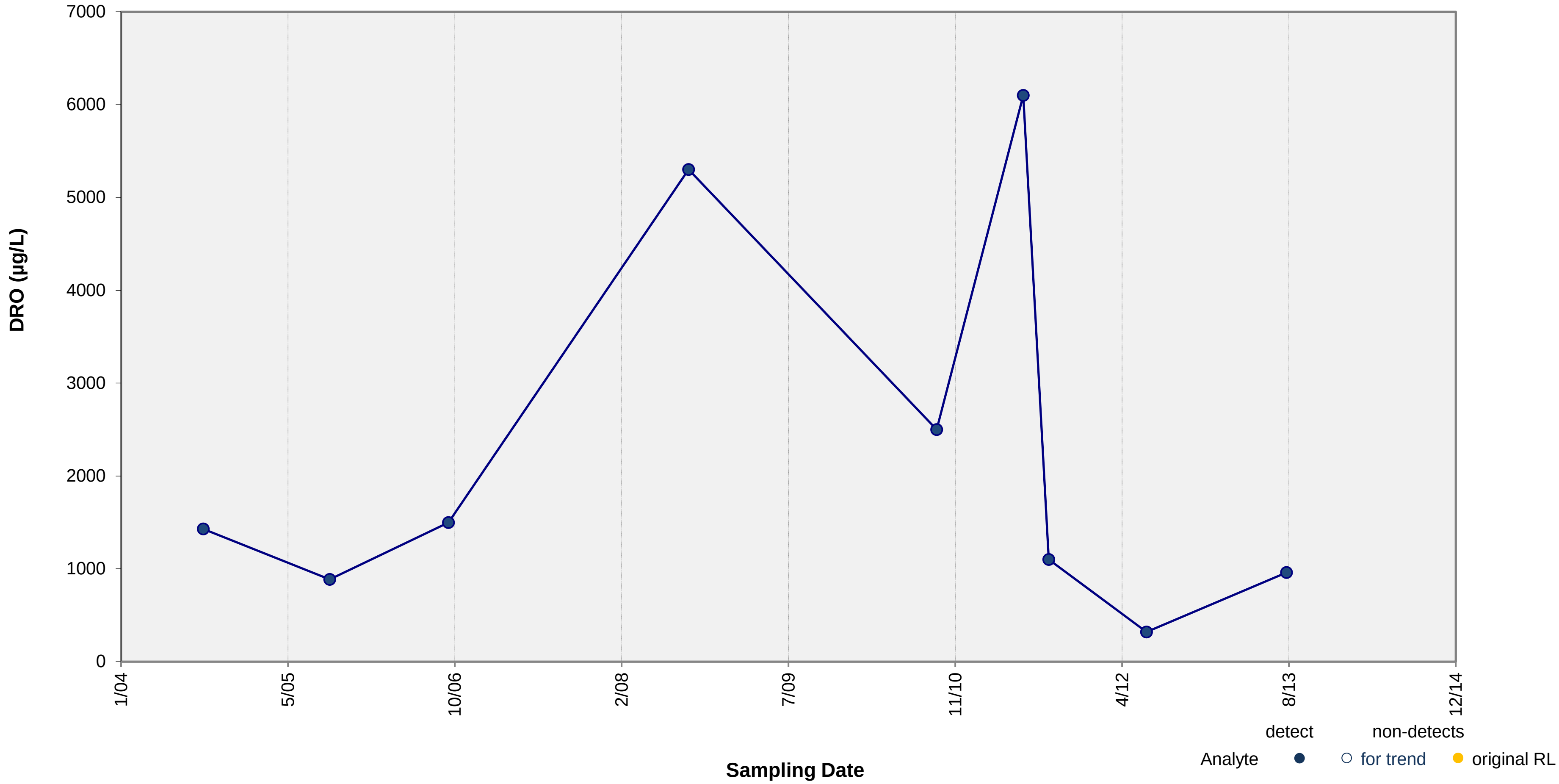
Concentration vs. Time Plot – DRO in GEI-1

Chevron Facility No. 306443



Results of Mann-Kendall Test for Trend: **No Significant Trend**

p value = 0.381 Note: p value < 0.05 indicates a statistically significant trend (95% confidence level).

Results of Sen's Estimator of Slope: **No Significant Trend**

Median Slope Estimate = -1.7E-01 ug/L Per Day

90% Confidence Interval = -2.3E+00 to 7.8E-01 ug/L Per Day

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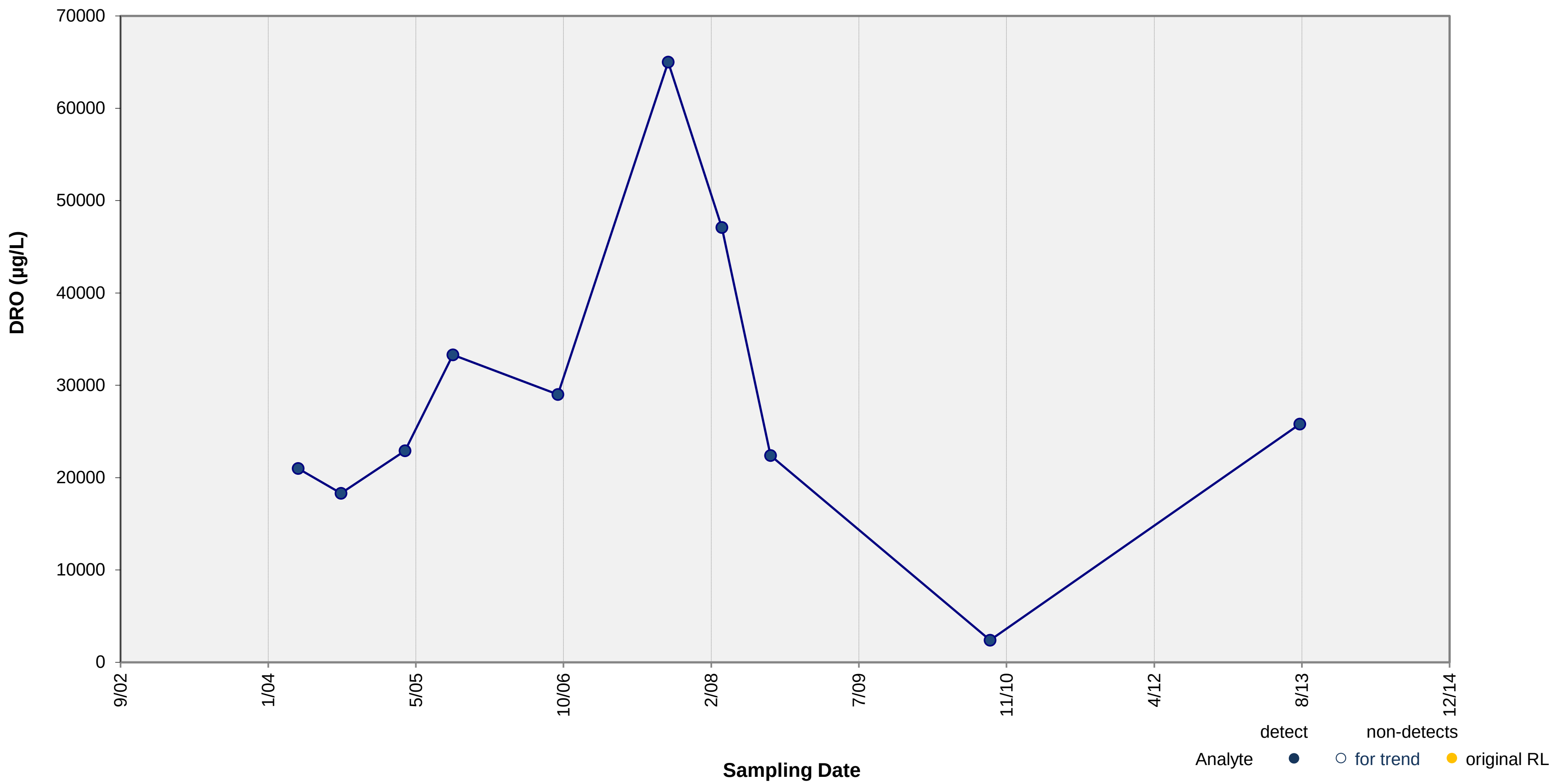
Concentration vs. Time Plot – DRO in GEI-2

Chevron Facility No. 306443



Results of Mann-Kendall Test for Trend: **No Significant Trend**

p value = 0.364 Note: p value < 0.05 indicates a statistically significant trend (95% confidence level).

Results of Sen's Estimator of Slope: **No Significant Trend**

Median Slope Estimate = 1.4E+00 ug/L Per Day

90% Confidence Interval = -1.0E+01 to 1.7E+01 ug/L Per Day

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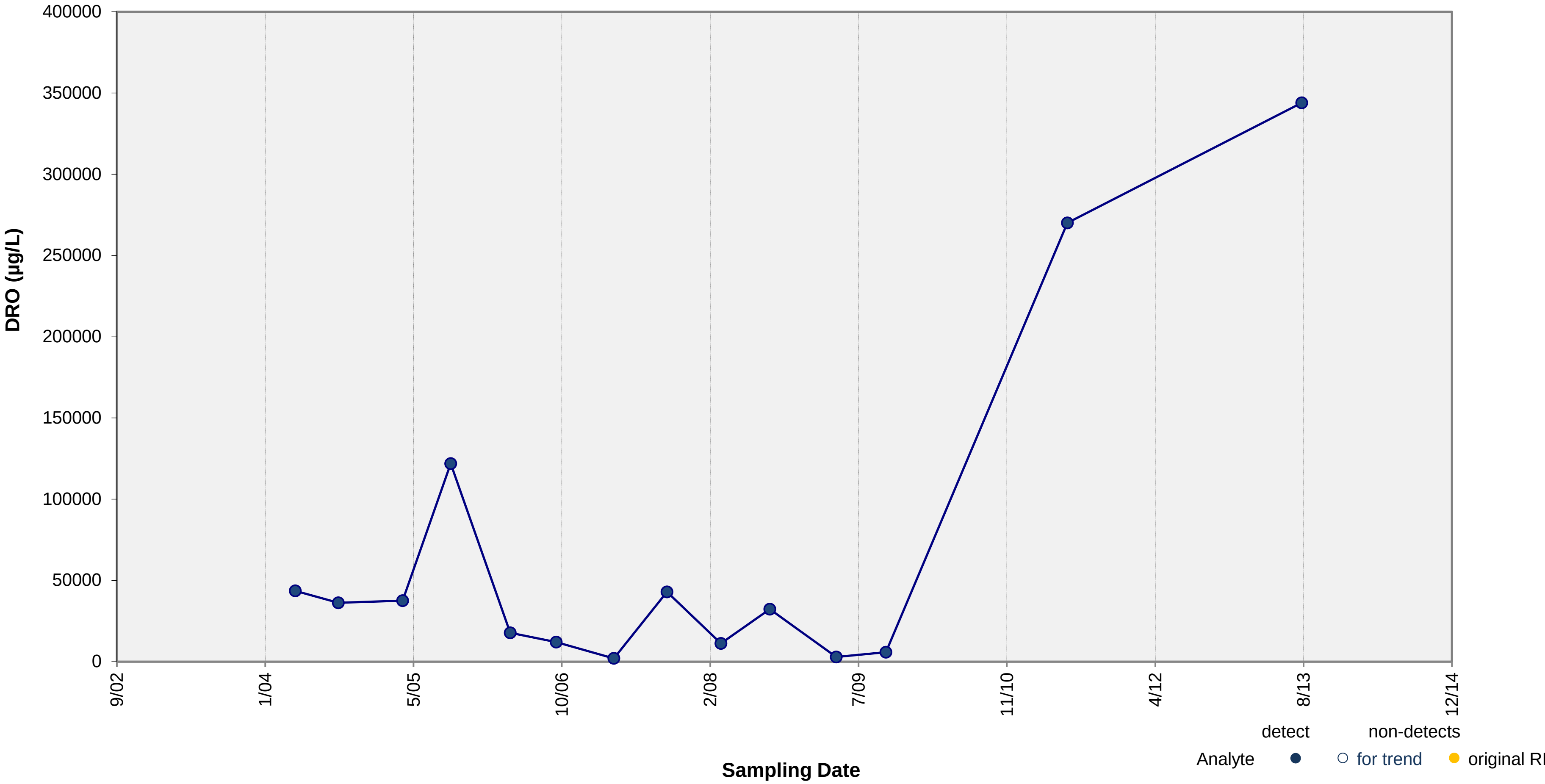
Concentration vs. Time Plot – DRO in GEI-3

Chevron Facility No. 306443



Results of Mann-Kendall Test for Trend: **No Significant Trend**

p value = 0.371 Note: p value < 0.05 indicates a statistically significant trend (95% confidence level).

Results of Sen's Estimator of Slope: **No Significant Trend**

Median Slope Estimate = -4.2E+00 ug/L Per Day

90% Confidence Interval = -2.2E+01 to 6.5E+01 ug/L Per Day

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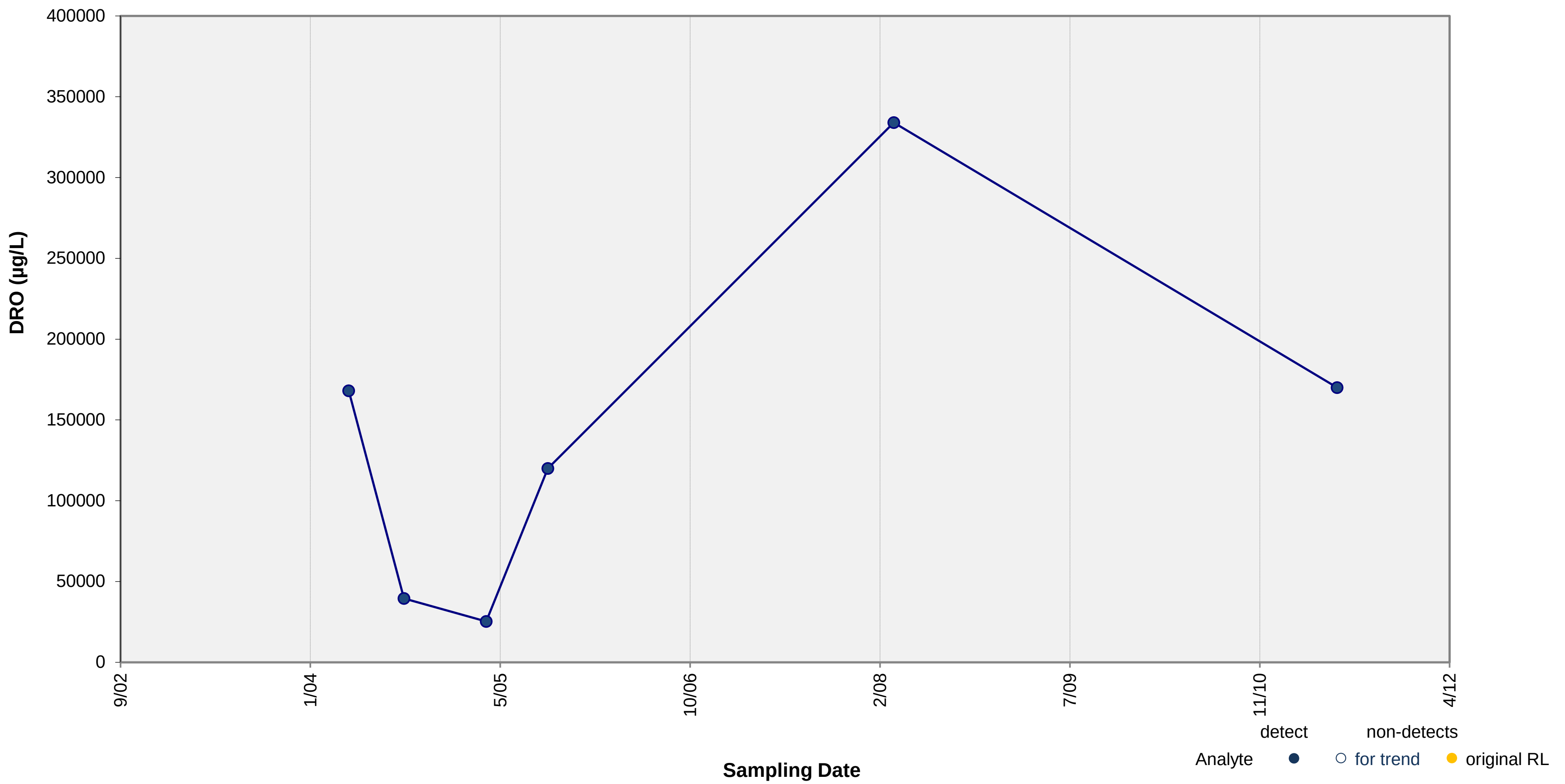
Concentration vs. Time Plot – DRO in GEI-4

Chevron Facility No. 306443



Results of Mann-Kendall Test for Trend: **No Significant Trend**

p value = 0.235 Note: p value < 0.05 indicates a statistically significant trend (95% confidence level).

Results of Sen's Estimator of Slope: **No Significant Trend**

Median Slope Estimate = 5.3E+01 ug/L Per Day

90% Confidence Interval = -1.3E+02 to 2.3E+02 ug/L Per Day

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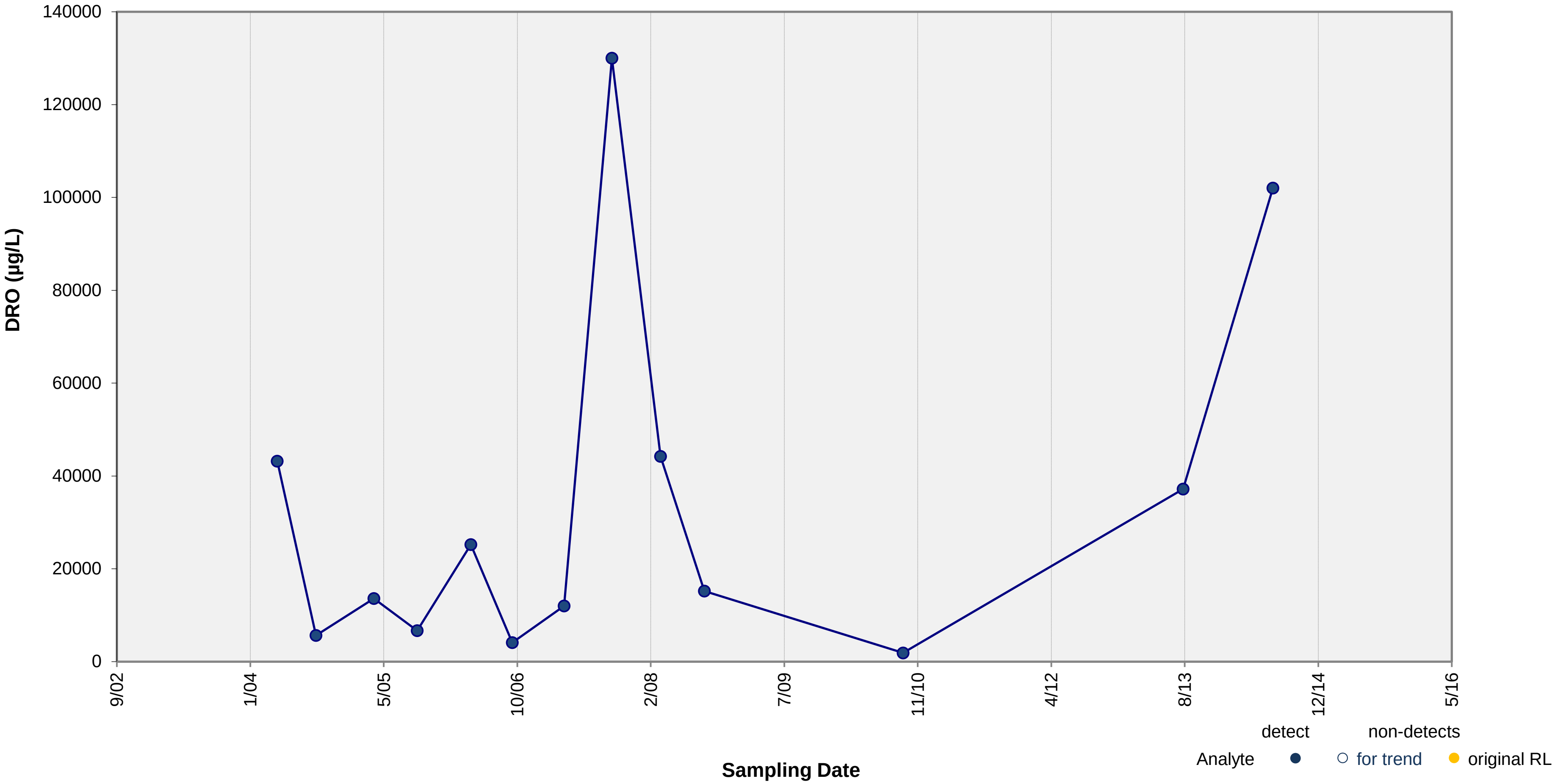
Concentration vs. Time Plot – DRO in GEI-6

Chevron Facility No. 306443

G:\COMMON\Data\Projects\Chevron\306443 - Fairbanks Int Airport Unocal\2015 MNA Analysis\MK Files\MK_DRO_GEI-6.xlsx - 5/27/2015



Results of Mann-Kendall Test for Trend: **No Significant Trend**

p value = 0.214 Note: p value < 0.05 indicates a statistically significant trend (95% confidence level).

Results of Sen's Estimator of Slope: **No Significant Trend**

Median Slope Estimate = 7.3E+00 ug/L Per Day

90% Confidence Interval = -4.7E+00 to 2.6E+01 ug/L Per Day

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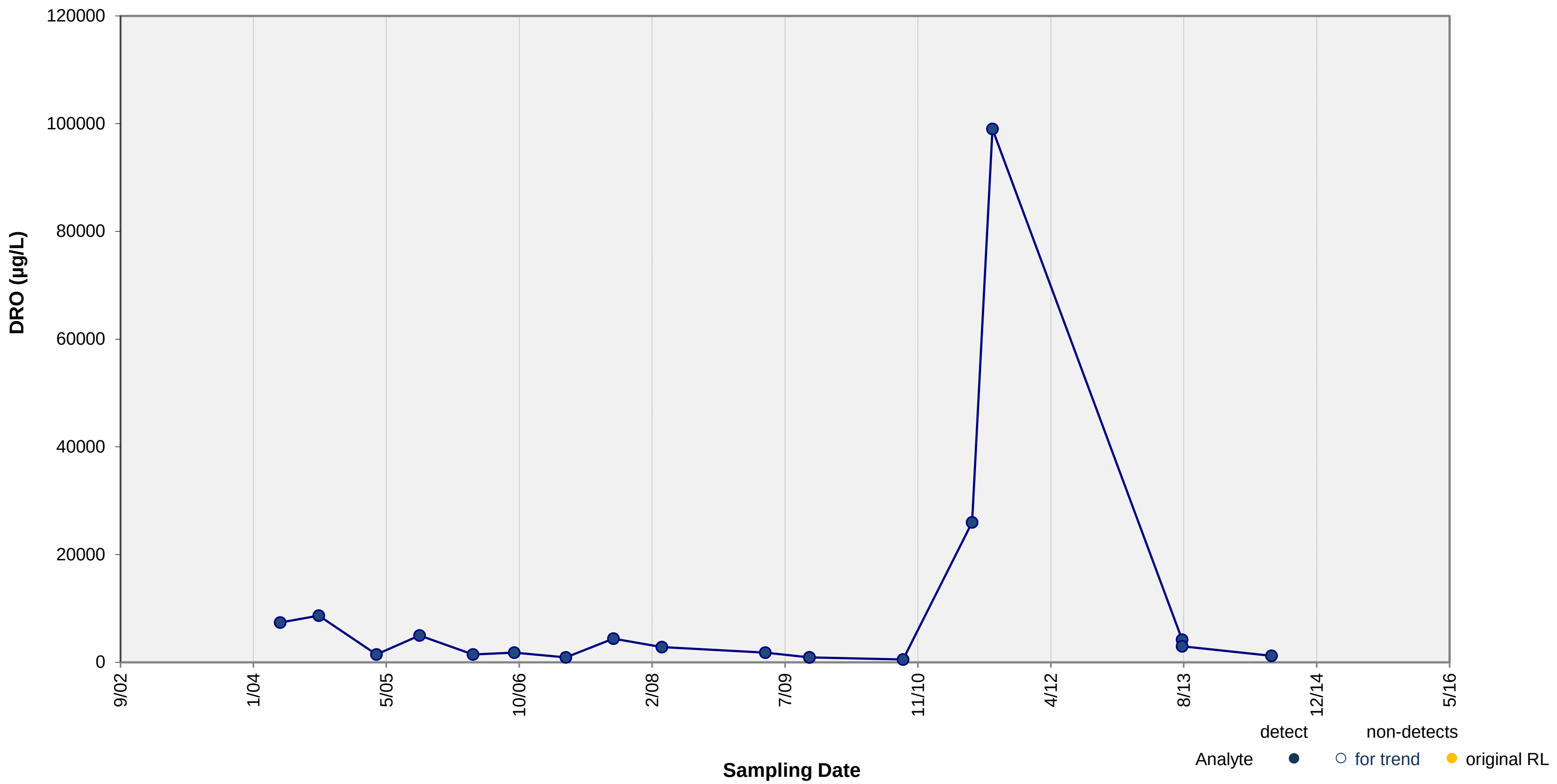
Concentration vs. Time Plot – DRO in GEI-7

Chevron Facility No. 306443



Results of Mann-Kendall Test for Trend: **No Significant Trend**

p value = 0.285 Note: p value < 0.05 indicates a statistically significant trend (95% confidence level).

Results of Sen's Estimator of Slope: **NA**

Median Slope Estimate = NA ug/L Per Day

90% Confidence Interval = NA to NA ug/L Per Day

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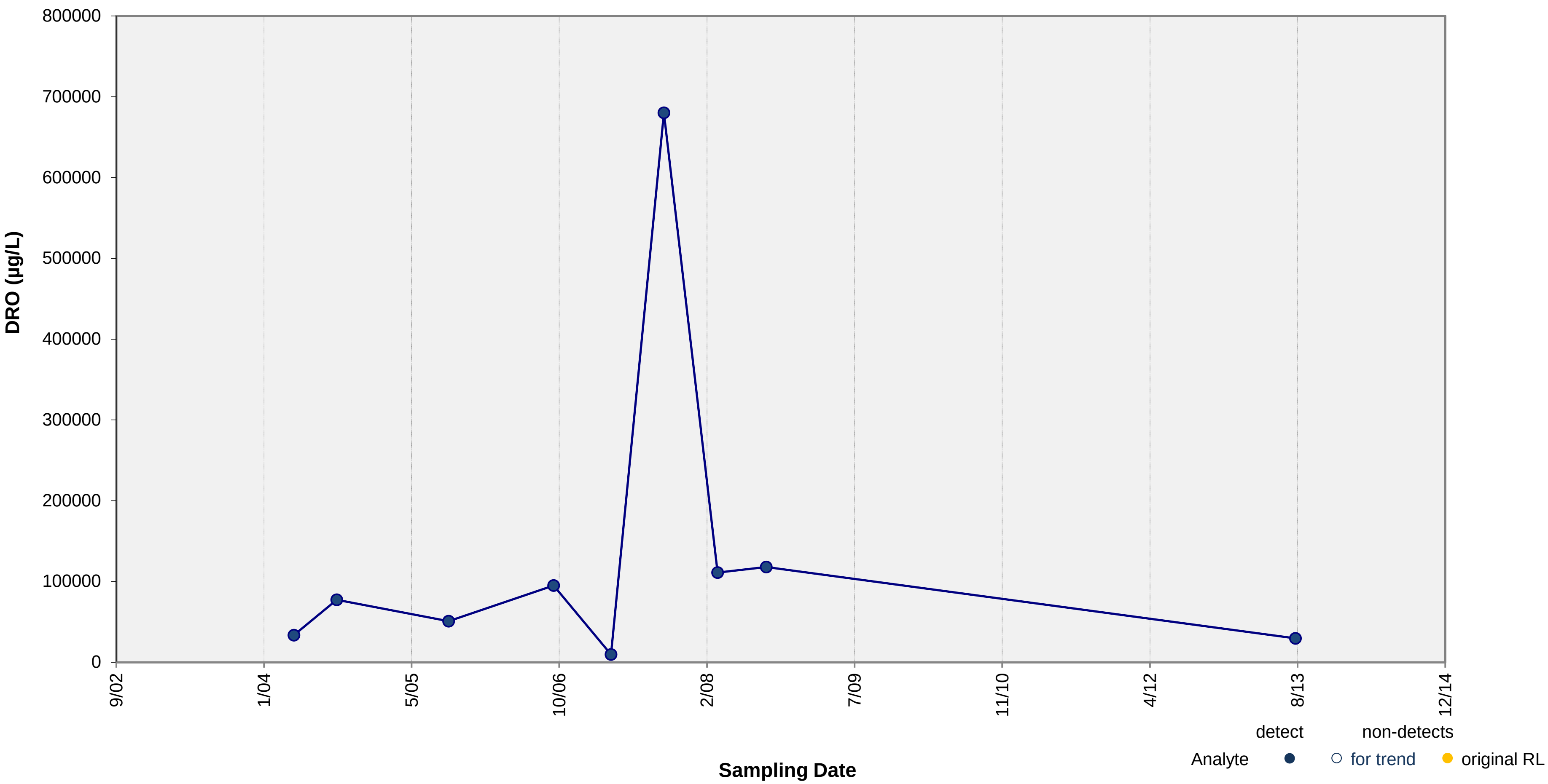
Concentration vs. Time Plot – DRO in GEI-8

Chevron Facility No. 306443



Results of Mann-Kendall Test for Trend: **No Significant Trend**

p value = 0.238 Note: p value < 0.05 indicates a statistically significant trend (95% confidence level).

Results of Sen's Estimator of Slope: **No Significant Trend**

Median Slope Estimate = 2.8E+01 ug/L Per Day

90% Confidence Interval = -2.6E+01 to 6.6E+01 ug/L Per Day

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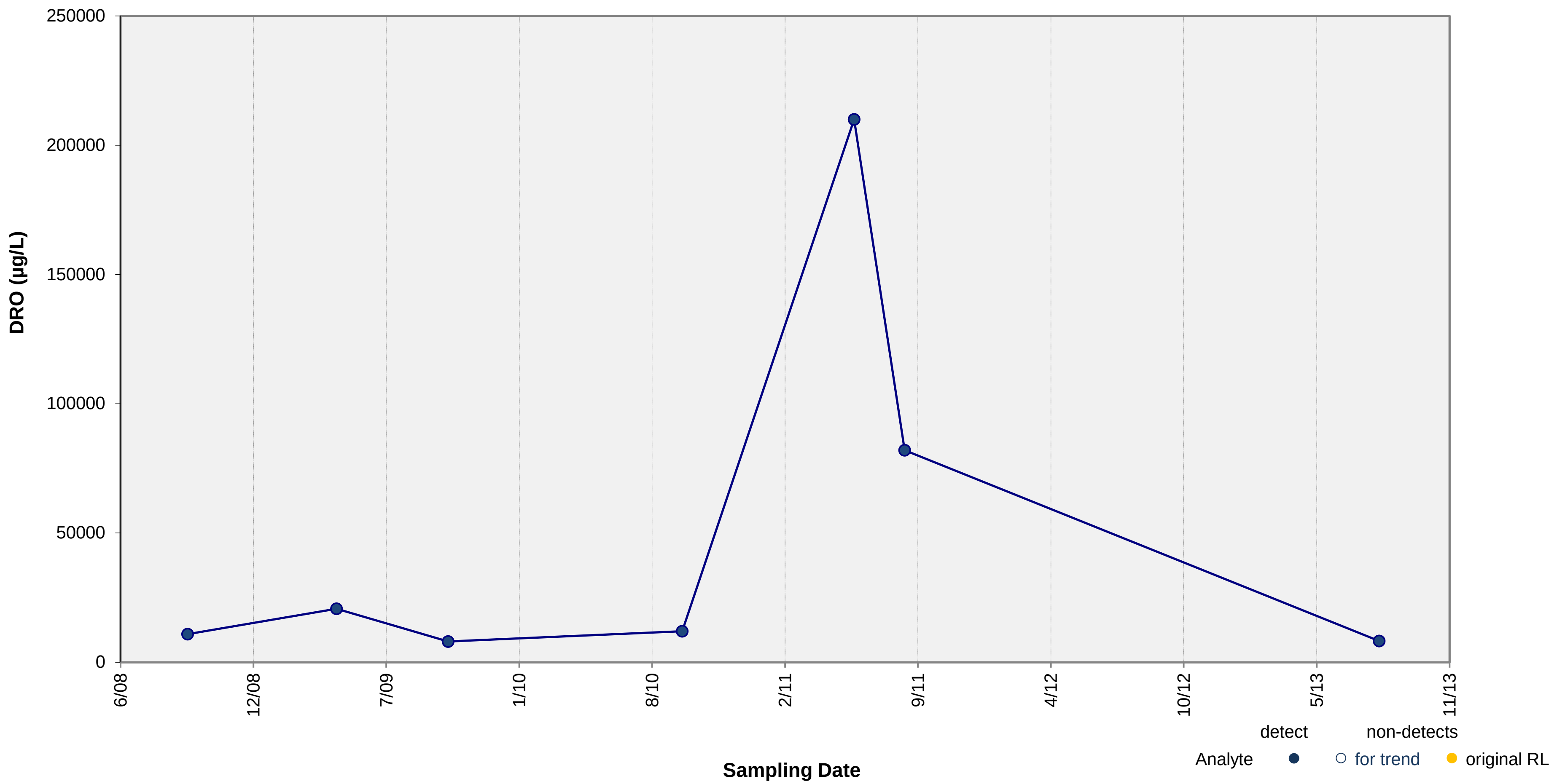
Concentration vs. Time Plot – DRO in GEI-9

Chevron Facility No. 306443



Results of Mann-Kendall Test for Trend: **No Significant Trend**

p value = 0.386 Note: p value < 0.05 indicates a statistically significant trend (95% confidence level).

Results of Sen's Estimator of Slope: **No Significant Trend**

Median Slope Estimate = 1.5E+00 ug/L Per Day

90% Confidence Interval = -1.7E+01 to 1.1E+02 ug/L Per Day

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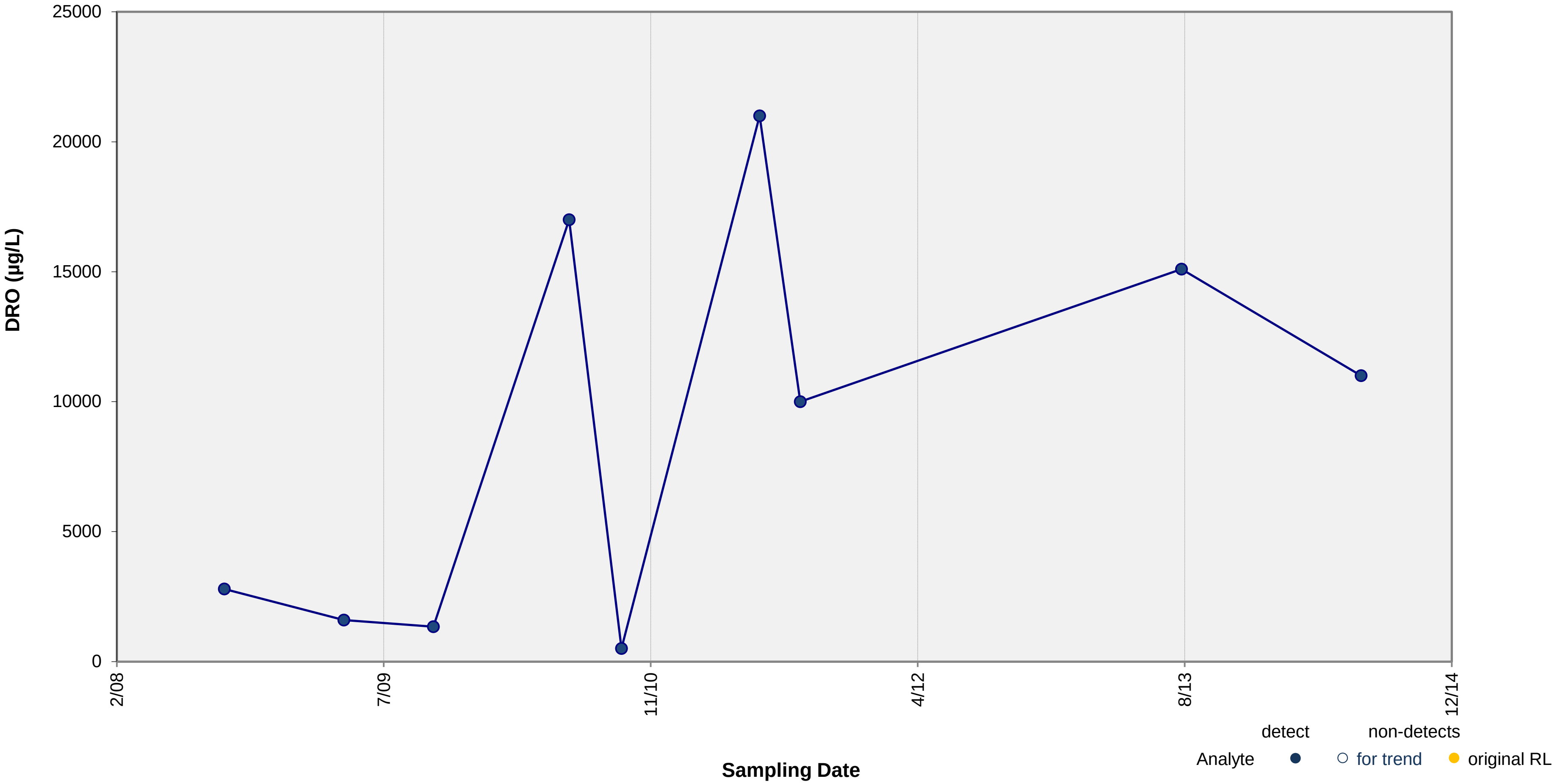
Concentration vs. Time Plot – DRO in MW-1

Chevron Facility No. 306443

G:\COMMON\Data\Projects\Chevron\306443 - Fairbanks Int Airport Unocal\2015 MNA Analysis\MK Files\MK_DRO_MW-1.xlsx - 5/27/2015

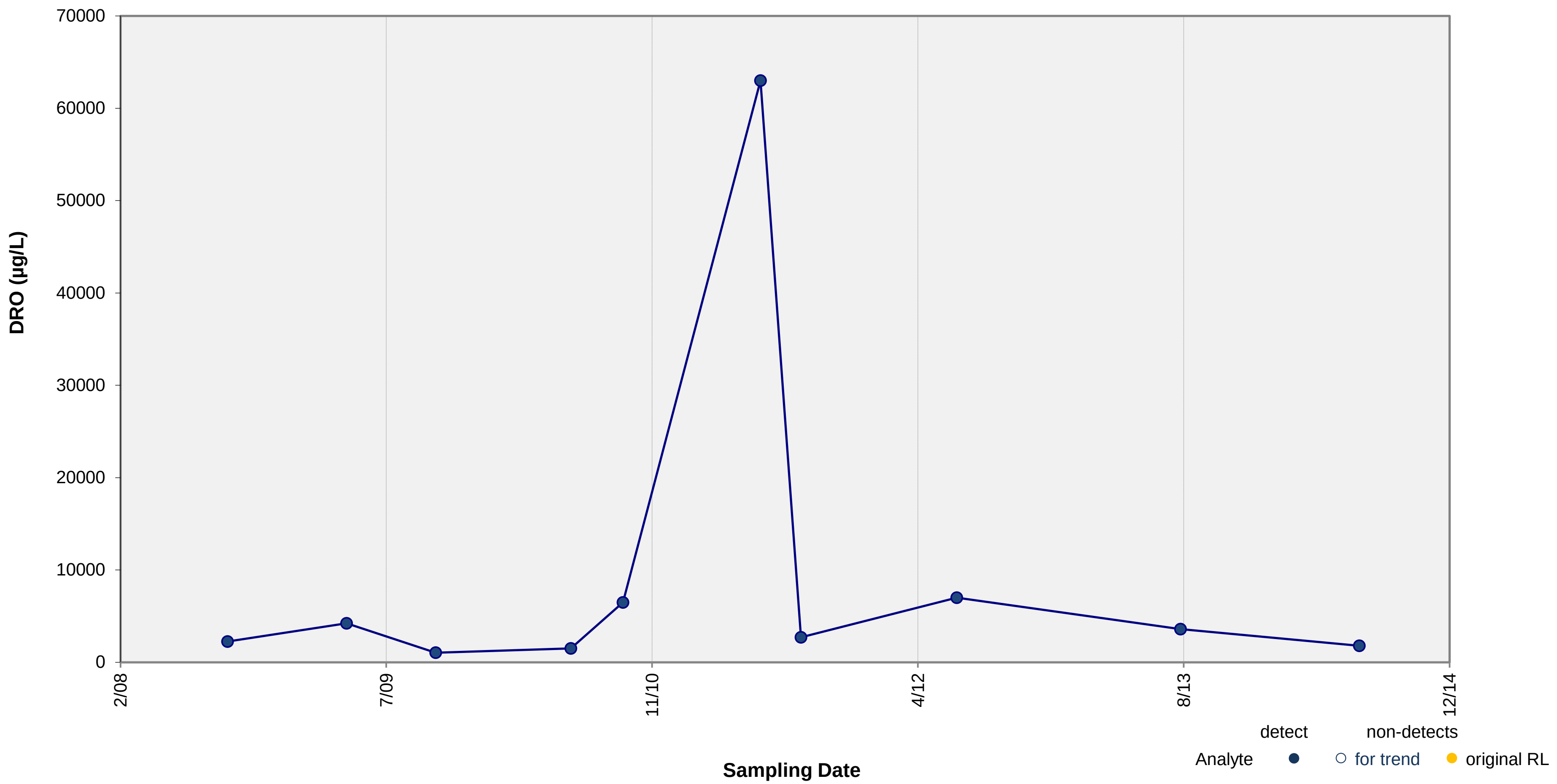


Results of Mann-Kendall Test for Trend:	**No Significant Trend**			
	p value =	0.238	Note: p value < 0.05 indicates a statistically significant trend (95% confidence level).	
Results of Sen's Estimator of Slope:	**No Significant Trend**			
	Median Slope Estimate =	6.1E+00	ug/L Per Day	
	90% Confidence Interval =	-3.0E+00	to 1.1E+01	ug/L Per Day

ARCADIS

Concentration vs. Time Plot – DRO in MW-3

Chevron Facility No. 306443



Results of Mann-Kendall Test for Trend: **No Significant Trend**

p value = 0.300 Note: p value < 0.05 indicates a statistically significant trend (95% confidence level).

Results of Sen's Estimator of Slope: **No Significant Trend**

Median Slope Estimate = 7.6E-01 ug/L Per Day

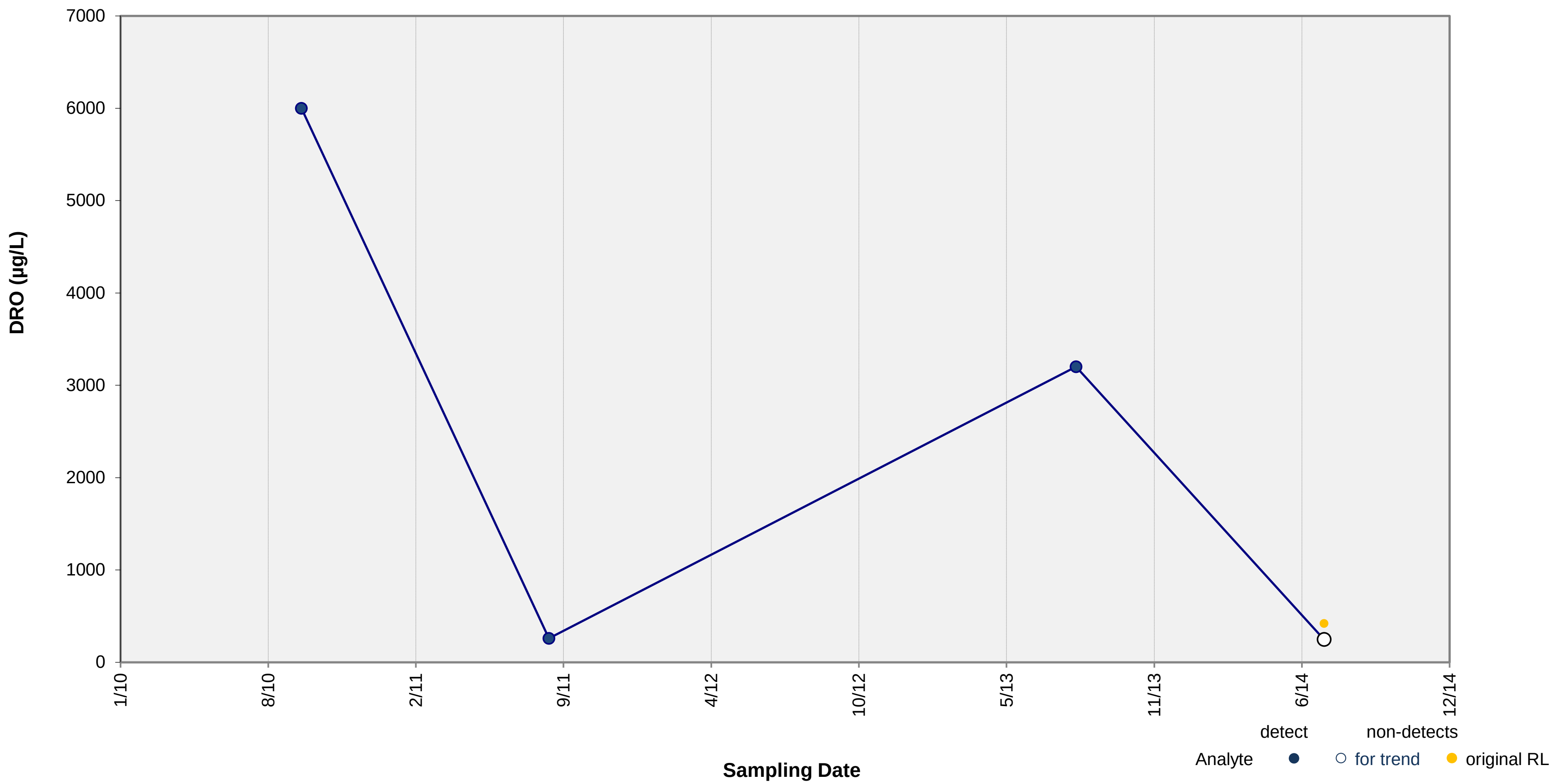
90% Confidence Interval = -2.5E+00 to 3.3E+00 ug/L Per Day

ARCADIS

Concentration vs. Time Plot – DRO in MW-5

Chevron Facility No. 306443

G:\COMMON\Data\Projects\Chevron\306443 - Fairbanks Int Airport Unocal\2015 MNA Analysis\MK Files\MK_DRO_MW-5.xlsx - 5/27/2015



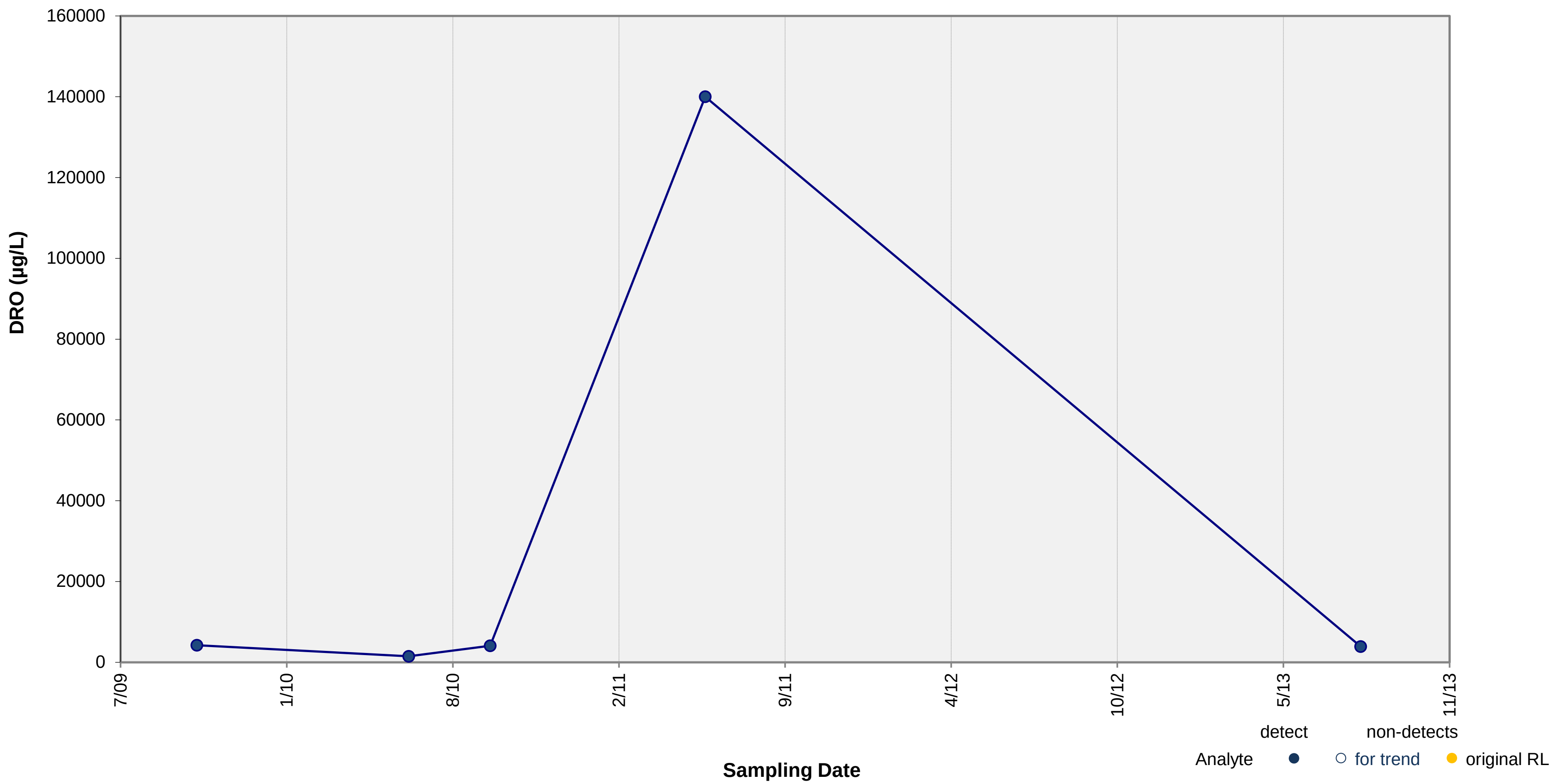
Results of Mann-Kendall Test for Trend:	**No Significant Trend**			
	p value =	0.167	Note: p value < 0.05 indicates a statistically significant trend (95% confidence level).	
Results of Sen's Estimator of Slope:	**NA**			
	Median Slope Estimate =	NA	ug/L Per Day	
	90% Confidence Interval =	NA	to NA	ug/L Per Day

ARCADIS

Concentration vs. Time Plot – DRO in MW-9

Chevron Facility No. 306443

G:\COMMON\Data\Projects\Chevron\306443 - Fairbanks Int Airport Unocal\2015 MNA Analysis\MK Files\MK_DRO_MW-9.xlsx - 5/27/2015



Results of Mann-Kendall Test for Trend: **No Significant Trend**

p value = 0.592 Note: p value < 0.05 indicates a statistically significant trend (95% confidence level).

Results of Sen's Estimator of Slope: **No Significant Trend**

Median Slope Estimate = 9.5E-01 ug/L Per Day

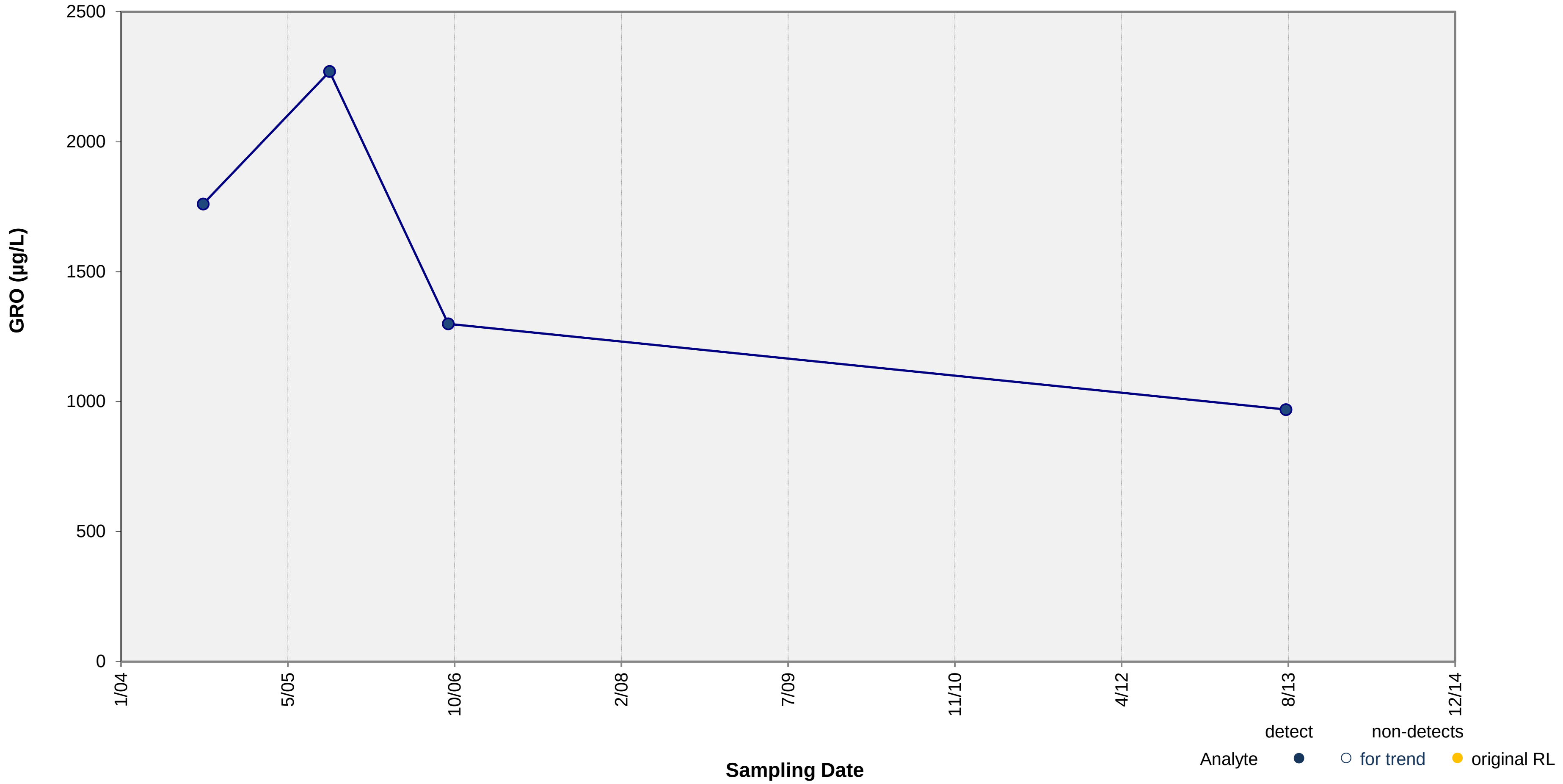
90% Confidence Interval = -6.9E+01 to 2.8E+02 ug/L Per Day

ARCADIS

Concentration vs. Time Plot – DRO in RW-1

Chevron Facility No. 306443

G:\COMMON\Data\Projects\Chevron\306443 - Fairbanks Int Airport Unocal\2015 MNA Analysis\MK Files\MK_DRO_RW-1.xlsx - 5/27/2015



Results of Mann-Kendall Test for Trend: **No Significant Trend**

p value = 0.167 Note: p value < 0.05 indicates a statistically significant trend (95% confidence level).

Results of Sen's Estimator of Slope: **NA**

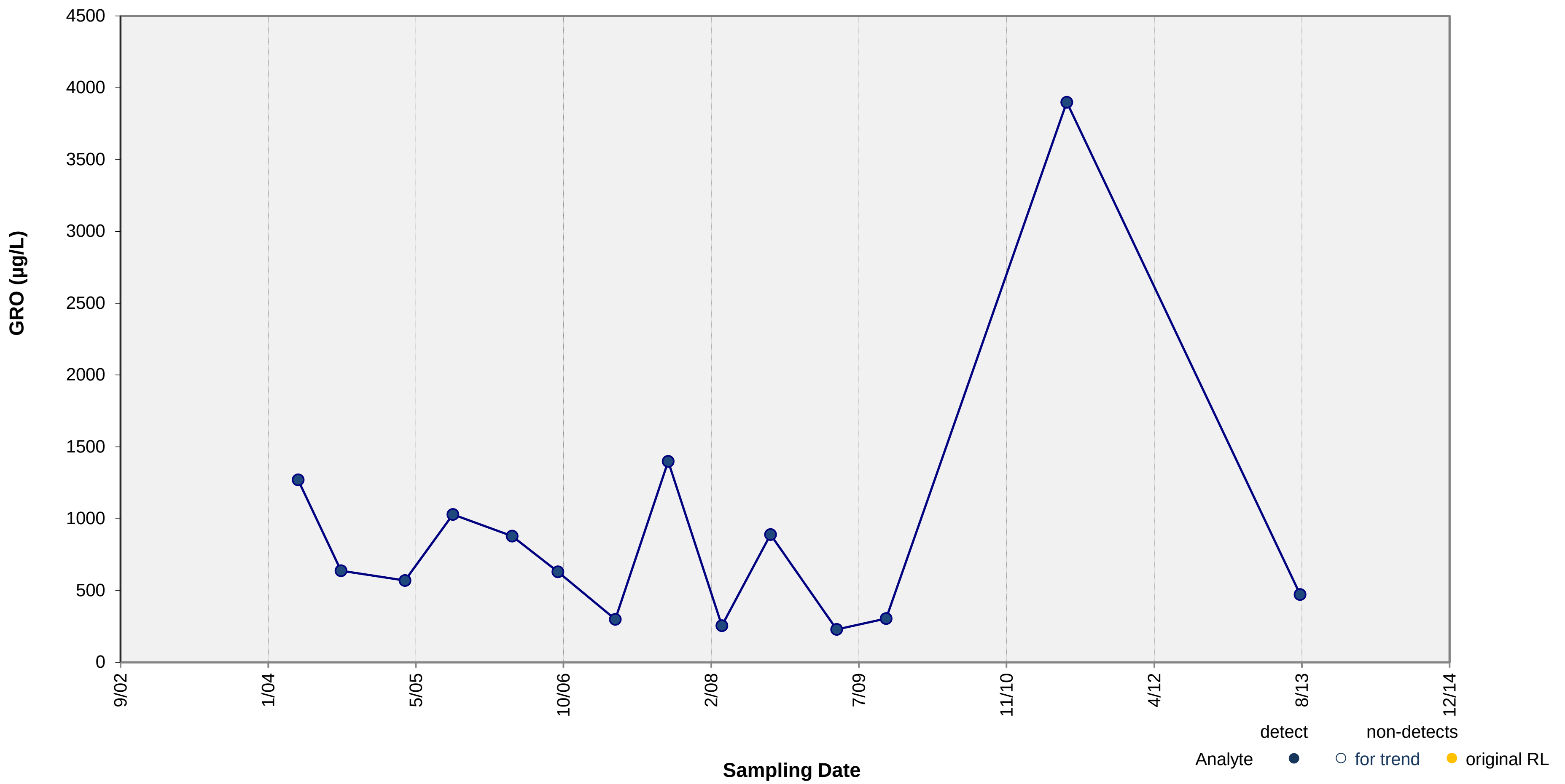
Median Slope Estimate = NA ug/L Per Day

90% Confidence Interval = NA to NA ug/L Per Day

ARCADIS

Concentration vs. Time Plot – GRO in GEI-1

Chevron Facility No. 306443



Results of Mann-Kendall Test for Trend: **No Significant Trend**

p value = 0.191 Note: p value < 0.05 indicates a statistically significant trend (95% confidence level).

Results of Sen's Estimator of Slope: **No Significant Trend**

Median Slope Estimate = -1.5E-01 ug/L Per Day

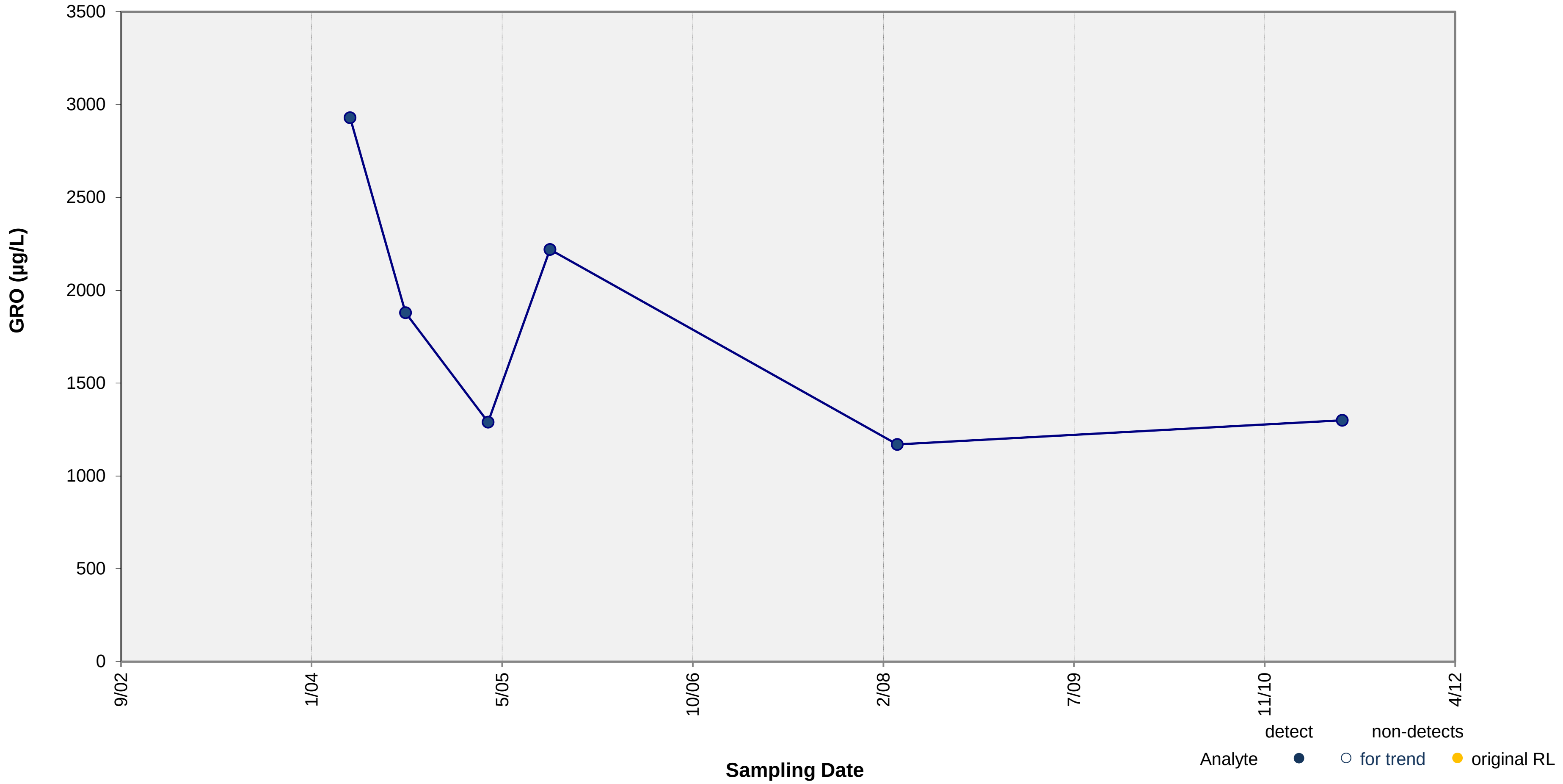
90% Confidence Interval = -4.3E-01 to 1.1E-01 ug/L Per Day

ARCADIS

Concentration vs. Time Plot – GRO in GEI-4

Chevron Facility No. 306443

G:\COMMON\Data\Projects\Chevron\306443 - Fairbanks Int Airport Unocal\2015 MNA Analysis\MK Files\MK_GRO_GEI-4.xlsx - 5/27/2015



Results of Mann-Kendall Test for Trend: **No Significant Trend**

p value = 0.136 Note: p value < 0.05 indicates a statistically significant trend (95% confidence level).

Results of Sen's Estimator of Slope: **DECREASING TREND**

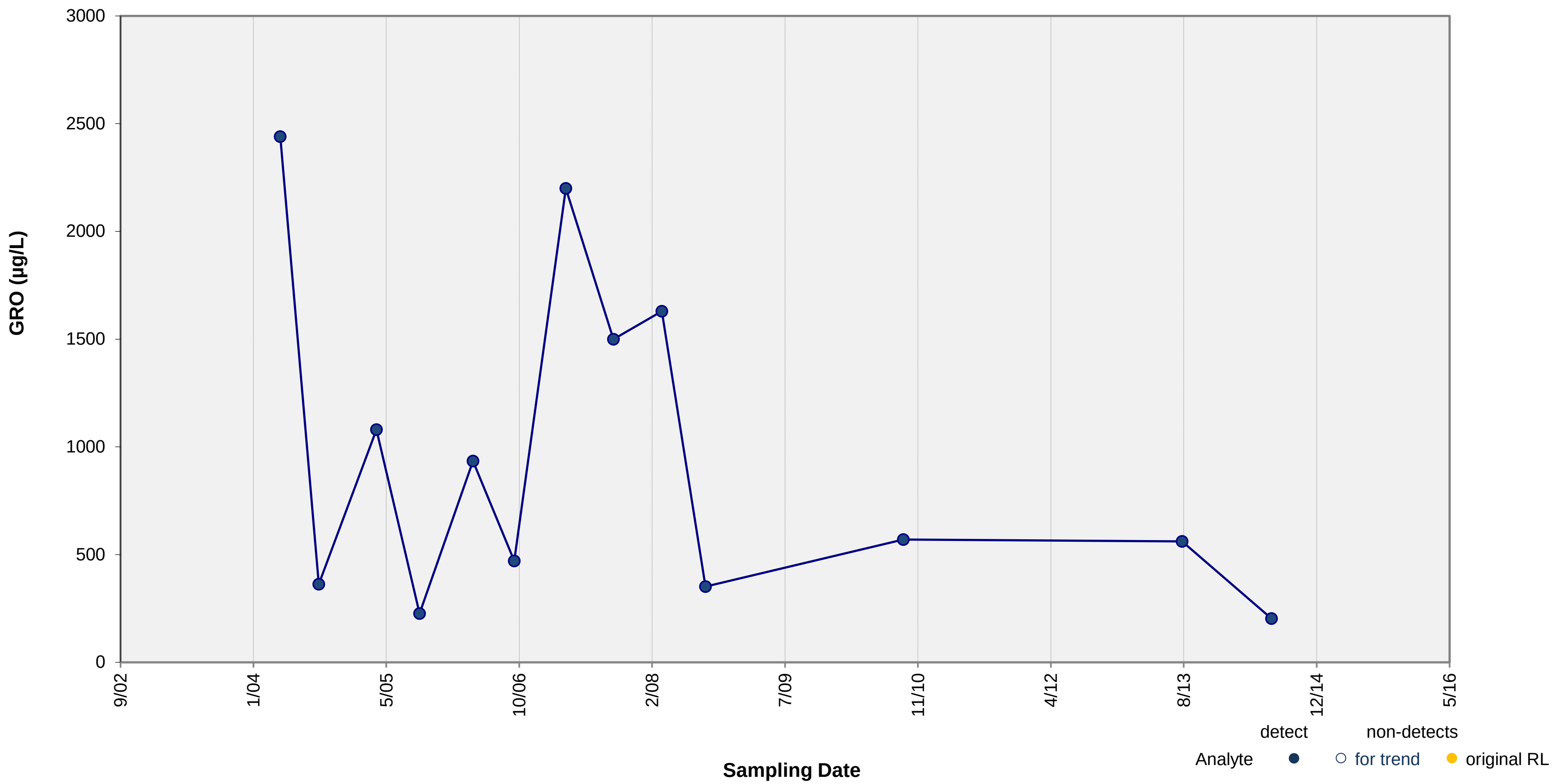
Median Slope Estimate = -5.5E-01 ug/L Per Day

90% Confidence Interval = -2.6E+00 to -9.8E-03 ug/L Per Day

ARCADIS

Concentration vs. Time Plot – GRO in GEI-6

Chevron Facility No. 306443



Results of Mann-Kendall Test for Trend: **No Significant Trend**

p value = 0.150 Note: p value < 0.05 indicates a statistically significant trend (95% confidence level).

Results of Sen's Estimator of Slope: **No Significant Trend**

Median Slope Estimate = -2.0E-01 ug/L Per Day

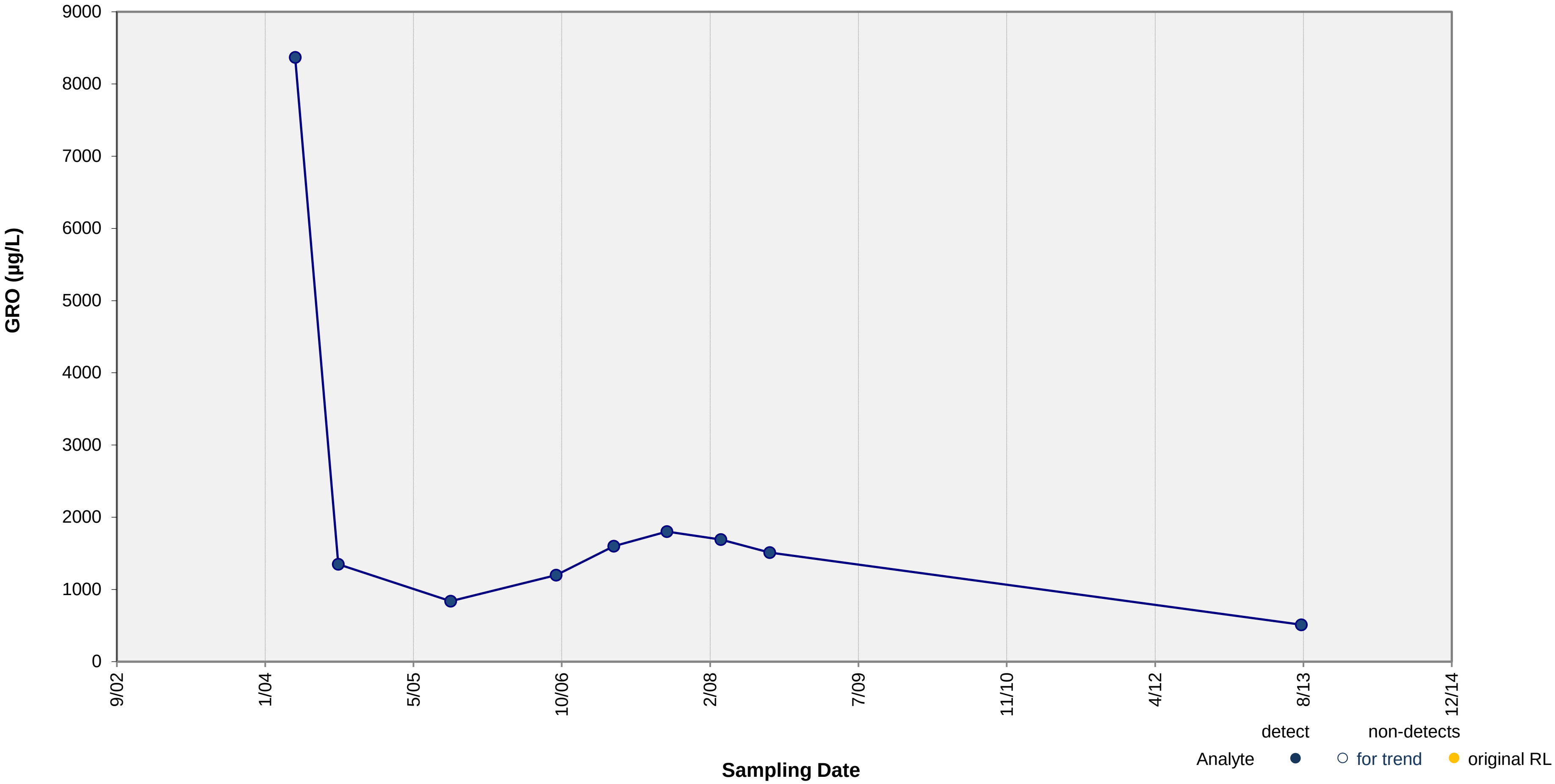
90% Confidence Interval = -5.9E-01 to 1.0E-01 ug/L Per Day

ARCADIS

Concentration vs. Time Plot – GRO in GEI-7

Chevron Facility No. 306443

G:\COMMON\Data\Projects\Chevron\306443 - Fairbanks Int Airport Unocal\2015 MNA Analysis\MK Files\MK_GRO_GEI-7.xlsx - 5/27/2015



Results of Mann-Kendall Test for Trend: **No Significant Trend**

p value = 0.306 Note: p value < 0.05 indicates a statistically significant trend (95% confidence level).

Results of Sen's Estimator of Slope: **No Significant Trend**

Median Slope Estimate = -2.3E-01 ug/L Per Day

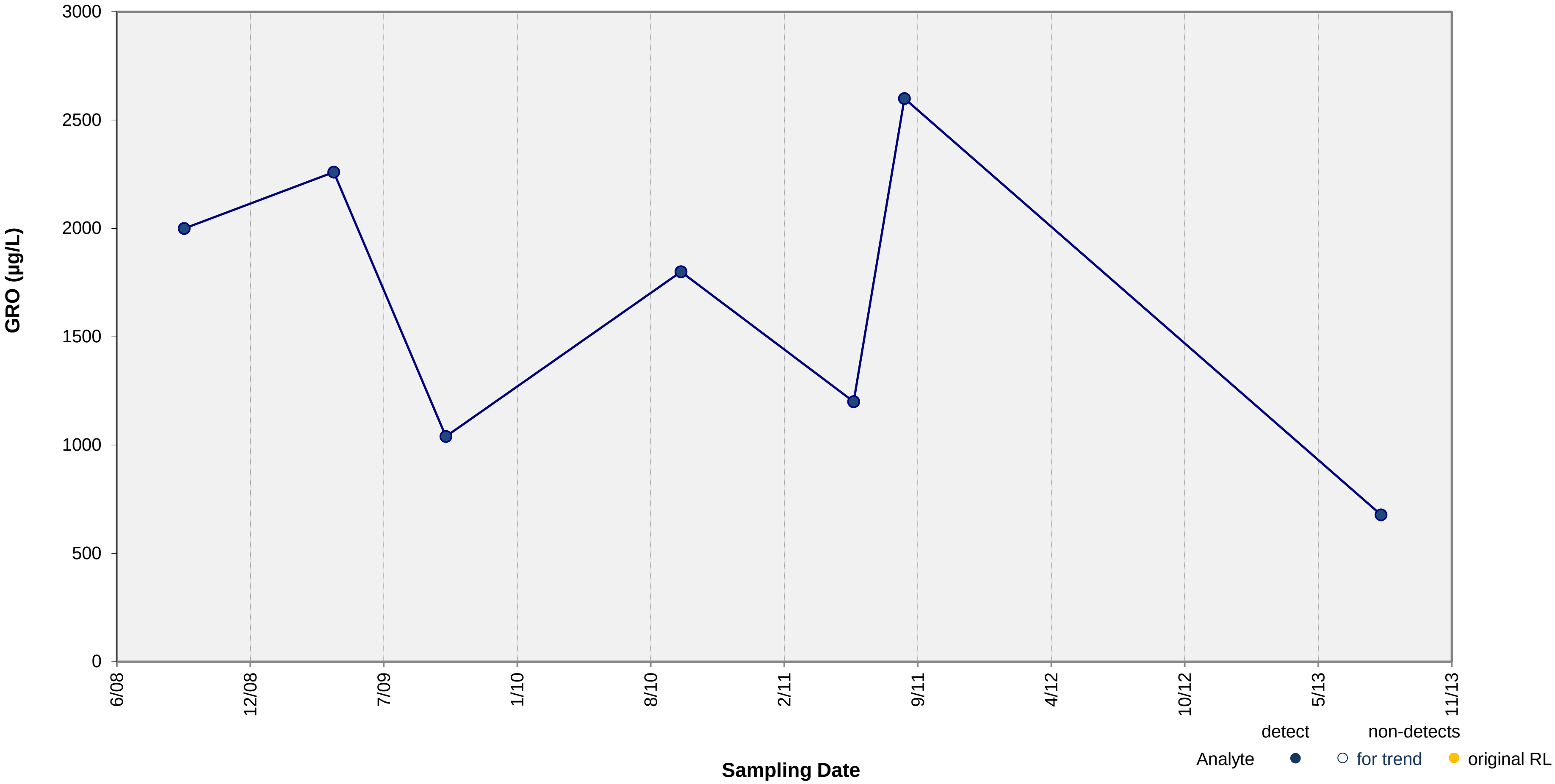
90% Confidence Interval = -1.1E+00 to 3.9E-01 ug/L Per Day

ARCADIS

Concentration vs. Time Plot – GRO in GEI-9

Chevron Facility No. 306443

G:\COMMON\Data\Projects\Chevron\306443 - Fairbanks Int Airport Unocal\2015 MNA Analysis\MK Files\MK_GRO_GEI-9.xlsx - 5/27/2015



Results of Mann-Kendall Test for Trend: **No Significant Trend**

p value = 0.179 Note: p value < 0.05 indicates a statistically significant trend (95% confidence level).

Results of Sen's Estimator of Slope: **NA**

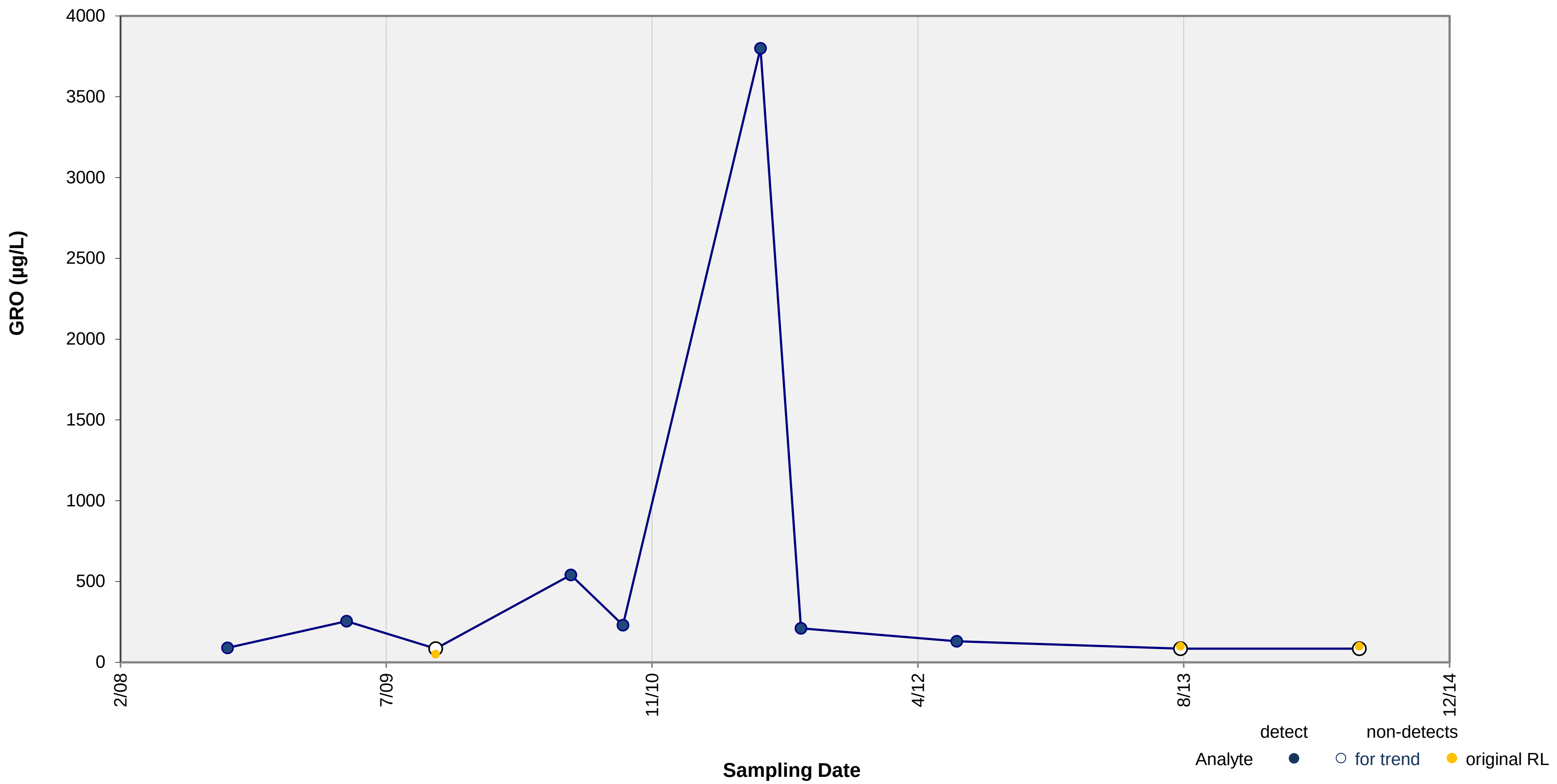
Median Slope Estimate = NA ug/L Per Day

90% Confidence Interval = NA to NA ug/L Per Day

ARCADIS

Concentration vs. Time Plot – GRO in MW-1

Chevron Facility No. 306443



Results of Mann-Kendall Test for Trend: **No Significant Trend**

p value = 0.168 Note: p value < 0.05 indicates a statistically significant trend (95% confidence level).

Results of Sen's Estimator of Slope: **No Significant Trend**

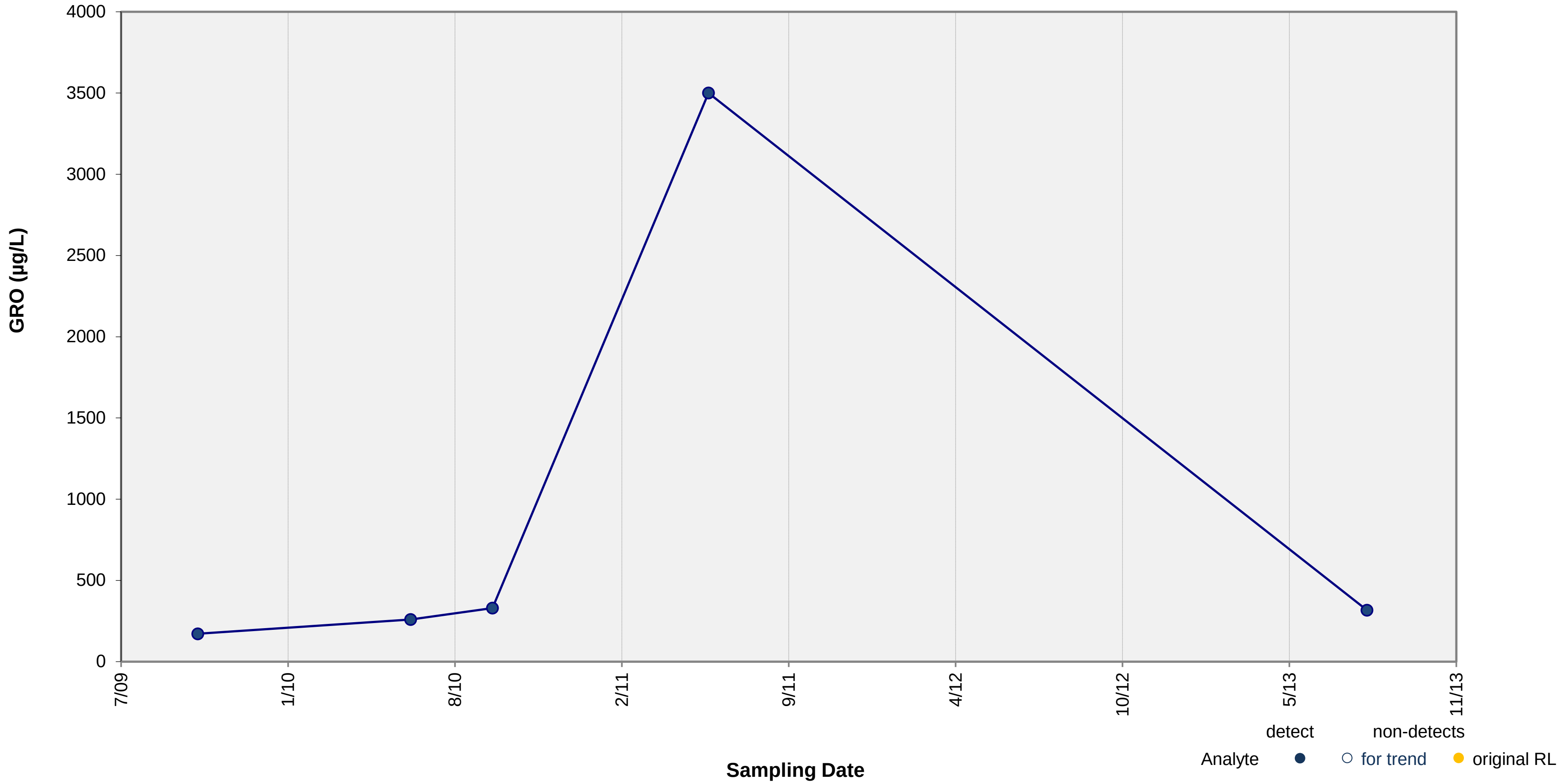
Median Slope Estimate = -5.1E-02 ug/L Per Day

90% Confidence Interval = -1.5E-01 to 3.9E-02 ug/L Per Day

ARCADIS

Concentration vs. Time Plot – GRO in MW-5

Chevron Facility No. 306443

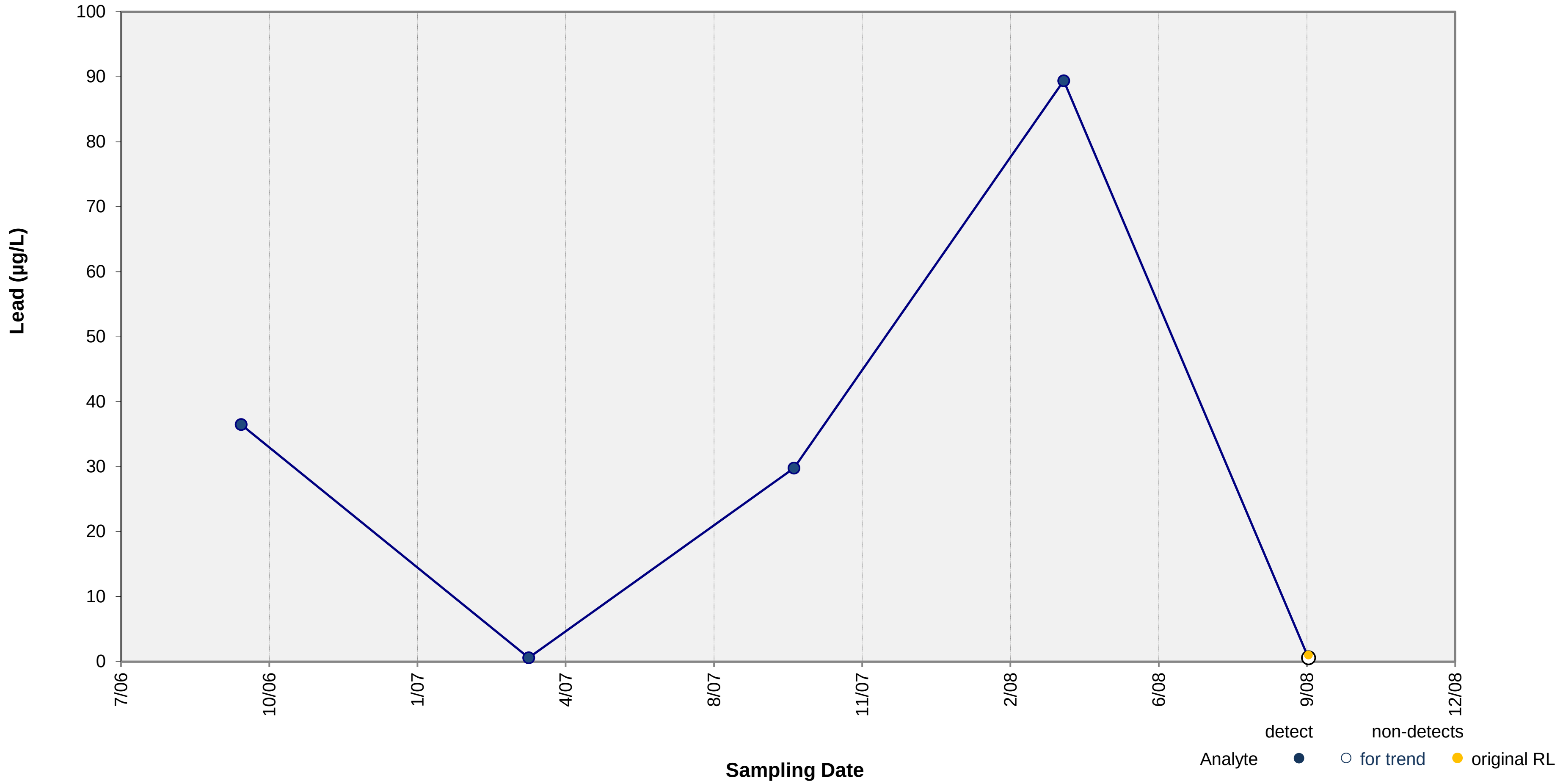


Results of Mann-Kendall Test for Trend:	**No Significant Trend**				
	p value =	0.117	Note: p value < 0.05 indicates a statistically significant trend (95% confidence level).		
Results of Sen's Estimator of Slope:	**No Significant Trend**				
	Median Slope Estimate =	4.0E-01	ug/L Per Day		
	90% Confidence Interval =	-1.5E+00	to	6.7E+00	ug/L Per Day

ARCADIS

Concentration vs. Time Plot – GRO in RW-1

Chevron Facility No. 306443



Results of Mann-Kendall Test for Trend: **No Significant Trend**

p value = 0.408 Note: p value < 0.05 indicates a statistically significant trend (95% confidence level).

Results of Sen's Estimator of Slope: **No Significant Trend**

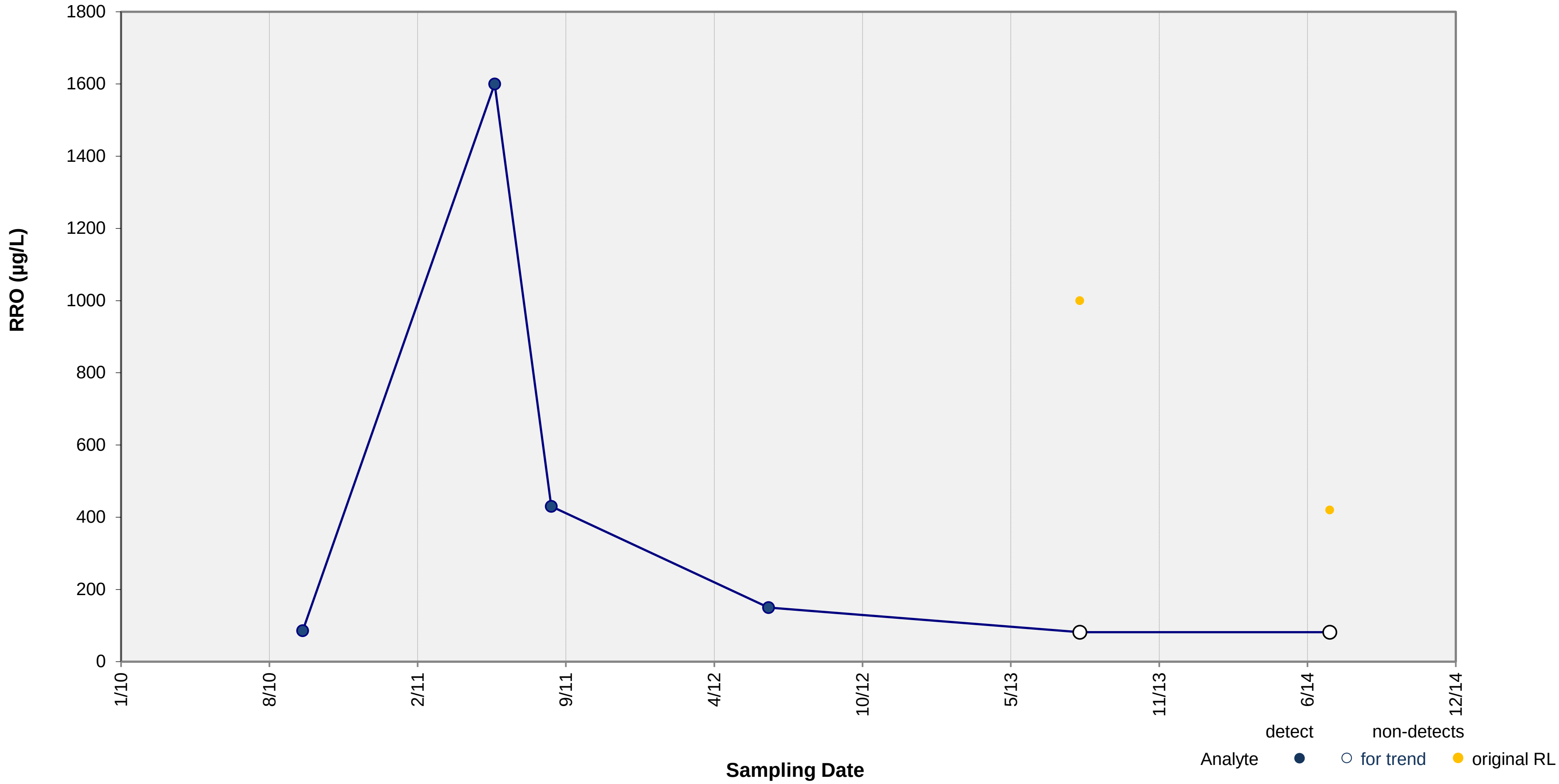
Median Slope Estimate = -9.0E-03 ug/L Per Day

90% Confidence Interval = -3.1E-01 to 1.9E-01 ug/L Per Day

ARCADIS

Concentration vs. Time Plot – Lead in GEI-9

Chevron Facility No. 306443



Results of Mann-Kendall Test for Trend: **No Significant Trend**

p value = 0.102 Note: p value < 0.05 indicates a statistically significant trend (95% confidence level).

Results of Sen's Estimator of Slope: **DECREASING TREND**

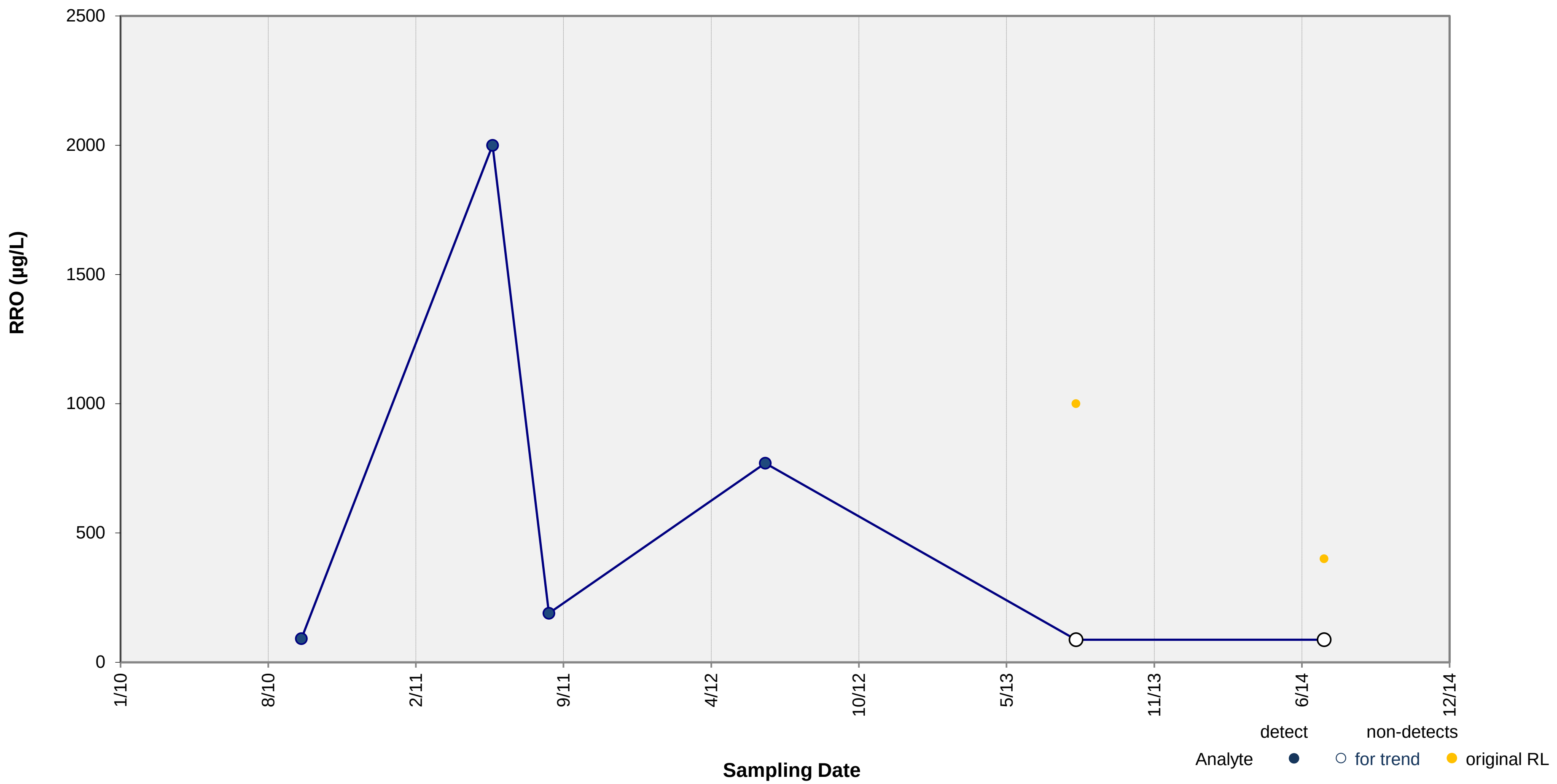
Median Slope Estimate = -1.6E-01 ug/L Per Day

90% Confidence Interval = -1.8E+00 to -6.2E-04 ug/L Per Day

ARCADIS

Concentration vs. Time Plot – RRO in MW-6

Chevron Facility No. 306443



Results of Mann-Kendall Test for Trend:	**No Significant Trend**			
	p value =	0.186	Note: p value < 0.05 indicates a statistically significant trend (95% confidence level).	
Results of Sen's Estimator of Slope:	**No Significant Trend**			
	Median Slope Estimate =	-9.8E-02	ug/L Per Day	
	90% Confidence Interval =	-2.3E+00	to 2.3E-01	ug/L Per Day

ARCADIS

Concentration vs. Time Plot – RRO in MW-7

Chevron Facility No. 306443