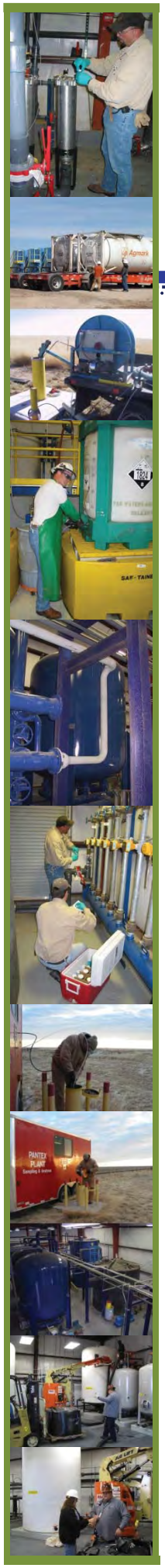

PANTEX QUARTERLY PROGRESS REPORT

Remedial Action Progress

2nd Quarter 2016

In support of Hazardous Waste Permit #50284 and

Pantex Plant Interagency Agreement

September 2016

Pantex Plant

FM 2373 and U.S. Highway 60

P.O. Box 30030

Amarillo, TX 79120

UNCLASSIFIED

CERTIFICATION STATEMENT

2nd Quarter 2016 Remedial Action Progress Report
Pantex Plant, September 2016

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Deborah Franklin 9-14-16

Deborah R. Franklin Date
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Susan D. Morris Date
Assistant Manager for
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Quarterly Progress Report
2nd Quarter 2016
in Support of Hazardous Waste Permit #50284
and Pantex Plant Interagency Agreement
for the Pantex Plant, Amarillo, Texas
September 2016

Prepared by
Consolidated Nuclear Security, LLC
Management and Operating Contractor
for the
Pantex Plant and Y-12 National Security Complex
under Contract No. DE-NA0001942
with the
U.S. Department of Energy
National Nuclear Security Administration

In accordance with 30 TAC §335.553 (g), this report has been prepared and sealed by an appropriately qualified licensed professional engineer or licensed professional geoscientist.

Tony Biggs
Licensed Professional Geologist No. 2693
Environmental Projects
Consolidated Nuclear Security, LLC

9/12/16
Date

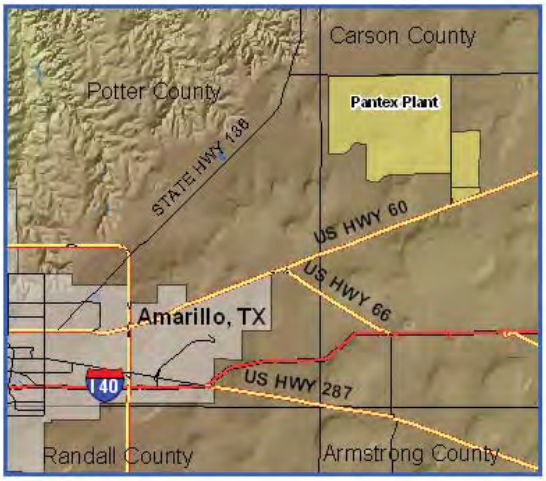
Project Team: Tony Biggs
Michelle Jarrett

List of Acronyms

µg/L	micrograms per liter
CatOX	catalytic oxidation
COC	contaminant of concern
Cr(VI)	hexavalent chromium
CSIA	compound-specific isotope analysis
DCE	dichloroethene
DHC	*Dehalococcoides* spp.
DNT	dinitrotoluene
DNX	hexahydro-1,3-dinitroso-5-nitro-1,3,5-triazine
DO	dissolved oxygen
FGZ	fine-grained zone
GAC	granular activated carbon
GWPS	groundwater protection standard
HE	high explosive
HW-50284	Hazardous Waste Permit #50284
IAG	Interagency Agreement
ISPM	in situ performance monitoring
ISB	in situ bioremediation
lb	pound
LiDAR	light detection and ranging
mg/kg	milligrams per kilogram
Mgal	million gallons
MNX	hexahydro-1-nitroso-3,5-dinitro-1,3,5-triazine
mV	millivolts
NAPL	non-aqueous phase liquid
ORP	oxidation-reduction potential
P1PTS	Playa 1 Pump and Treat System
PID	photoionization detector
PQL	practical quantitation limit
RDX	hexahydro-1,3,5-trinitro-1,3,5-triazine
SAP	sampling and analysis plan
SEPTS	Southeast Pump and Treat System
SVE	soil vapor extraction
SWMU	Solid Waste Management Units
TCE	trichloroethene
TNX	hexahydro-1,3,5-trinitroso-1,3,5-triazine
TOC	total organic carbon
TZM	treatment zone monitoring
VFA	volatile fatty acid
VOC	volatile organic compound
WWTF	wastewater treatment facility

INTRODUCTION

The Pantex Plant, located in the Texas Panhandle 17 miles northeast of Amarillo, has implemented a response action to remediate perched groundwater and soils. Two types of systems have been installed for the groundwater response action: pump and treat systems in two areas and in situ bioremediation (ISB) systems in two areas. A soil vapor extraction (SVE) system has been installed to remediate volatile organic compounds (VOCs) in soils at the Burning Ground area. This quarterly report addresses progress achieved through implementation of the Remedial Actions for 2nd quarter 2016.



This report provides an intermediate data summary for response action systems throughout the year. More intensive data reporting is included in the annual progress reports. The quarterly progress reports address three of the five evaluations included in the annual progress reports: response action effectiveness, uncertainty management, and early detection. The reports provide required information from Hazardous Waste Permit #50284 (HW-50284) CP Table VII and the Pantex Interagency Agreement (IAG).

Maps of the plumes, remedial action systems, sampling locations, and system wells are provided in Appendix A. Graphs of operation and flow rates for the pump and treat systems are provided in Appendix B. Graphs of important parameters for the ISB treatment zone and downgradient wells are provided in Appendix C.

RESPONSE ACTION EFFECTIVENESS

This quarterly progress report focuses on specific criteria for the pump and treat systems, ISB systems, and a small-scale SVE system. System operation, mass removal, and evaluation of effluent in reference to established operational goals are reported for the pump and treat systems. For the ISB systems, this report evaluates geochemical conditions and availability of food source in the treatment zone and reduction of concentrations of contaminants of concern (COCs) in downgradient performance monitoring wells to evaluate whether the treatment zone is working effectively. System operation, mass removal, and effluent photoionization detector (PID) readings are evaluated for the SVE system.

PUMP AND TREAT SYSTEMS

The Remedial Action at the Pantex Plant includes two pump and treat systems: Southeast Pump and Treat System (SEPTS) and Playa 1 Pump and Treat System (P1PTS). The pump and treat systems are designed to extract water and remove contaminant mass from the water before the

effluent is beneficially used by the wastewater treatment facility (WWTF) and irrigation system, for general Plant needs, or for amendment injections at the ISB systems. The systems were also designed to remove water from the perched aquifer to reduce saturated thickness. This reduction in saturated thickness reduces migration of contaminants both vertically and horizontally so that natural breakdown processes can occur over time. Reducing migration provides protection for the underlying High Plains Aquifer (also known as and referred to herein as the Ogallala Aquifer). The SEPTS has the capability to inject the treated water back into the perched aquifer when beneficial use is not possible. Operational priorities for the pump and treat systems emphasize beneficial use of water.

Pump and Treat System
4th Quarter Operation

Playa 1 Pump and Treat System (P1PTS)	
Days Operated	57
% Operation Time	60%
Volume Water Treated (Mgal)	13.8
HE Mass Removal (lbs)	6.3
Beneficial Use of Water	100%
Southeast Pump and Treat System (SEPTS)	
Days Operated	88
% Operation Time	93%
Volume Water Treated (Mgal)	30.7
HE Mass Removal (lbs)	125.7
Chromium Mass Removal (lbs)	16.5
Beneficial Use of Water	100%

Value below operational goals

SEPTS operation exceeded goals during 2nd quarter (see operational graphs in Appendix B). P1PTS was shut down in April for a planned GAC vessel replacement, but operated consistently in May and June after the vessel replacement. The throughput was low throughout the quarter at P1PTS and during May and June at the SEPTS. P1PTS throughput was primarily affected by the loss of two wells during the quarter. The SEPTS was affected by loss of multiple wells. Pantex has been troubleshooting the problems, contracting for support, and working toward getting the wells operational. Most of the wells were operational in July. Overall, the primary goal of beneficial use was met while continuing to operate the systems.

Figure 1. P1PTS Mass Removal

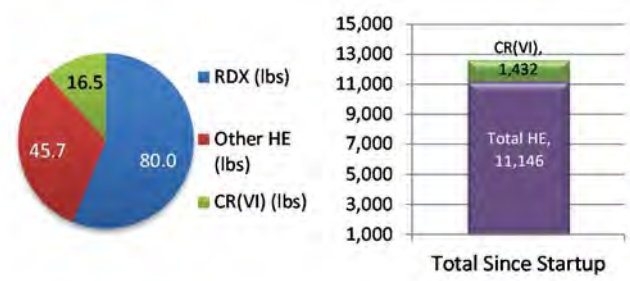


Figure 2. SEPTS Mass Removal

The P1PTS removes primarily RDX and the SEPTS removes primarily RDX and hexavalent chromium [Cr(VI)]. Figures 1 and 2 provide mass removal information for RDX and other high explosives (HEs) for 2nd

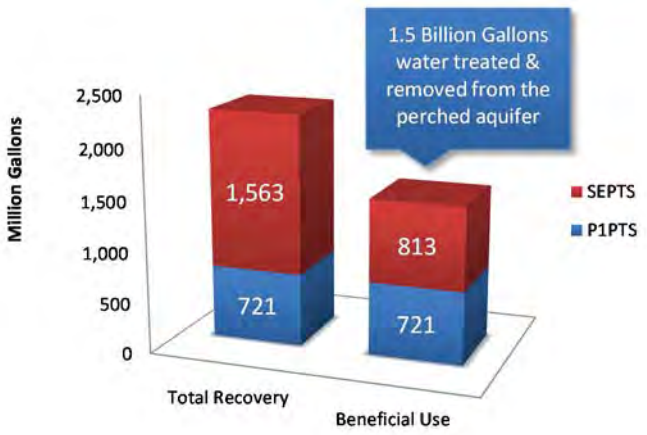


Figure 3. System Recovery and Use

quarter, as well as totals since system startup. Concentrations near Playa 1 are much lower due to the source declining; therefore, mass removal is much lower at this system. The primary goal of the P1PTS is water removal to decrease saturated thickness and remove head, with mass removal as a secondary goal.

The total recovery and treatment from both systems since startup has been calculated at about 2.3 billion gallons. Because the SEPTS was originally designed to inject treated water, all of the treated water prior to 2005 was injected. However, a significant volume of treated water has been used beneficially since 2005, with a total of over 1.5 billion gallons extracted and treated from the perched aquifer since startup of the irrigation system. The recovery and beneficial use totals are presented in Figure 3. Evaluation of effluent data from both systems indicates that all COCs were treated to levels below the groundwater protection standards (GWPS).

ISB Systems

Two ISB systems (Zone 11 ISB and Southeast ISB) were installed at Pantex. The systems are designed with closely spaced wells to set up a treatment zone in areas of the perched groundwater where pump and treat may not be as effective, or where the area is sensitive to vertical migration of COCs to the Ogallala Aquifer. Amendment is injected into these systems to establish treatment zones where COCs are degraded. Monitoring wells were installed downgradient of the treatment zone to monitor whether the system is effectively degrading the COCs (see maps in Appendix A). The primary COCs at the Zone 11 ISB are trichloroethene (TCE) and perchlorate. The primary COCs at the Southeast ISB are RDX and hexavalent chromium.

For the treatment zone wells, this report evaluates whether the conditions are present to degrade the COCs in each area, and evaluates the presence of a continued food source for the microbial reduction of COCs (see Table 1). Downgradient monitoring wells are evaluated to determine if the ISB systems are effective in degrading the COCs and any breakdown products of the COCs. Graphs of data from sampled treatment zone wells and downgradient in situ performance monitoring (ISPM) wells are included in Appendix C.

Zone 11 ISB

Installation of the Zone 11 ISB Remedial Action was completed in 2009, and an expansion was completed in early 2015. Seven injection events have been completed at the current system, with the first complete injection event occurring in the expansion zone in 2015. Because of the substantial saturated thickness of the perched aquifer in that area, the requirement for deep

reducing conditions to treat TCE completely, and a high groundwater velocity, Pantex has planned for yearly injections at this system. Pantex started the eighth injection event during 2nd quarter. However, sampling of the wells was completed before rehabilitation and injection began.

Table 1. ISB System Performance

	Treatment Zone Wells		Downgradient Performance Monitoring Wells		
System	**Reducing Conditions**	**Food Source Available**	**Primary COCs Reduced?**	**COCs < GWPS?**	**Degradation Products of COCs Reduced?**
Zone 11 ISB	Very Mild to Strong	Yes	Yes	Perchlorate in 4 of 6 wells TCE in 5 of 6 wells	No[1]
Southeast ISB	Very Mild to Strong	Yes	Yes	RDX in 2 of 3 wells Cr(VI) in 3 of 3 wells[2]	Yes

Mild conditions = oxidation-reduction potential (ORP) of 0 to -50 millivolts (mV)
Strong conditions = ORP < -100 mV and sulfate and nitrate reduced indicating conditions are present for methanogenesis.
[1] Cis-1,2-dichloroethene concentrations remain high in two downgradient wells, while vinyl chloride concentrations (final breakdown compound) remain at low concentrations or not detected. Pantex bioaugmented the original wells on the west side of the system during the seventh injection event in 2015. DHC counts indicate that the bioaugmentation was successful, but counts were too low for complete reductive dechlorination to occur. Analytical, CSIA, and DHC reductase data support this understanding, as no indication of complete reduction has been observed thus far.
[2]Pantex has been sampling four downgradient wells at this system. However, one of the wells (PTX06-1123) could not be sampled this quarter because the well did not have enough water to sample. This well had demonstrated complete treatment since October 2012.

The system has a well-established treatment zone in the original portion of the system where injection has occurred since 2009. The expansion area was injected in 2015 and is receiving a second injection in 2016. All sampling in the expansion area occurs at treatment zone monitoring wells that are located between the injection wells. Data indicate that the injection has affected oxidation-reduction potential (ORP) and dissolved oxygen (DO), but further injections will be necessary to achieve the deep reducing conditions needed to treat TCE. Because the expansion area is not demonstrating treatment yet, only data from the original portion of the system are reviewed here to evaluate the continued treatment of TCE and perchlorate.

Data indicate good reducing conditions for perchlorate at the original portion of the Zone 11 ISB. This condition also persists in the second row wells that no longer receive injection on the perchlorate side. Reducing conditions were milder than expected in some of the wells that were bioaugmented on the TCE side in 2015. Some of the conditions were higher than –75 mV, indicating that the *Dehalococcoides spp.* (DHC) growth or survival could be impacted in limited areas. However, methane concentrations were high in all but one treatment zone well this quarter, indicating deep reducing conditions conducive to TCE breakdown in most areas. TCE continues to be reduced to 1,2-dichloroethene (DCE), but further reduction is not yet generally indicated by the analytical data. Food source is adequate for continued reducing conditions at the sampled injection

wells. Analytical results for the treatment zone monitoring wells and PTX06-ISB075 replacement well indicate the food source is much lower in the areas between injection wells.

The original portion of the Zone 11 ISB has been effective at treating perchlorate and partially treating TCE. Perchlorate was not detected in the wells sampled in the treatment zone this quarter. In two non-injected monitoring wells in the original portion of the treatment zone (PTX06-1170 and PTX06-ISB075 replacement well), *cis*-1,2-DCE concentrations exceeded the GWPS. TCE concentrations were slightly above the GWPS in PTX06-1170, but were below the GWPS in PTX06-ISB075 replacement well. Vinyl chloride concentrations continue to be non-detect in the treatment zone in all but one well, where the detected concentration was low. TCE was not detected in any other injected treatment zone wells. Results do not currently indicate a strong influence from the DHC bioaugmentation event, as *cis*-1,2-DCE concentrations continue to remain high, and vinyl chloride is not detected or detected at very low concentrations. Further sampling will be conducted again later this year to evaluate the DHC.

Pantex evaluates performance at six downgradient monitoring wells for the original portion of the Zone 11 ISB. Four of these wells have demonstrated perchlorate concentrations below detection limits. Two of the wells (PTX06-1148 and 1150) farther downgradient have been slower to respond due to expected longer travel times. One of the two wells demonstrated continued decreasing perchlorate concentration, while the detected perchlorate concentration in the other well was consistent with the previous quarter's measurement. TCE concentrations are demonstrating a decreasing trend in the two wells downgradient of the TCE side (western side of the ISB), with TCE concentrations now below GWPS in one of the wells and slightly above the GWPS in the other well.

Pantex began rehabilitation at the Zone 11 ISB wells in March 2016 and started injection by May 2016. To avoid loss of reducing conditions that could affect the DHC, Pantex injected anaerobic makeup water mixed with amendment in the areas where bioaugmentation occurred. Pantex will collect more samples in late 2016 to continue to evaluate the effectiveness of the bioaugmentation.

Southeast ISB

The Southeast ISB was installed in 2007. Five injection events have been completed at this system. Pantex has scheduled the Southeast ISB for injections approximately every 18 months to avoid depletion of food source and possible loss of reducing conditions. The last injection was completed in April 2015.

Evaluation of data in treatment zone wells indicates adequate reducing conditions for the treatment of RDX and hexavalent chromium in most wells. Data indicate very mild reducing conditions in PTX06-ISB024, a first row well. Data indicate that food source is available for the continued reduction of COCs. Evaluation of COC data indicates no detection of HEs and chromium concentrations below background, where detected. Two wells, PTX06-ISB019 and PTX06-ISB042, continue to have low water conditions and could not be sampled.

Four downgradient wells have been historically sampled at this system. Two of the closest downgradient monitoring wells for the Southeast ISB, PTX06-1037 and PTX06-1154, demonstrate

that reduction of RDX, HE degradation products, and hexavalent chromium has occurred, resulting in concentrations below the GWPS, with most not detected. PTX06-1123 had demonstrated concentrations below the GWPS; however, this well could not be sampled again this quarter due to insufficient water. PTX06-1153 continues to exhibit RDX concentrations above 200 ug/L and variable hexavalent chromium concentrations, with the most recent result slightly above the GWPS. Pantex continues to monitor this well and other new wells installed nearby to determine if treated water is slow to reach the well, or if the well may not be hydraulically connected to the Southeast ISB. During 3rd quarter 2016, Pantex plans to install passive flux meters at specific well locations to determine the mass and water flux into the Southeast ISB. PTX06-1153 will be included in that study. Results will be available in 2017.

Some of the injection and performance monitoring wells indicate variable water conditions at the Southeast ISB. Two Southeast ISB performance monitoring wells (one upgradient and one farther downgradient) remain dry and cannot be sampled. PTX06-1123 could not be sampled again this quarter. The inability to sample these wells is expected to continue due to effects from injection and upgradient pump and treat operations that are decreasing the saturated thickness across the area.

Rehabilitation began in August at this system and injection is scheduled to begin in late September. The construction for the new Administrative Support Complex, which is close to the Southeast ISB, has delayed the schedule, as the equipment pad is planned to be moved before injection could begin. The injection event for the Southeast ISB is expected to be complete by the end of November 2016.

Burning Ground SVE

The Burning Ground SVE system began operation in 2002 as a large-scale catalytic oxidizer (CatOX) system. Due to a large reduction in VOC concentrations, a small CatOX system has been operating at the Burning Ground SVE system since April 2012. This small-scale system focuses on treating residual non-aqueous phase liquid (NAPL) and soil gas at a single extraction well, SVE-S-20, near the source area.

The system was intermittently operated during the 2nd quarter 2016. The system was shut down for power outages, minor repairs, and alarms; however, the system operated for over 90% of the quarter, with about 1,968 hours of operation.

Mass removal calculated for the 2nd quarter and since startup for VOCs contributing more than 1% of the total VOC concentration is presented in Figure 4. The system removed about 68 lbs of VOCs during 2nd quarter, and has removed over 18,300 lbs of VOCs since startup. Based on PID data, system destruction efficiency was at least 98%.

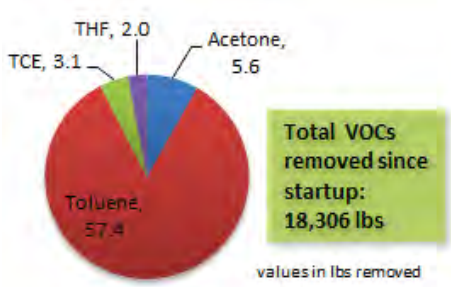


Figure 4. Burning Ground SVE Mass Removal

Uncertainty Management and Early Detection

Uncertainty management and early detection wells are evaluated to determine if there are unexpected conditions in areas where previous groundwater contamination has not been detected or confirmed (Ogallala and perched), or in previous plume locations where concentrations have fallen below GWPS, background, and the practical quantitation limit (PQL) (e.g., perched wells at the Burning Ground and Old Sewage Treatment Plant areas). Indicator COCs are evaluated at the uncertainty management/early detection wells in the quarterly report. A map depicting the wells evaluated is included in Appendix A.

Summary of Ogallala Detections, 2nd Quarter 2016

Well ID	Sample Date	Analyte	Measured Value (µg/L or pCi/L)	PQL (µg/L)
PTX06-1056	4/12/2016	4-Amino-2,6-Dinitrotoluene	0.286	0.266
PTX06-1056	4/12/2016	1,2-Dichloroethane	0.41	1

Review of the uncertainty management/early detection data collected during 2nd quarter indicates unexpected conditions continuing at one Ogallala Aquifer well (PTX06-1056). Data indicate continued detections of the HE 4-amino-2,6-dinitrotoluene (DNT) and the VOC 1,2-dichloroethane. No detections exceeded GWPS in the Ogallala Aquifer uncertainty management/early detection wells sampled during 2nd quarter.

PTX06-1056 continues to demonstrate detections of 4-amino-2,6-DNT, a breakdown product of the HE 2,4-trinitrotoluene (TNT), with the concentrations first exceeding the PQL in August 2015. The results have been variable, with a few values exceeding the PQL. The concentration detected during the 2nd quarter slightly exceeds the PQL. As agreed with regulatory agencies, Pantex will continue with quarterly sampling to evaluate trends in these detections.

Pantex has proactively evaluated potential sources for the contamination. A nearby perched well that was drilled deeply into the fine-grained zone (FGZ) was plugged to address that potential source. Pantex will also complete a cement bond log on PTX06-1056 to determine if the annular seal is competent. That log will be completed by the end of September. Pantex also contracted with Daniel B. Stephens & Associates, Inc. for outside review of PTX06-1056 and area data to determine further steps for source determination.

The outside review of PTX06-1056 included the evaluation of water samples, previous risk assessment fate and transport modeling, laboratory hydraulic parameter data, soil grain size and hydraulic data, well construction logs, actions taken to date, the current monitoring approach, and the contingency actions described in the Groundwater Contingency Plan. A new multiphase transport simulation was also conducted to evaluate the potential for cross-contamination from the

soils near PTX06-1056 and for preferential migration due to PTX06-1108 penetrating deeply into the FGZ.

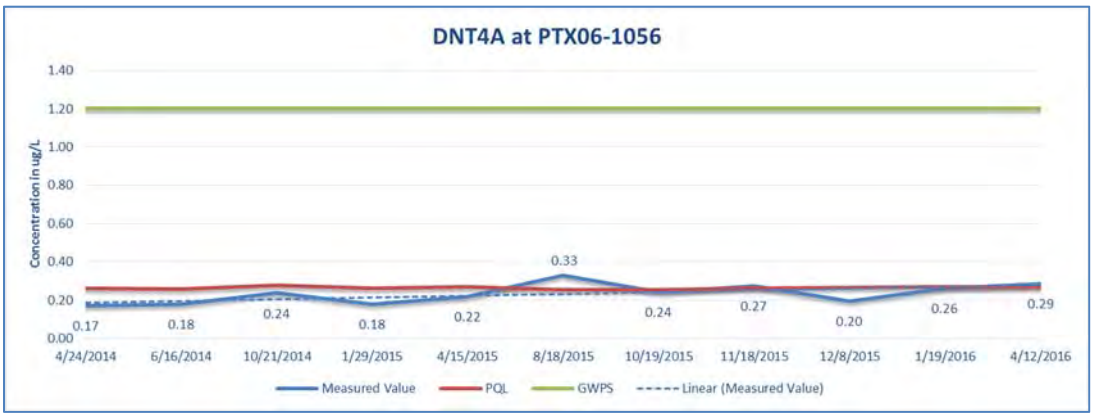
The study concluded that previous fate and transport modeling conducted for the risk assessment did identify potential migration pathways through the soils beneath Texas Tech property. The predicted concentrations from the early modeling do not match the current detected results; therefore, a new fate and transport simulation was conducted using HYDRUS 1-D to evaluate the natural migration in soils near PTX06-1056 and PTX06-1108, migration of contamination from the shorter route through the FGZ created by PTX06-1108 drilling, and to address contingency actions to identify the source area for the detected contaminants. The outside review concluded that results of the additional transport modeling are not entirely conclusive for identifying the pathway for contaminant migration to the Ogallala at PTX06-1056 with certainty. However, the weight of evidence from the transport simulations suggests that transport to the Ogallala is most likely to have occurred along the preferential pathway through PTX06-1108. Recommendations from the report include the following:

- Continue quarterly sampling for HEs and VOCs to more clearly establish whether or not trends are increasing.
- Continue current semiannual sampling schedule for other contaminants of concern.
- Consider additional high-volume purge sampling if contaminant concentrations begin to exhibit a consistent increasing trend.
- Pantex is on the right track with plans to run a cement bond log in PTX06-1056.
    - If the integrity of the annular seal can be confirmed, this will eliminate the possibility that the annulus of the PTX06-1056 could be a preferential pathway for contaminant migration to the Ogallala Aquifer.
    - If the integrity of the annular seal is convincingly demonstrated to be impaired, then repair or abandonment should be considered.
- As an early measure to potentially mitigate the observed detections, Pantex has already plugged and abandoned PTX06-1108 due to its penetration depth.
    - If the quarterly sampling results show the contaminant concentrations stabilizing or declining at levels significantly lower than the GWPS, that would support the premise that elimination of the preferential pathway at PTX06-1108 by its abandonment was successful. Resumption of normal semiannual monitoring would be justified going forward after that.
    - If trends increase to levels exceeding the GWPS, then the Contingent Action Process should be revisited and additional activities considered at that time, including:
        - Additional monitoring.
        - Delineation of extent.
        - Additional characterization of site-specific hydraulic properties to support more focused transport simulations.

The review also provided further information to answer questions for the contingent action process. As part of the review of the contingent action process, it was noted that contaminant extent has not been defined based on our current monitoring well network. As recognized by the

review, there are risks associated with installing Ogallala monitor wells through the contaminated regions of perched groundwater, and it is premature to consider such intensive efforts at this time because current contaminant levels are well below the GWPS.

Pantex has evaluated statistical trends at PTX06-1056. The Mann-Kendall trends indicate that 4-amino-2,6-DNT concentrations are increasing, but 1,2-dichloroethane concentrations are decreasing. However, these trends are based on low concentration data that have changed very little over time (see graph below). Additionally, variability in laboratory data can also be a confounding factor in these trends of low-level detections, as Pantex changed methods for the analysis of HEs in March 2016 (change from 8321A to 8330B consistent with EPA requirements). Based on a study performed on Pantex wells, the methods were comparable, but overall the 8330B results were slightly higher in concentration than the 8321A results, and a larger percentage of the results exceeded the PQL when concentrations were low. The graph of 4-amino-2,6-DNT depicts concentration data since detections began in 2014 and the linear regression line for the data, which also indicates a very slow increase in concentrations over time. Concentrations remain below the GWPS for both detected constituents; therefore, Pantex plans to continue the current monitoring and evaluate the results of the cement bond log and monitoring to determine if further actions are necessary.



There were no unexpected results in the perched uncertainty management/early detection data collected during 2nd quarter.

SCHEDULE UPDATE

Pantex has provided a detailed schedule of upcoming work in the 2015 Annual Progress Report. Completed work and ongoing and upcoming work to be started or completed by the date of publication of this report are provided here.

Pantex completed the following items prior to publication of this report:

- Pantex installed 4 new extraction wells east of FM 2373, near PTX06-1147. These wells will become part of the SEPTS expansion.

- Pantex installed four monitoring wells. One well was a replacement of PTX06-1071, one well, PTX06-1182, will be used to evaluate extent of the perched aquifer between PTX06-1133A and PTX06-1158, one well, PTX06-1181, will be used to evaluate the extent of the TCE plume along the western side of Zone 11, and one other well, PTX06-1183, to evaluate the hexavalent chromium plume emanating from the southwest corner of Zone 12.
- Pantex plugged unused soil gas monitoring wells in a landfill northeast of the Burning Ground SVE system. This was completed to ensure the integrity of the cover.
- Pantex set up contracting for long-term maintenance of landfills to address holes/voids, lack of vegetation, and erosion of landfill covers as needed. Work is expected to be completed annually, as needed, for filling holes/voids and seeding.
- Well rehabilitation efforts at the Zone 11 ISB began in March 2016, with injection completed in August 2016.

Pantex continues to progress toward completion of the following items:

- Pantex has contracted for replacement of the Solid Waste Management Unit (SWMU) 2 and SWMU 5/5 ditch liner. Inspection of the liner during 2nd quarter 2015 indicated that the liner had multiple tears and the edges are no longer anchored in some areas. Due to the age of the liner and the expected lifetime of 10 years, Pantex will replace the liner. Work is expected to be completed in early 2017.
- Pantex is addressing erosion of Landfill 3 slopes in specific areas noted in the 2014 and 2015 inspections by contracting for a design to prevent erosion in those areas. The contracting was completed in April 2016 and the design is scheduled for completion in October 2016.
- Well rehabilitation efforts began at the Southeast ISB in August 2016, with injection activities scheduled to begin in late September 2016.
- Contracting for design of the SEPTS extension began in June 2016, with the design scheduled for completion in January 2017.
- Pantex plans to install one additional extraction well east of the four new wells for the SEPTS expansion. This well is expected to be completed by the end of September.
- The cement bond log for PTX06-1056 was completed in September. A final report is expected in November.
- The RDX natural attenuation study has been contracted. The study is expected to be completed in one year.

Upcoming work includes the following:

- Contracting for installation of Closure Turf® on Landfill 2 to provide long-term prevention of erosion and infiltration. The Closure Turf® will be installed in early 2017.
- Pantex plans to conduct the light detection and ranging (LiDAR) study for the five-year review of the landfill covers. Data collection is expected to be completed by December 2016.
- Pantex will contract for road improvement (caliche and crushed asphalt) for better access to the SEPTS and Southeast ISB wells on Texas Tech property. The improved roads are expected to be completed in early 2017.
- Contracting for Landfill 3 erosion control construction is under way. Work is expected to be completed in early 2017.
- Annual landfill maintenance is expected to begin and be completed in October 2016.

Conclusions and Recommendations for Change

The Remedial Actions continue to operate and meet short-term expectations for cleanup of the perched groundwater in areas under influence of the remediation systems. The pump and treat systems continue to remove COC mass and water from the perched aquifer, thus decreasing head that is driving vertical and lateral movement of perched groundwater.

The ISB systems continue to demonstrate that treatment downgradient of the systems has been generally effective, and many COC concentrations have been greatly reduced or now meet the GWPS at the Southeast ISB. One downgradient well (PTX06-1153) for the Southeast ISB is not responding as well as others. Pantex continues to evaluate conditions in that area to determine if the well is impacted by water from the western end of the Southeast ISB or if it is not hydraulically connected to that system. As discussed above, passive flux meters will be deployed in September to evaluate water and mass flux into specific wells at the Southeast ISB. That information will be provided in the 2016 Annual Progress Report. Monitoring will continue at PTX06-1153 as described in the sampling and analysis plan (SAP), as the quarterly samples will provide adequate information for this well. Further recommendations will be made based on the evaluation of data over time.

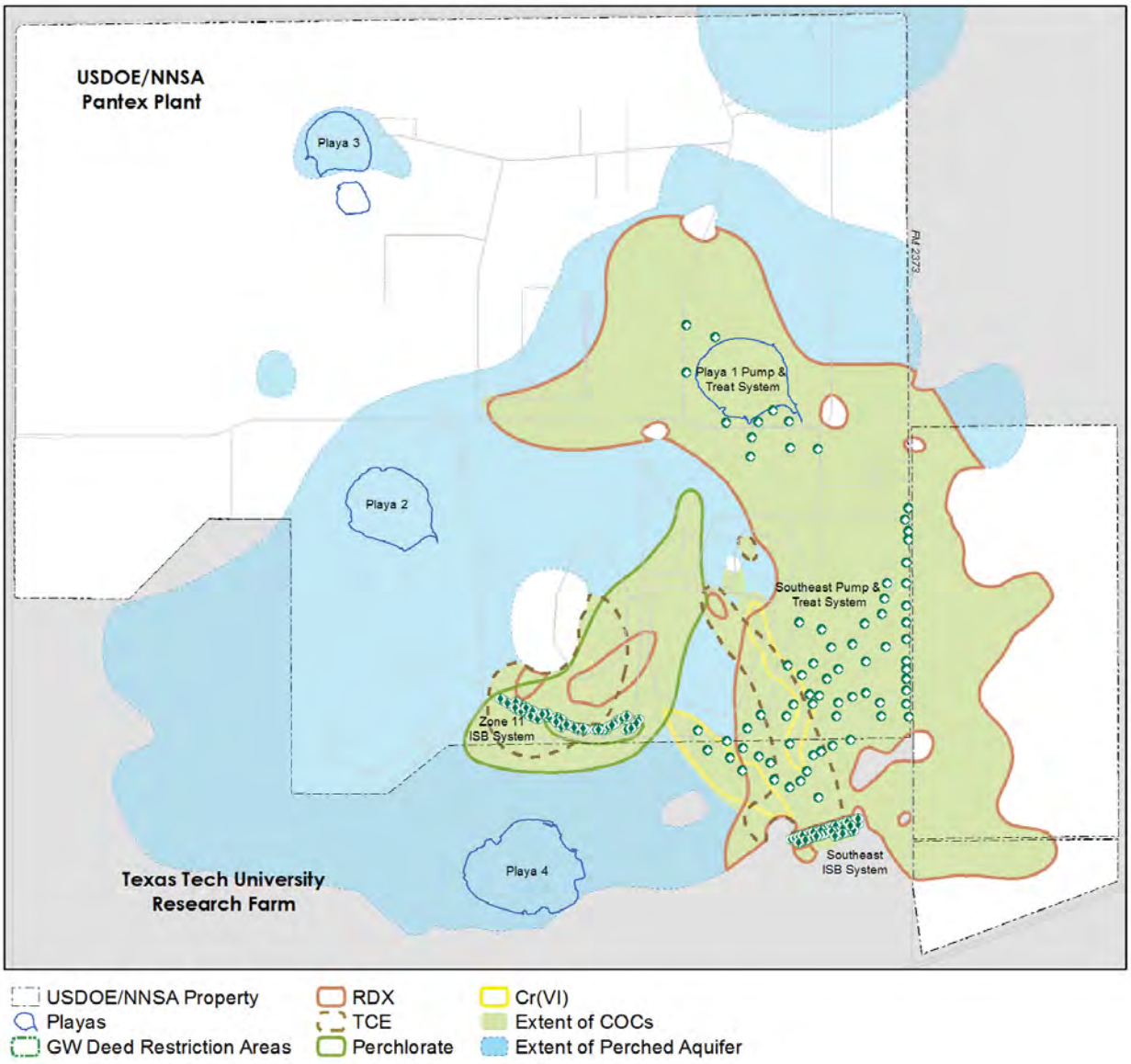
Downgradient wells at the Zone 11 ISB are generally demonstrating treatment. Four of the six downgradient ISPM wells exhibit perchlorate concentrations below the GWPS, and perchlorate concentrations are continuing to decline in the other two wells. TCE concentrations since the start of the Remedial Action continue to indicate a decreasing trend either below or near the GWPS in downgradient ISPM wells PTX06-1012 and PTX06-1155. Elevated c*is*-1,2-DCE concentrations and the lack of vinyl chloride at wells inside and downgradient of the treatment zone continue to suggest that complete dechlorination of TCE is not occurring. Pantex will collect samples again later this year to continue to evaluate the effectiveness of the bioaugmentation.

The SVE system continues to treat soil gas and residual NAPL in the SEP/CBP area of the Burning Ground, thereby mitigating vertical movement of VOCs to groundwater. Pantex has continued to have problems with completing rebound tests; progress toward a path to closure for this system will continue after evaluating other options.

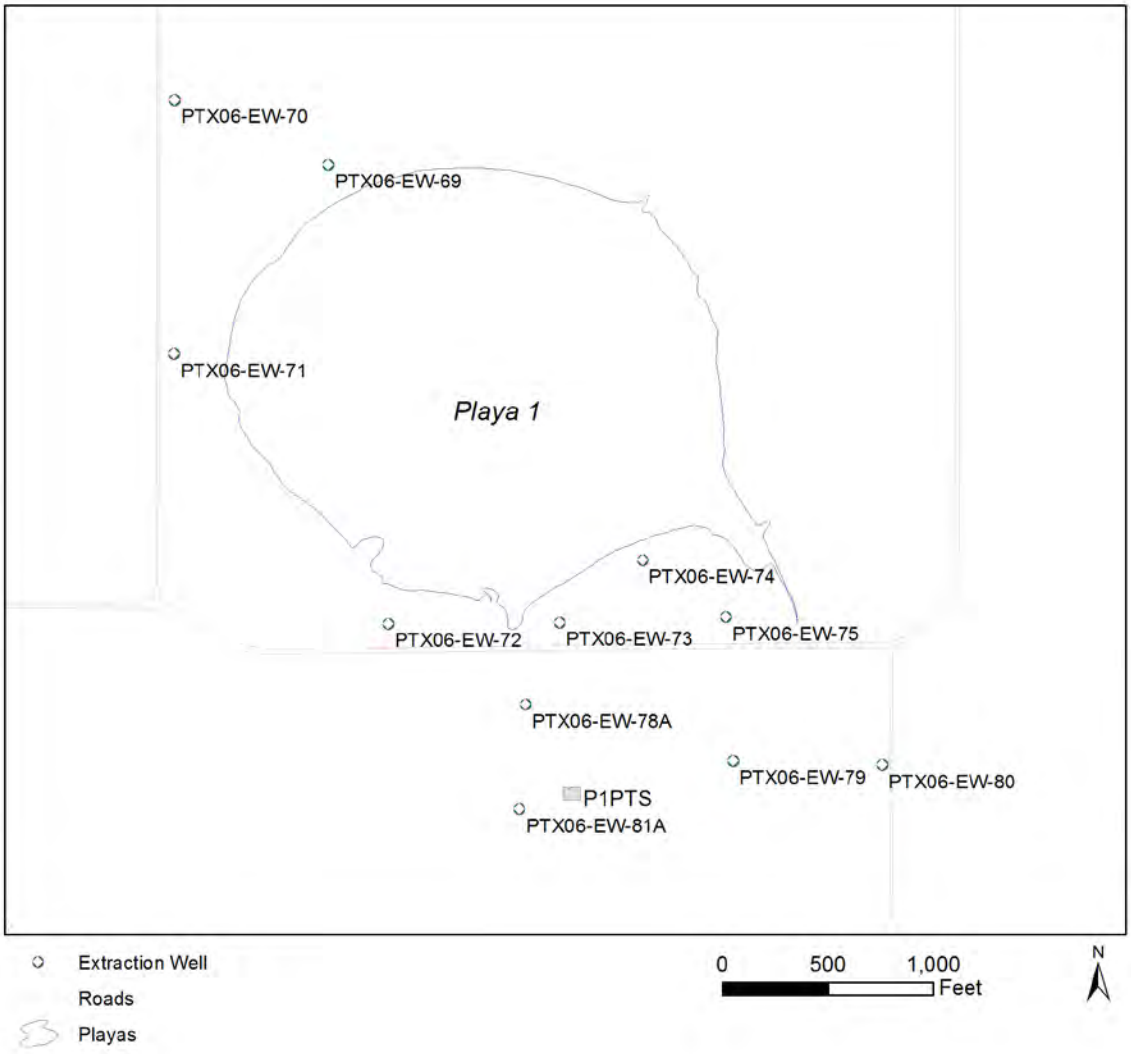
The groundwater remedies are considered to be protective for the short-term, as untreated perched groundwater use is controlled to prevent human contact and monitoring data continue to indicate that the Remedial Actions remain protective of the Ogallala Aquifer. Detections of 4-amino-2,6-DNT and 1,2-dichloroethane below the GWPS have occurred in one Ogallala well, and Pantex is actively following the Groundwater Contingency Plan to guide the response. Pantex proactively conducted work to determine possible causes of the detections. Pantex addressed one potential source by plugging a nearby perched well that was drilled deep into the FGZ and contracted for an outside review to determine further steps for source determination. Pantex will also complete a cement bond log on PTX06-1056 in 2016 to determine if the annular seal is competent. Further steps will be determined based on the outcome of the cement bond log and continued monitoring results. Pantex will continue to monitor this Ogallala well quarterly to determine if a trend emerges.

Pantex continues to evaluate options for the southeast lobe of perched groundwater east of FM 2373. As recommended in the 2015 Annual Progress Report, Pantex is actively working toward extending the SEPTS operation to that area to address the continued plume movement to the south.

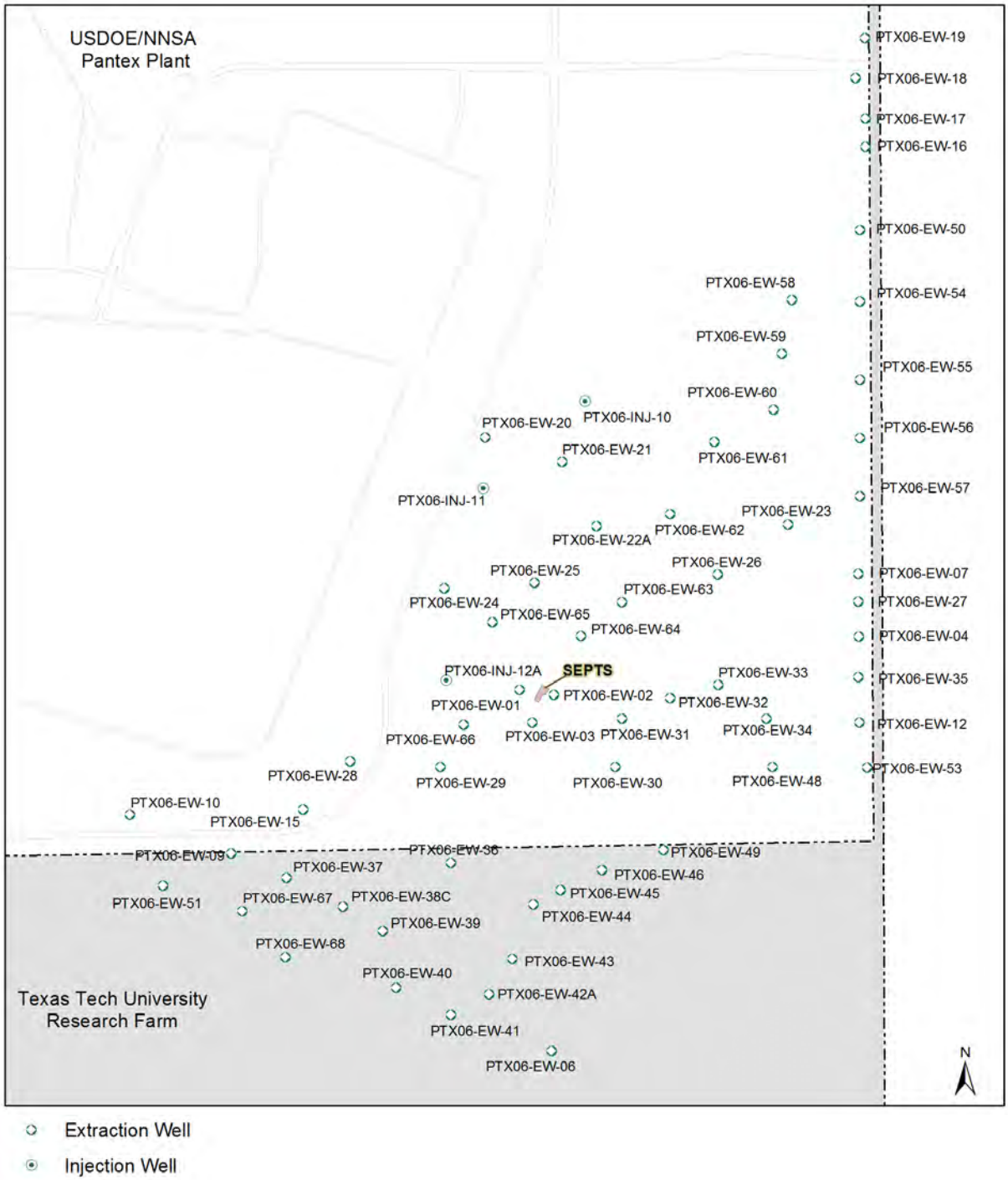
Appendix A
Maps



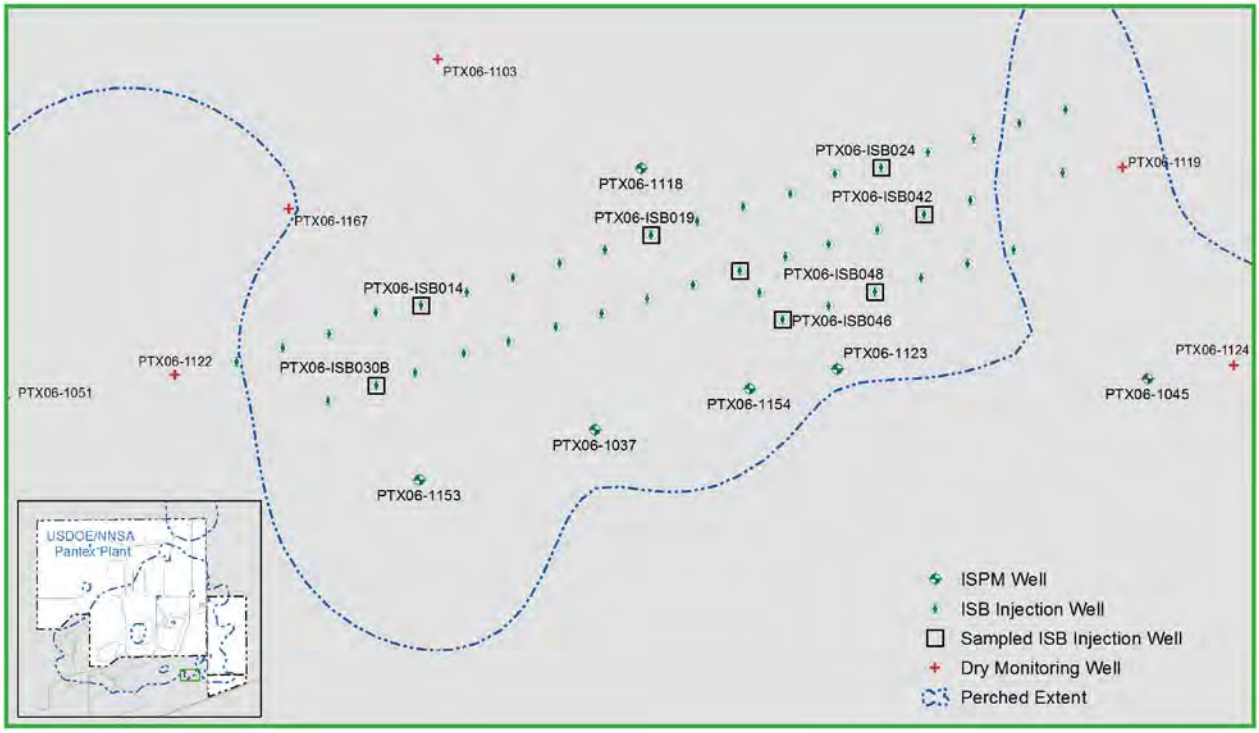
Extent of Perched Groundwater and Contaminant Plumes



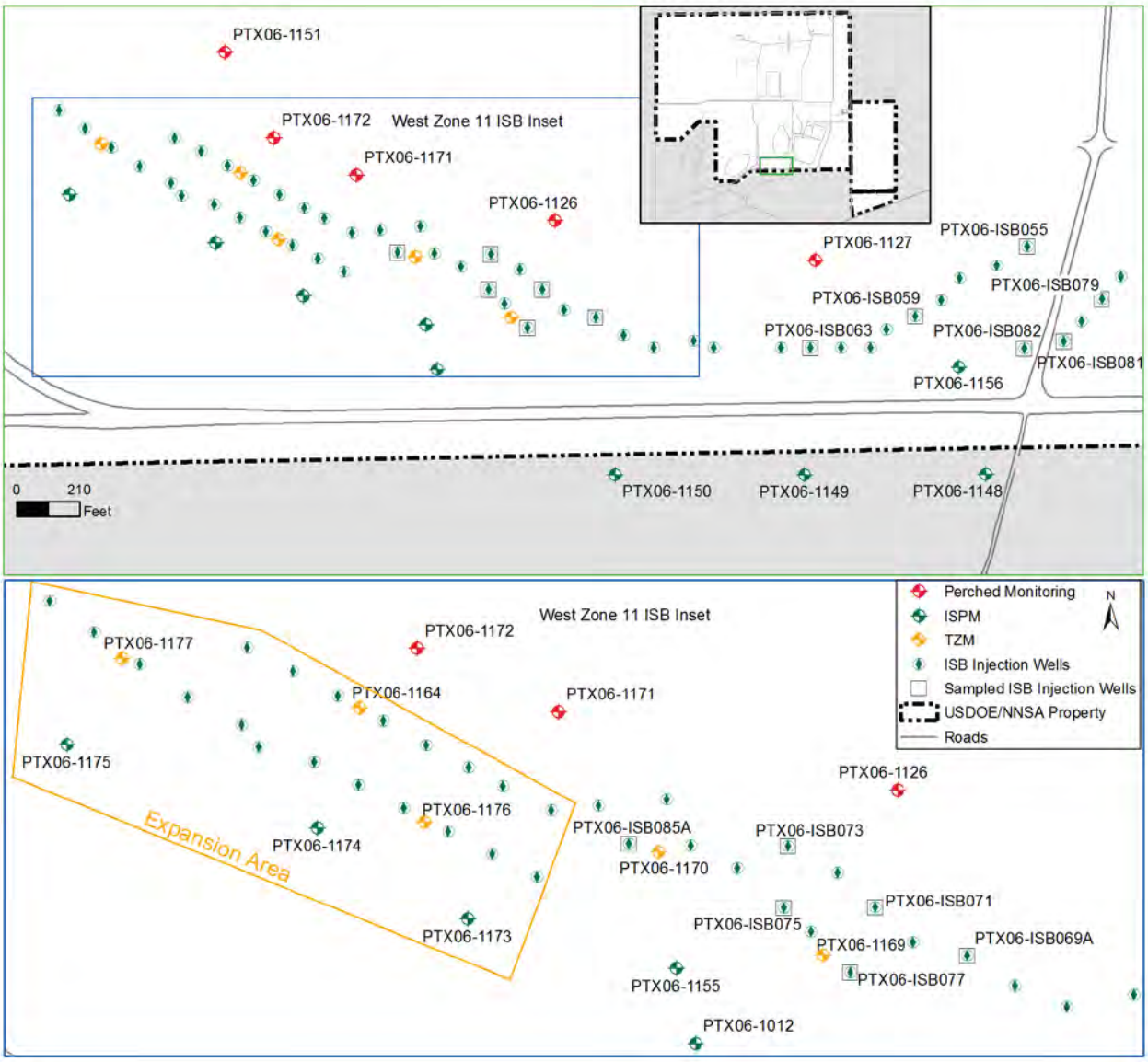
Playa 1 Pump and Treat System Wells



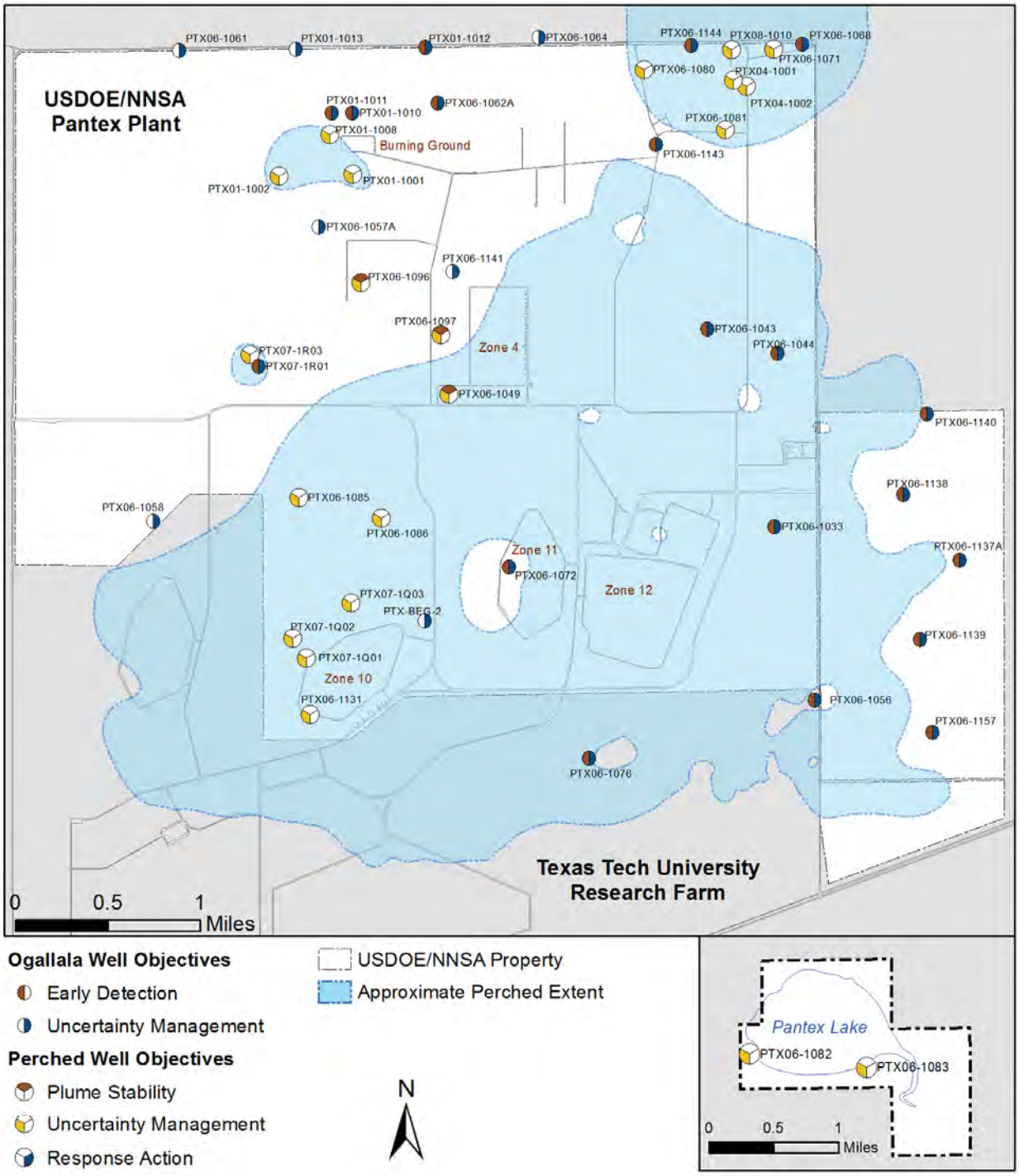
Southeast Pump and Treat System Wells



Southeast ISB Wells and Sampling Locations



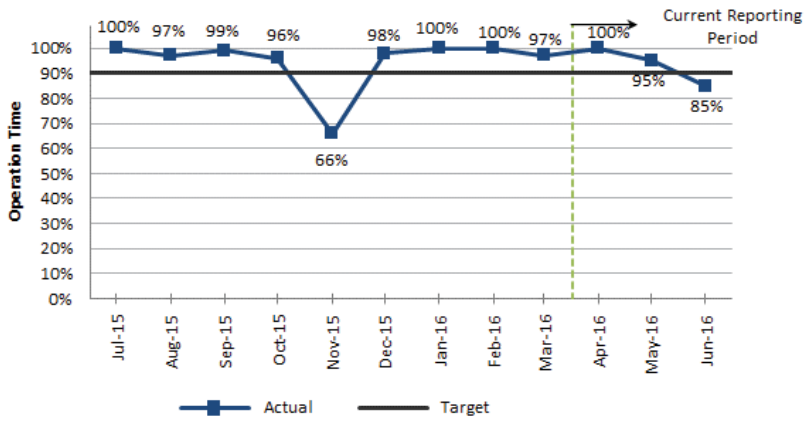
Zone 11 ISB Wells and Sampling Locations



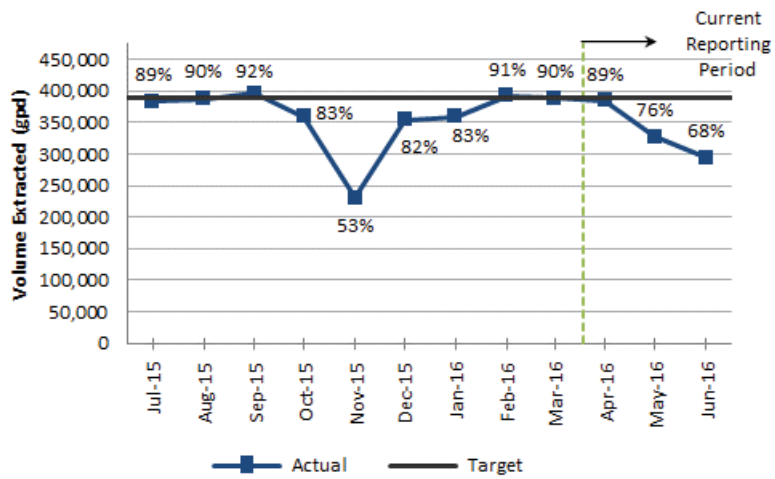
Uncertainty Management and Early Detection Wells Evaluated in the Quarterly Progress Report

Appendix B
Pump and Treat Systems Graphs

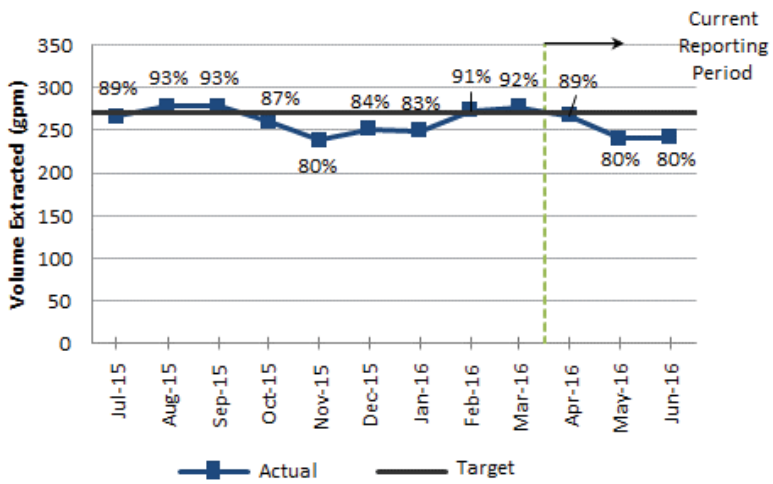
Southeast Pump and Treat Graphs



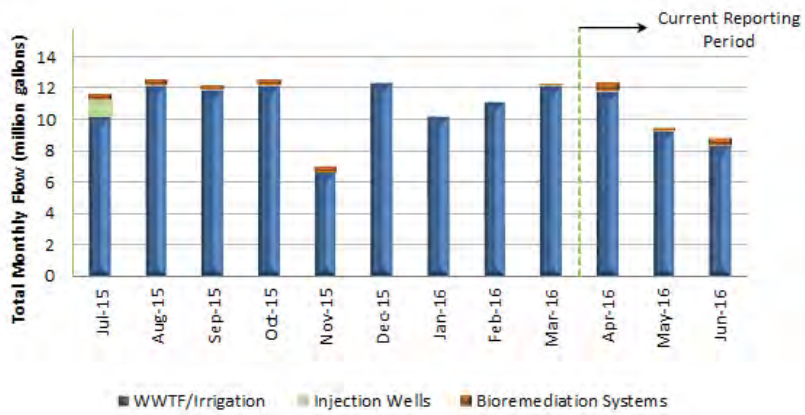
SEPTS Operation Time vs Target



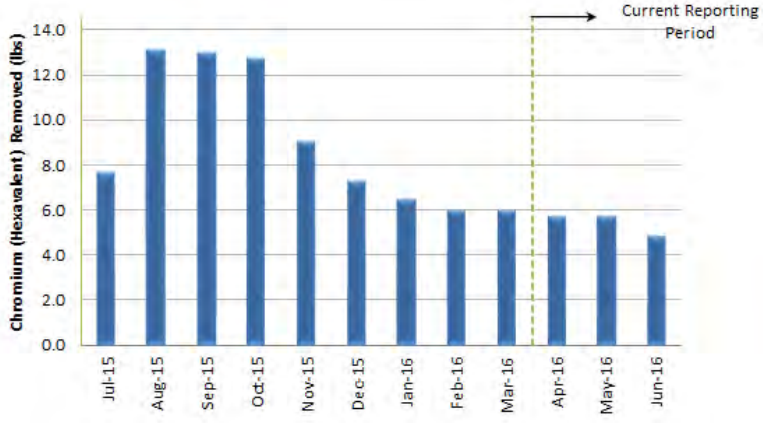
SEPTS GPD and % Capacity



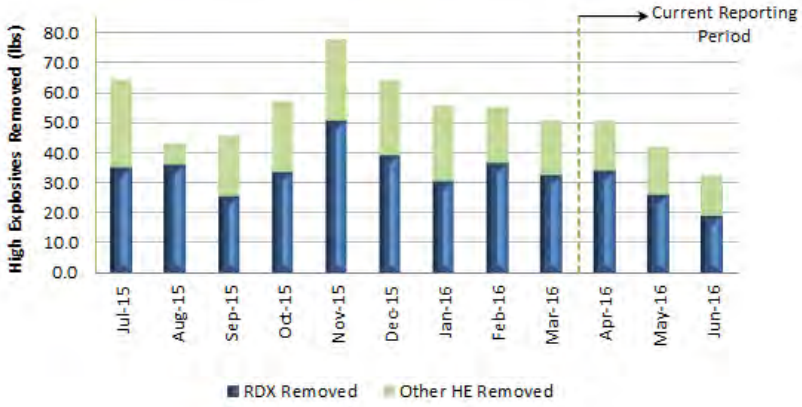
SEPTS Average GPM and % Capacity



SEPTS Monthly Total Flow

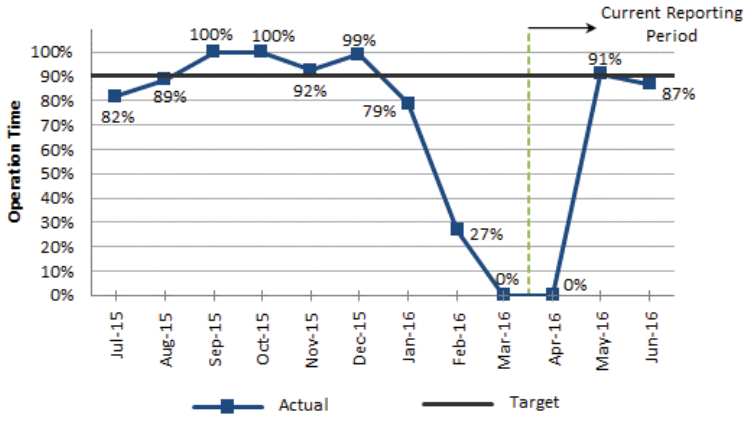


SEPTS Chromium Mass Removal by Month

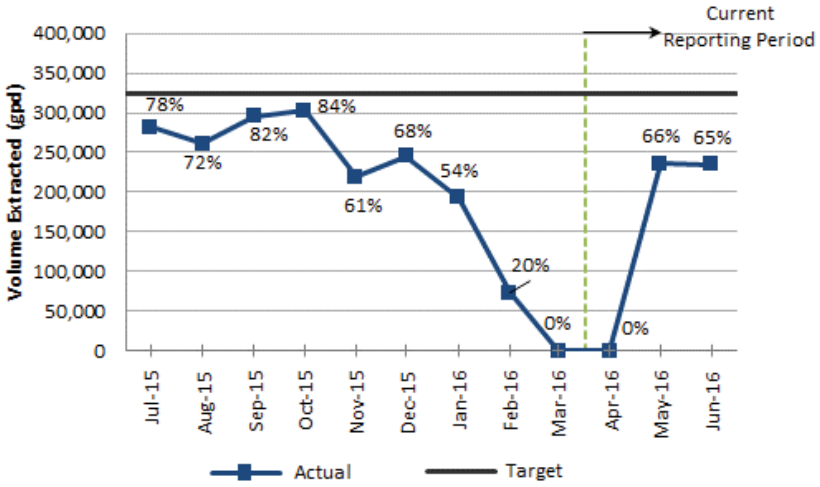


SEPTS HE Mass Removal by Month

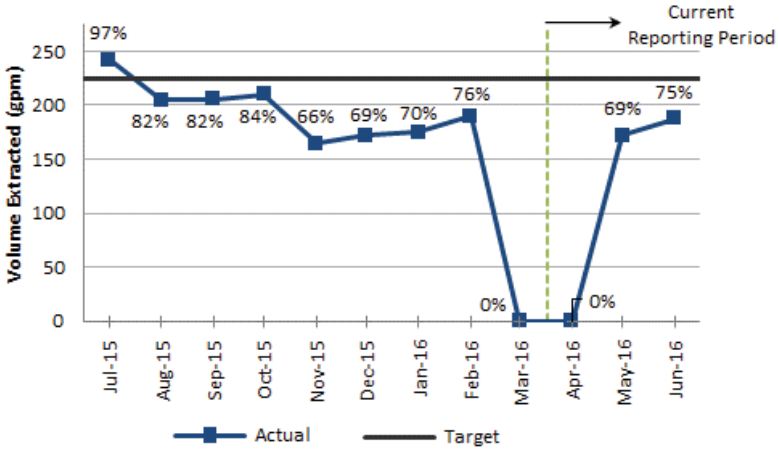
Playa 1 Pump and Treat Graphs



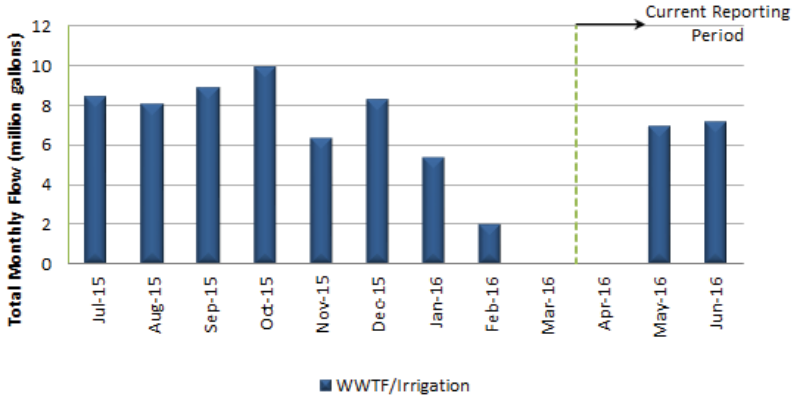
P1PTS Operational Time Vs Target



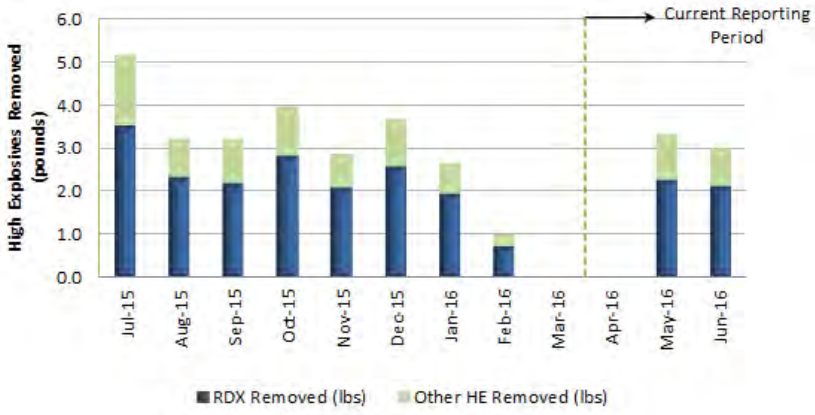
P1PTS Average GPD and % Capacity



P1PTS Average GPM and % Capacity



P1PTS Monthly System Total Flow



P1PTS HE Mass Removal by Month

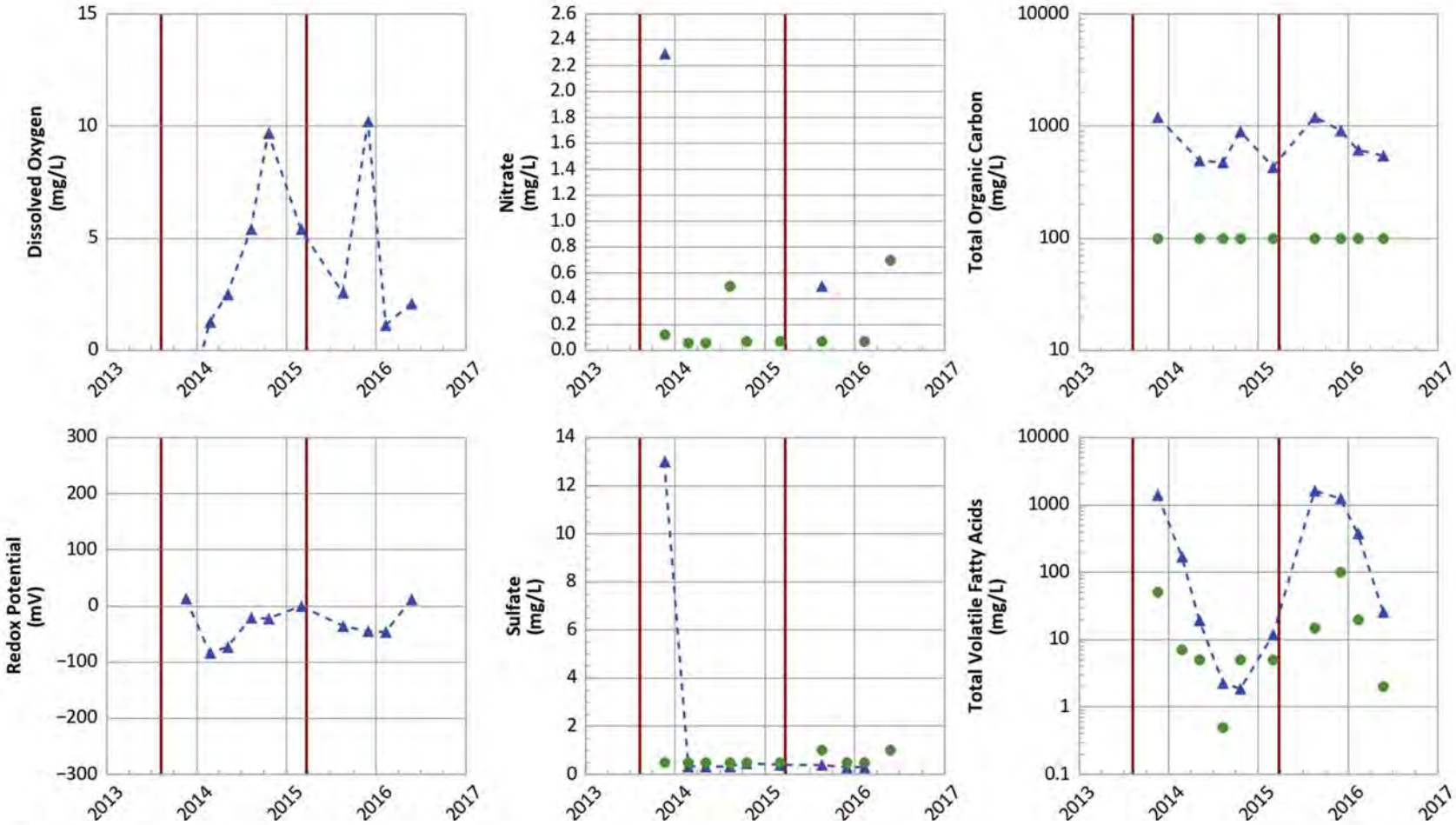
Appendix B Glossary

Operation Time	Operation time represents the percentage of the total number of hours the system was actually operated vs. the total possible hours the system could have operated on a monthly basis.
GPM Extraction	The gallons per minute (GPM) extraction rate represents the extraction rate from the well field while the system was operating. This is a measurement of the well field's capability to support the overall system throughput goals. Low well field rates can occur due to inoperable wells or decline in saturated thickness that makes extraction difficult.
GPD Extraction	The gallons per day (GPD) extraction rate represents the system's ability to meet overall throughput goals, considering the well field extraction rate and the system's operational rate. This rate is affected by the ability to extract water from the well field and the system downtime.
Total Monthly Flow	Total monthly flow is the total volume of extracted water measured at the influent point of the pump and treat system. Individual well measurements and flow rates are provided in the annual progress report.

Appendix C
ISB Graphs

Southeast ISB Graphs

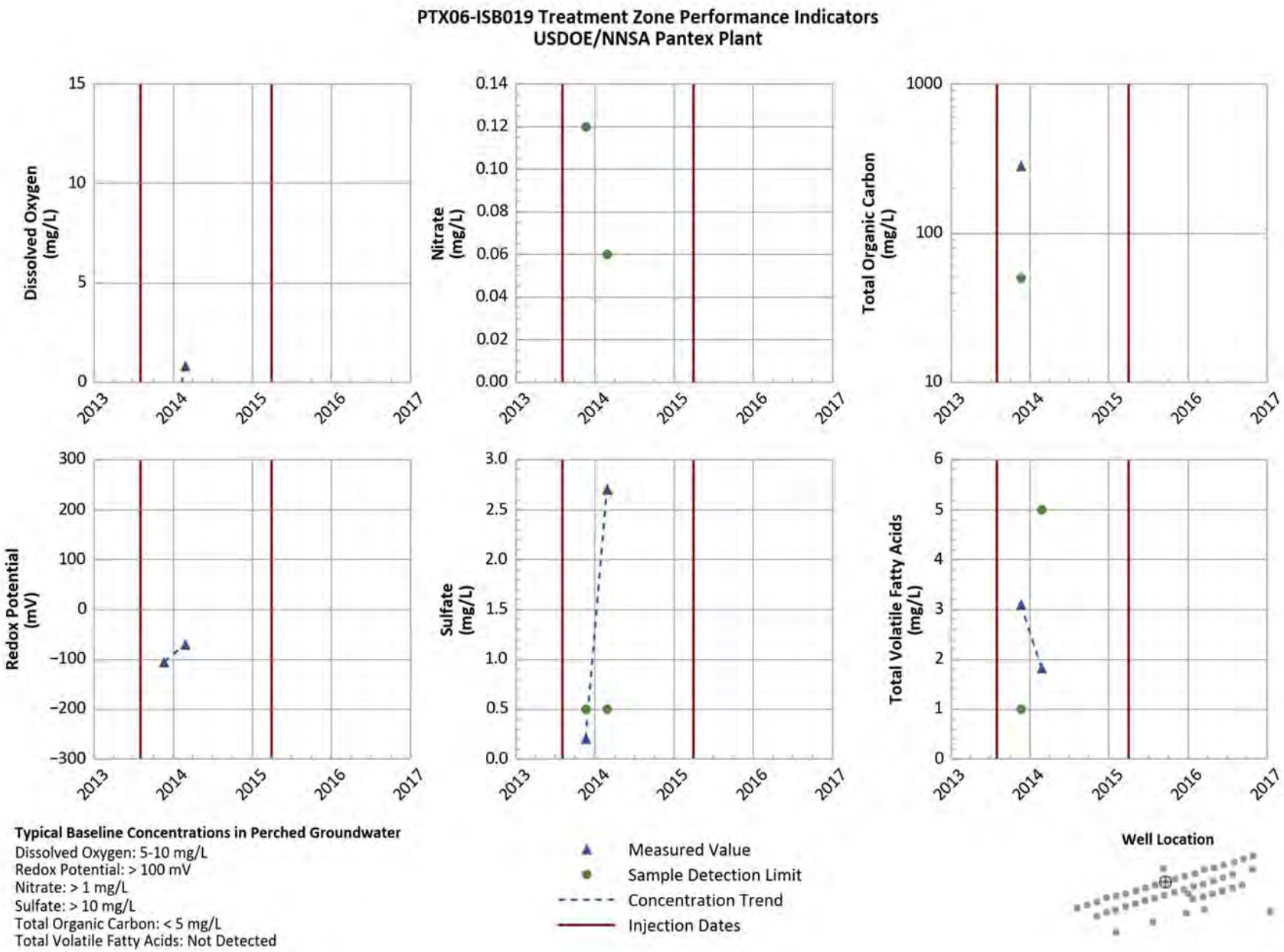
PTX06-ISB014 Treatment Zone Performance Indicators
USDOE/NNSA Pantex Plant



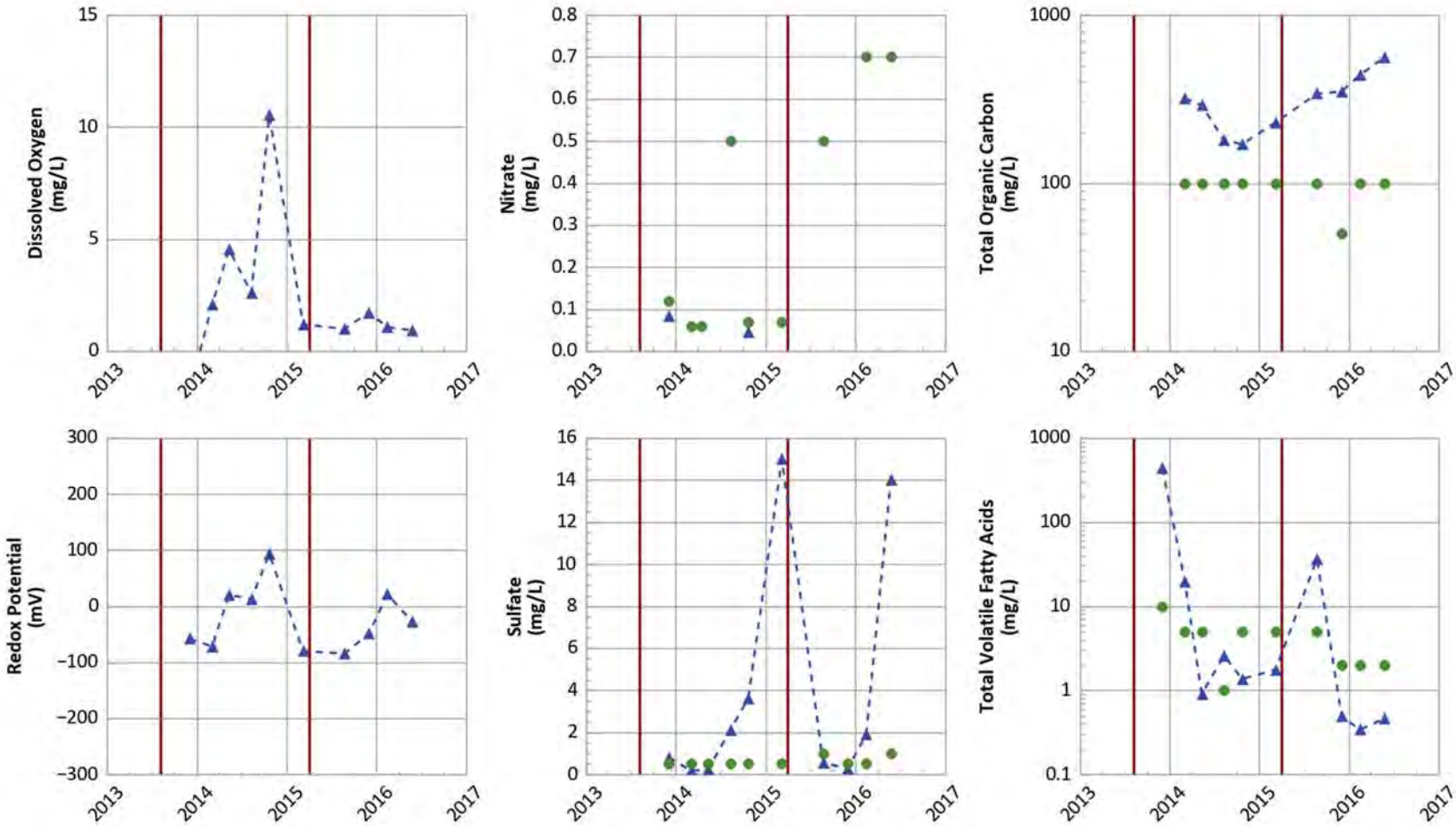
Typical Baseline Concentrations in Perched Groundwater
Dissolved Oxygen: 5-10 mg/L
Redox Potential: > 100 mV
Nitrate: > 1 mg/L
Sulfate: > 10 mg/L
Total Organic Carbon: < 5 mg/L
Total Volatile Fatty Acids: Not Detected

Measured Value
Sample Detection Limit
Concentration Trend
Injection Dates

Well Location


PTX06-ISB019 Treatment Zone Performance Indicators
USDOE/NNSA Pantex Plant
Dissolved Oxygen (mg/L)
Nitrate (mg/L)
Total Organic Carbon (mg/L)
Redox Potential (mV)
Sulfate (mg/L)
Total Volatile Fatty Acids (mg/L)
2013
2014
2015
2016
2017
Typical Baseline Concentrations in Perched Groundwater
Dissolved Oxygen: 5-10 mg/L
Redox Potential: > 100 mV
Nitrate: > 1 mg/L
Sulfate: > 10 mg/L
Total Organic Carbon: < 5 mg/L
Total Volatile Fatty Acids: Not Detected
Measured Value
Sample Detection Limit
Concentration Trend
Injection Dates
Well Location

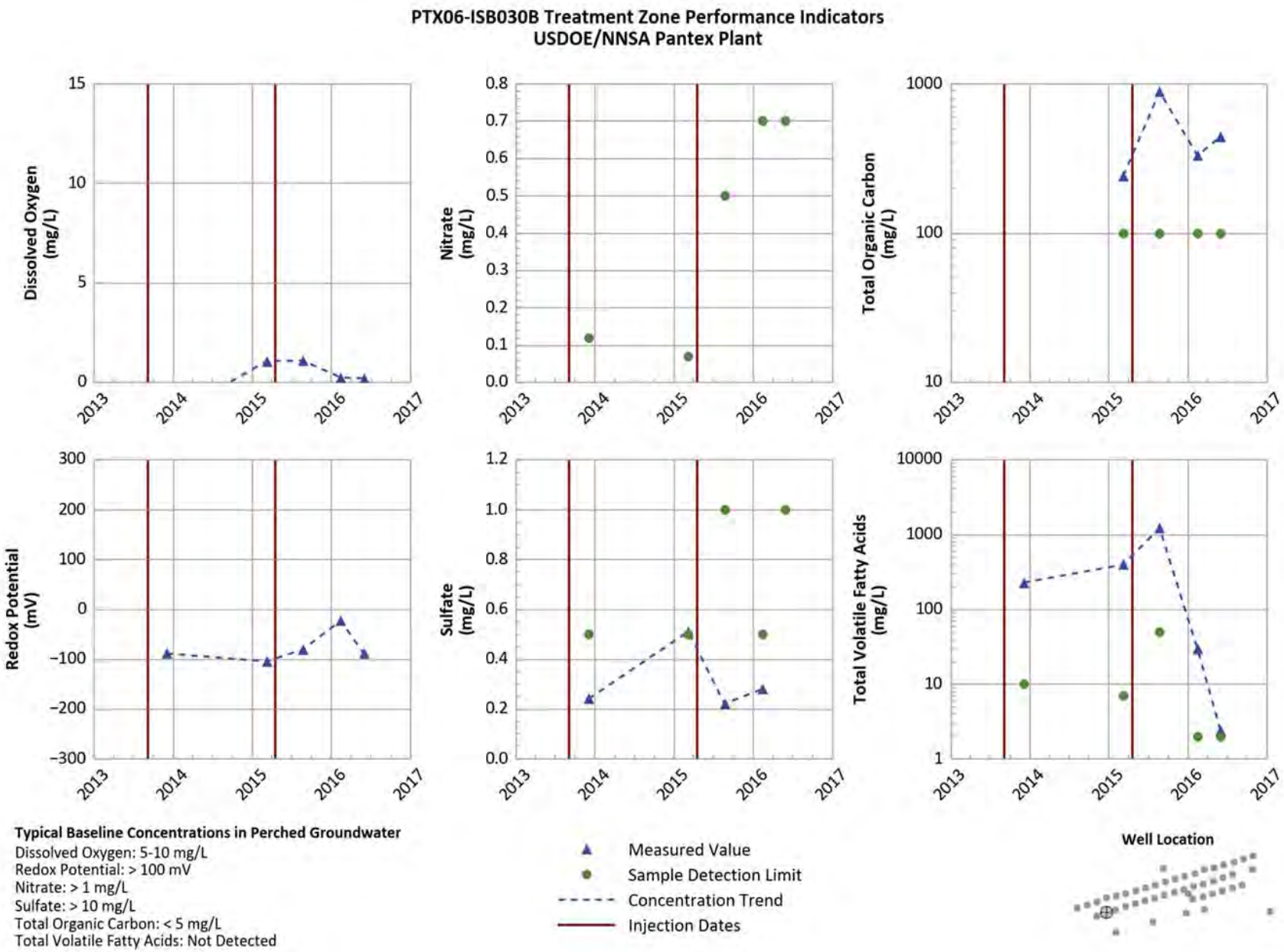
PTX06-ISB024 Treatment Zone Performance Indicators
USDOE/NNSA Pantex Plant



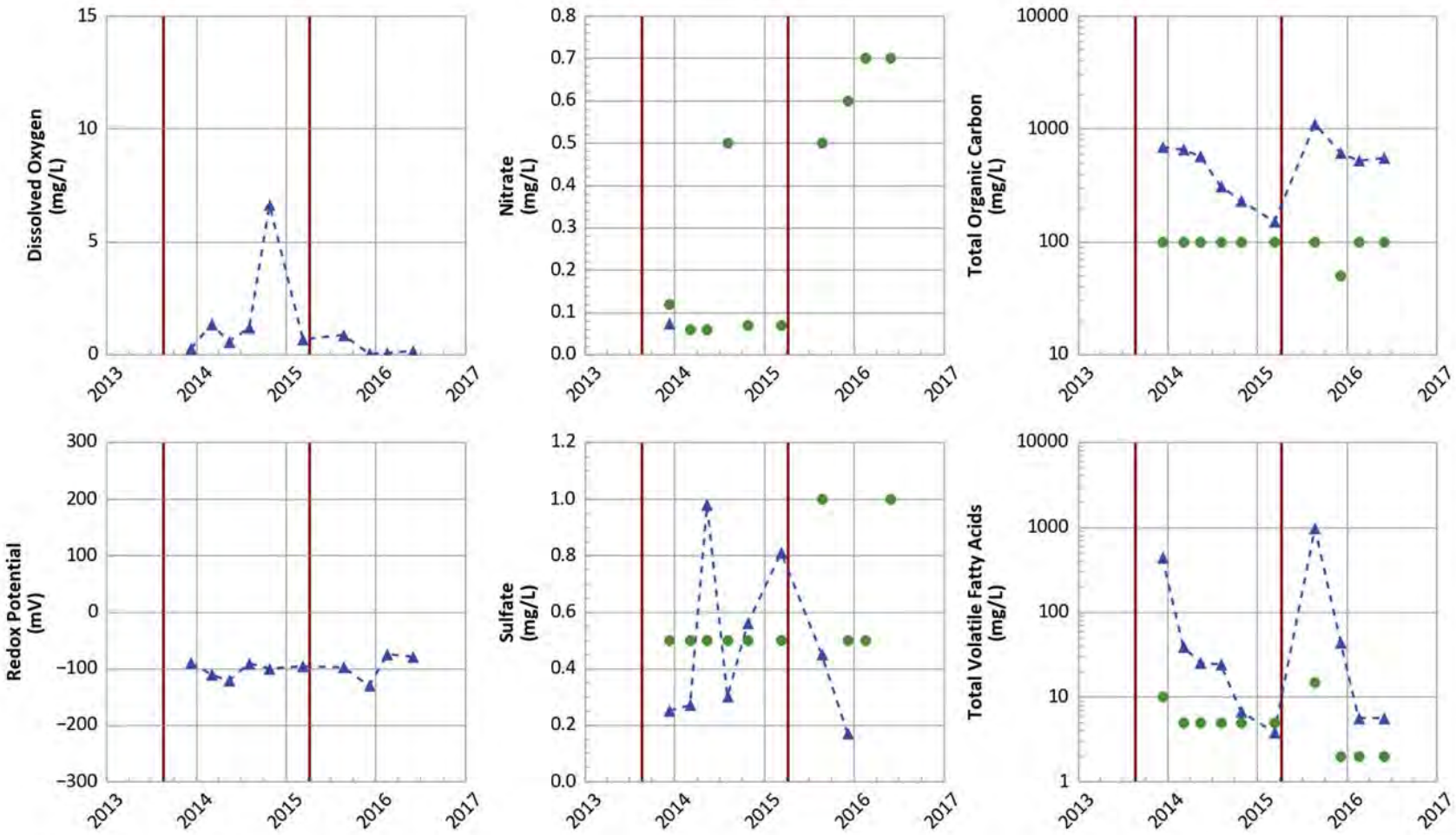
Typical Baseline Concentrations in Perched Groundwater
Dissolved Oxygen: 5-10 mg/L
Redox Potential: > 100 mV
Nitrate: > 1 mg/L
Sulfate: > 10 mg/L
Total Organic Carbon: < 5 mg/L
Total Volatile Fatty Acids: Not Detected

Measured Value
Sample Detection Limit
Concentration Trend
Injection Dates

Well Location


PTX06-ISB030B Treatment Zone Performance Indicators
USDOE/NNSA Pantex Plant
Dissolved Oxygen (mg/L)
Nitrate (mg/L)
Total Organic Carbon (mg/L)
Redox Potential (mV)
Sulfate (mg/L)
Total Volatile Fatty Acids (mg/L)
2013
2014
2015
2016
2017
Typical Baseline Concentrations in Perched Groundwater
Dissolved Oxygen: 5-10 mg/L
Redox Potential: > 100 mV
Nitrate: > 1 mg/L
Sulfate: > 10 mg/L
Total Organic Carbon: < 5 mg/L
Total Volatile Fatty Acids: Not Detected
Measured Value
Sample Detection Limit
Concentration Trend
Injection Dates
Well Location

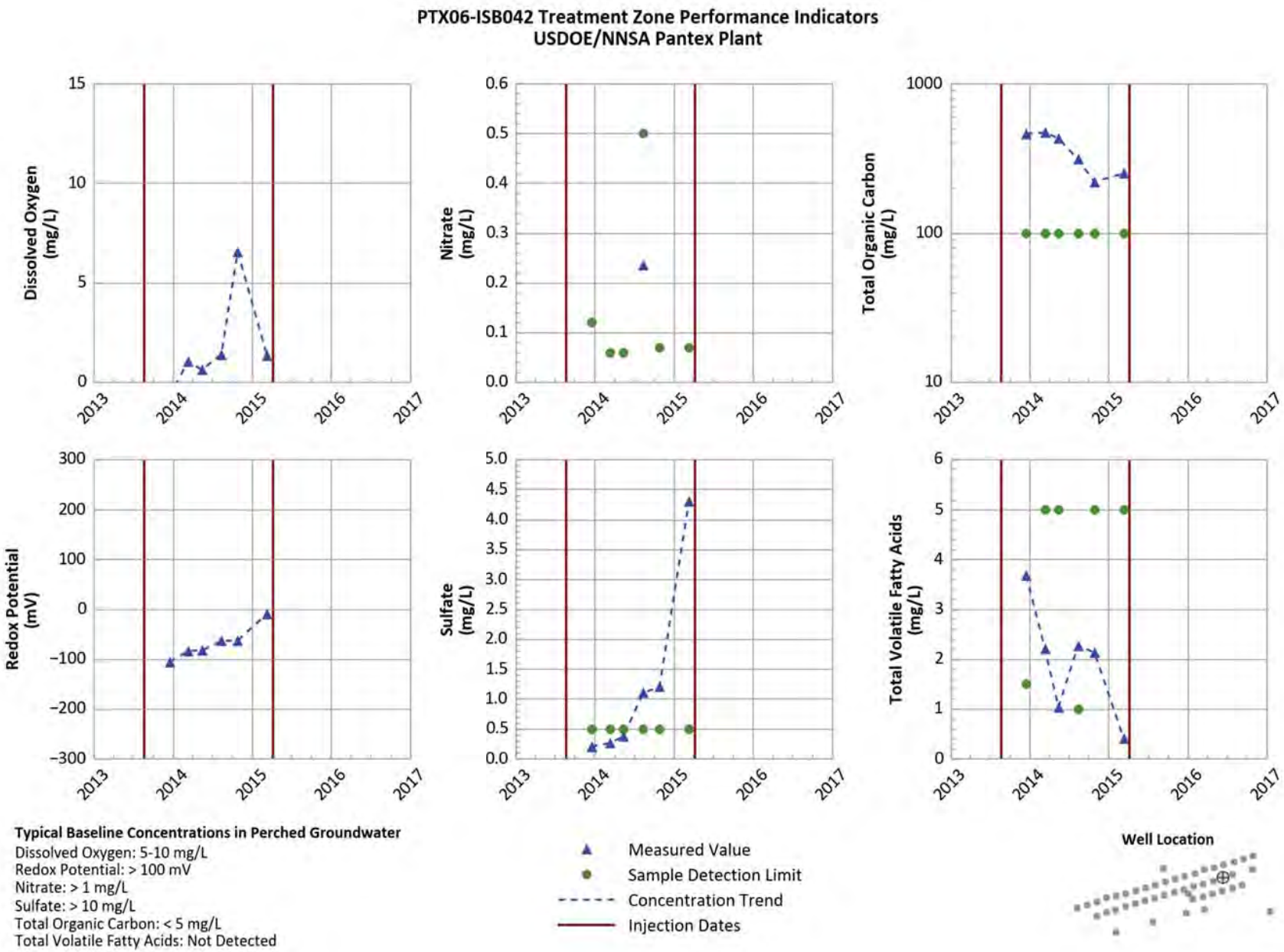
PTX06-ISB038 Treatment Zone Performance Indicators
USDOE/NNSA Pantex Plant



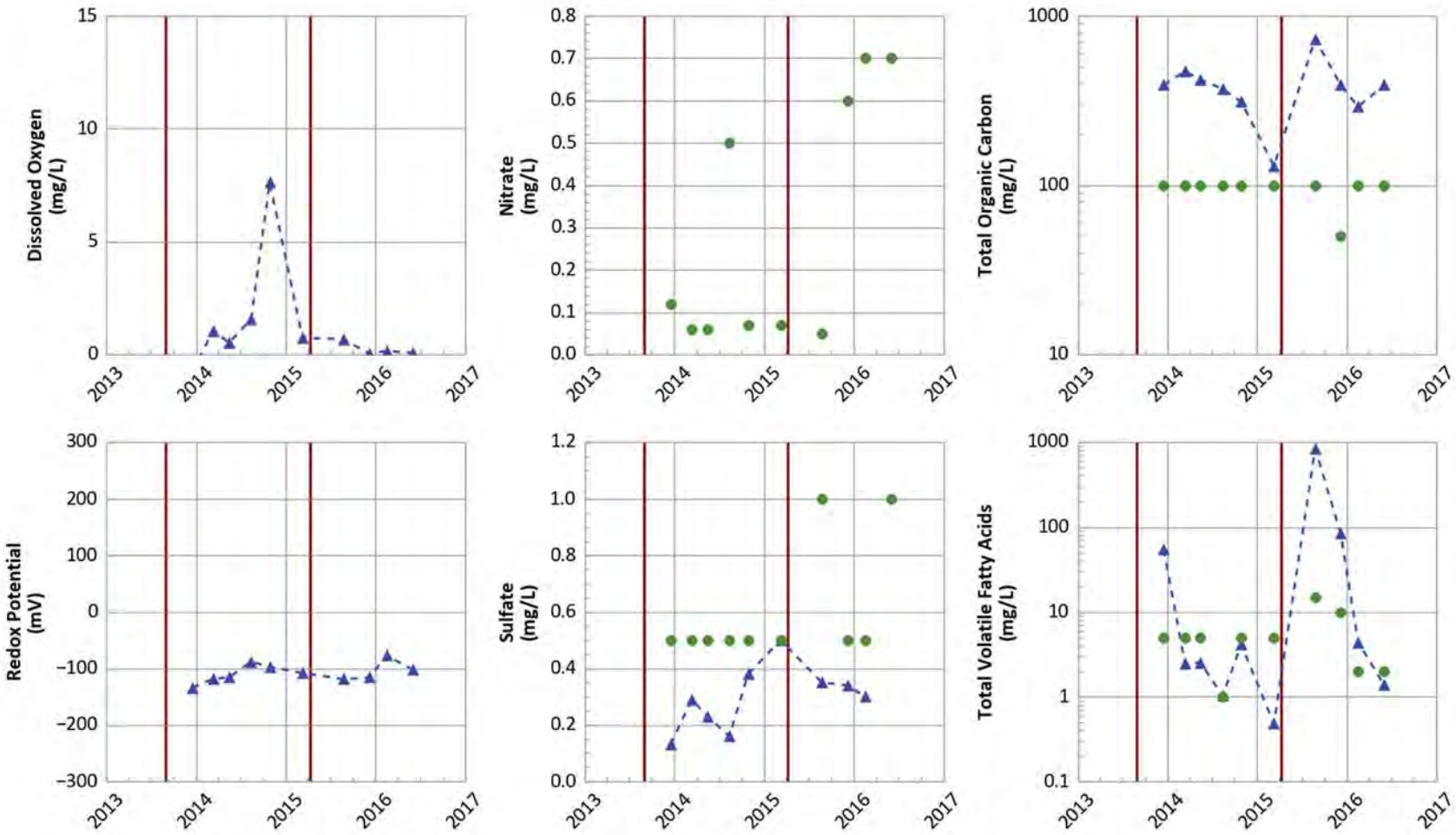
Typical Baseline Concentrations in Perched Groundwater
Dissolved Oxygen: 5-10 mg/L
Redox Potential: > 100 mV
Nitrate: > 1 mg/L
Sulfate: > 10 mg/L
Total Organic Carbon: < 5 mg/L
Total Volatile Fatty Acids: Not Detected

Measured Value
Sample Detection Limit
Concentration Trend
Injection Dates

Well Location


PTX06-ISB042 Treatment Zone Performance Indicators
USDOE/NNSA Pantex Plant
Dissolved Oxygen (mg/L)
Nitrate (mg/L)
Total Organic Carbon (mg/L)
Redox Potential (mV)
Sulfate (mg/L)
Total Volatile Fatty Acids (mg/L)
2013
2014
2015
2016
2017
Typical Baseline Concentrations in Perched Groundwater
Dissolved Oxygen: 5-10 mg/L
Redox Potential: > 100 mV
Nitrate: > 1 mg/L
Sulfate: > 10 mg/L
Total Organic Carbon: < 5 mg/L
Total Volatile Fatty Acids: Not Detected
Measured Value
Sample Detection Limit
Concentration Trend
Injection Dates
Well Location

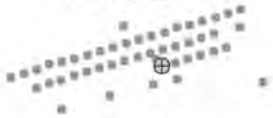
PTX06-ISB046 Treatment Zone Performance Indicators
USDOE/NNSA Pantex Plant

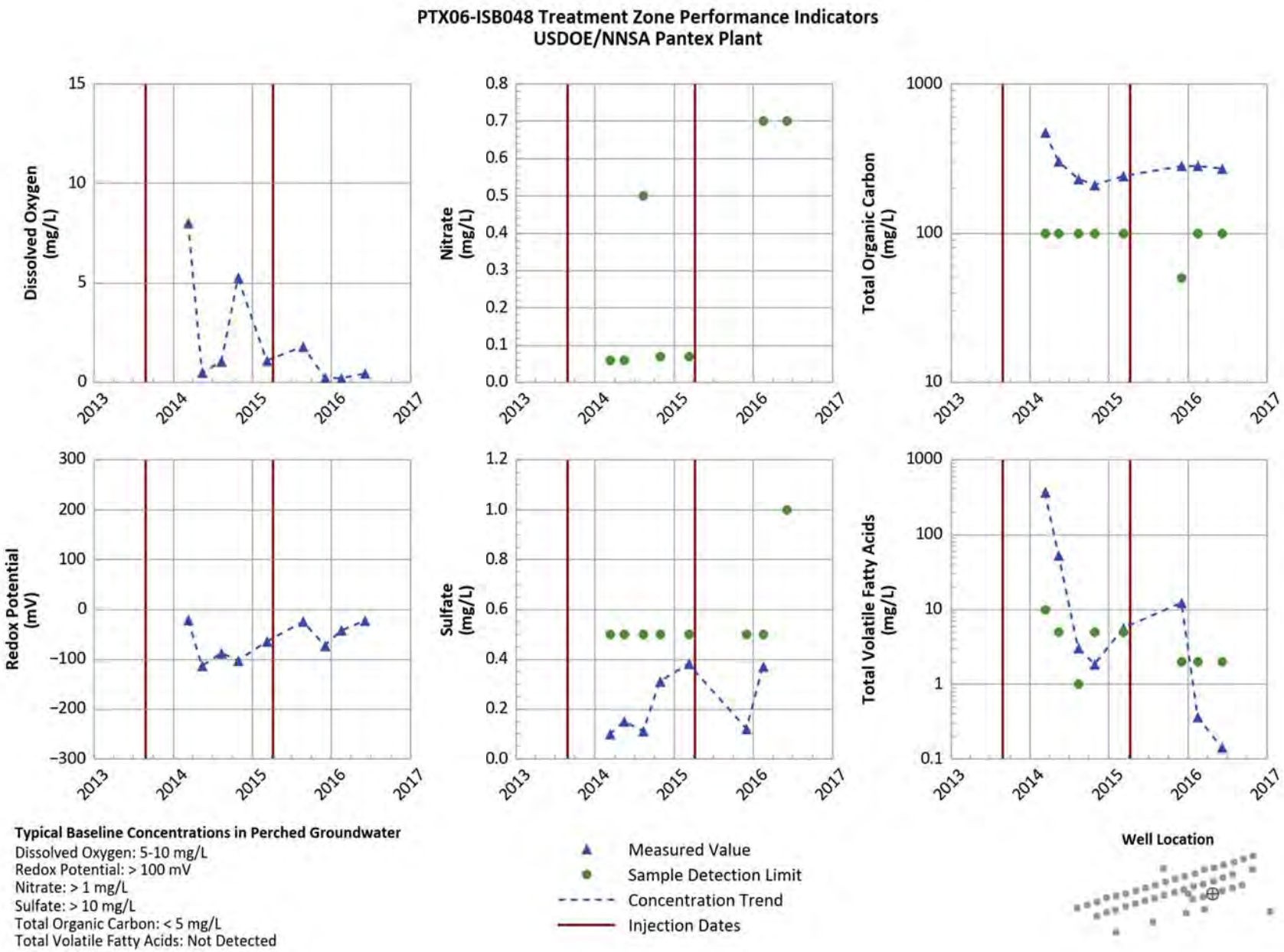


Typical Baseline Concentrations in Perched Groundwater
Dissolved Oxygen: 5-10 mg/L
Redox Potential: > 100 mV
Nitrate: > 1 mg/L
Sulfate: > 10 mg/L
Total Organic Carbon: < 5 mg/L
Total Volatile Fatty Acids: Not Detected

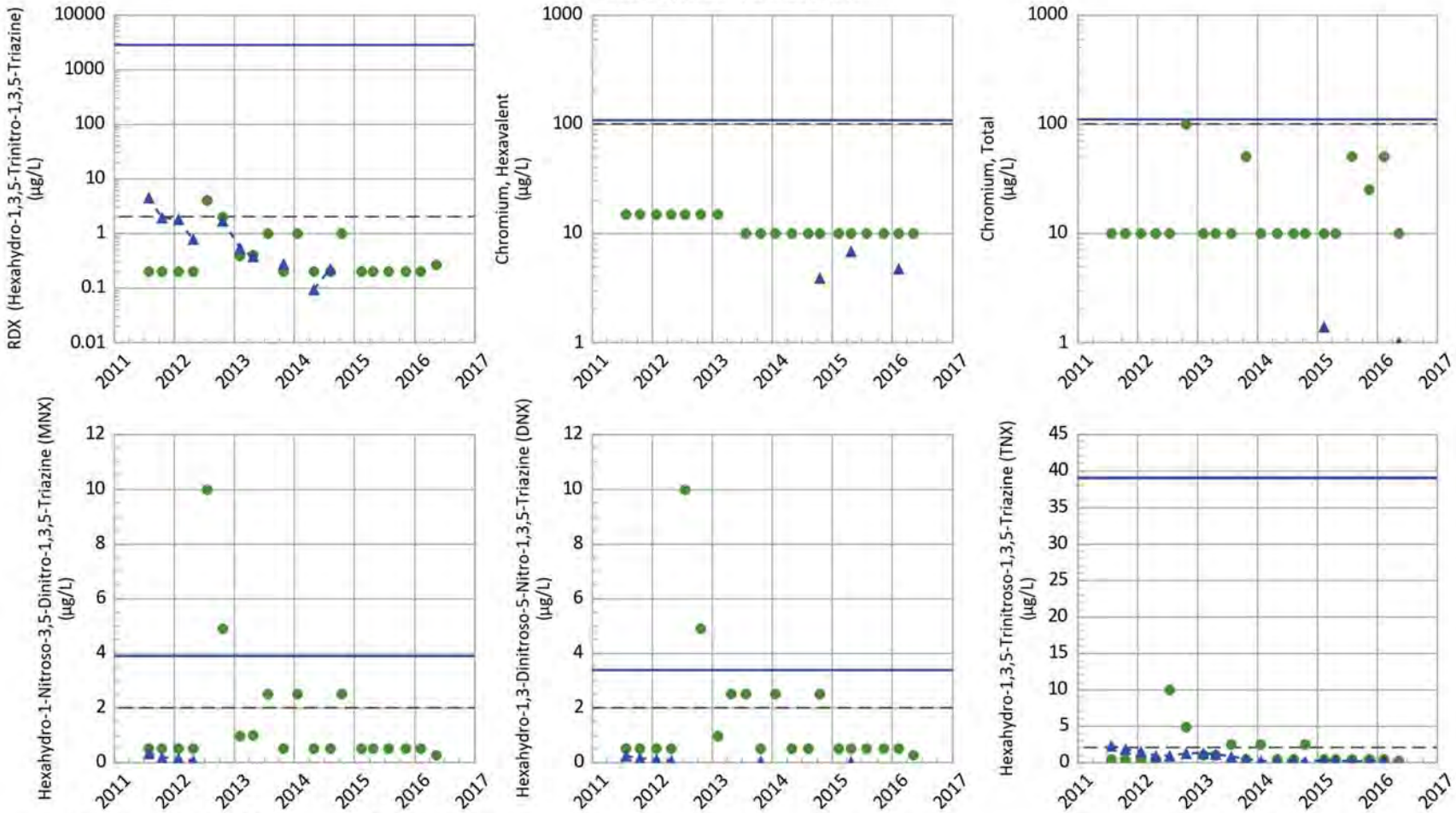
Measured Value
Sample Detection Limit
Concentration Trend
Injection Dates

Well Location




PTX06-ISB048 Treatment Zone Performance Indicators
USDOE/NNSA Pantex Plant
Dissolved Oxygen (mg/L)
Nitrate (mg/L)
Total Organic Carbon (mg/L)
Redox Potential (mV)
Sulfate (mg/L)
Total Volatile Fatty Acids (mg/L)
2013
2014
2015
2016
2017
Typical Baseline Concentrations in Perched Groundwater
Dissolved Oxygen: 5-10 mg/L
Redox Potential: > 100 mV
Nitrate: > 1 mg/L
Sulfate: > 10 mg/L
Total Organic Carbon: < 5 mg/L
Total Volatile Fatty Acids: Not Detected
Measured Value
Sample Detection Limit
Concentration Trend
Injection Dates
Well Location

PTX06-1037 Downgradient Performance Indicators
Southeast In Situ Bioremediation System
USDOE/NNSA Pantex Plant

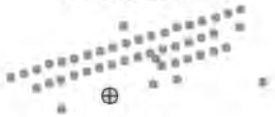


Most Recent Measured COC Concentrations (Feb 08, 2016)

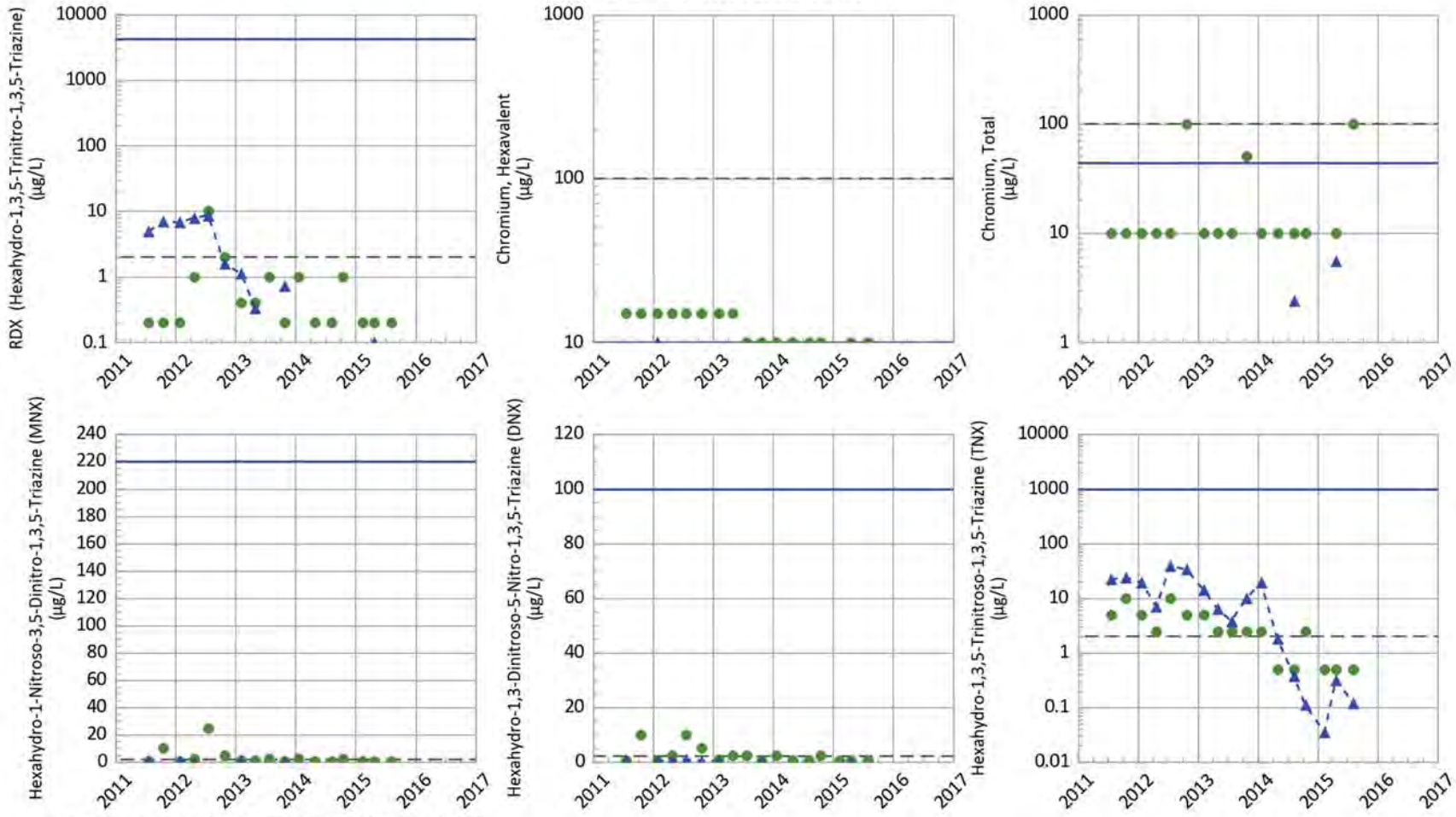
COC	Concentration (µg/L)	GWPS (µg/L)
RDX	Non-Detect	2.0
MNX	Non-Detect	2.0
CR-6	Non-Detect	100.0
DNX	Non-Detect	2.0
CR	1.0	100.0
TNX	Non-Detect	2.0

- Measured Value
- Sample Detection Limit
- Concentration Trend
- Maximum Concentration
- Groundwater Protection Standard

Well Location



PTX06-1123 Downgradient Performance Indicators
Southeast In Situ Bioremediation System
USDOE/NNSA Pantex Plant

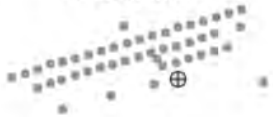


Most Recent Measured COC Concentrations (Aug 05, 2015)

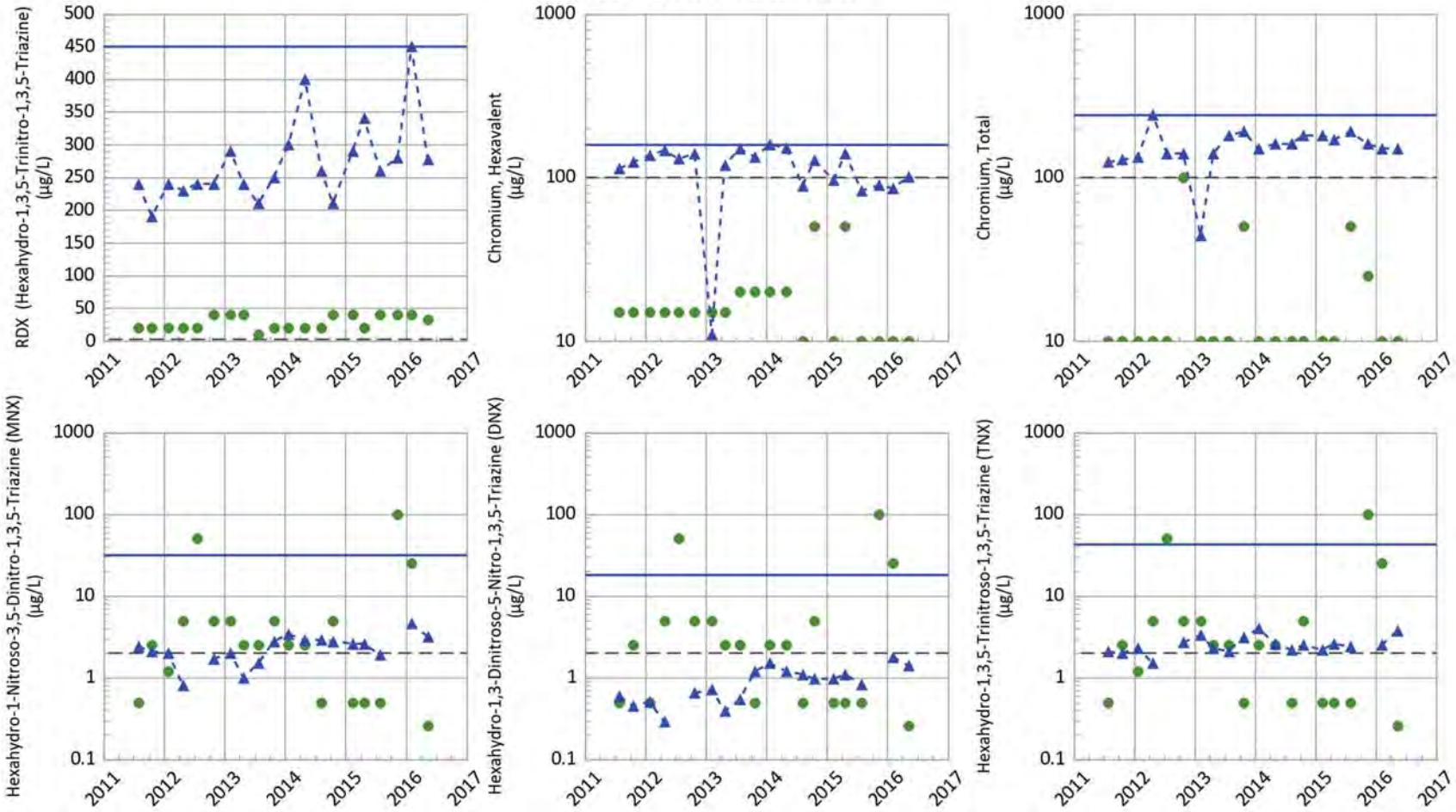
COC	Concentration (µg/L)	GWPS (µg/L)
RDX	Non-Detect	2.0
MNX	Non-Detect	2.0
CR-6	Non-Detect	100.0
DNX	Non-Detect	2.0
CR	Non-Detect	100.0
TNX	0.12	2.0

- Measured Value
- Sample Detection Limit
- Concentration Trend
- Maximum Concentration
- Groundwater Protection Standard

Well Location



PTX06-1153 Downgradient Performance Indicators
Southeast In Situ Bioremediation System
USDOE/NNSA Pantex Plant



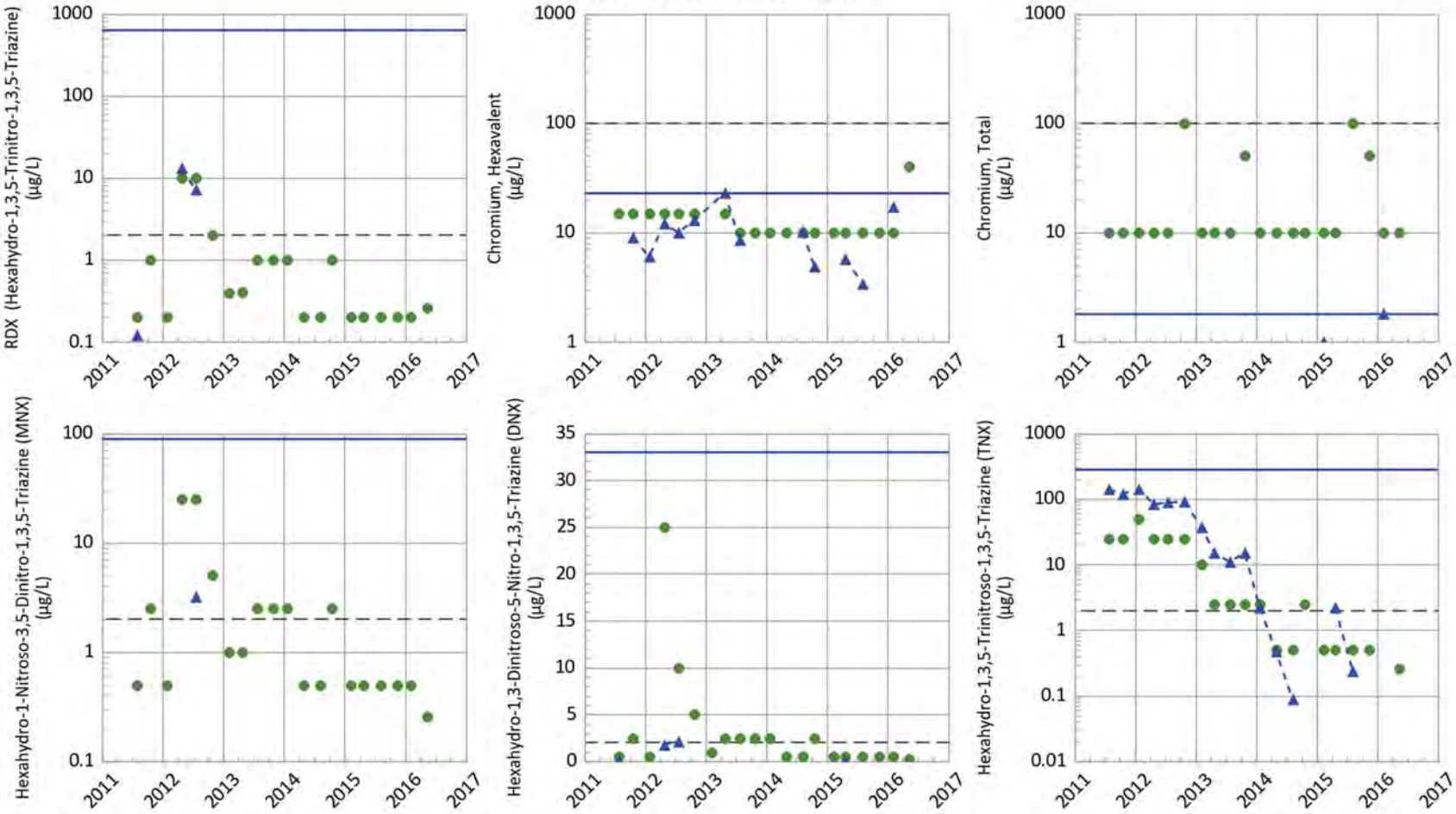
Most Recent Measured COC Concentrations (May 10, 2016)

COC	Concentration (µg/L)	GWPS (µg/L)
RDX	278.0	2.0
MNX	3.18	2.0
CR-6	101.0	100.0
DNX	1.4	2.0
CR	150.0	100.0
TNX	3.74	2.0

- Measured Value
- Sample Detection Limit
- Concentration Trend
- Maximum Concentration
- Groundwater Protection Standard

Well Location

PTX06-1154 Downgradient Performance Indicators
Southeast In Situ Bioremediation System
USDOE/NNSA Pantex Plant



Most Recent Measured COC Concentrations (Aug 05, 2015)

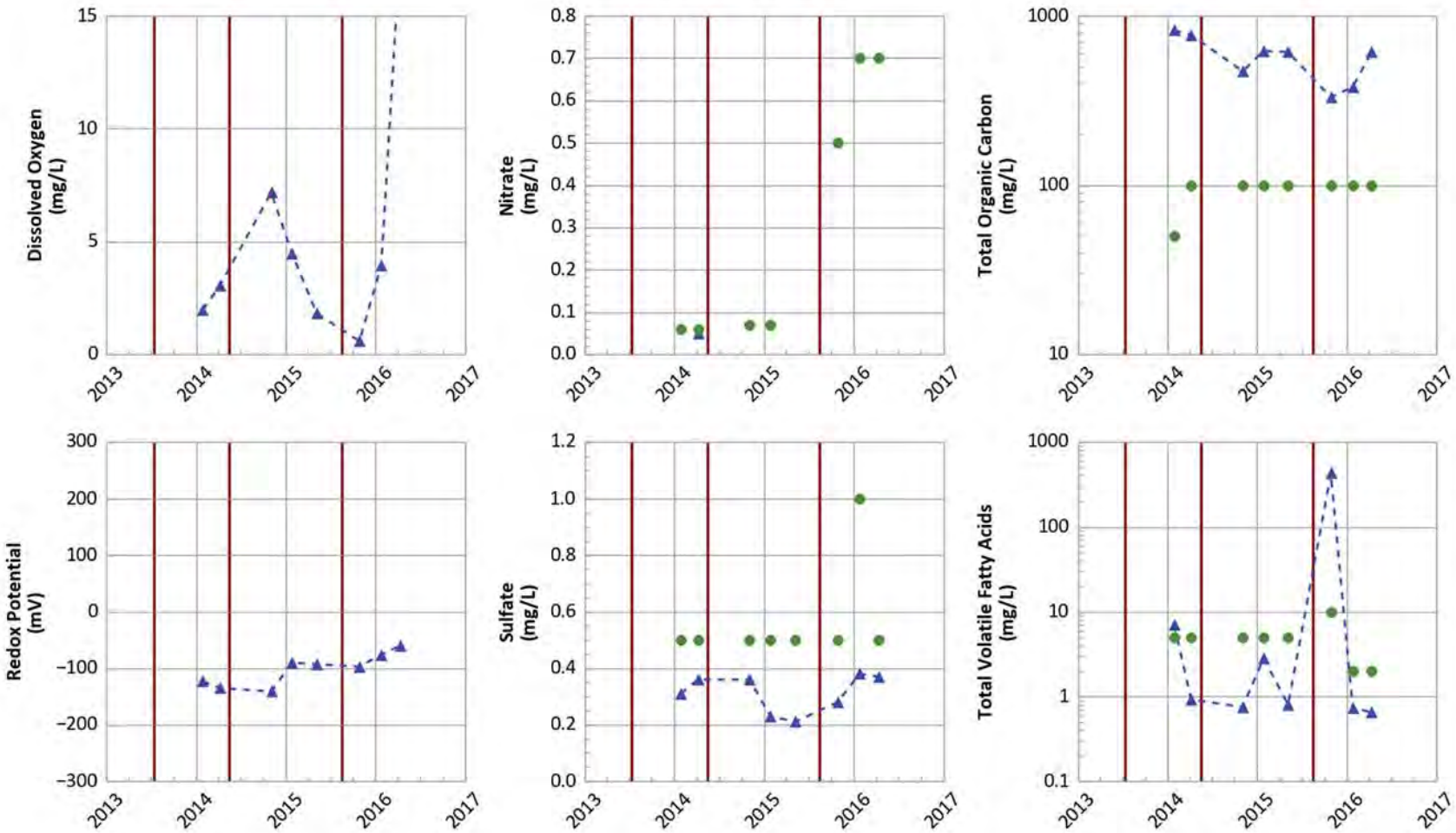
COC	Concentration (µg/L)	GWPS (µg/L)
RDX	Non-Detect	2.0
MNX	Non-Detect	2.0
CR-6	Non-Detect	100.0
DNX	Non-Detect	2.0
CR	Non-Detect	100.0
TNX	Non-Detect	2.0

- Measured Value
- Sample Detection Limit
- Concentration Trend
- Maximum Concentration
- Groundwater Protection Standard

Well Location

Zone 11 ISB Graphs

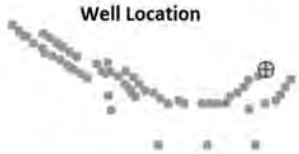
PTX06-ISB055 Treatment Zone Performance Indicators
USDOE/NNSA Pantex Plant

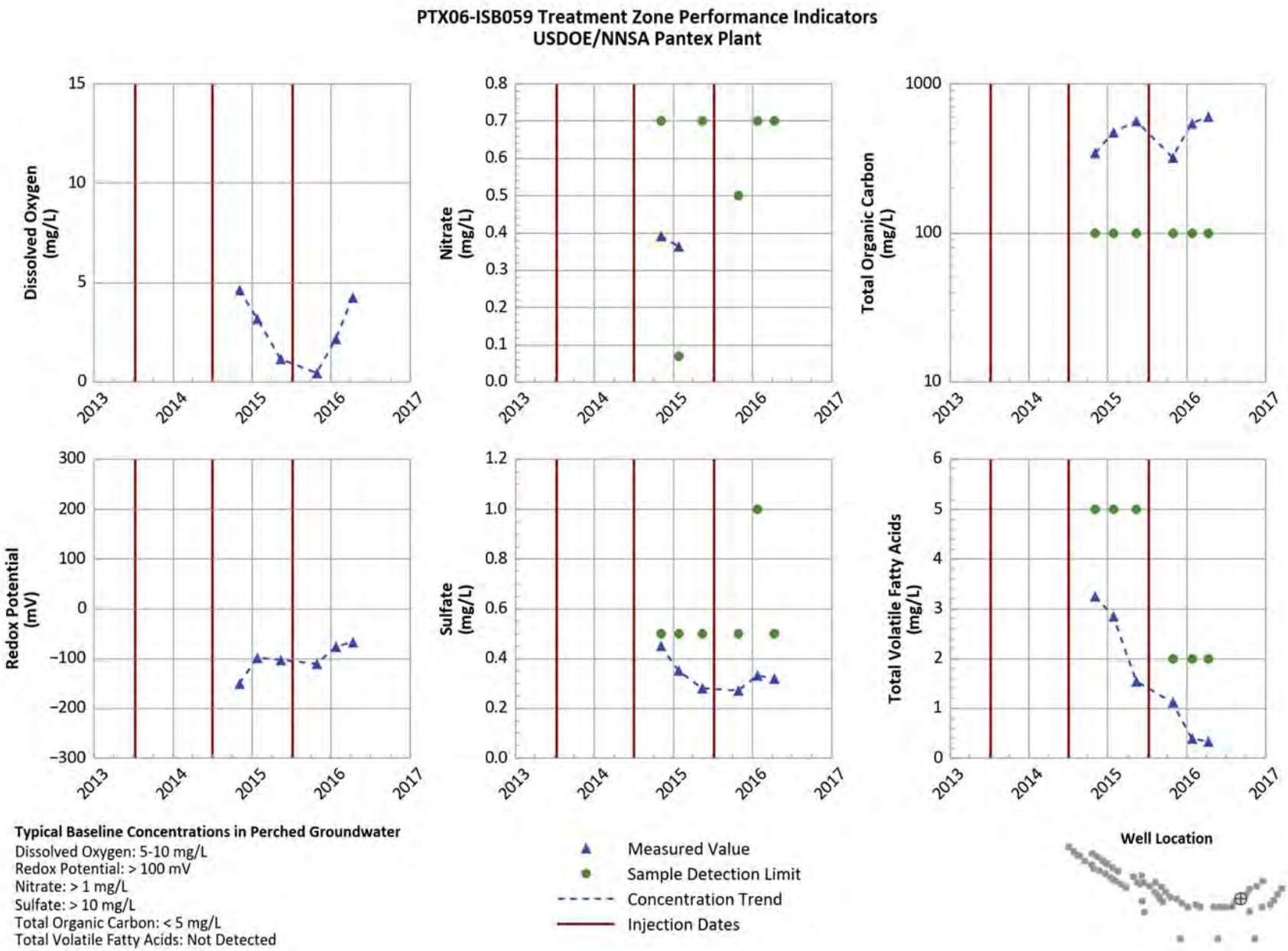


Typical Baseline Concentrations in Perched Groundwater
Dissolved Oxygen: 5-10 mg/L
Redox Potential: > 100 mV
Nitrate: > 1 mg/L
Sulfate: > 10 mg/L
Total Organic Carbon: < 5 mg/L
Total Volatile Fatty Acids: Not Detected

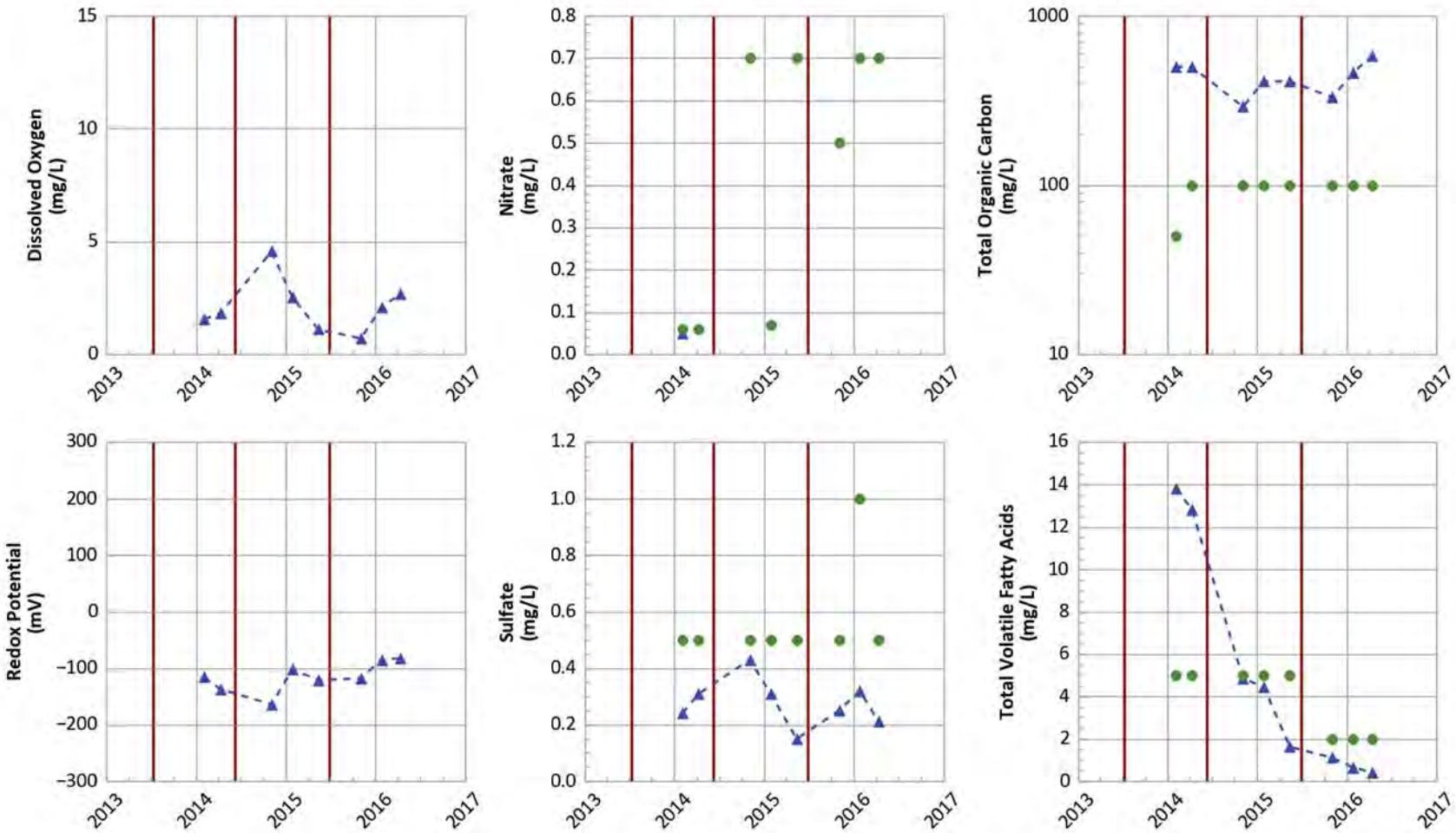
Measured Value
Sample Detection Limit
Concentration Trend
Injection Dates

Well Location




PTX06-ISB059 Treatment Zone Performance Indicators
USDOE/NNSA Pantex Plant
Dissolved Oxygen (mg/L)
Nitrate (mg/L)
Total Organic Carbon (mg/L)
Redox Potential (mV)
Sulfate (mg/L)
Total Volatile Fatty Acids (mg/L)
2013
2014
2015
2016
2017
Typical Baseline Concentrations in Perched Groundwater
Dissolved Oxygen: 5-10 mg/L
Redox Potential: > 100 mV
Nitrate: > 1 mg/L
Sulfate: > 10 mg/L
Total Organic Carbon: < 5 mg/L
Total Volatile Fatty Acids: Not Detected
Measured Value
Sample Detection Limit
Concentration Trend
Injection Dates
Well Location

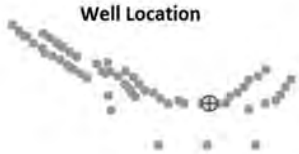
PTX06-ISB063 Treatment Zone Performance Indicators
USDOE/NNSA Pantex Plant



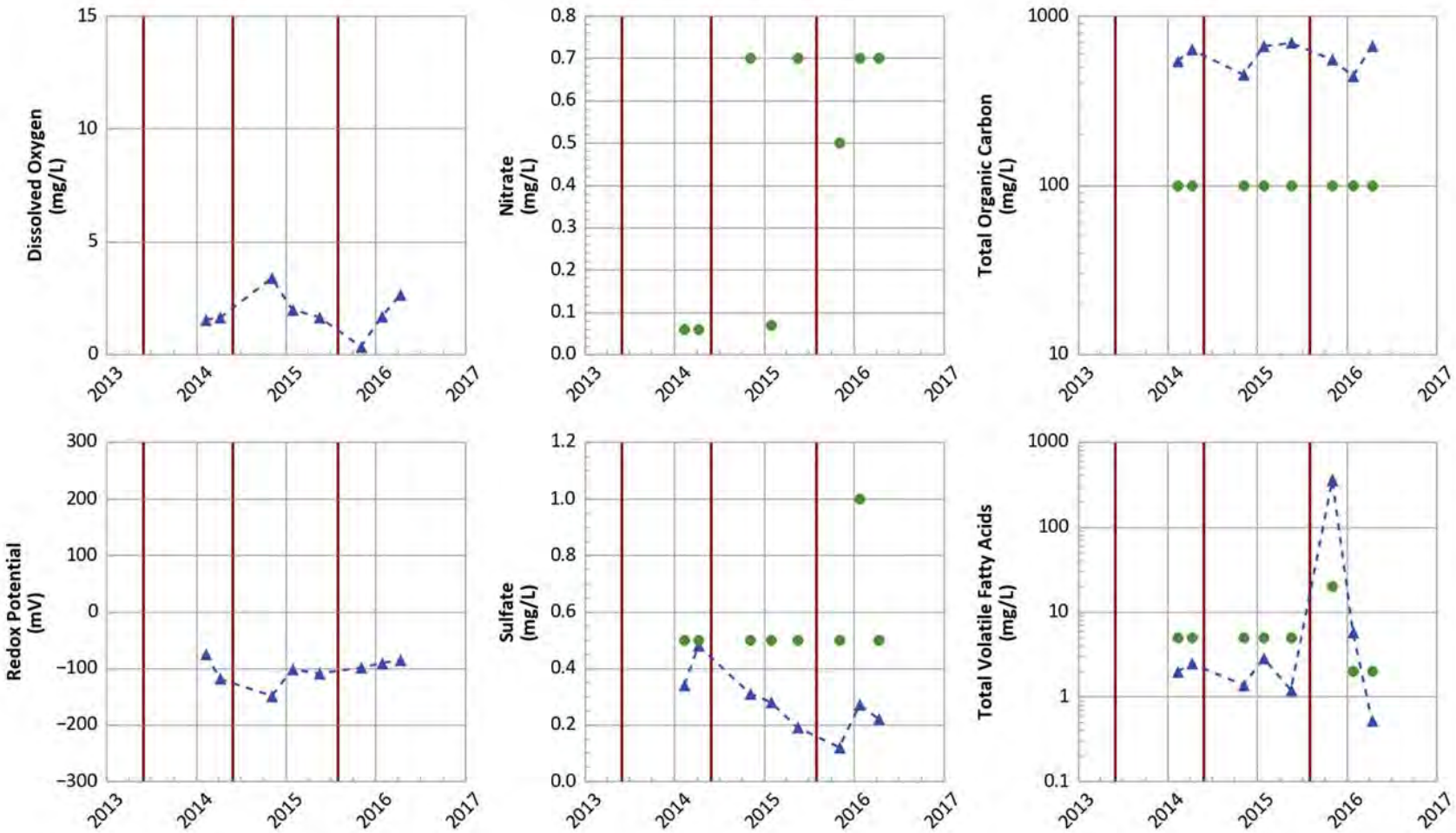
Typical Baseline Concentrations in Perched Groundwater
Dissolved Oxygen: 5-10 mg/L
Redox Potential: > 100 mV
Nitrate: > 1 mg/L
Sulfate: > 10 mg/L
Total Organic Carbon: < 5 mg/L
Total Volatile Fatty Acids: Not Detected

Measured Value
Sample Detection Limit
Concentration Trend
Injection Dates

Well Location



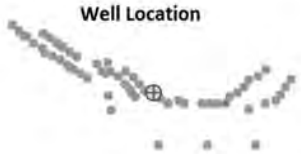
PTX06-ISB069A Treatment Zone Performance Indicators
USDOE/NNSA Pantex Plant



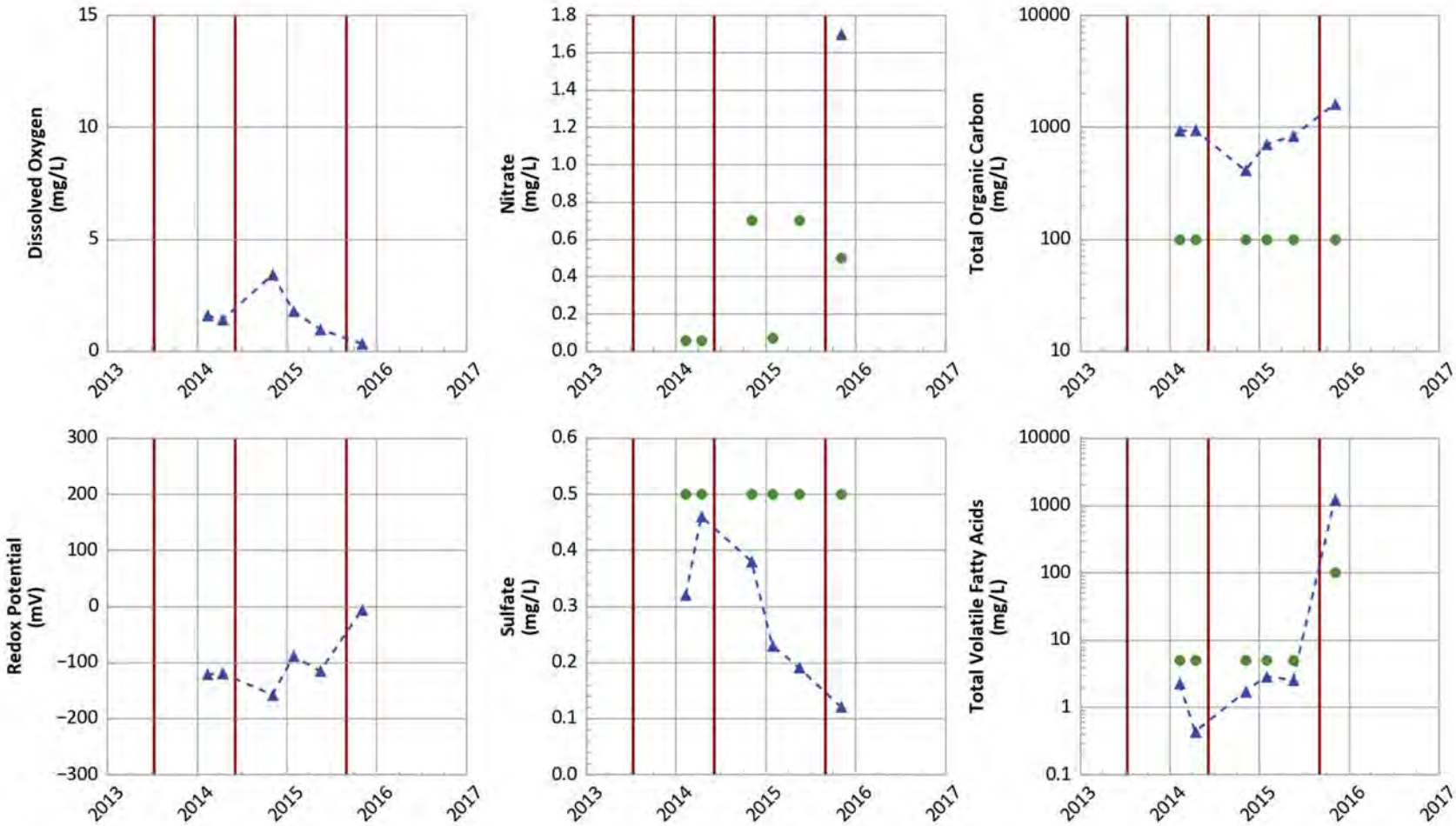
Typical Baseline Concentrations in Perched Groundwater
Dissolved Oxygen: 5-10 mg/L
Redox Potential: > 100 mV
Nitrate: > 1 mg/L
Sulfate: > 10 mg/L
Total Organic Carbon: < 5 mg/L
Total Volatile Fatty Acids: Not Detected

Measured Value
Sample Detection Limit
Concentration Trend
Injection Dates

Well Location



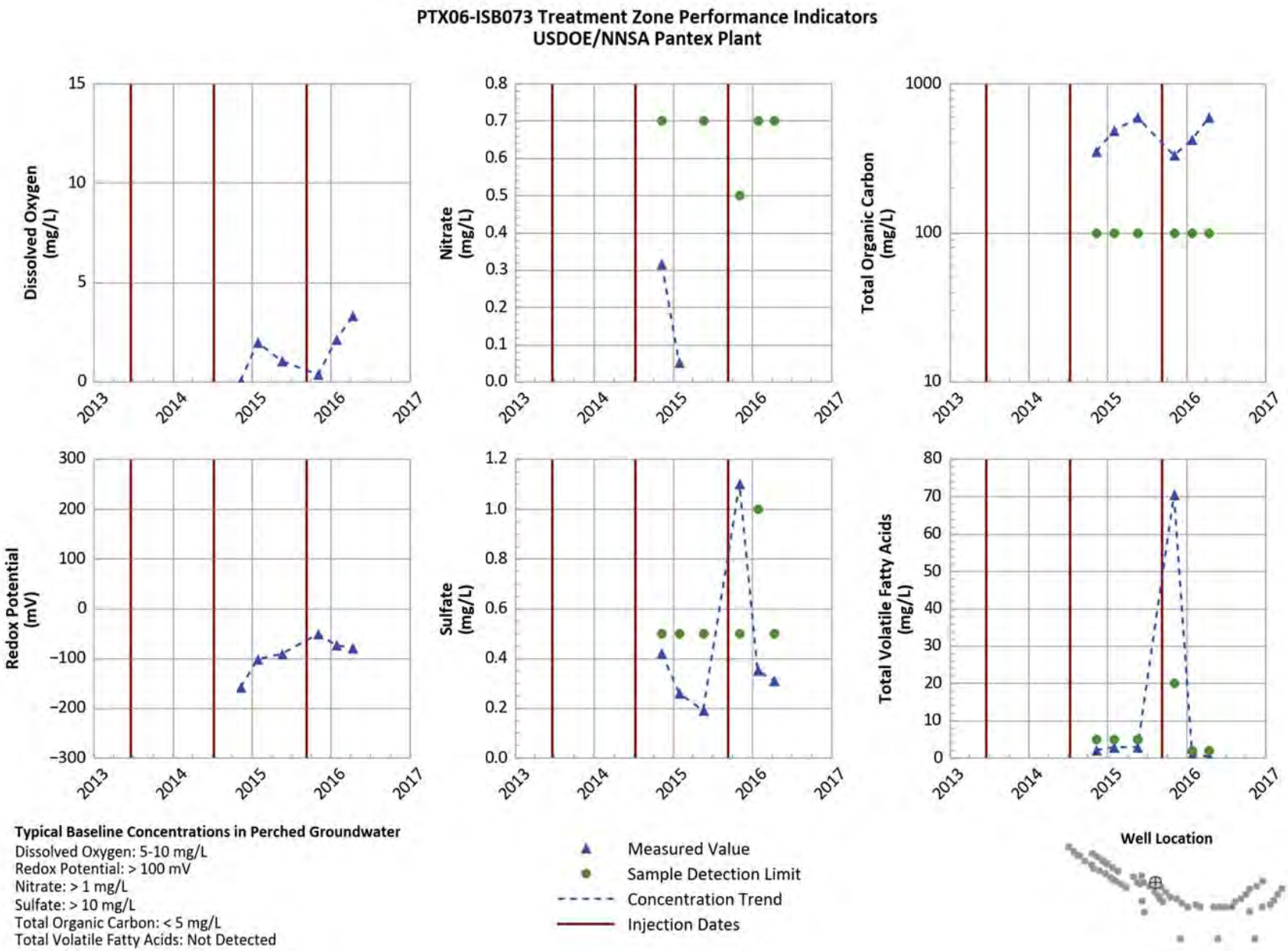
PTX06-ISB071 Treatment Zone Performance Indicators
USDOE/NNSA Pantex Plant



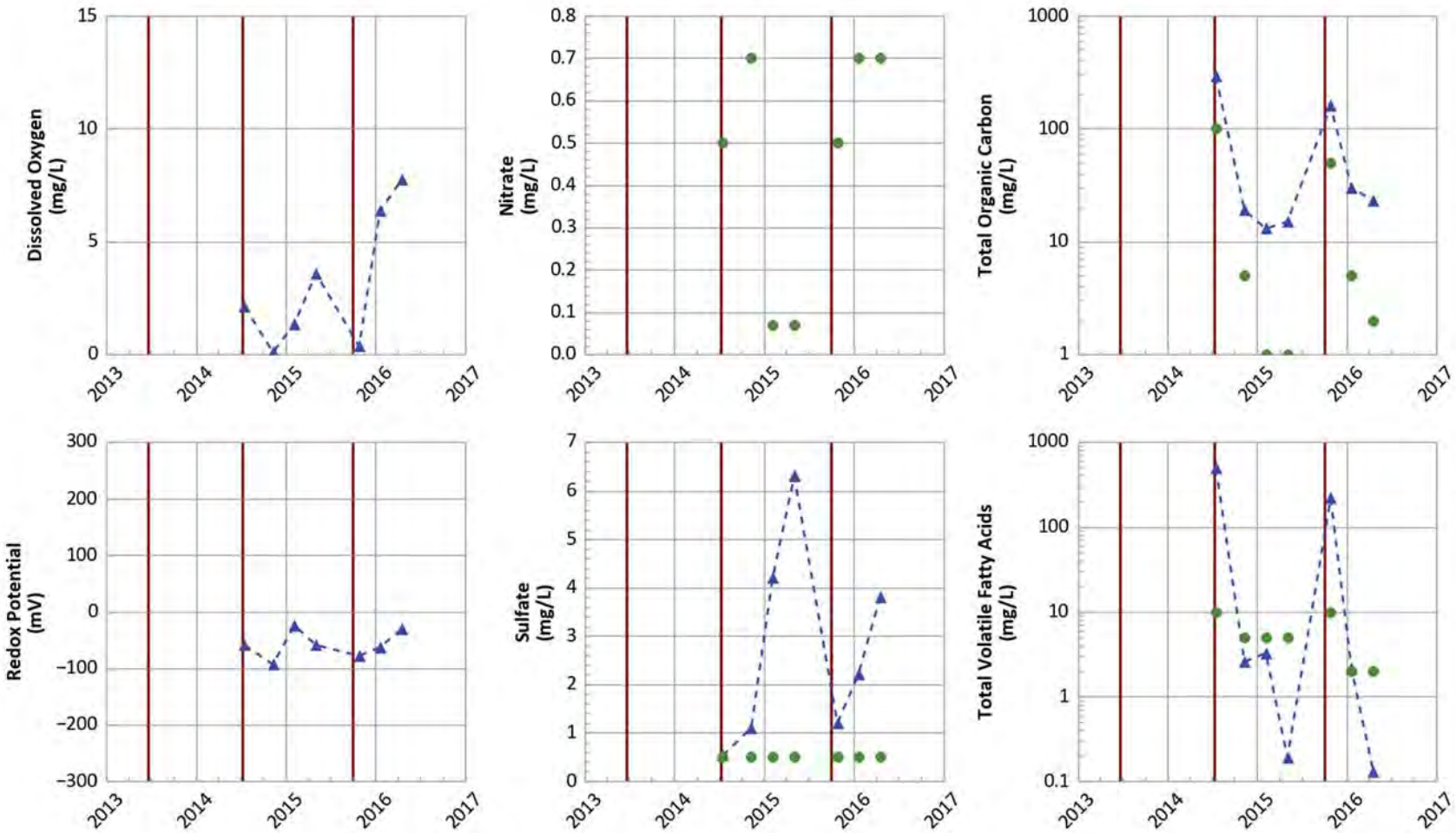
Typical Baseline Concentrations in Perched Groundwater
Dissolved Oxygen: 5-10 mg/L
Redox Potential: > 100 mV
Nitrate: > 1 mg/L
Sulfate: > 10 mg/L
Total Organic Carbon: < 5 mg/L
Total Volatile Fatty Acids: Not Detected

Measured Value
Sample Detection Limit
Concentration Trend
Injection Dates

Well Location


PTX06-ISB073 Treatment Zone Performance Indicators
USDOE/NNSA Pantex Plant
Dissolved Oxygen (mg/L)
Nitrate (mg/L)
Total Organic Carbon (mg/L)
Redox Potential (mV)
Sulfate (mg/L)
Total Volatile Fatty Acids (mg/L)
2013
2014
2015
2016
2017
Typical Baseline Concentrations in Perched Groundwater
Dissolved Oxygen: 5-10 mg/L
Redox Potential: > 100 mV
Nitrate: > 1 mg/L
Sulfate: > 10 mg/L
Total Organic Carbon: < 5 mg/L
Total Volatile Fatty Acids: Not Detected
Measured Value
Sample Detection Limit
Concentration Trend
Injection Dates
Well Location

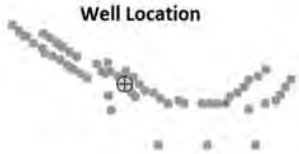
PTX06-ISB075 Treatment Zone Performance Indicators
USDOE/NNSA Pantex Plant

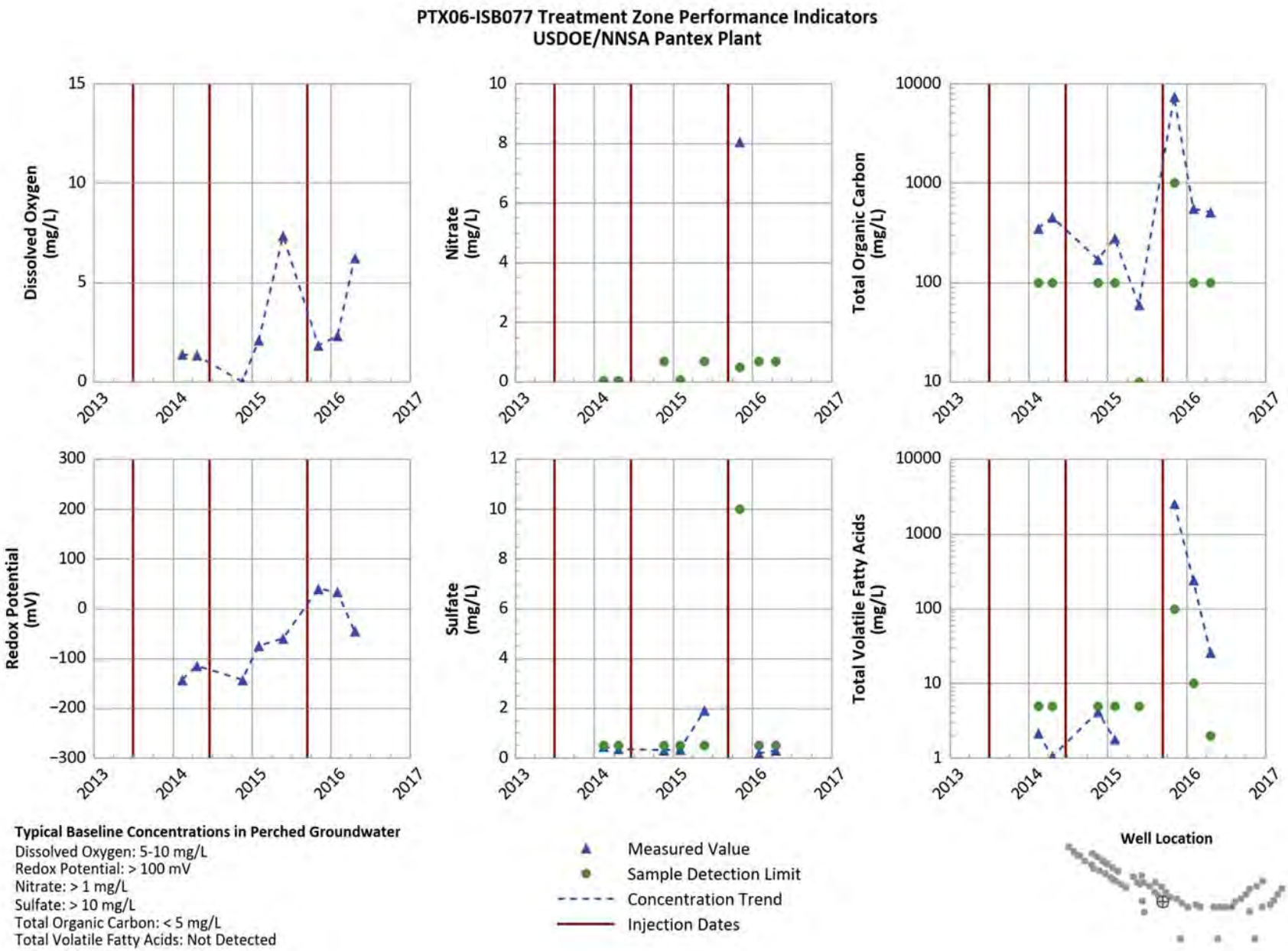


Typical Baseline Concentrations in Perched Groundwater
Dissolved Oxygen: 5-10 mg/L
Redox Potential: > 100 mV
Nitrate: > 1 mg/L
Sulfate: > 10 mg/L
Total Organic Carbon: < 5 mg/L
Total Volatile Fatty Acids: Not Detected

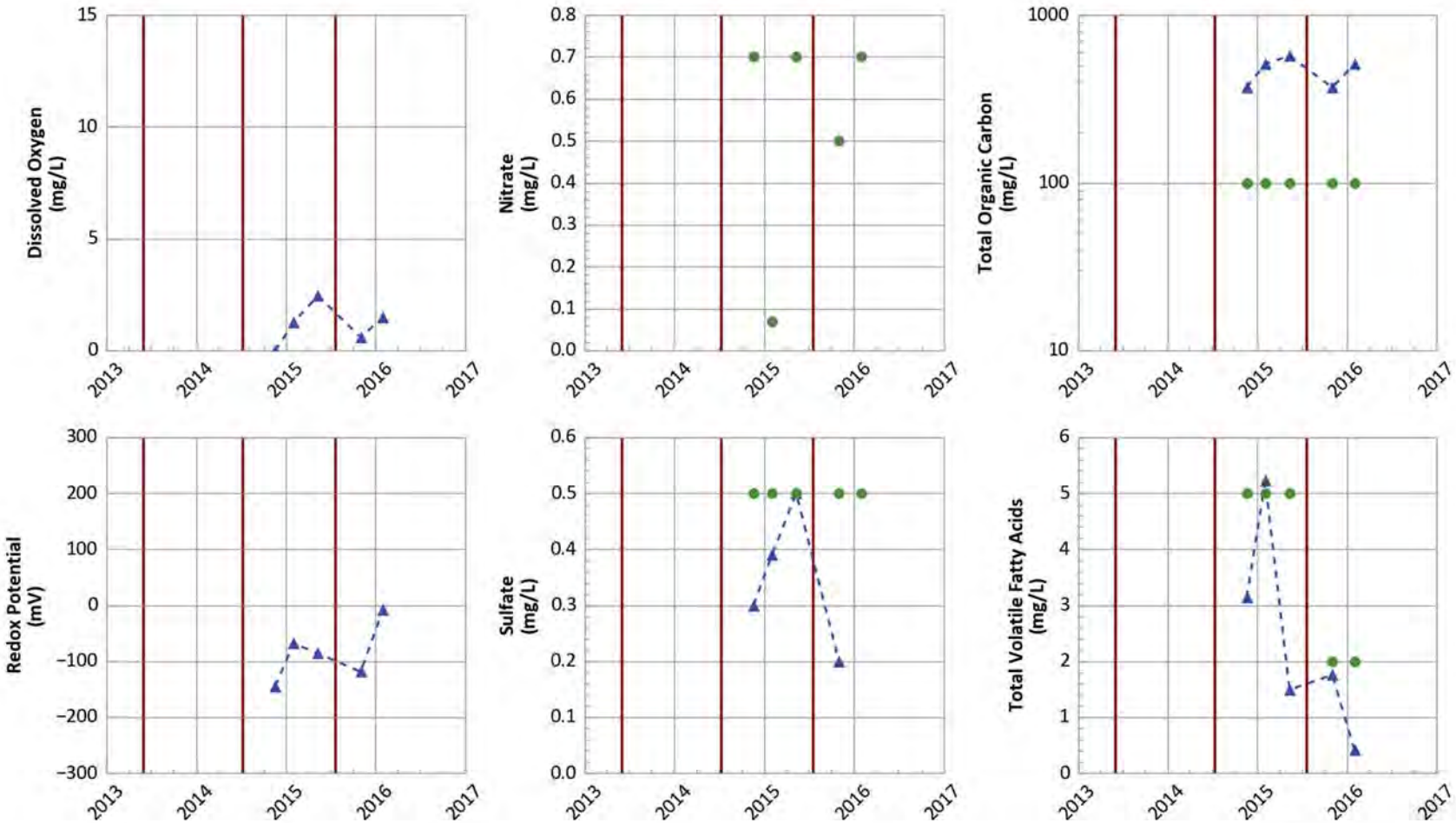
Measured Value
Sample Detection Limit
Concentration Trend
Injection Dates

Well Location




PTX06-ISB077 Treatment Zone Performance Indicators
USDOE/NNSA Pantex Plant
Dissolved Oxygen (mg/L)
Nitrate (mg/L)
Total Organic Carbon (mg/L)
Redox Potential (mV)
Sulfate (mg/L)
Total Volatile Fatty Acids (mg/L)
2013
2014
2015
2016
2017
Typical Baseline Concentrations in Perched Groundwater
Dissolved Oxygen: 5-10 mg/L
Redox Potential: > 100 mV
Nitrate: > 1 mg/L
Sulfate: > 10 mg/L
Total Organic Carbon: < 5 mg/L
Total Volatile Fatty Acids: Not Detected
Measured Value
Sample Detection Limit
Concentration Trend
Injection Dates
Well Location

PTX06-ISB081 Treatment Zone Performance Indicators
USDOE/NNSA Pantex Plant

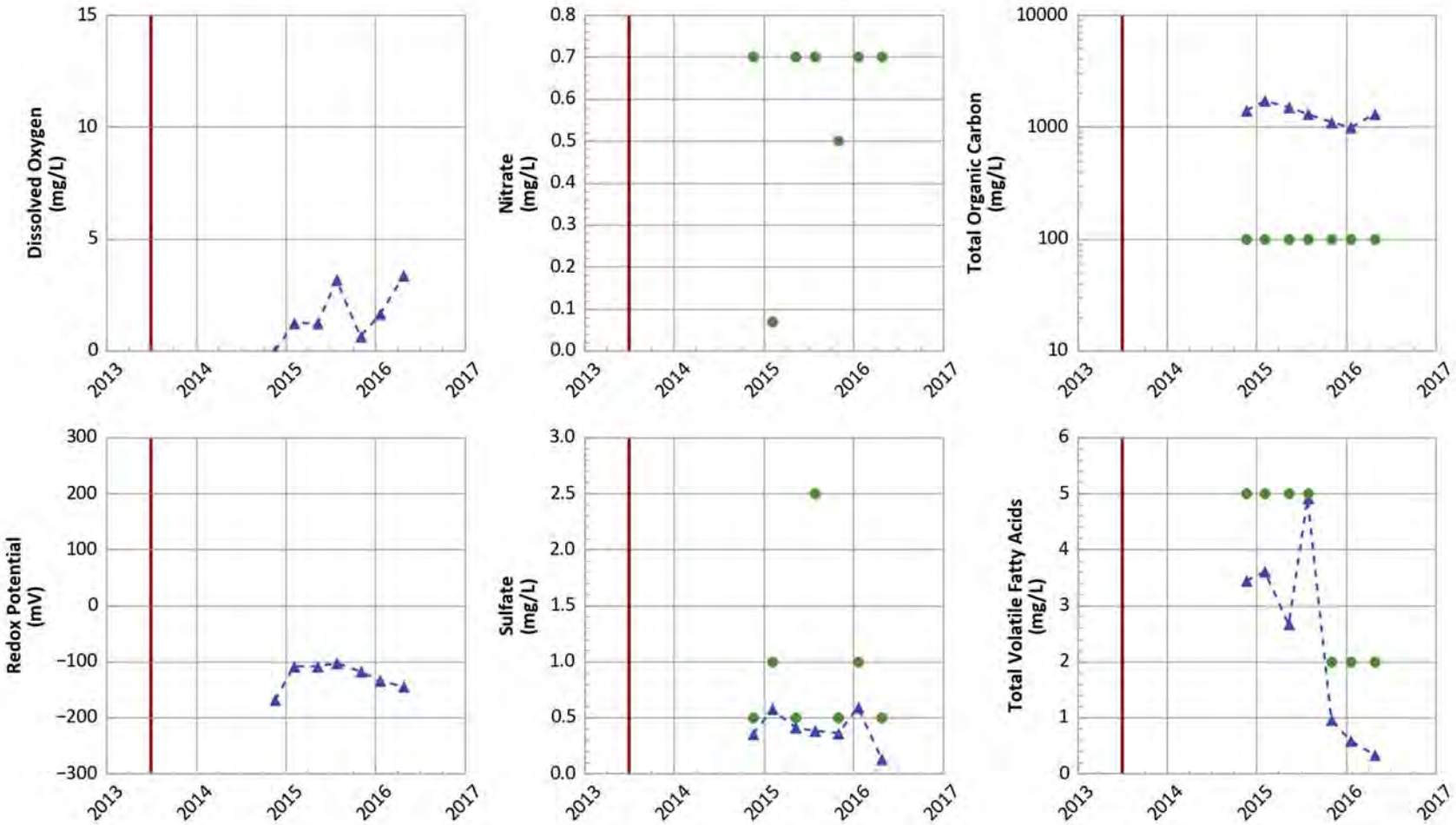


Typical Baseline Concentrations in Perched Groundwater
Dissolved Oxygen: 5-10 mg/L
Redox Potential: > 100 mV
Nitrate: > 1 mg/L
Sulfate: > 10 mg/L
Total Organic Carbon: < 5 mg/L
Total Volatile Fatty Acids: Not Detected

Measured Value
Sample Detection Limit
Concentration Trend
Injection Dates

Well Location

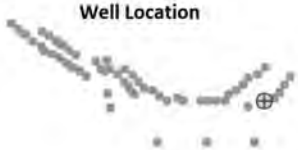
PTX06-ISB082 Treatment Zone Performance Indicators
USDOE/NNSA Pantex Plant



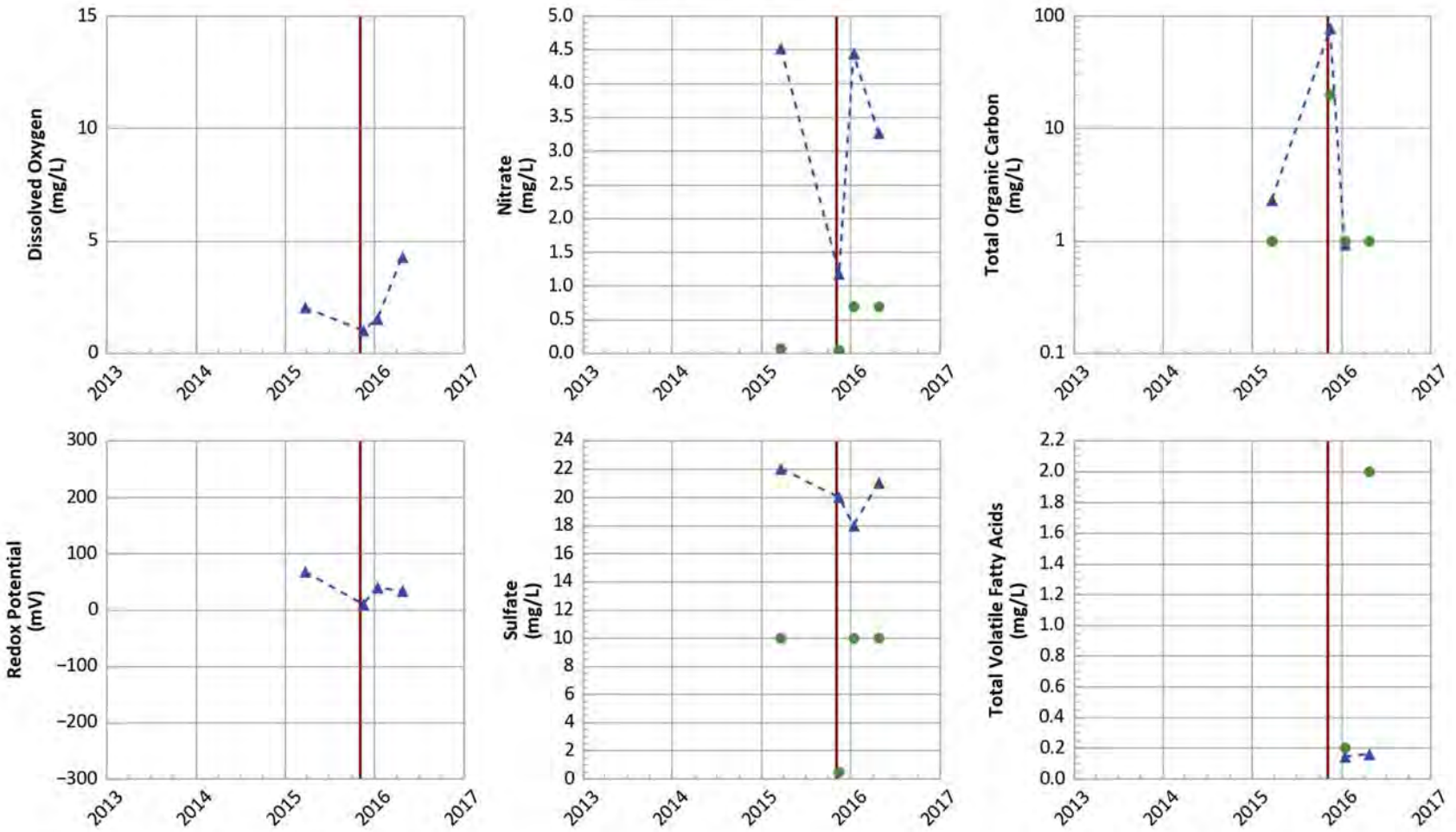
Typical Baseline Concentrations in Perched Groundwater
Dissolved Oxygen: 5-10 mg/L
Redox Potential: > 100 mV
Nitrate: > 1 mg/L
Sulfate: > 10 mg/L
Total Organic Carbon: < 5 mg/L
Total Volatile Fatty Acids: Not Detected

Measured Value
Sample Detection Limit
Concentration Trend
Injection Dates

Well Location



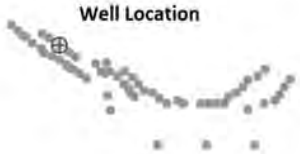
PTX06-1164 Treatment Zone Performance Indicators
USDOE/NNSA Pantex Plant



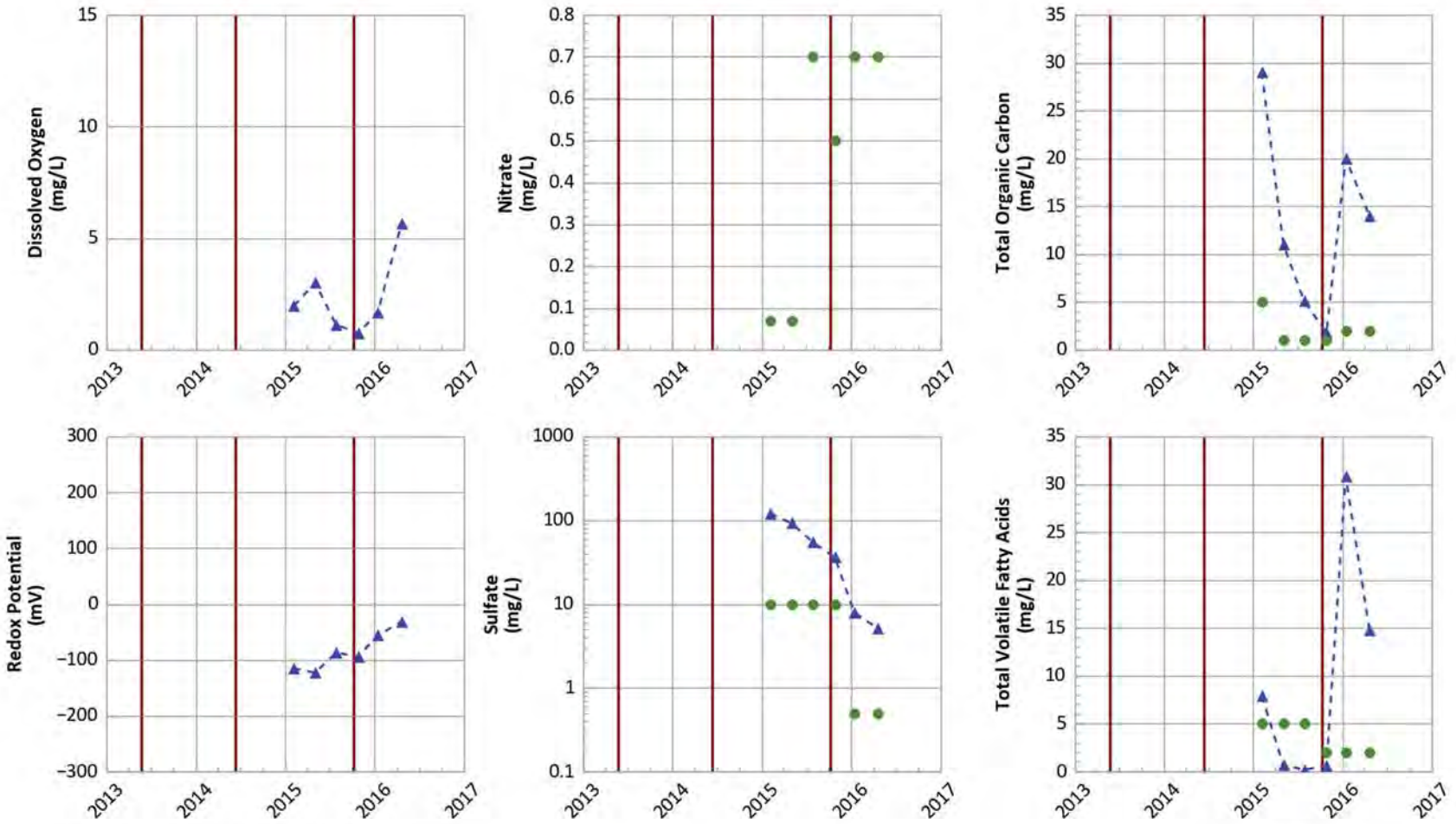
Typical Baseline Concentrations in Perched Groundwater
Dissolved Oxygen: 5-10 mg/L
Redox Potential: > 100 mV
Nitrate: > 1 mg/L
Sulfate: > 10 mg/L
Total Organic Carbon: < 5 mg/L
Total Volatile Fatty Acids: Not Detected

Measured Value
Sample Detection Limit
Concentration Trend
Injection Dates

Well Location



PTX06-1170 Treatment Zone Performance Indicators
USDOE/NNSA Pantex Plant

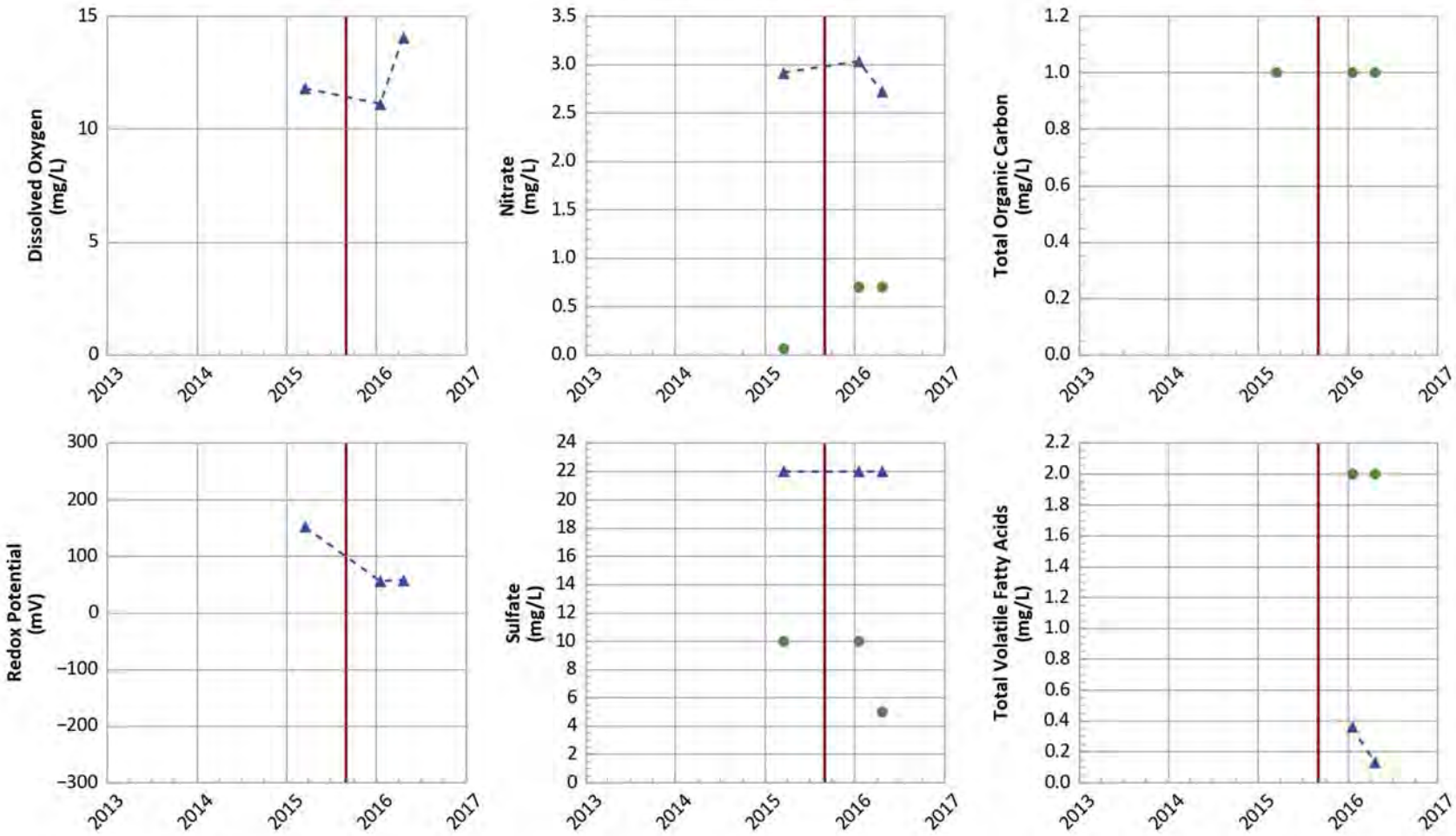


Typical Baseline Concentrations in Perched Groundwater
Dissolved Oxygen: 5-10 mg/L
Redox Potential: > 100 mV
Nitrate: > 1 mg/L
Sulfate: > 10 mg/L
Total Organic Carbon: < 5 mg/L
Total Volatile Fatty Acids: Not Detected

Measured Value
Sample Detection Limit
Concentration Trend
Injection Dates

Well Location

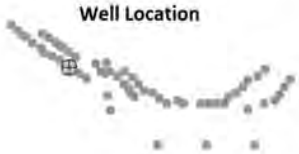
PTX06-1176 Treatment Zone Performance Indicators
USDOE/NNSA Pantex Plant



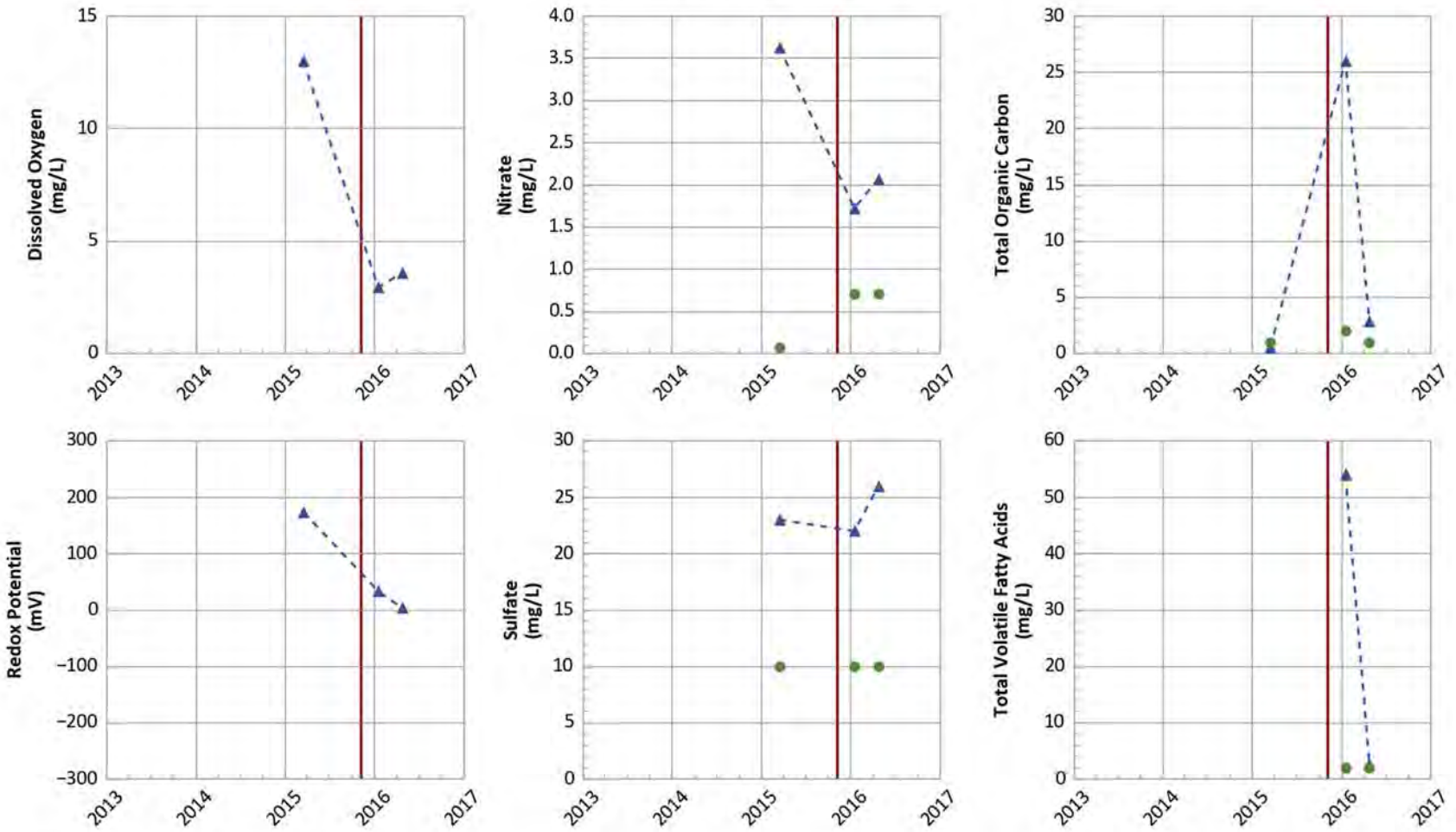
Typical Baseline Concentrations in Perched Groundwater
Dissolved Oxygen: 5-10 mg/L
Redox Potential: > 100 mV
Nitrate: > 1 mg/L
Sulfate: > 10 mg/L
Total Organic Carbon: < 5 mg/L
Total Volatile Fatty Acids: Not Detected

Measured Value
Sample Detection Limit
Concentration Trend
Injection Dates

Well Location



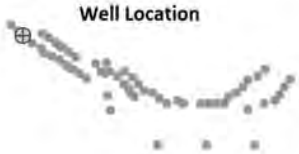
PTX06-1177 Treatment Zone Performance Indicators
USDOE/NNSA Pantex Plant



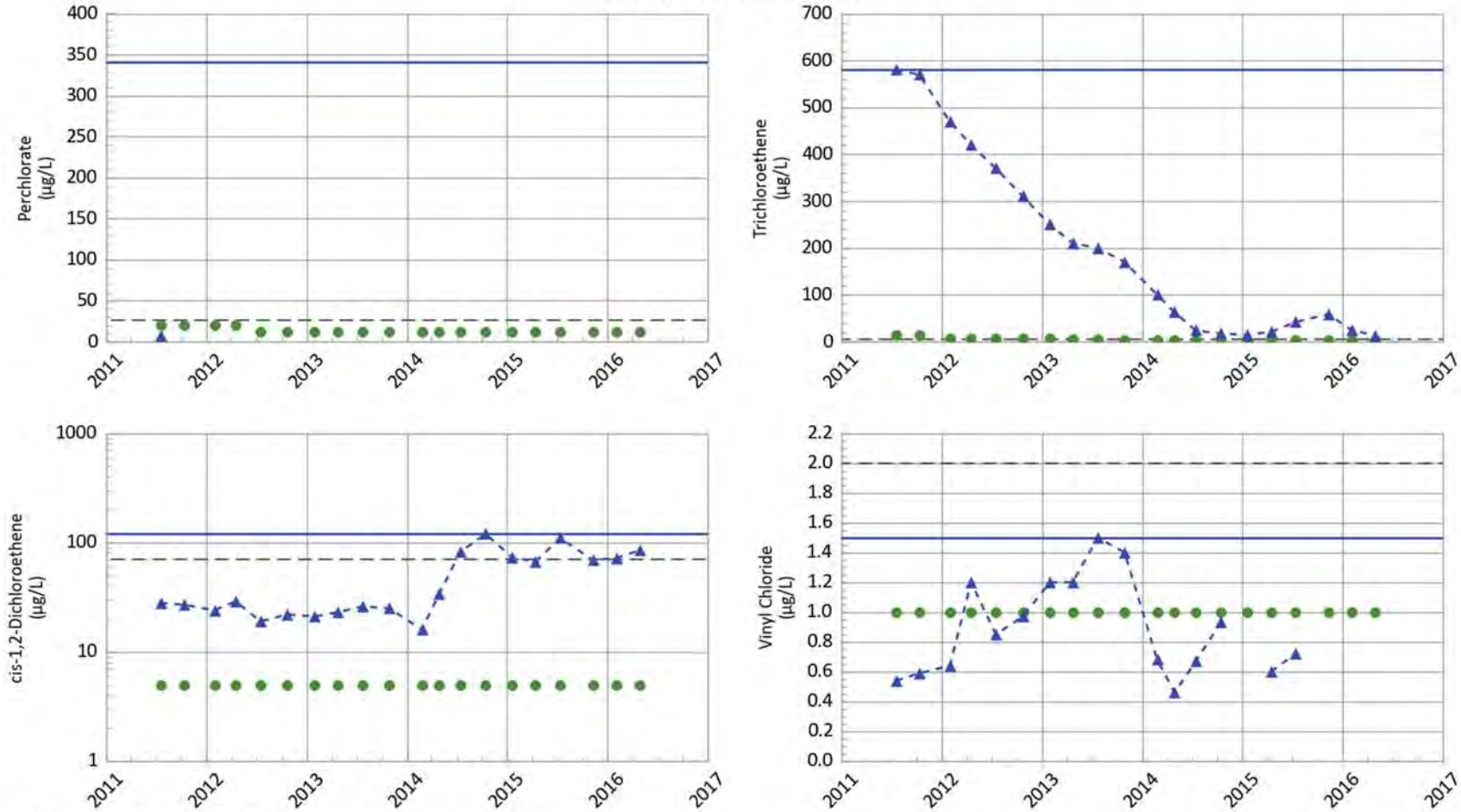
Typical Baseline Concentrations in Perched Groundwater
Dissolved Oxygen: 5-10 mg/L
Redox Potential: > 100 mV
Nitrate: > 1 mg/L
Sulfate: > 10 mg/L
Total Organic Carbon: < 5 mg/L
Total Volatile Fatty Acids: Not Detected

Measured Value
Sample Detection Limit
Concentration Trend
Injection Dates

Well Location



PTX06-1012 Downgradient Performance Indicators
Zone 11 In Situ Bioremediation System
USDOE/NNSA Pantex Plant

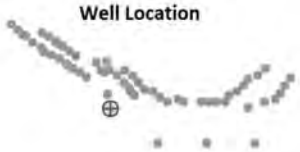


Most Recent Measured COC Concentrations (Jul 13, 2015)

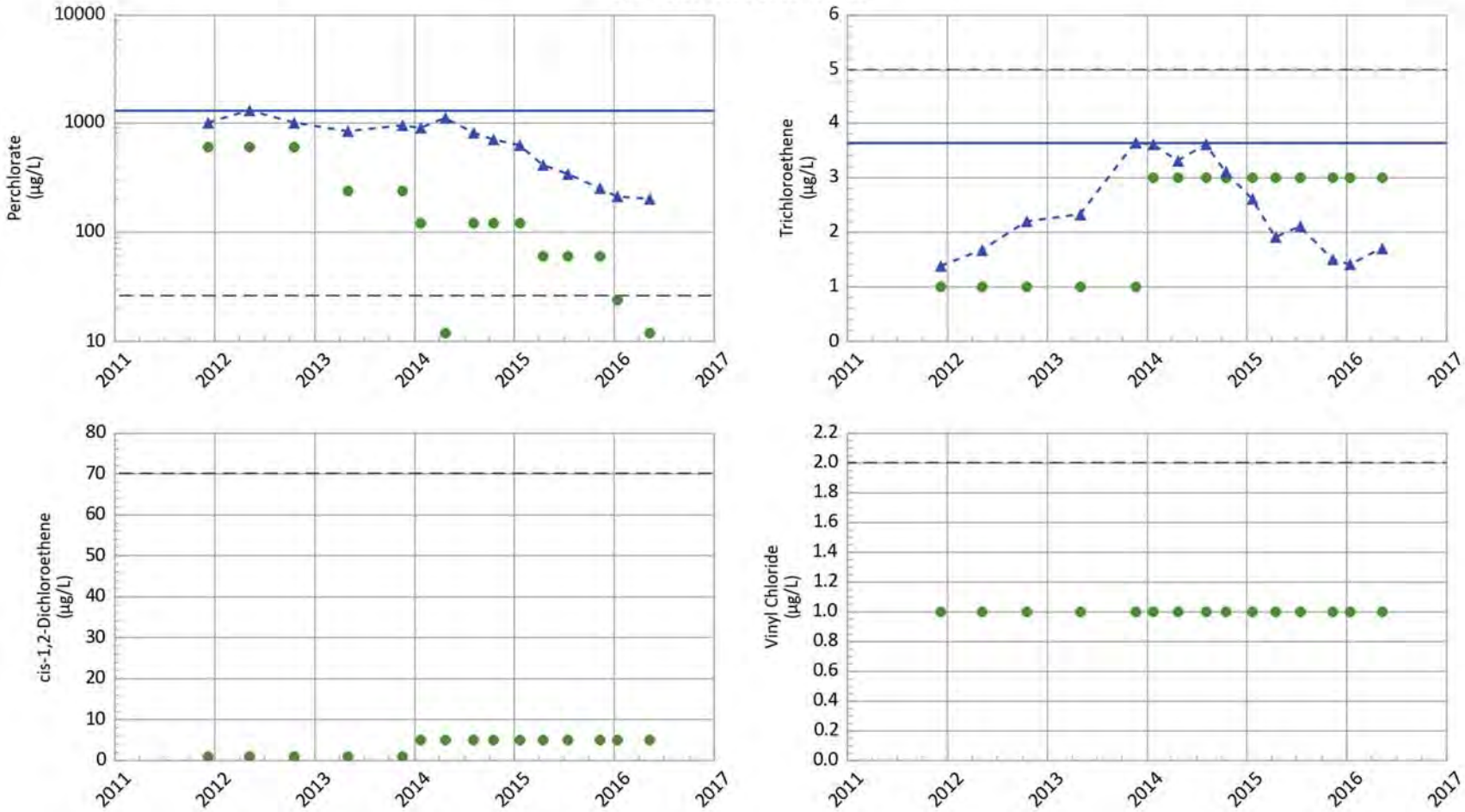
COC	Concentration (µg/L)	GWPS (µg/L)
PERC	Non-Detect	26.0
DCE12C	85.0	70.0
TCE	13.0	5.0
VC	Non-Detect	2.0

- Measured Value
- Sample Detection Limit
- Concentration Trend
- Maximum Concentration
- Groundwater Protection Standard

Well Location



PTX06-1148 Downgradient Performance Indicators
Zone 11 In Situ Bioremediation System
USDOE/NNSA Pantex Plant



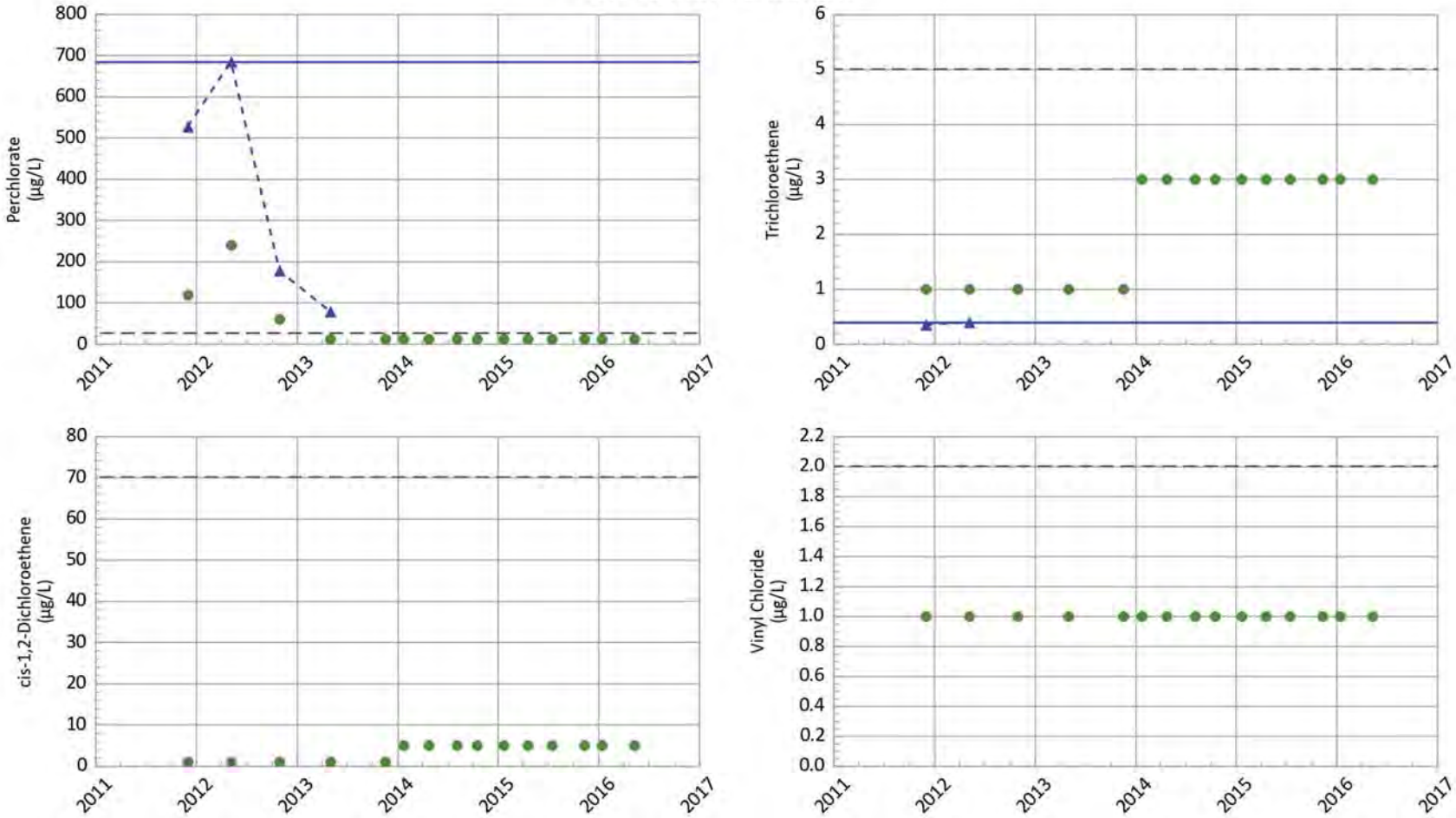
Most Recent Measured COC Concentrations (May 09, 2016)

COC	Concentration (µg/L)	GWPS (µg/L)
PERC	200.0	26.0
DCE12C	Non-Detect	70.0
TCE	1.7	5.0
VC	Non-Detect	2.0

- Measured Value
- Sample Detection Limit
- Concentration Trend
- Maximum Concentration
- Groundwater Protection Standard

Well Location

PTX06-1149 Downgradient Performance Indicators
Zone 11 In Situ Bioremediation System
USDOE/NNSA Pantex Plant



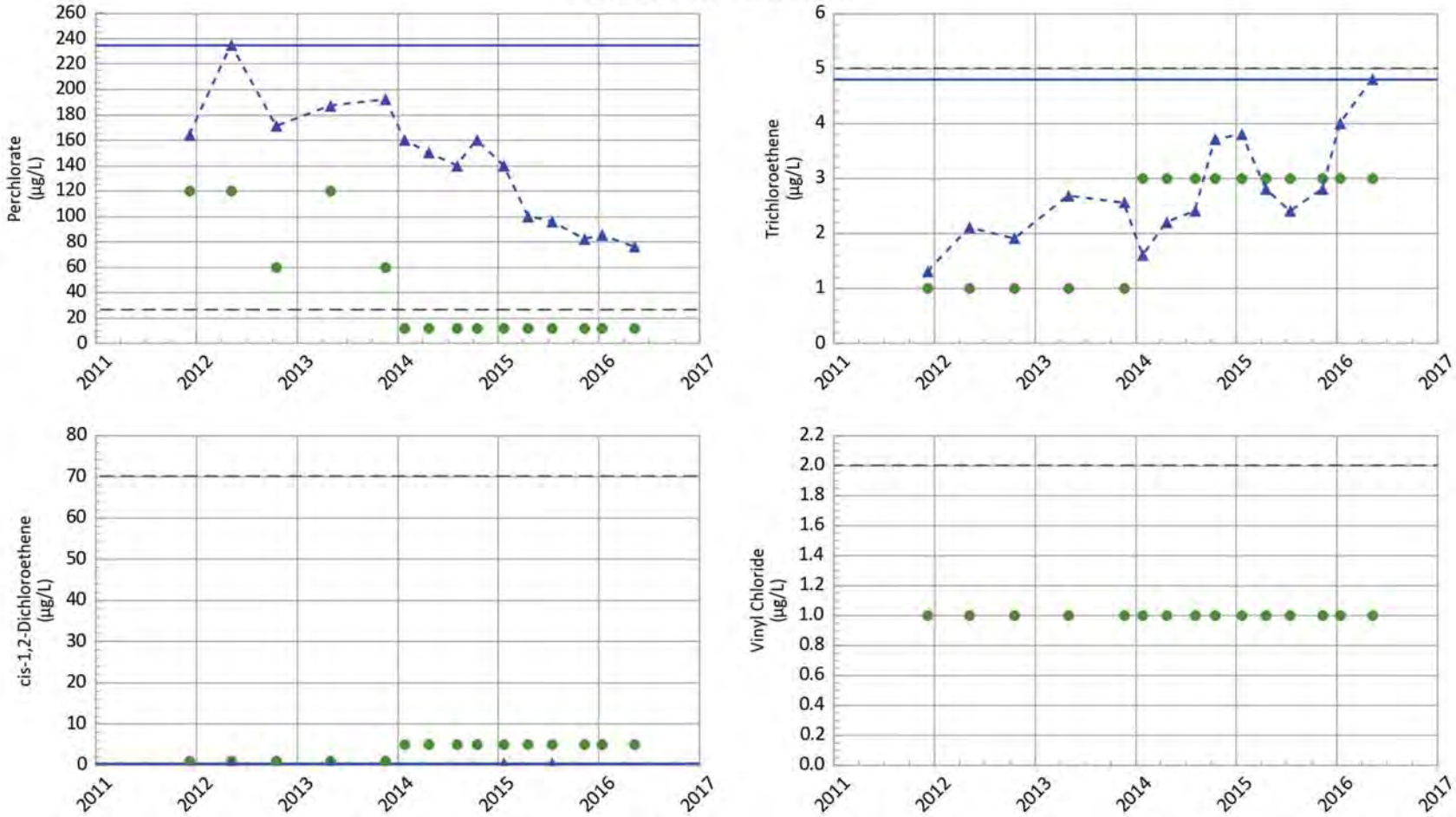
Most Recent Measured COC Concentrations (May 09, 2016)

COC	Concentration (µg/L)	GWPS (µg/L)
PERC	Non-Detect	26.0
DCE12C	Non-Detect	70.0
TCE	Non-Detect	5.0
VC	Non-Detect	2.0

- Measured Value
- Sample Detection Limit
- Concentration Trend
- Maximum Concentration
- Groundwater Protection Standard

Well Location

PTX06-1150 Downgradient Performance Indicators
Zone 11 In Situ Bioremediation System
USDOE/NNSA Pantex Plant



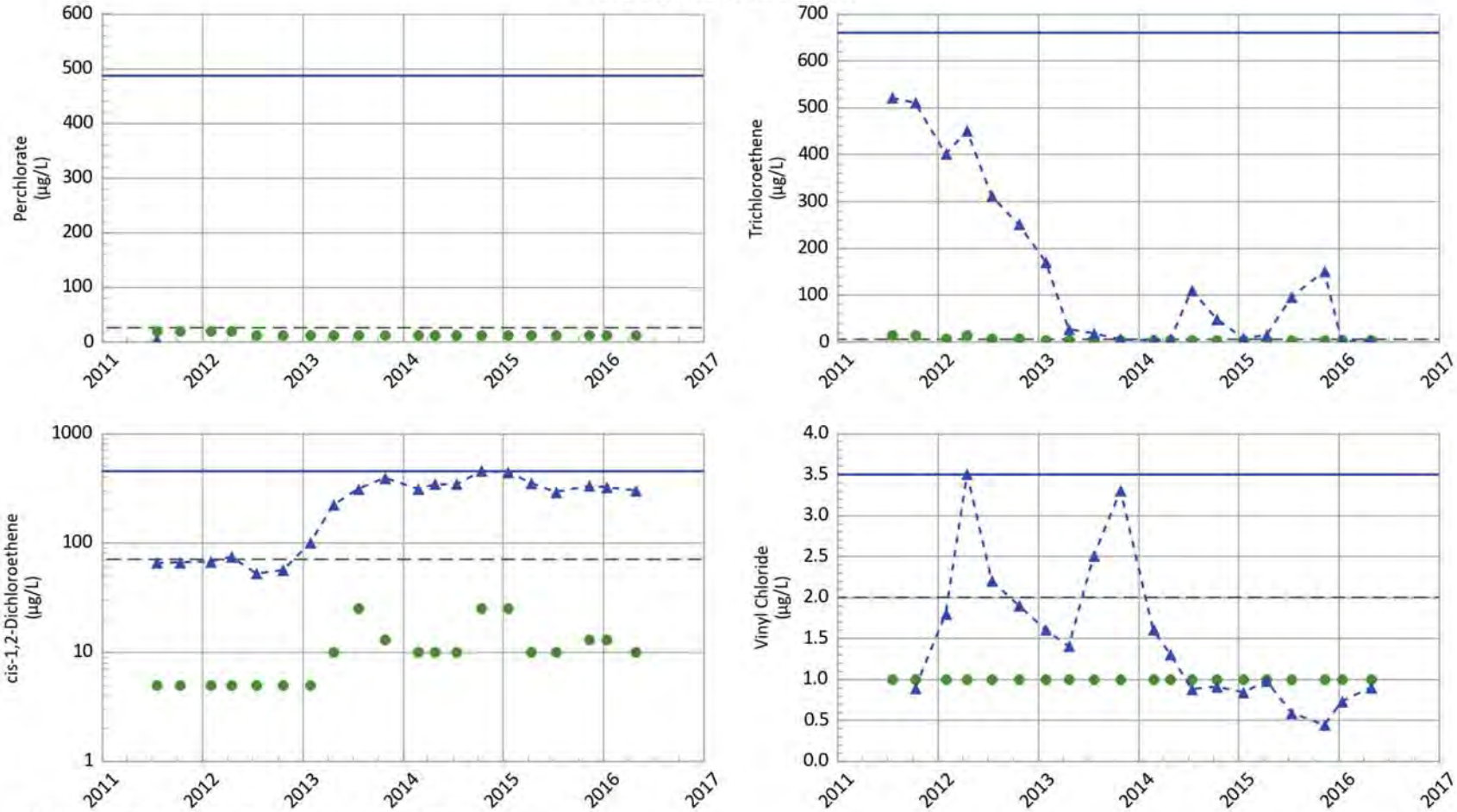
Most Recent Measured COC Concentrations (May 09, 2016)

COC	Concentration (µg/L)	GWPS (µg/L)
PERC	76.0	26.0
DCE12C	Non-Detect	70.0
TCE	4.8	5.0
VC	Non-Detect	2.0

- Measured Value
- Sample Detection Limit
- Concentration Trend
- Maximum Concentration
- Groundwater Protection Standard

Well Location

PTX06-1155 Downgradient Performance Indicators
Zone 11 In Situ Bioremediation System
USDOE/NNSA Pantex Plant

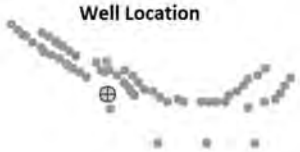


Most Recent Measured COC Concentrations (Apr 27, 2016)

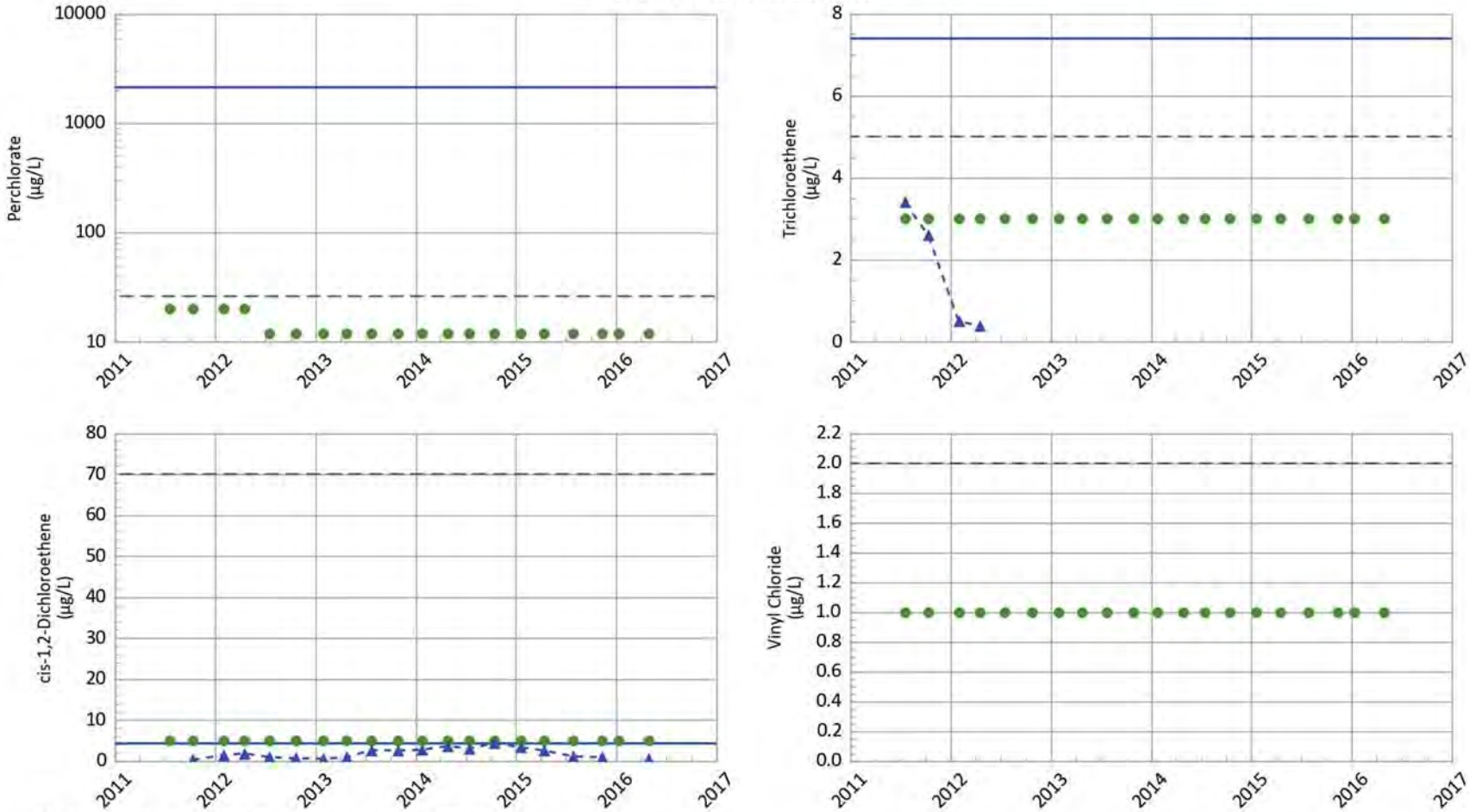
COC	Concentration (µg/L)	GWPS (µg/L)
PERC	Non-Detect	26.0
DCE12C	300.0	70.0
TCE	2.8	5.0
VC	0.9	2.0

- Measured Value
- Sample Detection Limit
- Concentration Trend
- Maximum Concentration
- Groundwater Protection Standard

Well Location

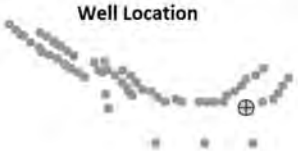


PTX06-1156 Downgradient Performance Indicators
Zone 11 In Situ Bioremediation System
USDOE/NNSA Pantex Plant



Most Recent Measured COC Concentrations (Apr 27, 2016)

COC	Concentration (µg/L)	GWPS (µg/L)
PERC	Non-Detect	26.0
DCE12C	0.61	70.0
TCE	Non-Detect	5.0
VC	Non-Detect	2.0

- Measured Value
- Sample Detection Limit
- Concentration Trend
- Maximum Concentration
- Groundwater Protection Standard

Well Location