Pantex Plant

2015 Annual Progress Report

Remedial Action Progress

In Support of Hazardous Waste Permit 50284 and
Pantex Plant Interagency Agreement

June 2016

Pantex Plant
FM 2373 and U.S. Highway 60
P.O. Box 30030
Amarillo, TX 79120

Pantex Plant Remedial Action Systems

CERTIFICATION STATEMENT

2015 Annual Remedial Action Progress Report
Pantex Plant, June 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.

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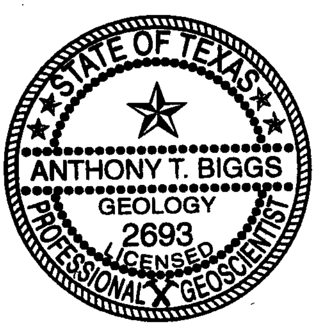
2015 Annual Remedial Action Progress Report in Support of Hazardous Waste Permit #50284 and Pantex Plant Interagency Agreement for the Pantex Plant, Amarillo, Texas

June 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
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E.0 Executive Summary

The Pantex Plant, located in the Texas Panhandle 17 miles northeast of Amarillo, is implementing a remedial 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. Other soil remedies (fencing, soil covers, and ditch liner) and institutional controls are also maintained as part of the soil remedy for Pantex. This annual report satisfies requirements in the Pantex Interagency Agreement (IAG) and Hazardous Waste Permit (HW) 50284 to provide information on the remedial action system performance and components. The focus for this report is the data and information collected for the soil and groundwater remedies during 2015. Data are evaluated according to criteria outlined in the *Long-Term Monitoring System Design Report* (Pantex, 2009a), HW-50284, the IAG, Land and Groundwater Use Control Implementation Plan, and various Operation and Maintenance (O&M) Plans for the remediation systems.

Annual Progress Report Outline

- Background Information
- O&M of Remedial Actions
- Groundwater Remedial Action Effectiveness
- Soil Remedial Action Effectiveness
- Recommendations and Conclusions

E.1 Remedial Actions

Pantex has implemented soil and groundwater remedial actions. Those actions and their objectives are described in the highlight box below.

Groundwater Remedial Actions

Two Pump & Treat Systems

- Reduce saturated thickness
- Reduce contaminant mass
- Plume stabilization

Two In Situ Bioremediation Systems

- Reduce contaminant concentrations as groundwater migrates through the treatment zone

Institutional Controls

- Control perched groundwater usage and drilling in contaminated areas

Soil Remedial Actions

Ditch Liner and Soil Covers on Landfills

- Protect future groundwater

Institutional Controls

- Protect workers

Soil Vapor Extraction System

- Clean up soil gas and residual non-aqueous phase liquid (NAPL) in soil at the Burning Ground

Fencing

- Prevent traffic and control access

E.2 O&M of Remedial Actions

E.2.1 Pump and Treat Systems

Operational goals have been developed to promote mass removal and continued removal of perched groundwater to reduce saturated thickness of the perched aquifer. The first goal of 90% system operation was not applicable at all times during the year due to shutdowns for upgrades, maintenance, and power losses. The pump and treat system performance for 2015 is depicted in Figure E-1.

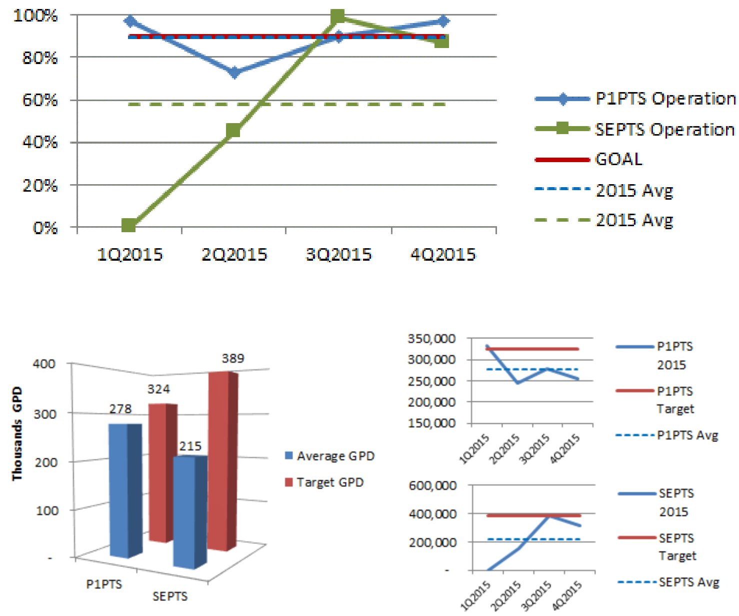

Figure E-1. Pump and Treat Systems Performance

Overall, both systems met the operational goal of 90% excluding the intentional shutdown for SEPTS system upgrades and maintenance and loss of power at the systems. While treatment throughput was not a primary goal after June 2014, the 90% goal is still depicted in the graphs and throughput is evaluated. When the systems operated, daily treatment throughput varied due to reduced flow to the WWTF and irrigation system or shutdown of system wells. As depicted in Figure E-1, P1PTS operated 89% of the year with an average gallon per day (gpd) throughput of about 278,000 gpd. SEPTS operated 58% of the year (January – September), with an average throughput over 215,000 gpd.

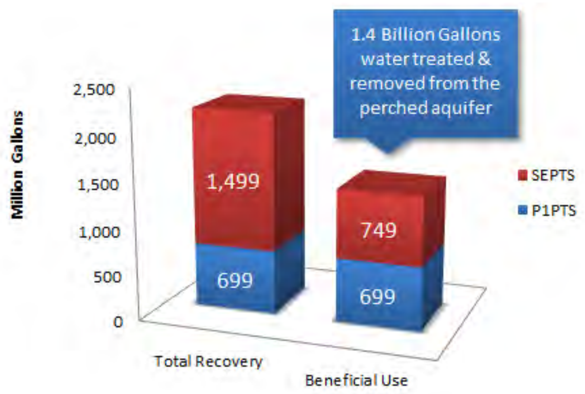

Figure E-2. Pump and Treat Recovery

Overall, the systems have operated efficiently to treat contamination and reduce saturated thickness. As depicted in Figure E-2, Pantex has treated more than 2.1 billion gallons since the startup of the systems, with more than 1.4 billion gallons removed and beneficially used. Pantex continues to reduce reliance on injection of treated water, and as recommended in the Five-Year Review, Pantex has implemented new throughput goals to align operations with the goal of reducing saturated thickness. During 2015, 97% of the treated water was beneficially used.

In addition to removing impacted water from the perched aquifer, the pump and treat systems remove contaminant mass from the groundwater that is extracted from the aquifer. The P1PTS primarily removes the high explosive RDX and the SEPTS primarily removes RDX and hexavalent chromium (CR(VI) in Figure E-3). The figures below provide the mass removal for high explosives (HEs) and chromium for 2015, as well as totals since startup of the systems. The SEPTS has been operating longer than the P1PTS and the greatest concentrations of HEs are found in the SEPTS extraction well field, so mass removal is much higher at that system. During 2015, SEPTS removed about 489 lbs of contaminants and P1PTS removed about 62 lbs of contaminants.

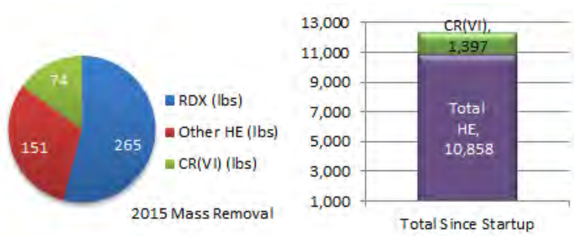

Figure E-3. SEPTS Mass Removal

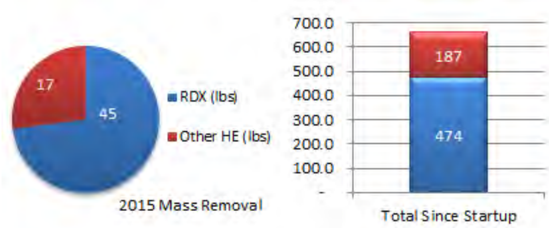

Figure E-4. P1PTS Mass Removal

E.2.2 In Situ Bioremediation Systems

For the treatment zone wells, this report evaluates whether the reducing conditions are present to degrade the contaminants of concern (COCs) in each area, as well as the presence of a continued food source for the bacterial reduction of COCs. Downgradient monitoring wells are evaluated to determine if COCs are being reduced to the GWPS and that complete degradation is occurring.

Installation of the Zone 11 ISB Remedial Action was completed in 2009, with initial amendment injection completed in 2009 and yearly injections thereafter. Data indicate that a reducing zone has been established and a fair to good food source is available for continued biologic growth. A seventh injection was completed in November 2015, which included bioaugmentation with *Dehalococcoides spp.* (DHC). The injection event included injection of the new wells in the expansion zone, the original wells (except PTX06-ISB082), and bioaugmentation of the TCE wells where the reducing zone was already established.

Perchlorate concentrations were non-detect in four of the six downgradient ISPM wells during 2015. Perchlorate is exhibiting decreasing trends in the other two downgradient ISPM wells. TCE concentrations were non-detect or below the groundwater protection standard (GWPS) in four of the six downgradient ISPM wells during 2015. TCE concentrations in PTX06-1012 and PTX06-1155 had been decreasing, but are now increasing in both wells. Pantex previously recognized in the 2013 Annual Progress Report that complete TCE treatment may be constrained by a lack of DHC that are necessary for complete dechlorination of TCE, and began working on a Bioaugmentation Plan in 2014. The seventh injection event, completed in 2015, included bioaugmentation of the western side of the Zone 11 ISB where reducing conditions are established and where the heart of the TCE plume is treated. Pantex is monitoring the impact of the bioaugmentation through the use of qPCR and compound specific isotope analysis (CSIA) sampling which began in February 2016. The results of that sampling will be reported in the quarterly progress reports throughout 2016.

The Southeast ISB was installed in 2007, with injection completed by March 2008. This system has established an adequate reducing zone for HEs and chromium, based on geochemical conditions monitored at the treatment zone. A fifth injection event was completed in April 2015. The system has adequately treated the primary COCs (RDX and hexavalent chromium) at three downgradient monitoring wells to concentrations below their respective GWPS during 2015. HE breakdown products were also treated to levels below their respective GWPS in these three wells during 2015. Pantex continues to investigate why one downgradient well, PTX06-1153, has not responded as strongly to treatment of RDX and hexavalent chromium. Two other performance monitoring wells (one upgradient and one farther downgradient) were dry and could not be sampled during 2015. Other wells in the treatment zone, as well as one other downgradient well, showed dry conditions in 2015. This condition is expected to continue as the pump and treat systems continue to remove water upgradient.

E.2.3 Soil Remedial Actions

A small-scale Catalytic Oxidation SVE system was installed at the Burning Ground in early 2012. This small-scale system focuses on treating residual non-aqueous phase liquid (NAPL) and soil gas at soil gas well SVE-S-20. The system was continuously operated except for testing, maintenance, repairs, or freezing weather that affects influent flow. Mass removal calculated for 2015 for VOCs contributing more than 1% of the total VOC concentration is presented in Figure E-5 along with total mass removed since the SVE was installed as an interim action in 2002. The system removed about 398 lbs of VOCs during 2015.

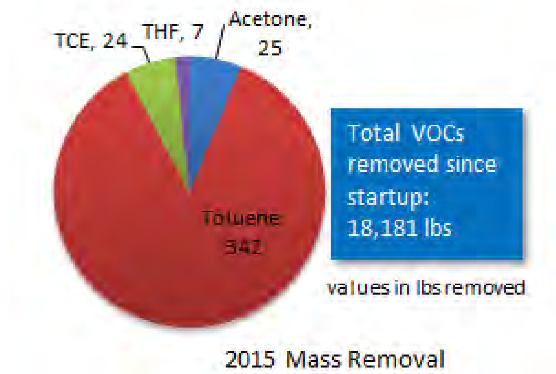

Figure E-5. Burning Ground SVE Mass Removal

In addition to the active soil remediation at the Burning Grounds, Pantex maintains institutional controls in accordance with deed restrictions and to protect workers and the environment. Pantex provides long-term control of any type of soil disturbance in the solid waste management units (SWMUs) to protect human health and to prevent spread of contaminated soils. SWMU interference was approved for three projects that required work in a SWMU in 2015. Pantex also regularly inspects and maintains all soil covers, fences, signs, postings, and ditch liners. Deficiencies in soil covers and the ditch liner were observed and planned for correction starting in 2016.

During 2015, Pantex continued to evaluate the landfill cover reseeding conducted in 2013. Conditions greatly improved in the landfill covers due to heavy rainfall in 2015. However, a few small bare areas will need to be addressed. Pantex will continue to evaluate the landfills annually and report the findings of the review and any plans that are developed to address bare areas. Pantex is contracting for long-term maintenance of the landfills, so identified problems will be addressed annually. Pantex also identified erosion problems at Landfill 3 related to the heavy rainfall. This erosion will be addressed through a separate design and construction contract to improve the cover.

E.3 Groundwater Remedial Action Effectiveness

E.3.1 Plume Stability

Plume stability was evaluated through examination of water level and concentration data. Water levels were used to generate hydrographs and trends for individual wells, maps of water elevations and contours, and water level trends. Concentration data were used to perform concentration trend analysis. The concentration data were also combined with the water level data to generate plume maps for each COC. The maps and trends together formed the basis for an evaluation of overall plume stability. In addition, a comparison of observed versus expected conditions from the Long Term Monitoring System Design Report (Pantex, 2009a) was conducted as part of the evaluation process.

Overall, calculated concentration and groundwater level trends were consistent with expected conditions defined in the LTM Design Report. Of the 43 monitor wells with expected water level conditions defined in the LTM Design Report, only five wells exhibited conditions inconsistent with the current expected conditions or trends. However, three of the wells, located around Playa 1, were affected by above normal precipitation during the spring and summer of 2015 which caused water levels to rise up to several feet.

Recent water level data for another well indicates no trend with relatively stable water levels and less than four feet of saturated thickness. This well is located near a zone of thin perched saturation which may limit the effects of the SEPTS in this area.

Water has been inconsistently measured in the sump of a historically dry well, but no trend is discernable. This well is located at the fringe of the perched aquifer extent and is not under the influence of a remedial action. Figure E-6 depicts recent water level trends in the perched aquifer LTM wells.

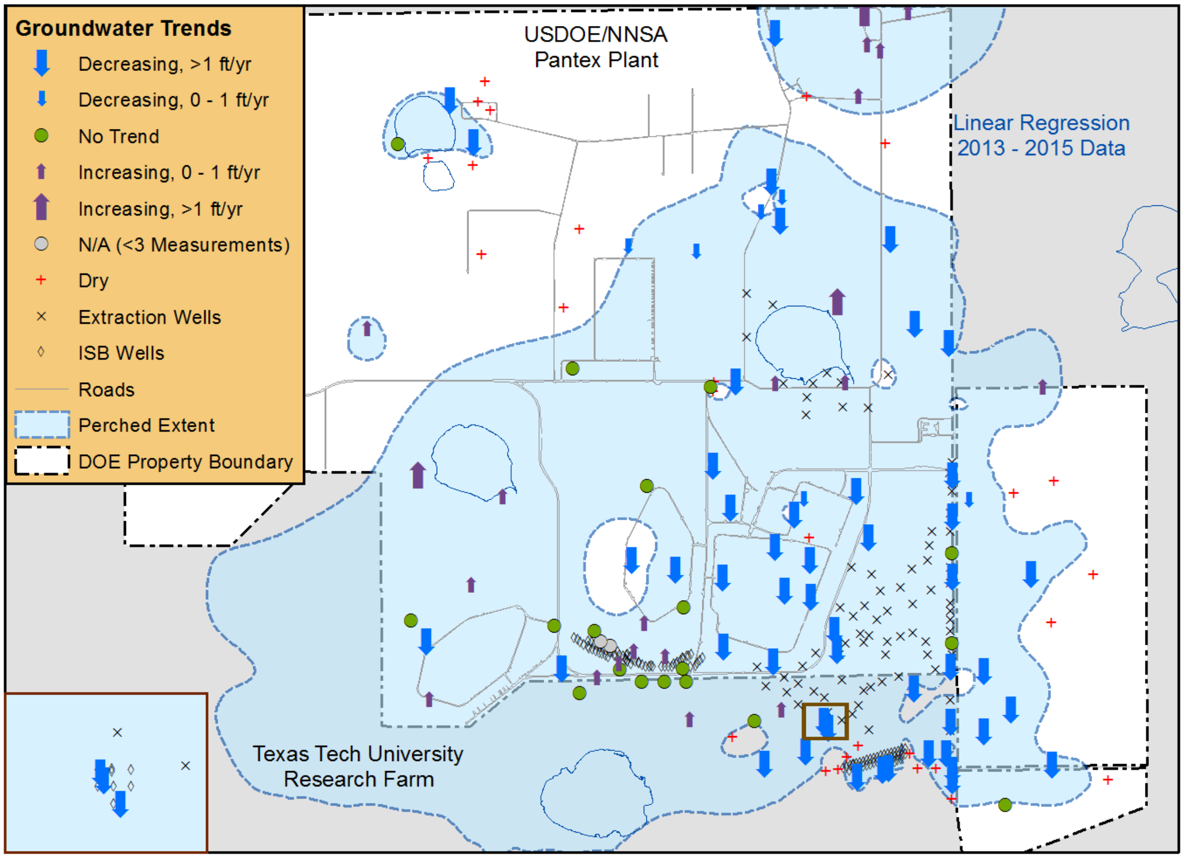

Figure E-6. Perched Aquifer Water Level Trends

Of the 103 monitor wells with expected COC concentration conditions defined in the LTM Design Report, 18 wells did not exhibit trends consistent with the expected conditions for the four major COCs (RDX, hexavalent chromium, TCE, and perchlorate). It is anticipated for these trends to meet expected conditions as the corrective actions continue to operate in the perched aquifer. Figure E-7 depicts RDX trends since the start of the full remedial action in the perched aquifer LTM wells. Wells in the southeast lobe of the perched aquifer are not under the influence of a remedial action.

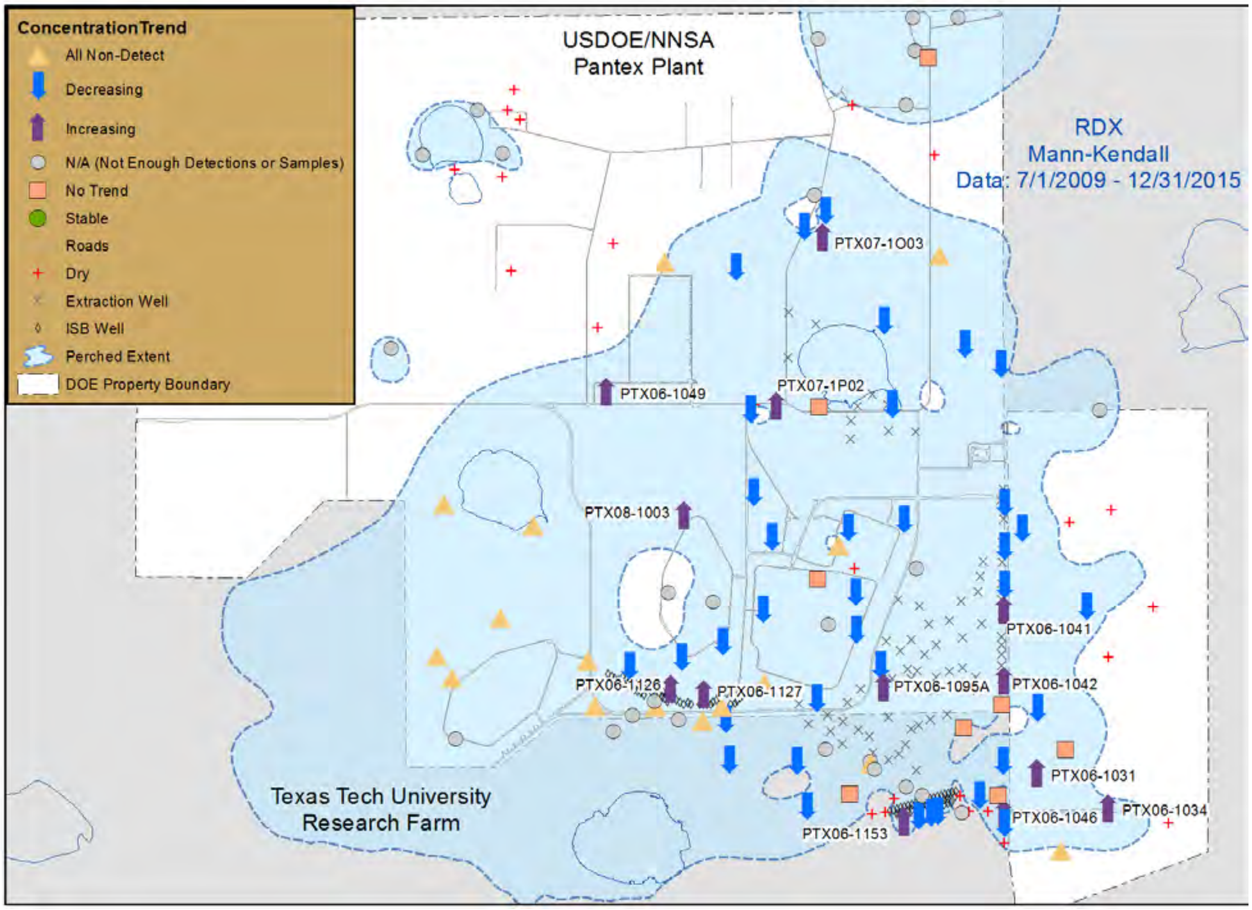

Figure E-7. RDX Trends in the Perched Aquifer

Generally, 2015 plume shapes are similar to the 2009 COC plumes. The major changes in plume size and shape were due to general plume movement downgradient, slight changes in concentrations that define the boundaries of the plumes, newly installed wells, or effects of the pump and treat systems. The major COC plumes of interest are depicted in Figure E-8.

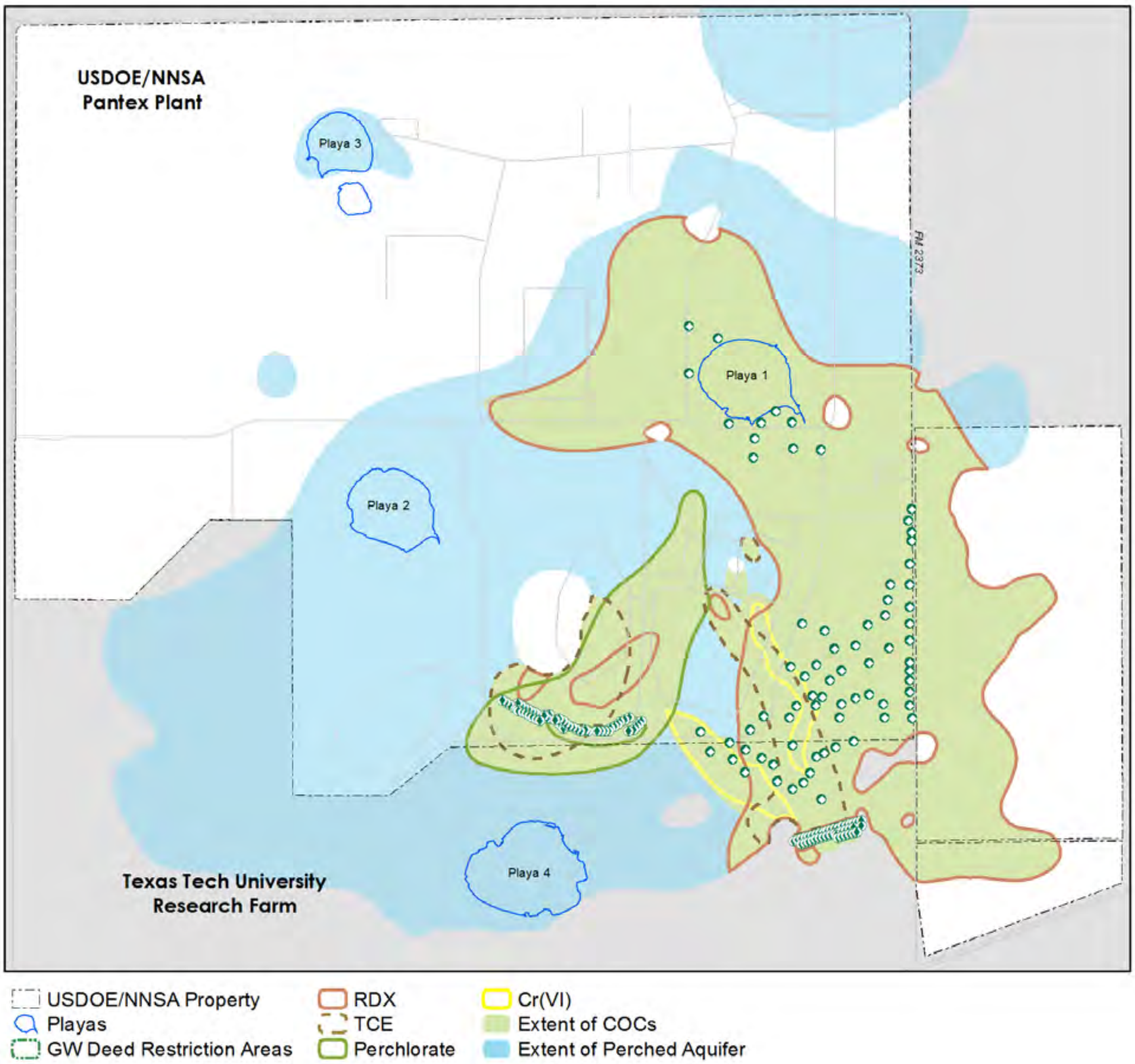

Figure E-8. Major COC Plumes in the Perched Aquifer

E.3.2 Remedial Action Effectiveness

Considering that one goal of both pump and treat systems is to affect plume movement, the plume stability evaluation can be used to determine the effectiveness of these systems. To this end, the pump and treat systems have been very effective in 2015. The SEPTS has altered the groundwater flow direction and gradient at localized areas near the extraction wells in the perched aquifer. The P1PTS appears to be influencing local water levels and hydraulic gradient in the area near Playa 1. When comparing the 2015 conditions to LTM Design expected conditions, the majority are meeting expected conditions. Most wells not yet meeting expected conditions are in locations that have not yet been affected by the systems.

The Southeast ISB system data collected in 2015 indicates that it is effective in meeting the treatment objectives set in the *Remedial Design/Remedial Work Plan* (Pantex, 2009c). Based on geochemical conditions monitored at the treatment zone, the Southeast ISB system has established an adequate reducing zone for the contamination that is present. Three of the closest downgradient monitoring wells for the Southeast ISB (PTX06-1037, 1123, and 1154) demonstrate that reduction of RDX, HE degradation products, and hexavalent chromium has occurred resulting in concentrations below the GWPS, with most not detected. The fourth downgradient well (PTX06-1153) continues to exhibit RDX concentrations above 200 ug/L and variable hexavalent chromium concentrations near the GWPS. Pantex continues to monitor this well and other new wells installed nearby to determine if treated water is slow to arrive, or if this well may not be hydraulically connected to the Southeast ISB.

Monitoring data collected in 2015 also indicate the Zone 11 ISB system has been effective in its sixth year of operation. Data indicate that an adequate reducing zone has been established for perchlorate and conditions appear to be favorable for reductive dechlorination of TCE. Perchlorate concentrations were non-detect in four of the six downgradient ISPM wells in 2015 and were decreasing in the two remaining wells located further downgradient. TCE concentrations remain below GWPS in four of the downgradient wells, but are increasing in the other two. Data continue to suggest that TCE treatment may be limited by a lack of the proper bacterial strains (DHC) necessary for complete TCE dechlorination; bioaugmentation was conducted during the 2015 injection event in the established portion of the Zone 11 ISB system. Initial injection of amendment occurred in the expansion wells of the Zone 11 ISB in 2015.

E.3.3 Uncertainty Management/Early detection

The purpose of uncertainty management wells in High Plains Aquifer (commonly and hereafter referred to as the Ogallala Aquifer) and perched aquifer is to confirm expected conditions identified in the Resource Conservation and Recovery Act (RCRA) Facility Investigations and ensure there are not any deviations, fill potential data gaps, and fulfill long-term monitoring requirements for soil units evaluated in a baseline risk assessment. The purpose of early detection wells is to identify breakthrough of constituents to the Ogallala Aquifer from overlying perched groundwater, if present, or potential source areas in the unsaturated zone before potential points of exposure have been impacted. These wells were proposed in the LTM Design Report for purposes of evaluating the effectiveness of the soil and groundwater remedial actions.

Group 1 wells are located where contamination has not been detected or confirmed, or in previous plume locations where concentrations have fallen below GWPS, background, or practical quantitation limit (PQL). These wells were evaluated in the quarterly reports. No Group 1 perched aquifer wells had unexpected conditions in 2015.

Several Ogallala Aquifer Group 1 wells had nickel, manganese, and boron detections exceeding background levels. However, these exceedences are likely due to stainless steel well screen corrosion, influence from deeper formations, sample turbidity, or background variability. All of these metals detections are significantly lower than their respective GWPS.

Hexavalent chromium was detected below the GWPS of 100 ug/L in eight wells (PTX06-1033, PTX06-1043, PTX06-1044, PTX06-1056, PTX06-1068, PTX06-1076, PTX06-1144, and PTX06-1157) in 2015. The detections in all but two of the wells were below the laboratory PQL of 10 ug/L. These detections are likely a result of one or more of the following:

- Low-level background of hexavalent chromium in the Ogallala Aquifer as suggested in a recent Texas Tech study. As presented in the 3rd quarter Progress Report, Pantex worked with the Texas Tech University Water Resources Center to investigate the occurrence, distribution, and speciation of chromium in the Ogallala Aquifer system in the Texas Panhandle. Study results suggest that the oxidized conditions in the Ogallala Aquifer are converting naturally occurring chromium to the hexavalent oxidation state, creating a possible low-level hexavalent chromium background in the aquifer.
- Lower detection limits for Method SW-7196 based on improvements to the method. MDLs dropped from 5 ug/L to 3.3 ug/L and the PQL dropped from 15 ug/L to 10 ug/L in June 2013. The new detection limits allow low-level background concentrations to be detected between the new MDL and PQL.
- Corrosion of stainless steel screen/casing. Specific wells at Pantex have documented evidence of corrosion and conversion of total chromium to hexavalent chromium is possible due to oxidized conditions in the Ogallala Aquifer.
- False positive detections near the MDL due to the colorimetric analytical method. Typically, these detections are not confirmed by total chromium results.

It is likely that most of these sporadic detections are related to the lower detection limits and the ability to quantify low-level background detections. For example, hexavalent chromium was not detected in five of the eight wells in 2014, while four wells that had detections in 2014 did not have detections in 2015. One of the wells, PTX06-1033, has long-term documented evidence of well corrosion.

PTX06-1056 continues to demonstrate detections of 4-amino-2,6-DNT, a breakdown product of the high explosive 2,4-trinitrotoluene (TNT), first detected in April 2014. All detections are below the GWPS, although the HE is detected variably above and below the PQL. The VOC 1,2-dichloroethane was also detected for the first time in PTX06-1056 in August 2015 below the PQL and GWPS. Subsequent sampling confirmed the original detection with the new result also below the PQL and GWPS.

In response to these detections, Pantex has fully implemented the conditions specified in the *Pantex Plant Ogallala Aquifer and Perched Groundwater Contingency Plan* (Pantex, 2009d). Pantex has addressed one potential source by plugging a nearby perched aquifer well that was drilled deeply into the fine-grained zone. Pantex will continue quarterly sampling for HEs and VOCs at PTX06-1056 to determine if a trend emerges. In addition, Pantex will obtain a cement bond log of PTX06-1056 to evaluate the integrity of the casing where it penetrates the fine-grained zone. Pantex has also engaged a third-party hydrogeological consulting firm to conduct an independent assessment of the detections.

Group 2 wells are perched wells near source areas and generally have contamination above the GWPS. The purpose of the Group 2 well annual evaluation is to determine if source strength is declining. The ditches and playas are expected to continue to source contaminants to the perched aquifer for a long period of time (20 years or more), but at much lower concentrations than in the past (Pantex 2006). For many of these wells, it is expected that concentrations will stabilize with an eventual long-term decreasing trend below the GWPS.

Most of the Group 2 wells that have detections of COCs already meet expected conditions at the well. There are 12 wells that do not yet meet expected conditions, i.e., increasing trends (since remedial actions began in 2009) when long-term decreasing trends are expected. Several of these wells are experiencing more recent decreasing trends while some could be due to changing gradients and/or plume movement away from the source. Pantex will continue to evaluate these trends over time. Several other Group 2 wells had metals detections above their site-specific backgrounds, but were below GWPS. These metals detections are likely due to either well screen corrosion or variation in background.

E.3.4 Natural Attenuation

Natural attenuation is the result of processes that naturally lower concentrations of contaminants over time. Data are collected at Pantex to help determine where natural attenuation is occurring, under what conditions it is occurring, and to eventually estimate a rate of attenuation. This is an important process for RDX, the primary risk driver in perched groundwater, because it is widespread and extends beyond the reach of the groundwater remediation systems in some areas. Pantex has historically monitored for RDX (since 2009), 2,4,6-trinitrotoluene (TNT), and TCE degradation products in key areas.

Although Pantex has monitored for breakdown products of TCE for many years, a strong indication of natural attenuation of TCE has not been observed in perched groundwater. Based on monitoring results for TNT and its breakdown products, TNT has naturally attenuated over time, with data indicating that the breakdown products are more widespread than TNT.

Perched groundwater sampling results for RDX and breakdown products (MNX, DNX, and TNX) indicate that the breakdown products are present throughout most of the RDX plume, with TNX being the most widespread. If complete biodegradation of RDX is occurring, RDX and all breakdown products would be expected to decrease over time. A recent SERDP study (2014) provided evidence that aerobic degradation is occurring in the Pantex RDX plume with strong evidence of aerobic degradation found in two monitoring wells. This study provided new methods for better evaluating RDX degradation at Pantex. Pantex is currently in the process of contracting for further study at the Pantex Plant to apply the CSIA and other new analytical techniques to determine where and what type of degradation is occurring across the RDX plume.

Overall, it appears that natural attenuation of HEs may be occurring at Pantex. More data will be required over time to determine trends and possibly estimate rates of attenuation.

E.4 Soil Remedial Action Effectiveness

The small-scale SVE system at the Burning Ground is the only active soil remediation system at Pantex. The current CatOx/wet scrubber system continues to focus on treating residual NAPL and soil gas at well SVE-S-20.

E.5 Recommendations and Conclusions

Pantex plans to continue the current approved remedial actions. The groundwater remedies are considered protective for the short-term as untreated perched groundwater use is controlled to prevent human contact and Ogallala Aquifer data continues to indicate COC concentrations either non-detect or below GWPS. The systems are proving to be effective in reaching long-term established objectives for cleanup. Soil remedies have been effective at Pantex as workers and the public are protected from exposure to contaminated soils and data do not indicate that new contamination is migrating to the underlying groundwater from soil source areas. The SVE system is actively removing soil gas and residual NAPL in soils at the Burning Ground thereby mitigating vertical movement of VOCs to the Ogallala Aquifer.

Based on issues identified in the Five-Year Review and during completion of this report, several changes are recommended or have been implemented to enhance the effectiveness of the remedies in some areas and to better monitor the effectiveness of the actions. Those recommendations are provided in the following sections.

E.5.1 Recommended changes to the Pump and Treat Systems

Pantex recommends extending SEPTS extraction east of FM 2373 to limit further migration of impacted perched water southward along the eastern margin of the perched aquifer. This action is in agreement with the selected remedy for the southeast perched groundwater. The ROD selected the SEPTS as the final remedy to stabilize migration and treat perched groundwater contaminants.

E.5.2 Recommended Changes to the ISB Systems

E.5.2.1 Southeast ISB

Since no clear reason for the unexpected conditions in PTX06-1153 has been identified, it is recommended to continue monitoring the water level and analytical data collected in and around the Southeast ISB to continue to attempt to discern groundwater flow patterns. Pantex will install passive flux meters in select wells in 2016 and will provide results and recommendations in the 2016 Annual Report.

E.5.2.2 Zone 11 ISB

As discussed in Section 2.2.2.3, Pantex will pause injection at two wells on the perchlorate (eastern) side of the ISB. The pause will evaluate whether the life of the well can be extended while continuing to treat perchlorate because only mildly reducing conditions are required for treatment of perchlorate. The Design Basis Document and the RD/RA Work Plan recognize that the interval between injections may be lengthened once the system is fully developed. Pantex will collect field data including DO, ORP, and pH to evaluate changes in those wells until they are injected in the 2017 injection event. The wells will be rehabilitated at each injection event (2016 and 2017) to help increase the potential for future injections. These wells be used as a test case for rehabilitation of wells experiencing problems with biofouling and decreased injection rates.

E.5.3 Recommended Changes to the Monitoring Network

Pantex will replace PTX06-1071 during 2016 due to a failed screen. Pantex will also install a well south of the southeast lobe, between PTX06-1133A and PTX06-1158, to verify dry conditions in that area. A well will also be drilled downgradient of the hexavalent chromium plume that originates from the southwest corner of Zone 12. This new well will address a gap downgradient of well PTX06-1052.

E.5.4 Recommended Changes to Soil Remedies

Vegetative loss on landfill covers was identified as an issue in the first Five-Year Review Report, primarily due to the drought conditions in the Texas panhandle. Therefore, Pantex proposed to develop and implement a phased plan to revegetate the landfill covers as outlined in Section 2.3.2. Pantex completed reseeding in 2013 and is now evaluating its effectiveness. Based on the 2015 evaluations, most areas have recovered due to heavy rainfall that occurred in 2015. A few small bare areas remain and will be planned for reseeding under the new long-term landfill maintenance contract.

Pantex has contracted for a design to improve the side slopes of Landfill 3. Heavy rainfall in 2015 increased runoff to the nearby ditches and caused erosion. A more aggressive plan to stabilize the slopes is being developed. Construction of the landfill design is expected to begin in 2016 and complete in 2017.

The small-scale SVE system continues to remove VOCs from SVE-S-20 and the VOC source area may be slowly decreasing. As discussed in the Five-Year Review and 2012 Annual Progress Report, no expected conditions or path toward closure were defined for the SVE system, other than "significant reduction in soil gas VOCs". Therefore, Pantex recommended the development of a Burning Ground SVE Performance Monitoring Plan, which will define expected conditions of the system performance as well as a clear path towards an end point of active SVE operations and potential transition to a passive system. To this end, three rebound tests were conducted in 2014, resulting in conflicting or unusable data. Using lessons learned from the 2014 testing, another rebound test was conducted in 2015, but was also unsuccessful. Pantex has contracted outside review of the SVE and will provide a plan for a path to closure after review and recommendations are complete.

Pantex will replace the ditch liner at SWMUs 5-05 and 2 in Zone 12 due to observed degradation of the liner. Considering the age and life cycle of the liner, it was determined that it would be best to replace the liner rather than just complete repairs. The liner will be replaced in early 2017.

Pantex has received additional funding to upgrade a select amount of landfill covers with Closure Turf® that was previously installed at Landfill 1. Pantex will evaluate the landfills to identify the most appropriate landfills to be lined and will complete that project in 2017. The liner is expected to reduce long-term maintenance costs and provides superior erosion and infiltration control for the landfills.

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Appendices

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List of Acronyms

amsl	above mean sea level
AOC	Area of Concern
bgs	below ground surface
btoc	below top of casing
CatOx	Catalytic Oxidation
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	contaminant of concern
CP-50284	Compliance Plan 50284
CR(VI)	hexavalent chromium
DCE	dichloroethene

DHC	*Dehalococcoides sp.*
DNT	dinitrotoluene
DNX	hexahydro-1,3-dinitroso-5-nitro-1,3,5-triazine
DO	dissolved oxygen
EDTA	Ethylenediaminetetraacetic acid
EPA	Environmental Protection Agency
FM	Farm-to-Market Road
FS	Firing Site
ft	feet
FGZ	fine-grained zone
GAC	granular activated carbon
gpm	gallons per minute
gpd	gallons per day
GWPS	groundwater protection standard
HE	high explosive
HMX	octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
in	inches
IAG	Interagency Agreement
IRAR	Interim Remedial Action Report
IRPIM	Installation Restoration Program Information Management System
ISB	in situ bioremediation
ISM	interim stabilization measure
ISPM	in situ performance monitoring
LTM	long-term monitoring
Mgal	million gallons
MAROS	Monitoring and Remediation Optimization System
MCL	Maximum Contaminant Limit
MNX	hexahydro-1-nitroso-3,5-dinitro-1,3,5-triazine
mV	millivolts
NAPL	non-aqueous phase liquid
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
O&M	operation and maintenance
ORP	oxidation reduction potential
OSTP	Old Sewage Treatment Plant
P&A	plugging and abandonment
P1PTS	Playa 1 Pump and Treat System
PCA	1,1,2,2 - tetrachloroethane
PCE	perchloroethene
PID	photoionization detector
POC	point of compliance
POE	point of exposure
ppmv	parts per million by volume

PQL	practical quantitation limit
RCRA	Resource Conservation and Recovery Act
RDX	hexahydro-1,3,5-trinitro-1,3,5-triazine
ROD	Record of Decision
SAP	Sampling and Analysis Plan
SEP/CBP	Solvent Evaporation Pit/Chemical Burn Pit
SEPTS	Southeast Pump and Treat System
SERDP	Strategic Environmental Research and Development Program
SVE	soil vapor extraction
SWMU	Solid Waste Management Unit
TCE	trichloroethene
TCEQ	Texas Commission on Environmental Quality
THF	tetrahydrofuran
TLAP	Texas Land Application Permit
TNB	trinitrobenzene
TNX	hexahydro-1,3,5-trinitroso-1,3,5-triazine
TNT	trinitrotoluene
TOC	total organic carbon
TWDB	Texas Water Development Board
TTU	Texas Tech University
TZM	treatment zone monitoring
USDOE/NNSA	United States Department of Energy/National Nuclear Security Administration
VFA	volatile fatty acid
VOC	volatile organic compound
WMG	waste management group
WWTF	Wastewater Treatment Facility

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1.0 INTRODUCTION

The Pantex Plant, located in the Texas Panhandle approximately 17 miles northeast of Amarillo (see Figure 1-1), was established in 1942 to build conventional munitions in support of World War II. The Plant was deactivated in 1945, and was sold to Texas Tech University (TTU). In 1951, it was reclaimed for use by the Atomic Energy Commission to build nuclear weapons. Pantex continues with an active mission to support the nuclear weapons stockpile for the United States Department of Energy/National Nuclear Security Administration (USDOE/NNSA).

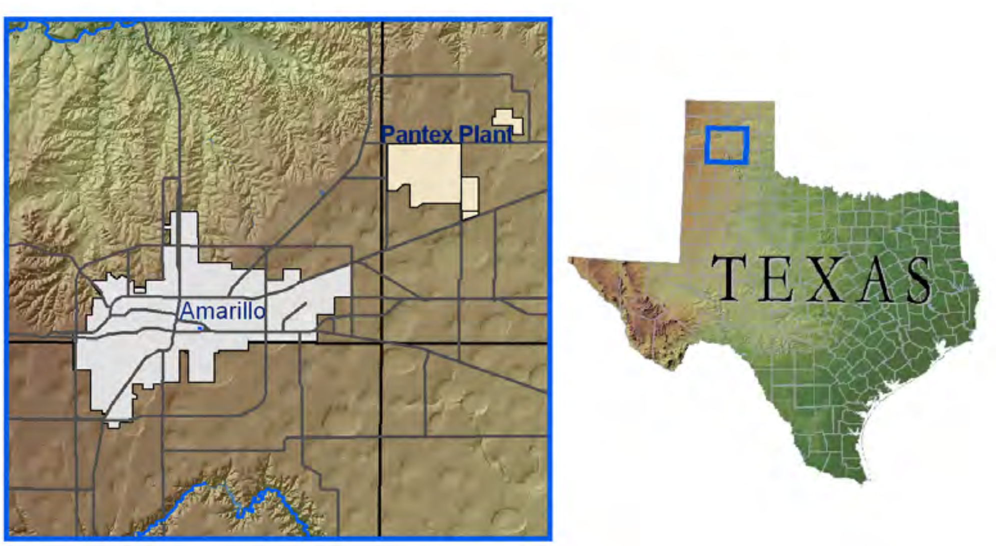

Figure 1-1. Location of Pantex Plant

The main Pantex Plant site encompasses approximately 9,100 acres. Approximately 2,000 acres of the USDOE/NNSA-owned property are used for industrial operations at Pantex, excluding the Burning Ground, Firing Sites, and other outlying areas. The Burning Ground and Firing Sites occupy approximately 489 acres. Remaining USDOE/NNSA-owned land serves safety and security purposes. Approximately 1,526 acres east of FM 2373 was purchased in 2008 to provide better access and control of perched groundwater areas included in the Remedial Action. USDOE/NNSA also owns a detached piece of property, called “Pantex Lake,” approximately 2.5 miles northeast of the main Plant. This property, comprised of 1,077 acres, includes the playa lake itself. No industrial operations are conducted at the Pantex Lake property.

Historical waste management practices at Pantex resulted in the release of contaminants through various waste streams. Treated and untreated industrial wastewater released to the ditches and playas resulted in the contamination of perched groundwater beneath Playa 1, portions of Zone 11, Zone 12, Texas Tech University property to the south, and property east of FM 2373. The extent of perched groundwater and the major contaminant plumes are depicted in Figure 1-2. Pantex has implemented remedial actions to mitigate perched groundwater contamination and to prevent contamination of the deeper drinking water aquifer.

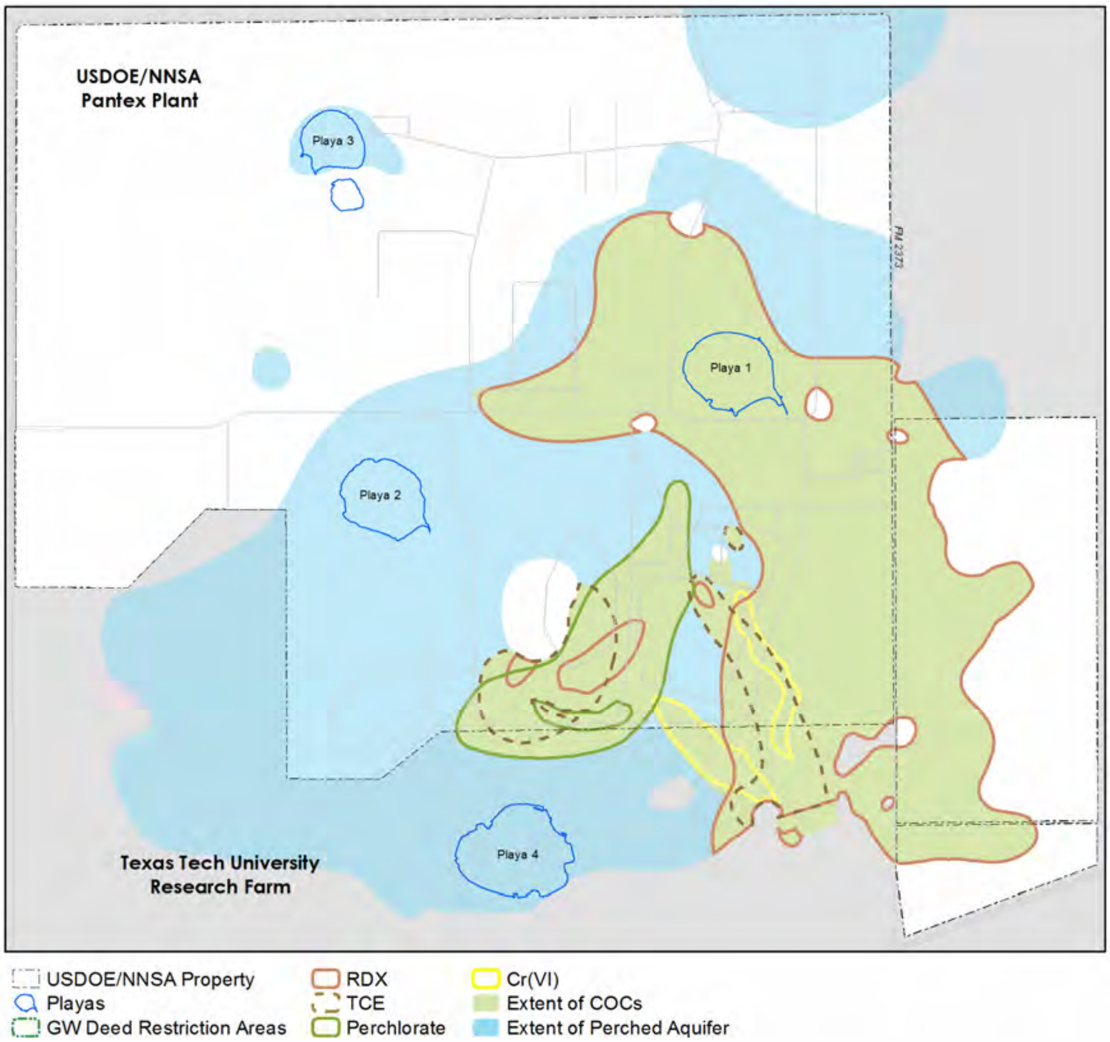

Figure 1-2. Extent of Perched Groundwater and Contaminant Plumes Exceeding GWPS

Impacted perched groundwater is not used for residential purposes; however, the perched aquifer overlies the Ogallala Aquifer, a drinking water source for the Texas Panhandle and Pantex. This aquifer system, which is dominated by the Ogallala Formation, includes the Dockum Formation in the Pantex vicinity.

Historical waste management practices also resulted in the contamination of soil sites at Pantex. Landfills and specific soil sites require institutional controls to ensure continued use of the land for industrial purposes. In addition, some areas require maintenance of soil covers and ditch liners to prevent infiltration of water and downward migration of contaminants to groundwater. Fencing and signs are also maintained to control worker use and traffic in the soil units.

1.1 Regulatory Background

Pantex implemented its remedial actions in accordance with the Compliance Plan for Industrial Solid Waste Management Sites, originally issued on October 21, 2003, and updated on September 16, 2010 to include final remedial actions, under the provisions of Texas Health and Safety Code Annotated, Chapter 361 and Chapter 26 of the Texas Water Code. The Compliance Plan is a Texas Commission on Environmental Quality (TCEQ) permit, which delineates the requirements for conduct of corrective actions and groundwater monitoring programs according to Resource Conservation and Recovery Act (RCRA). In 2014, the Hazardous Waste Permit was renewed and the compliance plan requirements were incorporated into the permit.

Pantex was listed on the National Priorities List in 1994, requiring Pantex to also investigate and cleanup according to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Pantex meets the requirements of CERCLA through the Pantex Interagency Agreement (IAG), effective February 22, 2008. The IAG is issued through the U.S. Environmental Protection Agency (EPA). Table 1-1 lists the Compliance Plan and IAG, date of issuance, modifications, and descriptions of each issue or modification.

Table 1-1. Regulatory Compliance Documents

Document	Date of Issue	Description
CP-50284	10/21/2003	Interim stabilization measure compliance plan issued to describe interim measures for stabilization of groundwater plumes and monitoring of that action.
Interagency Agreement for the Pantex Superfund Site	2/22/2008	Established an agreement between EPA, TCEQ, and USDOE for the final remedial actions, framework for responding to and implementing CERCLA requirements, and framework for participation and exchange of information between parties.
CP-50284	9/16/2010	Modification issued to remove interim stabilization requirements and incorporate final corrective/remedial actions for Pantex and required monitoring and reporting of those actions.
HW-50284	5/30/2014	Hazardous waste permit renewal, with inclusion of the compliance plan into the permit. Minor changes to include corrective action observation wells and minor edits. Compliance plan requirements are included in Provision XI of HW-50284.

A Compliance Plan was issued in 2003 that defined the requirements for conducting corrective actions and groundwater monitoring associated with the defined interim stabilization measures (ISMs) and provided the operating requirements for ISMs that were in place for Pantex. The final corrective action/remedy has been approved through the Pantex Site-Wide Record of Decision (ROD) (Pantex and Sapere Consulting, 2008) and the final remedy was incorporated into CP-50284 effective September 16, 2010. The *Long-Term Monitoring System Design Report* (Pantex, 2009a) and *Sampling and Analysis Plan* (Pantex, 2009b) are approved through the Compliance Plan as the bases for monitoring and reporting of the remedies. The 2009 documents were updated and submitted in January 2014 (Pantex, 2014a and 2014b). The updated reports were approved by the TCEQ in March 2014 so those changes were fully implemented by July 2014. HW-50284 was renewed in May 2014 and included the compliance plan requirements from the September 2010 CP-50284 with minor changes.

HW-50284 Provision XI (compliance plan) requires reporting of information pertaining to effectiveness of the remedies, treatment of perched groundwater, contaminant data and plumes, and monitoring. Information on operation and maintenance of corrective action systems and components, new construction, condition and status of corrective actions/remedies, and recommendations for change is also required.

The IAG is a legally binding agreement between the USDOE, EPA, and the TCEQ to accomplish the cleanup of hazardous substances contamination at and from the Pantex Plant, pursuant to CERCLA, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), and Executive Order 12580, as amended by Executive Order 13016. The general purpose of the IAG is to:

1. Ensure that the environmental impacts associated with past and present activities at Pantex Plant have been analyzed, tested, and thoroughly evaluated, and appropriate remedial action is taken as necessary to protect the public health, welfare, and the environment.
2. Establish a procedural framework and schedule for developing, implementing, and monitoring appropriate response actions in accordance with CERCLA, the NCP, Superfund policy, RCRA, RCRA policy, and applicable, relevant, and appropriate environmental laws.
3. Facilitate continued cooperation, exchange of information and participation of the Parties (USDOE, EPA, and TCEQ) in such actions.

The IAG provides requirements for developing schedules, remedial design and remedial action implementation and reporting, record preservation, public participation, budget review, notification requirements, and periodic progress reports. Progress reports are required semi-annually and are combined with the Compliance Plan reports to fulfill the requirements of both RCRA and CERCLA.

Table 1-2 provides a detailed crosswalk of the Compliance Plan and IAG requirements to specific chapters or section of the annual or quarterly report where the requirements are fulfilled. The requirements are from CP Table VII and VIII of HW-50284. The specific Articles in the IAG that contain reporting requirements are listed in the table. Although not included in the crosswalk, other requirements in the ROD and final documents supporting the design of the Remedial Actions were also considered in the development of this report.

Table 1-2. Crosswalk of Regulatory Requirements to Quarterly and Annual Progress Reports

Item	Program	Reporting Frequency	Requirements	Location of Information in Progress Reports
Hazardous Waste Permit 50284 Requirements from CP Table VII:				
1.	All programs	Annual June 30	Each report shall be certified by a qualified engineer and/or geologist.	See certification page inside front cover of Quarterly and Annual Progress Reports.
2.	Corrective Action	Annual June 30	A table of all modifications and amendments made to this Compliance Plan with their corresponding approval dates by the executive director or the Commission and a brief description of each action;	Section 1.1, Table 1-1.
3.	Corrective Action	Annual June 30	A summary of any activity within an area subject to institutional control.	Section 2.3.2.
4.	Corrective Action	Annual June 30	Tabulation of well casing elevations in accordance with Attachment B;	Section 2.4.2.
5.	Corrective Action	Annual June 30	Certification and well installation diagram for any new well installation or replacement and certification for any well plugging and abandonment;	When applicable, certifications and diagrams are included as an appendix. See List of Appendices.
6.	Corrective Action	Annual June 30	Recommendation for any changes to the program;	Chapter 5.0 of annual report. Chapter 4.0 of quarterly reports.
7.	Corrective Action	Annual June 30	Any other items requested by the executive director;	Crosswalk of requirements to information contained in report. Section 1.1. Information will be added as requested.
8.	Corrective Action	Annual June 30	Water table maps shall be prepared from the groundwater data collected pursuant to Provision VII and shall be evaluated by the Permittee with regard to the following parameters: a. Development and maintenance of a cone of depression during operation of the system; b. Direction and gradient of groundwater flow; c. Effectiveness of hydrodynamic control of the contaminated zone during operation; and, d. Estimation of the rate and direction of groundwater contamination migration.	Sections 3.1.5, 3.1.7, and 3.2.

Item	Program	Reporting Frequency	Requirements	Location of Information in Progress Reports
9.	Corrective Action	Annual June 30	The Permittee shall submit a report to each recipient listed in Provision X.C, which includes the information in items 3 through 26 determined since the previously submitted report, if those items are applicable. If both Corrective Action and Compliance Monitoring [Reserved] Programs are authorized, then the June 30th report shall contain information required for both programs.	Reports submitted as required. See items 3 through 26 of this table for location of report information.
10.	Corrective Action	Annual June 30	The Corrective Action System(s) authorized under Provision II in operation during the reporting period and a narrative summary of the evaluations made in accordance with Provisions XI.E, XI.F, and XI.G of this Compliance Plan for the preceding reporting period. The reporting periods shall be annual, January 1 through December 31, for Corrective Action Monitoring, unless an alternative schedule is approved by the Commission. The period for Compliance Monitoring [Reserved] shall be based on the calendar year;	Chapter 2.0 Chapter 3.0 Chapter 4.0 Appendices containing extraction well flow information, data tables, data evaluation tables, expected condition evaluation, COC trending, and hydrographs.
11.	Corrective Action	Annual June 30	The method(s) utilized for management of recovered/purged groundwater shall be identified in accordance with Provision XIB.8. The Permittee shall maintain this list as part of the facility operating record and make it available for inspection upon request.	Section 2.5 and Appendix C

Item	Program	Reporting Frequency	Requirements	Location of Information in Progress Reports
12.	Corrective Action	Annual June 30	An updated table and map of all monitoring and corrective action system wells. The wells to be sampled shall be those wells proposed in the Compliance Plan Application referenced in Provision XI.A.7. and any changes subsequently approved by the executive director pursuant to Provision XI.B.3. Provide in chronological order, a list of those wells which have been added to, or deleted from, the groundwater monitoring and remediation systems since original issuance of the Compliance Plan. Include the date of the Commission's approval for each entry;	Section 1.4.
13.	Corrective Action	Annual June 30	The results of the chemical analyses, submitted in a tabulated format acceptable to the executive director which clearly indicates each parameter that exceeds the GWPS. Copies of the original laboratory report for chemical analyses showing detection limits and quality control and quality assurance data shall be provided if requested by the executive director;	See List of Appendices for data evaluation tables and electronic data. A summary of the POC/POE well detections above GWPS is included in Section 3.5.
14.	Corrective Action	Annual June 30	Tabulation of all water level elevations required in Provision XI.F.3.d.1 depth to water measurements, and total depth of well measurements collected since the data that was submitted in the previous monitoring report;	Section 2.4 and Appendix C. Appendix containing electronic data tables.
15.	Corrective Action	Annual June 30	Potentiometric surface maps showing the elevation of the water table at the time of sampling, delineation of the radius of influence of the Corrective Action System, and the direction of groundwater flow gradients outside any radius of influence;	Section 3.1.
16.	Corrective Action	Annual June 30	Tabulation of all data evaluation results pursuant to Provision XI.F.4 and status of each well with regard to compliance with the Corrective Action objectives and compliance with the GWPS;	These evaluations are summarized in Section 3.4 and 3.5. See List of Appendices for complete electronic data tables and expected conditions evaluation.
17.	Corrective Action	Annual June 30	An updated summary as required by CP Table VIII;	Chapters 1.0 through 4.0.

Item	Program	Reporting Frequency	Requirements	Location of Information in Progress Reports
18.	Corrective Action	Annual June 30	Summary of any changes made to the monitoring/ corrective action program and a summary of well inspections, repairs, and any operational difficulties;	Chapters 2.0 and 5.0 and Appendix C.
19.	Corrective Action	Annual June 30	A notation of the presence or absence of NAPLs, both light and dense phases, in each well during each sampling event since the last event covered in the previous monitoring report and tabulation of depth and thickness of NAPLs, if detected;	Section 3.4.
20.	Corrective Action only	Annual June 30 Quarterly 90 days after end of quarter	Quarterly tabulations of quantities of recovered groundwater and NAPLs, and graphs of monthly recorded flow rates versus time for the Recovery Wells during each reporting period. A narrative summary describing and evaluating the NAPL recovery program shall also be submitted;	Annual Report: Section 2.1 and see List of Appendices for detailed extraction well flow information. See Section 2.3.1 for soil vapor extraction of residual NAPLs in soils at the Burning Ground. Quarterly Report: Section 2.1 and 2.3.
21.	Corrective Action only	Annual June 30 Quarterly 90 days after end of quarter	Tabulation of the total contaminant mass recovered from each recovery system for each reporting period;	Annual Report: Section 2.1. Quarterly Report: Section 2.1.
22.	Corrective Action only	Annual June 30	Maps of the contaminated area where GWPSs are exceeded depicting concentrations of CP Table IIIA constituents and any newly detected CP Table III constituents as isopleth contours or discrete concentrations if isopleth contours cannot be inferred. Areas where concentrations of constituents exceed the GWPS should be clearly delineated. Depict the boundary of the plume management zone (PMZ), if applicable;	Section 3.1.6.
23.	Corrective Action only	Annual June 30	Maps and tables indicating the extent and thickness of the NAPLs both light and dense phases, if detected;	No detected NAPLs in groundwater.

Item	Program	Reporting Frequency	Requirements	Location of Information in Progress Reports
24.	Corrective Action only	Quarterly 90 days after end of quarter	Corrective Measures Implementation (CMI) Progress Report or Response Action Effectiveness Report or Response Action Completion Report to be submitted as a section of the Compliance Plan report in accordance with Provision XI.H.6, if necessary. The Permittee will include a narrative summary of the status of the approved final corrective measures conducted in accordance with the approved CMI Workplan or Response Action Plan (RAP), and that the requirements of Provision XI.H.7 are being met. The report shall include the following information: a. Information required for Item 20 of this table. b. Information required for Item 21 of this table. c. Trend charts of target COCs and degradation products at downgradient performance monitoring locations for the in-situ bioremediation systems. d. Summary of unexpected conditions, if found, at monitoring wells.	Annual Report: a. Section 2.1 and see List of Appendices for detailed extraction well flow information. See Section 2.3.1 for soil vapor extraction of residual NAPLs in soils at the Burning Ground. b. Section 2.1 c. See List of Appendices for COC concentration trends. Information is summarized in Section 3.2.3 of this report. d. Section 3.4. Quarterly Report: a. Section 2.1 and 2.3. b. Section 2.1. c. See Appendix A. d. Section 3.0 and 4.0.
25.	Corrective Action only	Annual June 30	The Permittee will include a narrative summary of the status of each Solid Waste Management Unit (SWMU) and/or Area of Concern (AOC) subject to the requirements of Provision XI.H and ICMs Program for a SWMU and/or AOC which documents that the objectives of Provision XI.H.8.b are being achieved. This summary shall be included as a section of the Compliance Plan annual report.	No units at Pantex are subject the ICM requirements in Provision VIII.
26.	Corrective Action only	5-Year Review	Conduct five-year review to be consistent with CERCLA §121(c) and the NCP (40 CFR Part 300.430(f)(4)(ii)). The five-year review will be conducted to evaluate the need to adjust corrective actions and associated monitoring.	The five-year review was conducted in 2012 with a Final Report approved in 2013. A summary of the major conclusions and recommendations from the Five-Year Review is included in Chapter 5 of the 2013 Annual Progress Report. A summary of complete and outstanding action items are included in Chapter 5 of this report.

Item	Program	Reporting Frequency	Requirements	Location of Information in Progress Reports
Hazardous Waste Permit 50284 CP Table VIII				
A	Corrective Action	Annually	Submit to the Executive Director a schedule summarizing all activities required by the Compliance Plan in the annual progress report. The schedule shall list the starting dates of all routine activities. The permittee shall include an updated schedule in the annual groundwater monitoring report required by Provision XI.G.3. The schedule shall list the activity or report, the Compliance Plan Section which requires the activity or report and the calendar date the activity or report is to be completed or submitted (if this date can be determined).	Section 1.5 of the annual report contains the Schedule of Activities completed since the last annual report, work in progress, and upcoming activities that are scheduled for the next year. The quarterly report provides a listing of activities completed, in progress, or upcoming in Section 5.0.
IAG Progress Report Requirements:				
16.4.	Remedial Action	Quarterly Annual	All results of sampling or other monitoring results obtained during the previous quarter.	Chapter 3.0 of quarterly report summarizes the quarterly data. Annual Report: These data are summarized in Section 3.4 and 3.5. See List of Appendices for complete electronic data tables and expected conditions evaluation.
16.4	Remedial Action	Annual and Quarterly	Describe the actions which DOE has taken during the previous quarter to implement the requirements of this Agreement.	Section 1.5 provides a schedule of activities.
16.4	Remedial Action	Annual	Include a detailed statement of how the requirements and time schedules set out in the attachments to this Agreement are being met, identify any anticipated delays in meeting time schedules, including the reason(s) for each delay and actions taken to prevent or mitigate the delay, and identify any potential problems that may result in a departure from the requirements and time schedules.	Section 1.5.

1.2 Remedial Action Background

Pantex has implemented soil and groundwater remedial actions to mitigate contamination that resulted from historical waste management practices.

1.2.1 Soil Remedial Actions

In accordance with RCRA and CERCLA, Pantex and regulatory agencies identified 254 units at the Pantex Plant for further investigation and cleanup. Investigations that identified the nature and extent of contamination at solid waste management units and associated groundwater were submitted to the TCEQ and EPA in the form of RCRA Facility Investigation Reports. Those investigation reports closed many units through interim remedial actions and no further controls other than deed recordation are necessary for those units. Other units were evaluated in human health and ecological risk assessments to identify units that required further remedial actions to protect human health and the environment. Figure 1-3 depicts the location and status of the 254 units. The 16 units still in active use will be closed in accordance with CERCLA and RCRA permit provisions when they become inactive and are determined to be of no further use. A detailed summary of actions for the 254 units can be found in the ROD (Pantex and Sapere Consulting, 2008).

Those units requiring further remedial actions were then assessed in a corrective measures study to identify and recommend final remedial actions. The final approved remedial actions are detailed in the ROD. A detailed status table of the SWMUs is included in Appendix A of this report.

Soil remedial actions focus on:

- Cleanup of soil gas and NAPL in soil at the Burning Ground for future protection of groundwater resources,
- Institutional controls to protect workers,
- Fencing to prevent traffic and control access to Firing Site 5 (FS-5), and
- Maintenance of soil remedies (ditch liner and soil covers) for future protection of groundwater resources.

Soil Remedial Actions

Ditch Liner

Soil Covers on Landfills

Institutional Controls

Soil Vapor Extraction System

Fencing

In addition to the remedial actions, Pantex has deed recorded all soil units where contamination was identified. Those areas are restricted to industrial use to ensure future use of the area is in agreement with cleanup assumptions.

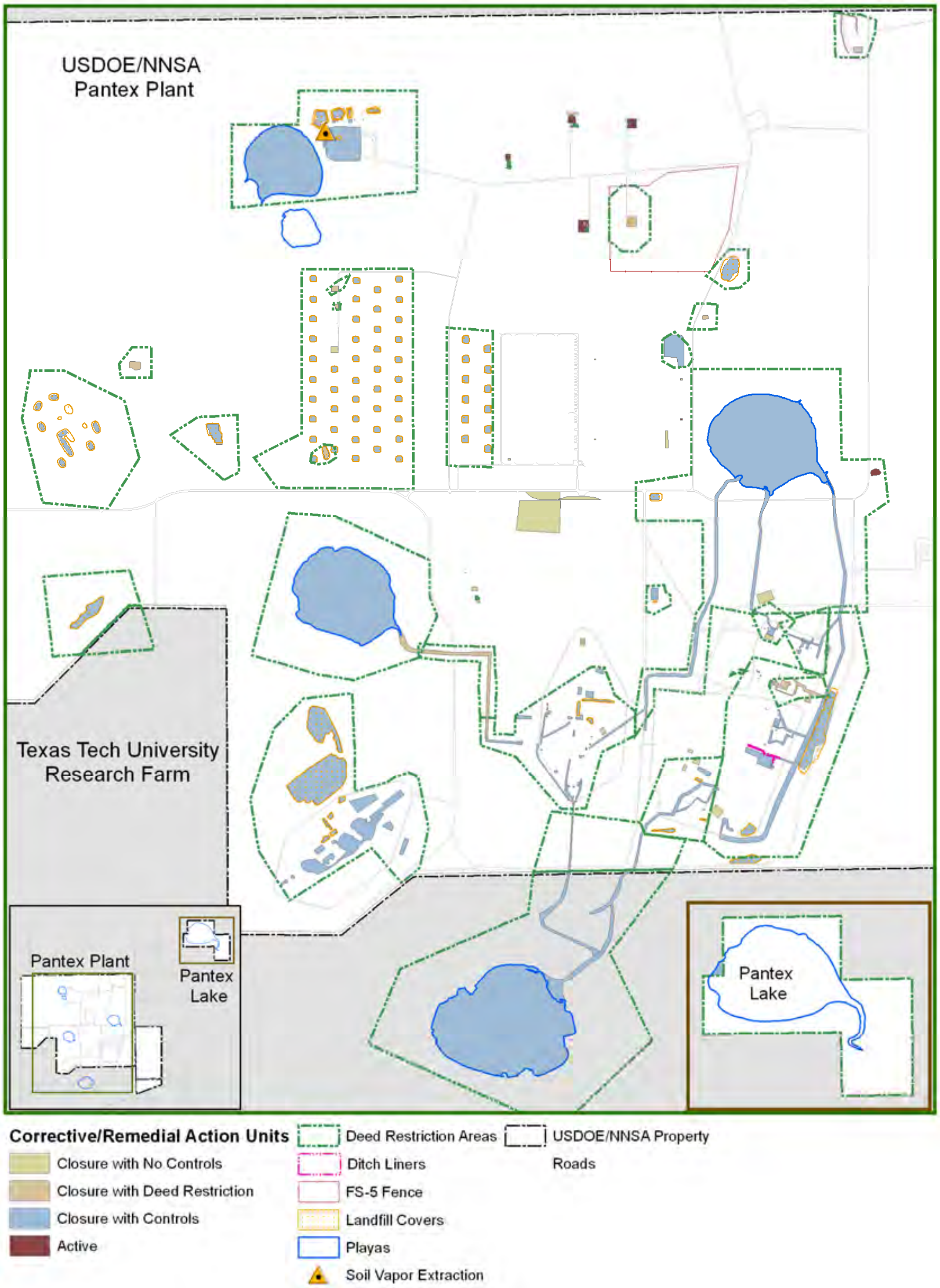

Figure 1-3. Status of Corrective/Remedial Action Units

1.2.2 Groundwater Remedial Actions

In accordance with the IAG and HW-50284, Pantex has implemented remedial actions to remediate the contaminated perched groundwater. Two types of active remediation systems (see Figure 1-4) were installed to address the contamination: pump and treat systems and in situ bioremediation (ISB) systems. Institutional controls are also part of the final remedy for groundwater.

Groundwater remedial actions focus on:

- Cleanup of perched aquifer to the GWPS,
- Reduction of perched water levels to protect the underlying drinking water aquifer and to prevent growth of plumes; and
- Institutional controls to restrict perched groundwater use without treatment and to control drilling into and through the perched aquifer to prevent cross contamination.

Groundwater Remedial Actions

Pump & Treat Systems

- Playa 1 Pump and Treat
- Southeast Pump and Treat

In situ Bioremediation Systems

- Zone 11 ISB
- Southeast ISB

Institutional Controls

The pump and treat systems were installed to address contamination in areas where there is generally greater than 15 ft of saturation in the perched aquifer. These systems are designed to remove and treat perched groundwater to achieve contaminant mass reduction and reduction in the saturated thickness of the perched aquifer. Reduction in saturated thickness should significantly reduce the migration of contaminants both vertically and horizontally so that natural breakdown processes can occur over time.

Pantex has installed in situ bioremediation systems to reduce the concentration of contaminants as they migrate through the remediation zone in targeted areas of the groundwater plumes.

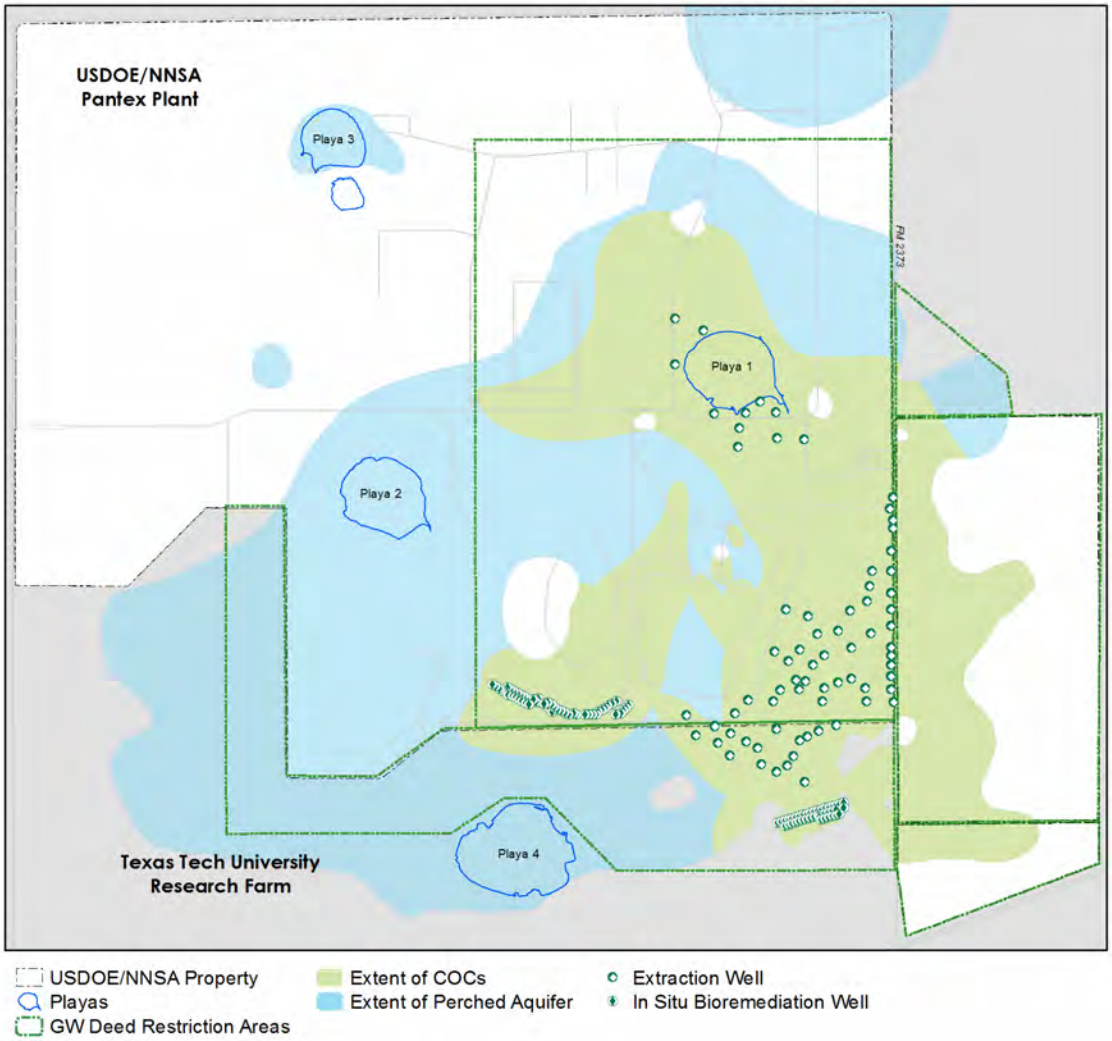

Figure 1-4. Groundwater Remedial Actions

1.3 Purpose and Objectives

This report satisfies requirements in the IAG and HW-50284 to provide information on the remedial system performance and components. The focus for this report is the data and information collected for the soil and groundwater remedies during the previous year. The objective is to provide a more detailed account of the remedies than the quarterly reports.

The only active soil remedy is the Burning Ground SVE system. This report provides information on its operation, mass removal, and effluent readings during 2015. This report also provides information on the inspection and maintenance of the ditch liner, soil covers, and fencing that are part of the remedial action. In addition, information on site control in accordance with institutional controls and deed restrictions is provided.

Groundwater Remedial Action Evaluation Criteria

- Plume Stability
- Remedial Action Effectiveness
- Uncertainty Management
- Early Detection
- Natural Attenuation of COCs

This progress report provides information for the maintenance and operation of the groundwater remediation systems and components. Data are evaluated according to criteria outlined in the *Update to the Long-Term Monitoring System Design Report* (Pantex, 2014a). Those criteria are included in the highlight box and are detailed in the appropriate sections of this report.

This report is organized to present detailed information in a summary form in the main report along with appropriate supporting detail to provide an understanding of the conclusions of the report. Detailed information such as statistical trending of concentrations and water levels at each well, electronic data, SWMU status, and data usability review is included in the appendices.

1.4 Long-Term Monitoring of Remedial Actions

Pantex has developed a long-term monitoring network to evaluate the effectiveness of the remedial actions, ensure that remedial action objectives (from the ROD) are achieved, and to confirm expected future conditions within the perched aquifer and the Ogallala Aquifer. The long-term monitoring design and evaluation criteria are provided in the *Update to the Long-Term Monitoring System Design Report* (Pantex, 2014a). The final system design was incorporated into the compliance plan when it was issued. The design was further detailed in in the compliance plan to include point of exposure and point of compliance wells where the GWPS is required to be met.

1.4.1 Perched Aquifer Long-Term Monitoring Network

The final perched aquifer LTM network is divided into four areas defined by indicator COC monitoring lists for wells in each area. The network consists of:

- 121 perched wells – 20 of those wells are monitored for continued dry or limited water conditions, with 86 sampled for indicator COCs and other applicable analytes including natural attenuation products, corrosion indicators, and general water quality indicators, and 15 are monitored as in situ performance monitoring (ISPM) wells for the ISB systems. The ISPM wells are monitored for COCs, degradation products, and ISB treatment zone parameters. All 121 perched LTM wells and 42 additional wells not included in the LTM network have water levels measured semi-annually. It is anticipated that more wells within the influence of the pump and treat systems will go dry as the systems continue to remove water from the perched aquifer.

- 48 wells are sampled semi-annually, 31 wells annually, 15 wells quarterly, and 7 wells are sampled every five years.
- 42 of the sampled wells are sampled every five years using a modified 40 CFR Part 264 Appendix IX groundwater list to satisfy uncertainty management requirements. The five-year sampling started in 2016 (Figure 1-5).
- Four indicator areas were defined for the perched groundwater. COCs to be monitored are defined for each of those areas.
- By October 2014, Pantex expanded the Zone 11 ISB to the northwest of the current system. As included in the long-term monitoring, the expansion included 3 new downgradient ISPM wells. Baseline sampling was conducted at these wells in early 2016. Quarterly sampling will commence in 2017.

Table 1-3 lists all wells in the perched LTM network and HW-50284, their LTM objective, indicator monitoring area, Compliance Plan objective (point of compliance/point of exposure [POC/POE] well), date of inclusion or removal from HW-50284, and coordinates. The wells are listed in chronological order according to the date of inclusion in HW-50284, in accordance with CP Table VII requirements. Figure 1-5 depicts the current active LTM wells listed in Table 1-3.

Table 1-3. Perched LTM Network and ISM Compliance Plan Wells

Well ID	Indicator Area	ISM Well[1]	LTM Well[2]	CP Approval Date	CP Removal Date	Well Status	LTM Objectives	POC/ POE	Northing	Easting
PTX-BEG3		Y	N	6/9/2003	9/16/2010	Inactive			3773380.09	643702.32
PTX01-1008	Burning Ground	Y	Y	6/9/2003		Active	UM	POC	3770782.89	629942.97
PTX01-1001	Burning Ground	Y	Y	6/9/2003		Active	UM	POC	3769641.90	630592.95
PTX01-1002	Burning Ground	Y	Y	6/9/2003		Active	UM		3769596.99	628496.92
PTX06-1012	ISPM Zone 11	Y	Y	6/9/2003		Active	PS, RA		3755068.80	634640.91
PTX04-1002	Miscellaneous	Y	Y	6/9/2003		Active	UM		3772165.27	641818.01
PTX06-1080	Miscellaneous	Y	Y	6/9/2003		Active	UM		3772643.95	638901.00
PTX06-1081	Miscellaneous	Y	Y	6/9/2003		Active	UM		3770912.33	641222.41
PTX08-1010	Miscellaneous	Y	Y	6/9/2003		Active	UM		3773206.74	641401.47
PTX06-1048A	North	Y	Y	6/9/2003		Active	PS, RA		3766957.63	642103.43
PTX06-1015	Southeast	Y	Y	6/9/2003		Active	RA		3753617.00	643765.00
PTX06-1023	Southeast	Y	Y	6/9/2003		Active	RA	POC	3764603.10	642773.84
PTX06-1030	Southeast	Y	Y	6/9/2003		Active	RA		3755008.03	644670.42
PTX06-1R01	Southeast	Y	Y	6/9/2003		Active	RA	POC	3753348.03	644674.92
PTX06-1034	Southeast	Y	Y	6/9/2003		Active	RA	POC	3752434.98	646555.62
PTX06-1036	Southeast	Y	Y	6/9/2003		Active	PS		3752455.56	638615.43
PTX06-1038	Southeast	Y	Y	6/9/2003		Active	RA		3760426.35	643802.04
PTX06-1040	Southeast	Y	Y	6/9/2003		Active	RA		3758262.93	643811.23
PTX06-1042	Southeast	Y	Y	6/9/2003		Active	RA	POC	3755779.88	643812.20
PTX06-1046	Southeast	Y	Y	6/9/2003		Active	RA	POC	3752292.55	643802.63
PTX06-1052	Southeast	Y	Y	6/9/2003		Active	RA	POC	3753957.66	639100.91
PTX06-1069	Southeast	Y	Y	6/9/2003		Active	PS		3762879.60	646317.00
PTX06-1053	Southeast, Zone 11	Y	Y	6/9/2003		Active	PS, UM		3753672.06	636576.74
PTX08-1008	Southeast, Zone 11	Y	Y	6/9/2003		Active	UM, RA		3755695.51	637485.10
PTX06-1035	Zone 11	Y	Y	6/9/2003		Active	PS		3755092.64	633027.45
PTX10-1014	Southeast, Zone 11	N	Y	8/26/2010		Active	UM		3759769.72	639701.73
PTX01-1004	Burning Ground	N	Y	9/16/2010		Dry	PS		3770768.71	630729.82

Well ID	Indicator Area	ISM Well[1]	LTM Well[2]	CP Approval Date	CP Removal Date	Well Status	LTM Objectives	POC/ POE	Northing	Easting
PTX01-1009	Burning Ground	N	Y	9/16/2010		Dry	PS		3769018.50	630594.67
PTX06-1037	ISPM Southeast	N	Y	9/16/2010		Active	RA		3752194.06	641549.25
PTX06-1045	ISPM Southeast	N	Y	9/16/2010		Dry	RA	POC	3752300.00	642697.65
PTX06-1118	ISPM Southeast	N	Y	9/16/2010		Dry	RA		3752736.07	641644.92
PTX06-1123	ISPM Southeast	N	Y	9/16/2010		Active	RA		3752319.94	642051.96
PTX06-1153	ISPM Southeast	N	Y	9/16/2010		Active	RA	POC	3752089.44	641184.13
PTX06-1154	ISPM Southeast	N	Y	9/16/2010		Active	RA	POC	3752278.90	641870.52
PTX06-1155	ISPM Zone 11	N	Y	9/16/2010		Active	RA	POC	3755215.62	634603.74
PTX06-1156	ISPM Zone 11	N	Y	9/16/2010		Active	RA	POC	3755076.47	636378.92
PTX04-1001	Miscellaneous	N	Y	9/16/2010		Active	UM		3772334.66	641458.10
PTX06-1049	Miscellaneous	N	Y	9/16/2010		Active	PS, UM		3763376.96	633343.53
PTX06-1055	Miscellaneous	N	Y	9/16/2010		Dry	PS		3767254.87	633521.90
PTX06-1071	Miscellaneous	N	Y	9/16/2010		Active	UM		3773219.43	642601.46
PTX06-1082	Miscellaneous	N	Y	9/16/2010		Active	UM		3780321.59	653856.27
PTX06-1083	Miscellaneous	N	Y	9/16/2010		Active	UM		3779777.76	658643.46
PTX06-1085	Miscellaneous	N	Y	9/16/2010		Active	UM		3760418.31	629059.82
PTX06-1086	Miscellaneous	N	Y	9/16/2010		Active	UM		3759843.32	631411.81
PTX06-1096A	Miscellaneous	N	Y	9/16/2010		Dry	PS, UM		3766548.35	630823.57
PTX06-1097	Miscellaneous	N	Y	9/16/2010		Dry	PS, UM		3765068.63	633104.35
PTX06-1131	Miscellaneous	N	Y	9/16/2010		Active	UM		3754232.91	629371.68
PTX07-1Q01	Miscellaneous	N	Y	9/16/2010		Active	UM		3755836.12	629274.83
PTX07-1Q02	Miscellaneous	N	Y	9/16/2010		Active	UM		3756408.66	628876.97
PTX07-1Q03	Miscellaneous	N	Y	9/16/2010		Active	UM		3757408.87	630542.61
PTX07-1R03	Miscellaneous	N	Y	9/16/2010		Active	UM		3764501.80	627664.39
OW-WR-38	North	N	Y	9/16/2010		Active	UM, RA		3765214.16	640649.01
PTX06-1050	North	N	Y	9/16/2010		Active	UM, RA	POC	3766622.06	636746.04
PTX06-1136	North	N	Y	9/16/2010		Active	PS		3766771.76	634860.83
PTX07-1O01	North	N	Y	9/16/2010		Active	PS, UM, RA		3767695.22	638532.53

Well ID	Indicator Area	ISM Well[1]	LTM Well[2]	CP Approval Date	CP Removal Date	Well Status	LTM Objectives	POC/ POE	Northing	Easting
PTX07-1O02	North	N	Y	9/16/2010		Active	PS, UM, RA	POC	3768117.46	639106.56
PTX07-1O03	North	N	Y	9/16/2010		Active	PS, UM, RA		3767462.56	639046.64
PTX07-1O06	North	N	Y	9/16/2010		Active	PS, UM, RA		3768536.81	638814.40
PTX06-1002A	Southeast	N	Y	9/16/2010		Active	UM, RA		3759984.00	641161.56
PTX06-1003	Southeast	N	Y	9/16/2010		Active	UM, RA		3758711.05	641498.93
PTX06-1005	Southeast	N	Y	9/16/2010		Active	UM, RA		3756139.87	640545.44
PTX06-1010	Southeast	N	Y	9/16/2010		Active	UM		3758067.00	639886.62
PTX06-1013	Southeast	N	Y	9/16/2010		Active	RA		3764075.09	643710.38
PTX06-1014	Southeast	Y	Y	9/16/2010		Active	RA		3755125.71	643758.88
PTX06-1039A	Southeast	N	Y	9/16/2010		Active	RA		3759272.56	643807.47
PTX06-1041	Southeast	N	Y	9/16/2010		Active	RA		3757622.78	643803.61
PTX06-1047A	Southeast	N	Y	9/16/2010		Active	RA		3752004.39	643817.46
PTX06-1051	Southeast	N	Y	9/16/2010		Dry	PS		3752279.10	640332.91
PTX06-1088	Southeast	N	Y	9/16/2010		Active	UM, RA		3757059.42	639902.10
PTX06-1089	Southeast	N	Y	9/16/2010		Dry	PS		3760258.95	646637.32
PTX06-1090	Southeast	N	Y	9/16/2010		Dry	PS		3757684.39	647727.51
PTX06-1091	Southeast	N	Y	9/16/2010		Dry	PS		3756363.40	646554.01
PTX06-1093	Southeast	N	Y	9/16/2010		Dry	PS		3759922.32	645529.01
PTX06-1094	Southeast	N	Y	9/16/2010		Dry	PS		3751494.55	643813.77
PTX06-1095A	Southeast	N	Y	9/16/2010		Active	UM, RA		3755598.65	640634.87
PTX06-1098	Southeast	N	Y	9/16/2010		Active	RA		3753628.43	640266.14
PTX06-1100	Southeast	N	Y	9/16/2010		Active	RA		3753579.52	640285.97
PTX06-1101	Southeast	N	Y	9/16/2010		Active	RA		3753437.09	640383.57
PTX06-1102	Southeast	N	Y	9/16/2010		Active	RA		3754532.94	642751.09
PTX06-1103	Southeast	N	Y	9/16/2010		Dry	RA	POC	3752963.37	641222.64
PTX06-1119	Southeast	N	Y	9/16/2010		Dry	PS		3752739.01	642646.10
PTX06-1120	Southeast	N	Y	9/16/2010		Active	PS		3752735.03	643152.43
PTX06-1121	Southeast	N	Y	9/16/2010		Active	PS		3752750.09	643645.57

Well ID	Indicator Area	ISM Well[1]	LTM Well[2]	CP Approval Date	CP Removal Date	Well Status	LTM Objectives	POC/ POE	Northing	Easting
PTX06-1122	Southeast	N	Y	9/16/2010		Dry	PS		3752308.74	640677.35
PTX06-1124	Southeast	N	Y	9/16/2010		Dry	PS		3752327.45	642877.91
PTX06-1125	Southeast	N	Y	9/16/2010		Dry	PS		3752331.14	643377.53
PTX06-1130	Southeast	N	Y	9/16/2010		Active	RA	POC	3759745.02	644270.36
PTX06-1133A	Southeast	N	Y	9/16/2010		Active	PS		3751315.73	645287.37
PTX06-1135	Southeast	N	Y	9/16/2010		Active	PS		3753631.93	638343.76
PTX06-1146	Southeast	N	Y	9/16/2010		Active	PS	POC	3757691.87	645978.91
PTX06-1147	Southeast	N	Y	9/16/2010		Active	PS		3753953.21	645431.85
PTX08-1002	Southeast	N	Y	9/16/2010		Active	UM, RA		3763003.22	640859.00
PTX08-1009	Southeast	N	Y	9/16/2010		Active	UM, RA		3755275.01	638866.95
PTX06-1008	Southeast, Zone 11	N	Y	9/16/2010		Active	UM		3759325.25	639441.93
PTX06-1011	Southeast, Zone 11	N	Y	9/16/2010		Active	UM		3757219.75	639178.93
PTX08-1007	Southeast, Zone 11	N	Y	9/16/2010		Active	UM		3758440.46	638900.04
1114-MW4	Zone 11	N	Y	9/16/2010		Active	UM		3757809.40	636151.93
PTX06-1006	Zone 11	N	Y	9/16/2010		Active	PS		3757599.75	637450.19
PTX06-1007	Zone 11	N	Y	9/16/2010		Active	UM		3759513.00	637679.37
PTX06-1073A	Zone 11	N	Y	9/16/2010		Dry	PS		3758072.00	634963.34
PTX06-1077A	Zone 11	N	Y	9/16/2010		Active	UM		3760689.50	637201.80
PTX06-1126	Zone 11	N	Y	9/16/2010		Active	PS, UM	POC	3755562.85	635034.72
PTX06-1127	Zone 11	N	Y	9/16/2010		Active	PS, UM	POC	3755432.03	635901.90
PTX06-1134	Zone 11	N	Y	9/16/2010		Active	PS		3754409.17	633520.06
PTX06-1148	Zone 11	N	Y	9/16/2010		Active	PS, RA		3754719.67	636467.02
PTX06-1149	Zone 11	N	Y	9/16/2010		Active	PS		3754717.64	635864.13
PTX06-1150	Zone 11	N	Y	9/16/2010		Active	PS, RA		3754718.24	635233.98
PTX06-1151	Zone 11	N	Y	9/16/2010		Active	PS		3756123.62	633935.95
PTX07-1P02	Zone 11	N	Y	9/16/2010		Active	UM	POC	3763019.08	637817.70
PTX07-1P05	Zone 11	N	Y	9/16/2010		Active	UM		3762886.83	637136.13
PTX08-1001	Zone 11	N	Y	9/16/2010		Active	UM, RA		3762976.26	638941.45

Well ID	Indicator Area	ISM Well[1]	LTM Well[2]	CP Approval Date	CP Removal Date	Well Status	LTM Objectives	POC/ POE	Northing	Easting
PTX08-1003	Zone 11	N	Y	9/16/2010		Active	PS		3760136.56	635385.36
PTX08-1005	Zone 11	N	Y	9/16/2010		Active	UM		3756346.19	635316.66
PTX08-1006	Zone 11	N	Y	9/16/2010		Active	UM		3756761.86	636400.41
PTX06-1167[3]	Southeast	N	Y	7/28/2013		Active	RA		3752653.00	640913.72
PTX06-1158	Zone 11	N	Y	5/30/2014		Active	PS		3752025.93	648137.99
PTX06-1159	Zone 11	N	Y	5/30/2014		Active	PS, RA		3754843.46	634015.04
PTX06-1160	Zone 11	N	Y	5/30/2014		Active	PS		3756274.13	632835.73
PTX06-1166	Southeast	N	Y	5/30/2014		Active	PS		3752799.74	639750.35
PTX06-1173[4]	Zone 11	N	Y	11/17/2015		Active	RA		3755312.40	634197.62
PTX06-1174[4]	Zone 11	N	Y	11/17/2015		Active	RA		3755489.15	633904.63
PTX06-1175[4]	Zone 11	N	Y	11/17/2015		Active	RA		3755651.06	633416.97

POC – point of compliance POE – point of exposure

PS – plume stability RA – Remedial Action effectiveness UM – uncertainty management

Wells with no designation in the POC/POE column are considered as observation wells. These wells are not listed in HW-50284 Table V, so the corresponding date of HW-50284 approval corresponds to either the date of inclusion in a compliance plan modification or approval letter date for the corresponding progress report where the recommendation was made to include the well in the monitoring network.

[1]ISM – interim stabilization monitoring (from CP-50284 issued 10/21/2003) – most of these wells were retained in the Corrective Action Compliance Plan issued in 2010.

[2]LTM –long-term monitoring from CP-50284 issued 9/16/2010 which included the final Corrective Actions and long-term monitoring for the Actions.

[3]Well was recommended for inclusion in the network in the *2012 Annual Progress Report* (Pantex, June 2013).

[4]These wells were recommended for inclusion in the network in the *2014 Annual Progress Report* (Pantex, 2015). Report approval letter from TCEQ was dated November 17, 2015.

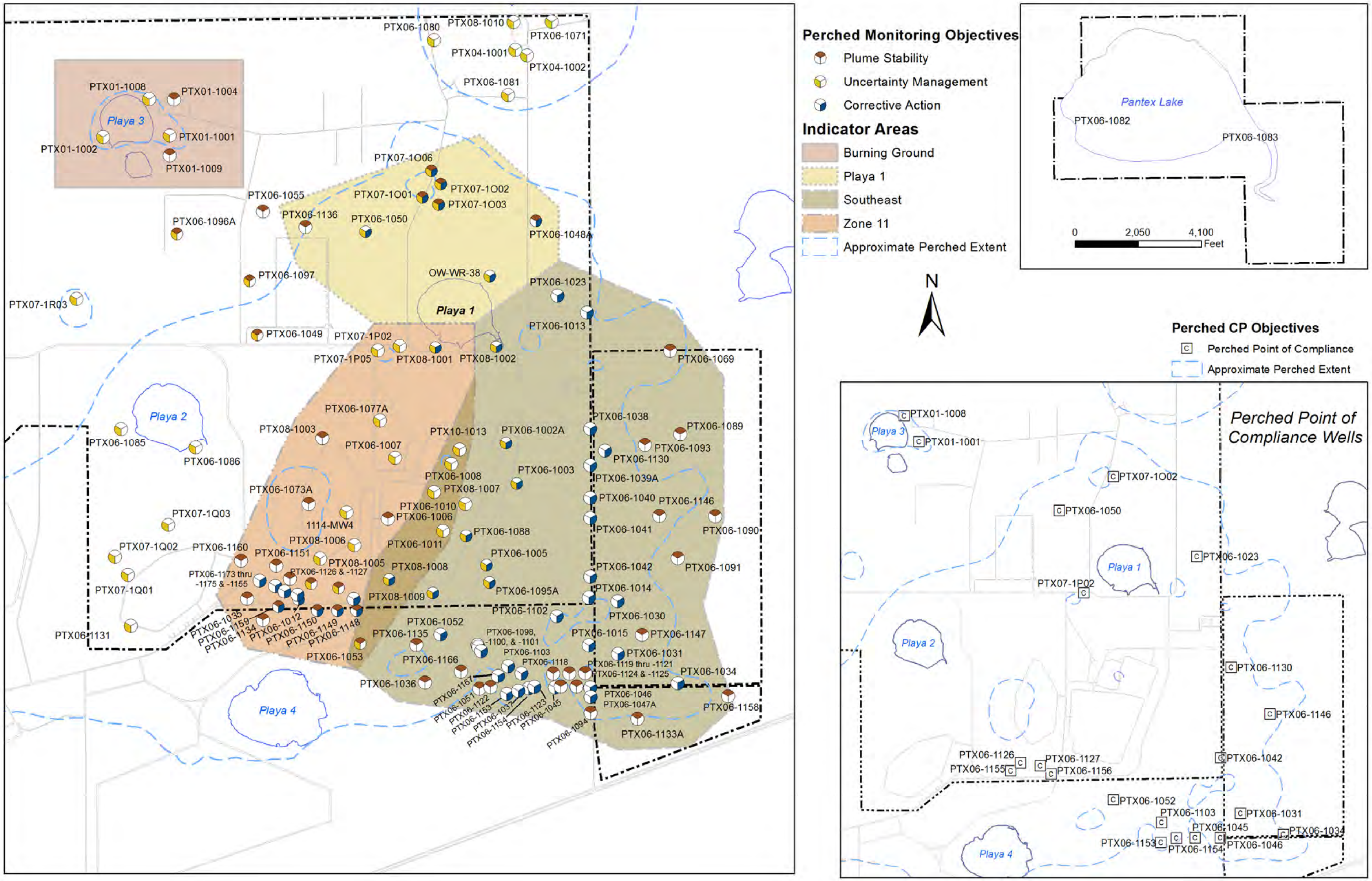

Figure 1-5. Perched LTM Network and Compliance Plan Wells

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1.4.2 Ogallala Aquifer Long-Term Monitoring Network

The final Ogallala Aquifer LTM network consists of:

- 26 LTM wells are monitored for indicator COCs and water levels. An additional well is used for monitoring water levels in the Ogallala Aquifer.
- 23 wells are sampled semi-annually and 3 are sampled annually.
- Seven (7) wells are sampled at multiple levels every five years. The baseline multi-level sampling was conducted after the wells were installed. All other multi-level sampling will be conducted for future five-year reviews. The next 5-year sampling started in 2016. PTX06-1137A was installed with two sampling intervals; however, water levels dropped below the first interval so the well is now only sampled in the deeper interval.
- Ten (10) wells are sampled every five years using a modified 40 CFR Part 264 Appendix IX groundwater list to satisfy uncertainty management requirements. That sampling started in 2016.
- Two (2) indicator areas were defined for the Ogallala wells and indicator COC monitoring lists were developed for each of those areas.
- Four (4) additional monitoring wells along the southern and western boundaries are monitored annually to evaluate the quality of groundwater upgradient of the Plant.

Table 1-4 lists all wells in the LTM network and HW-50284, with the corresponding LTM objective, indicator monitoring area, CP objective (POC/POE well), date of inclusion or removal from HW-50284, and coordinates. Figure 1-6 depicts the current active monitor wells listed in Table 1-4, as well as the additional four wells monitored along the southern and western boundaries. The wells are listed in chronological order according to the date of inclusion in HW-50284, in accordance with CP Table VII requirements.

Table 1-4. Ogallala Aquifer LTM and Compliance Plan Wells

Well ID	Indicator Area	ISM Well[1]	LTM Well[2]	CP Approval Date	CP Removal Date	Current Status	LTM Objectives	POC/ POE	Multi-Level Well	Easting	Northing
PTX01-1010	Northwest	Y	Y	6/9/2003		Active	ED, UM	POC		630576.88	3771397.26
PTX01-1011	Northwest	Y	Y	6/9/2003		Active	ED, UM			629986.45	3771397.29
PTX01-1012	Northwest	Y	Y	6/9/2003		Active	ED, UM	POE		632664.21	3773264.13
PTX01-1013	Northwest	Y	Y	6/9/2003		Active	UM	POE		628976.89	3773218.25
PTX06-1033	Southeast/Northwest	Y	Y	6/9/2003		Active	ED, UM			642614.48	3759581.41
PTX06-1044	Southeast/Northwest	Y	Y	6/9/2003		Active	ED, UM			642706.18	3764538.54
PTX06-1054		N	N	6/9/2003	8/11/2004	P&A					
PTX06-1056	Southeast	Y	Y	6/9/2003		Active	ED, UM	POC		643767.03	3754642.87
PTX06-1057A	Northwest	Y	Y	6/9/2003		Active	UM			629630.04	3768142.23
PTX06-1058	Northwest	Y	Y	6/9/2003		Active	UM			624894.00	3759747.11
PTX06-1059[3]		Y	N	6/9/2003	9/16/2010	Active				628129.98	3760459.31
PTX06-1061	Northwest	Y	Y	6/9/2003		Active	UM			625651.61	3773186.59
PTX06-1062A	Northwest	Y	Y	6/9/2003		Active	ED, UM			633017.18	3771685.22
PTX06-1063A[4]		Y	N	6/9/2003	9/16/2010	Unknown				639265.11	3775502.62
PTX06-1064	Northwest	Y	Y	6/9/2003		Active	UM	POE		635900.45	3773557.90
PTX06-1065		Y	N	6/9/2003	9/16/2010	P&A				633197.45	3775896.50
PTX06-1066		Y	N	6/9/2003	9/16/2010	P&A				632838.71	3773430.45
PTX06-1067		Y	N	6/9/2003	9/16/2010	P&A				622714.85	3773696.89
PTX06-1068	Northwest	Y	Y	6/9/2003		Active	ED, UM	POE		643403.70	3773360.30
PTX06-1074[3]		Y	N	6/9/2003	9/16/2010	Active				620994.02	3765626.52
PTX06-1075[3]		Y	N	6/9/2003	9/16/2010	Active				630512.54	3753624.01
PTX06-1076	Southeast/Northwest	Y	Y	6/9/2003		Active	ED, UM			637327.32	3752978.41
PTX-BEG2	Northwest	Y	Y	6/9/2003		Active	UM			632652.49	3756906.56
PTX06-1157	Southeast	N	Y	2/10/2010		Active	ED, UM		Y	647100.00	3753700.00
PTX06-1043	Southeast/Northwest	N	Y	9/16/2010		Active	ED, UM			640711.00	3765225.21
PTX06-1072	Northwest	N	Y	9/16/2010		Active	ED, UM			635047.45	3758434.63

Well ID	Indicator Area	ISM Well[1]	LTM Well[2]	CP Approval Date	CP Removal Date	Current Status	LTM Objectives	POC/ POE	Multi-Level Well	Easting	Northing
PTX06-1137A	Southeast	N	Y	9/16/2010		Active	ED, UM			647900.89	3758635.67
PTX06-1138	Southeast	N	Y	9/16/2010		Active	ED, UM	POE	Y	646285.31	3760503.82
PTX06-1139	Southeast	N	Y	9/16/2010		Active	ED, UM	POE	Y	646768.73	3756376.08
PTX06-1140	Southeast	N	Y	9/16/2010		Active	ED, UM		Y	646959.38	3762807.67
PTX06-1141	Northwest	N	Y	9/16/2010		Active	UM		Y	633445.44	3766872.94
PTX06-1143	Northwest	N	Y	9/16/2010		Active	ED, UM	POE	Y	639244.72	3770496.78
PTX06-1144	Northwest	N	Y	9/16/2010		Active	ED, UM	POE	Y	640252.98	3773320.45
PTX07-1R01	Northwest	N	Y	9/16/2010		Active	ED, UM			627914.28	3764159.91
PTX06-1032	Southeast	N	Y		2/10/2010	P&A	ED, UM			646004.29	3752640.94
PTX06-1060[3]		N	N			Active				620969.93	3758599.72

POC – point of compliance POE – point of exposure

ED – early detection RA – Remedial Action effectiveness UM – uncertainty management

[1]ISM – interim stabilization monitoring (from CP-50284 issued 10/21/2003) – most of these wells were retained in the Corrective Action Compliance Plan issued in 2010.

[2]LTM –long-term monitoring from CP-50284 issued 9/16/2010 which included the final Corrective Actions and long-term monitoring for the Actions.

[3]These wells are retained for monitoring water upgradient to Pantex Plant but are not considered as LTM wells.

[4]This well was located on offsite property. Well ownership has been transferred to the landowner.

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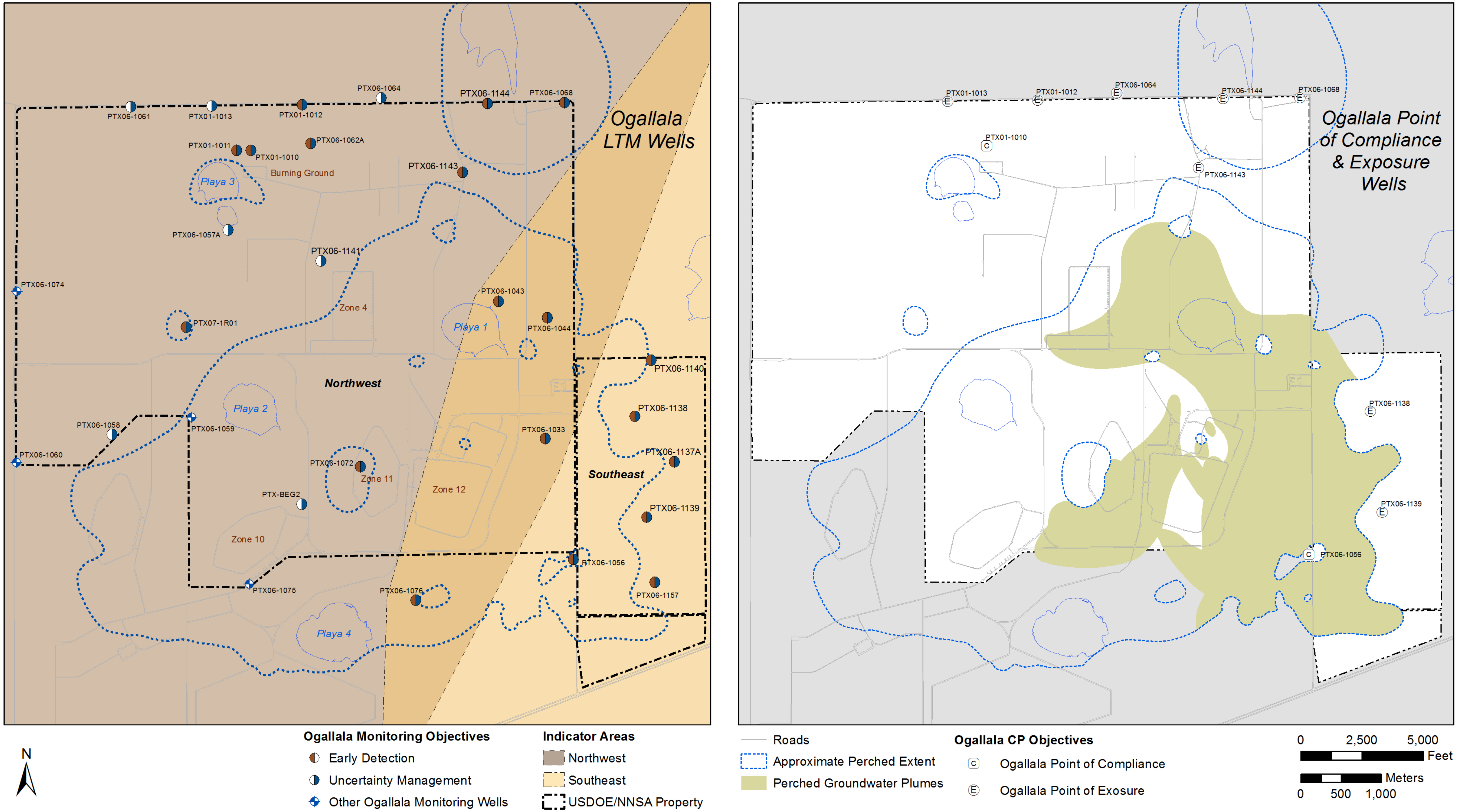

Figure 1-6. Ogallala Aquifer LTM and Compliance Plan Wells

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1.4.3 Remedial Action Wells

Two groundwater remedial actions and one soil remedial action are being performed at Pantex. Wells have been installed for two pump and treat systems, two ISB systems, and an SVE system.

Table 1-5 details all installed wells for the pump and treat systems, as well as their current status, date of plugging and abandonment, and coordinates. Table 1-6 details all installed wells for the ISB systems, as well as their current status, date of plugging and abandonment, and coordinates. Table 1-7 details all installed wells for the SVE system, their current status, plugging and abandonment dates, well depths, and coordinates. Figures depicting the active well systems follow each table.

The network is used for remediation, but some wells are also sampled to provide information for the remedial action.

- Seventeen ISB wells are used to monitor treatment zone conditions in the two ISB systems.
- All available extraction wells are monitored during June/July of each year. These data are used to support the plume mapping.
- The SVE system is monitored to evaluate effectiveness and to provide information for the Air Quality Monitoring Report for the TCEQ.

No changes to the Remedial Action Systems occurred during 2015.

Table 1-5. Pump and Treat System Wells

Well ID	Completion/ Replacement Date	Current Status	P&A Date	Easting	Northing
Southeast Pump and Treat System					
PTX06-EW-01	9/13/1995	Active		641278.87	3756038.24
PTX06-EW-02	8/30/1995	Active		641528.4	3756005.28
PTX06-EW-03	9/8/1995	Active		641366.55	3755801.72
PTX06-EW-04	8/23/1996	Active		643755.08	3756426.14
PTX06-EW-05	8/23/1996	P&A	12/30/2011	643358.11	3755061.32
PTX06-EW-06	9/15/1996	Active		641510.19	3753404.52
PTX06-EW-07	8/26/1996	Active		643751.83	3756882.87
PTX06-EW-08A[1]	10/2/1996	Converted to PTX06-1102		642751.09	3754532.94
PTX06-EW-09	9/28/1996	Active		639170.49	3754843.18
PTX06-EW-10	8/17/1996	Active		638430.01	3755126.91
PTX06-EW-11	9/18/1996	P&A	12/28/2011	643761.85	3754217.08
PTX06-EW-12	8/26/1996	Active		643756.48	3755796.66
PTX06-EW-13[1]	9/13/1996	Converted to PTX06-1108	11/19/2014	643764.04	3754617.19
PTX06-EW-14	9/24/1996	P&A	12/28/2011	643767.08	3753367.23
PTX06-EW-15	8/19/1996	Active		639694.26	3755163.6

Well ID	Completion/ Replacement Date	Current Status	P&A Date	Easting	Northing
PTX06-EW-16	9/8/1998	Active		643801.7	3759993.02
PTX06-EW-17	9/11/1998	Active		643801.02	3760200.19
PTX06-EW-18	9/14/1998	Active		643731.32	3760496.47
PTX06-EW-19	9/18/1998	Active		643797.5	3760790.28
PTX06-EW-20	2/23/2000	Active		641025.56	3757877.46
PTX06-EW-21	8/1/1999	Active		641586.01	3757701.14
PTX06-EW-22A	8/26/1999	Active		641838.18	3757228.36
PTX06-EW-23A	9/26/1999	Active		643234.37	3757243.67
PTX06-EW-24	9/12/1999	Active		640724.28	3756777.19
PTX06-EW-25	8/9/1999	Active		641383.9	3756817.82
PTX06-EW-26	9/24/1999	Active		642723.35	3756878.53
PTX06-EW-27	8/13/1999	Active		643750.35	3756680.87
PTX06-EW-28	6/20/1999	Active		640036.65	3755513.98
PTX06-EW-29	7/28/1999	Active		640696.41	3755476.57
PTX06-EW-30	9/1/1999	Active		641973.98	3755476.99
PTX06-EW-31	8/30/1999	Active		642024.65	3755827.25
PTX06-EW-32	8/28/1999	Active		642374.99	3755975.61
PTX06-EW-33	8/25/1999	Active		642726.52	3756075.79
PTX06-EW-34	8/18/1999	Active		643080.1	3755826.59
PTX06-EW-35	8/14/1999	Active		643750.86	3756128.69
PTX06-EW-36	9/24/1999	Active		640775.89	3754778.09
PTX06-EW-37	1/25/2000	Active		639573.03	3754667.07
PTX06-EW-38C	4/6/2000	Active		639987.21	3754454.74
PTX06-EW-39	9/29/1999	Active		640275.11	3754278.61
PTX06-EW-40	3/28/2000	Active		640372.77	3753865.67
PTX06-EW-41	3/15/2000	Active		640775.16	3753666.41
PTX06-EW-42A	3/10/2000	Active		641052.06	3753818.72
PTX06-EW-43	9/15/1999	Active		641223.53	3754077.05
PTX06-EW-44	3/9/2000	Active		641376.89	3754474.61
PTX06-EW-45	9/23/1999	Active		641575.19	3754577.81
PTX06-EW-46	3/12/2000	Active		641876.25	3754724.89
PTX06-EW-47[1]	9/11/1999	Converted to PTX06-1168		642128.78	3755035.31
PTX06-EW-48	9/12/1999	Active		643124.45	3755475.11
PTX06-EW-49	2/28/2000	Active		642325.53	3754868.53
PTX06-EW-50	9/1/2005	Active		643762.45	3759386.42
PTX06-EW-51	9/9/2005	Active		638670.18	3754606.95
PTX06-EW-52[1]	9/15/2005	Converted to PTX06-1103	10/28/2010	641248.7	3752987.68
PTX06-EW-53	5/14/2001	Active		643813.98	3755471.87
PTX06-EW-54	2/21/2007	Active		643766.44	3758870.74
PTX06-EW-55	2/22/2007	Active		643763.99	3758298.96
PTX06-EW-56	2/24/2007	Active		643763.8	3757875.83
PTX06-EW-57	2/25/2007	Active		643766.32	3757453.43
PTX06-EW-58	2/12/2007	Active		643262.82	3758881.53
PTX06-EW-59	2/8/2007	Active		643197.17	3758490.03
PTX06-EW-60	2/1/2007	Active		643131.98	3758083.47
PTX06-EW-61	1/30/2007	Active		642700.95	3757847.08
PTX06-EW-62	1/28/2007	Active		642379.35	3757323.3
PTX06-EW-63	1/27/2007	Active		642028.64	3756678.15
PTX06-EW-64	1/25/2007	Active		641727.44	3756431.79

Well ID	Completion/ Replacement Date	Current Status	P&A Date	Easting	Northing
PTX06-EW-65	1/17/2007	Active		641081.67	3756535.05
PTX06-EW-66	1/11/2007	Active		640868.51	3755784.1
PTX06-EW-67	3/6/2007	Active		639249.6	3754428.77
PTX06-EW-68	3/6/2007	Active		639566.17	3754095.17
PTX06-INJ-1	1/12/1993	P&A	9/24/2004	641043	3757545
PTX06-INJ-2	9/8/1996	P&A	11/23/2011	641155.36	3758791.57
PTX06-INJ-3	2/10/2000	P&A	10/25/2004	643226.15	3756469.63
PTX06-INJ-4	2/26/2000	P&A	3/26/2008	640126.87	3755016.27
PTX06-INJ-5	2/10/2000	P&A	10/25/2004	641482	3755164.77
PTX06-INJ-6	2/26/2000	P&A	10/26/2004	642521.57	3755369.02
PTX06-INJ-7	3/7/2000	P&A	10/27/2004	640774.75	3754319.02
PTX06-INJ-8	2/27/2000	P&A	3/25/2008	640419.84	3756164.91
PTX06-INJ-9	2/17/2000	P&A	10/26/2004	642024.8	3756518.86
PTX06-INJ-10	9/12/2004	Active		641005.96	3757505.73
PTX06-INJ-11	8/28/2004	Active		641752.09	3758137.05
PTX06-INJ-12A	1/24/2008	Active		640737.15	3756104.67
Playa 1 Pump and Treat System					
PTX06-EW-69	7/22/2007	Active		638869.86	3765146.41
PTX06-EW-70	8/11/06	Active		638141.28	3765454.51
PTX06-EW-71	7/24/2007	Active		638139.57	3764250.42
PTX06-EW-72	8/20/2007	Active		639152.16	3762973.95
PTX06-EW-73	8/10/2007	Active		639962.23	3762980.08
PTX06-EW-74	8/18/2007	Active		640354.99	3763274.66
PTX06-EW-75	8/19/2006	Active		640751.11	3763004.67
PTX06-EW-76[1]	7/13/2007	Converted to PTX06-1128		641330.75	3763667.42
PTX06-EW-77[1]	8/6/2007	Converted to PTX06-1129		641330.75	3763667.42
PTX06-EW-78A	8/23/2007	Active		639800.79	3762590.92
PTX06-EW-79	8/18/2007	Active		640784.57	3762323.44
PTX06-EW-80	8/14/2007	Active		641490.31	3762305.03
PTX06-EW-81A[2]	9/21/2013	Inactive		639773.41	3762095.77

P&A = plugging and abandonment
[1]Due to low well yield and need for monitoring data, extraction well was converted to monitoring well rather than plugged and abandoned.
[2]Pantex completed connection to the system in June 2016.

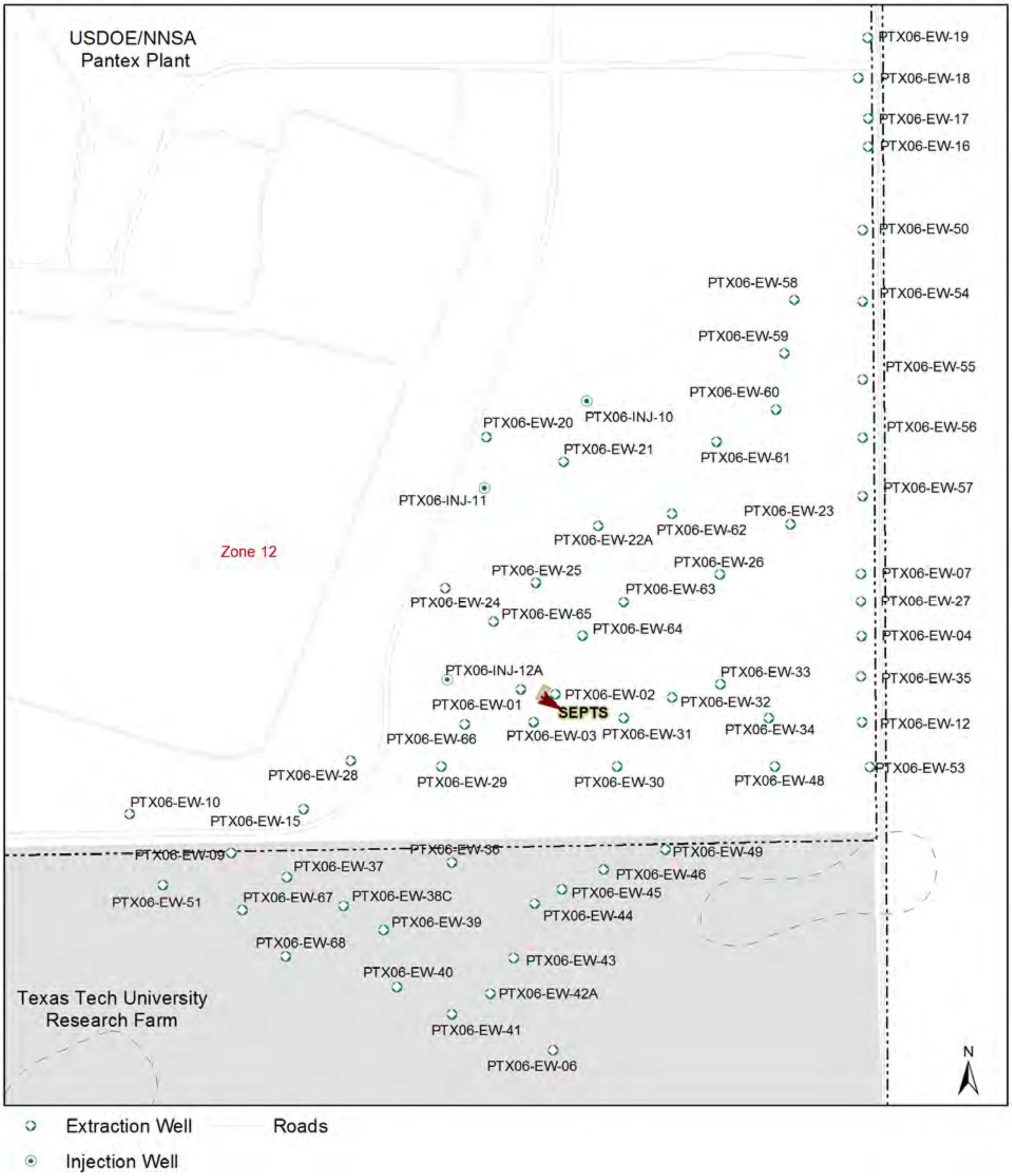

Figure 1-7. SEPTS Wells

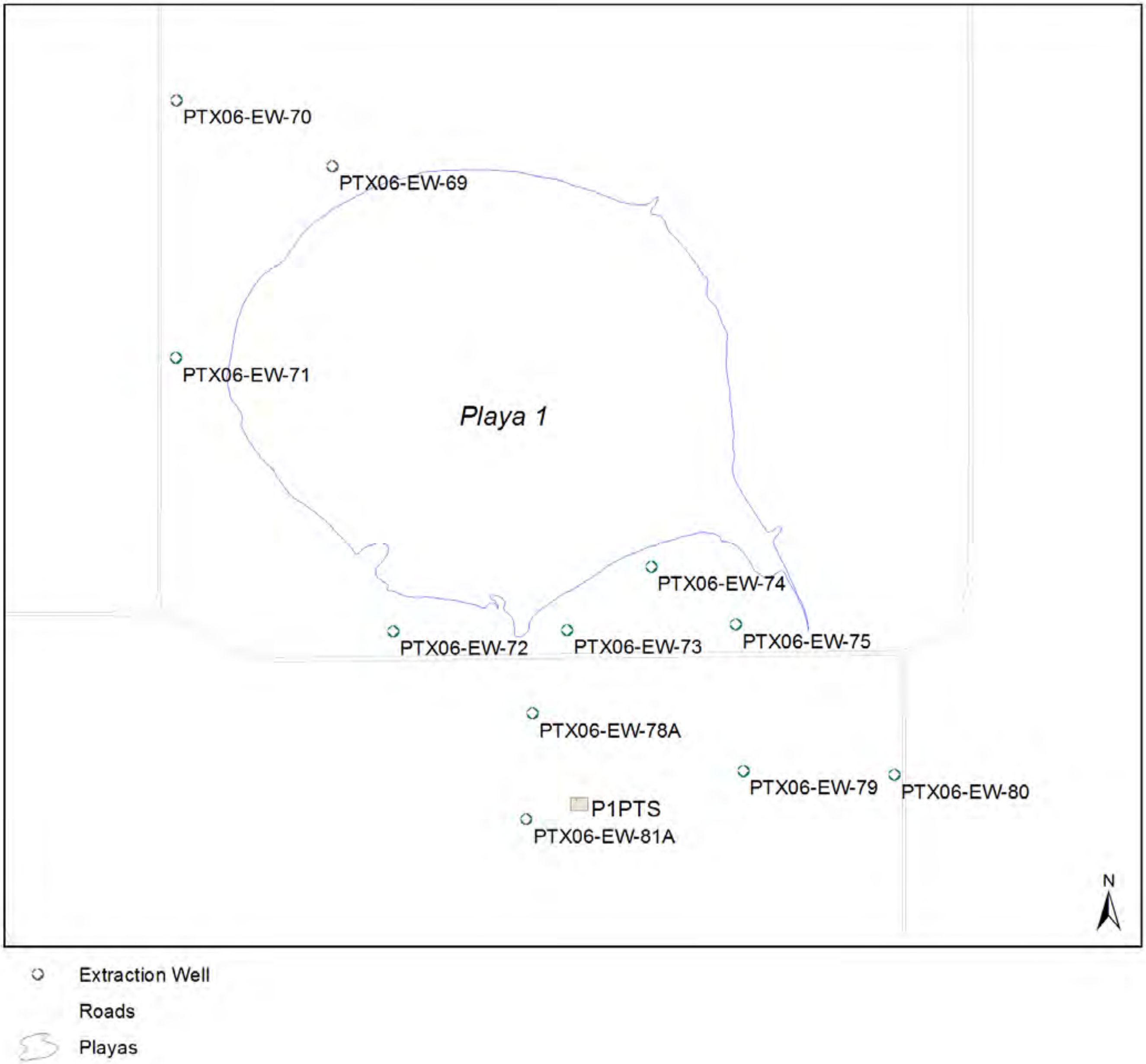

Figure 1-8. P1PTS Wells

Table 1-6. ISB System Wells

Well ID	Completion Date	Current Status	Replacement Date	P&A Date	Easting	Northing
Southeast ISB System						
PTX06-ISB010	10/4/2007	Active			640805.43	3752335.36
PTX06-ISB011	8/6/2007	Active			640901.34	3752364.37
PTX06-ISB012	10/3/2007	Active			640997.33	3752392.85
PTX06-ISB013	10/2/2007	Active	6/17/2011		641094.48	3752437.36
PTX06-ISB014	10/1/2007	Active			641188.34	3752451.45
PTX06-ISB015	10/1/2007	Active			641282.85	3752478.49
PTX06-ISB016	8/4/2007	Active			641379.46	3752509.22
PTX06-ISB017	10/4/2007	Active			641476.26	3752538.73
PTX06-ISB018	9/18/2007	Active			641570.69	3752567.95
PTX06-ISB019	9/19/2007	Active			641666.28	3752597.62
PTX06-ISB020	9/24/2007	Active			641762.34	3752625.80
PTX06-ISB021	9/24/2007	Active			641857.77	3752657.45
PTX06-ISB022	10/1/2007	Active			641955.44	3752684.48
PTX06-ISB023A	10/22/2007	Active			642048.63	3752724.53
PTX06-ISB024	7/18/2007	Active			642144.65	3752737.70
PTX06-ISB025	9/14/2007	Active			642241.84	3752770.49
PTX06-ISB026	9/13/2007	Active			642336.93	3752798.27
PTX06-ISB027	8/22/2007	Active			642431.36	3752828.68
PTX06-ISB028	8/20/2007	Active			642527.37	3752858.27
PTX06-ISB029A	9/27/2007	Active			640994.88	3752253.46
PTX06-ISB030B	9/17/2007	Active			641094.72	3752286.25
PTX06-ISB031	7/11/2007	Active			641176.52	3752313.22
PTX06-ISB032	8/15/2007	Active			641277.51	3752351.41
PTX06-ISB033	8/16/2007	Active			641370.09	3752378.35
PTX06-ISB034	9/9/2007	Active			641467.88	3752407.71
PTX06-ISB035	9/7/2007	Active			641563.65	3752435.15
PTX06-ISB036	9/6/2007	Active			641657.73	3752465.76
PTX06-ISB037	9/11/2007	Active			641753.03	3752494.63
PTX06-ISB038	8/14/2007	Active			641850.23	3752524.17
PTX06-ISB039	9/26/2007	Active			641945.73	3752552.70
PTX06-ISB040	8/31/2007	Active			642035.47	3752578.67
PTX06-ISB041	8/29/2007	Active			642136.52	3752608.90
PTX06-ISB042	8/25/2007	Active			642233.39	3752640.96
PTX06-ISB043	10/24/2007	Active			642329.34	3752670.29
PTX06-ISB044	8/3/2007	P&A		7/27/2011	642425.15	3752698.59
PTX06-ISB044A	6/12/2011	Active			641891.24	3752479.24
PTX06-ISB045	8/24/2007	Active			642521.05	3752726.81
PTX06-ISB046	10/24/2007	Active			641939.34	3752422.69
PTX06-ISB047	10/10/2007	Active			642035.50	3752450.45
PTX06-ISB048	10/24/2007	Active			642131.84	3752479.89
PTX06-ISB049	10/24/2007	Active			642227.63	3752509.10
PTX06-ISB050	10/24/2007	Active			642323.05	3752537.46
PTX06-ISB051	10/19/2007	Active			642419.78	3752567.70
Zone 11 ISB System						
PTX06-ISB055	3/4/2009	Active			636606.08	3755477.40
PTX06-ISB056A	3/3/2009	Active			636503.22	3755414.42
PTX06-ISB057	2/27/2009	Active	6/15/2011		636381.76	3755371.18
PTX06-ISB058	2/26/2009	Active			636320.75	3755299.58
PTX06-ISB059	2/25/2009	Active			636234.22	3755246.12

Well ID	Completion Date	Current Status	Replacement Date	P&A Date	Easting	Northing
PTX06-ISB060A	2/24/2009	Active			636136.74	3755200.44
PTX06-ISB061	2/23/2009	Active			636085.48	3755140.80
PTX06-ISB062	2/20/2009	Active			635986.17	3755141.57
PTX06-ISB063	2/19/2009	Active			635886.33	3755141.05
PTX06-ISB064	2/18/2009	Active			635785.77	3755140.34
PTX06-ISB065	2/17/2009	Active			635563.31	3755140.57
PTX06-ISB066	2/17/2009	Active	9/21/2012		635495.33	3755164.83
PTX06-ISB067	2/13/2009	Active			635364.80	3755140.76
PTX06-ISB068	2/12/2009	Active			635263.93	3755181.61
PTX06-ISB069A	2/11/2009	Active			635170.02	3755241.04
PTX06-ISB070	2/10/2009	Active			635064.71	3755266.05
PTX06-ISB071	11/25/2008	Active			634991.20	3755334.12
PTX06-ISB072	11/20/2008	Active			634917.45	3755401.42
PTX06-ISB073	11/19/2008	Active	9/29/2011		634821.31	3755453.71
PTX06-ISB074	11/18/2008	Active			634722.57	3755411.00
PTX06-ISB075	11/17/2008	Active	9/28/2012		634813.17	3755333.92
PTX06-ISB076A	11/26/2008	Active			634867.07	3755287.08
PTX06-ISB077	11/13/2008	Active			634942.76	3755207.57
PTX06-ISB078	9/18/2009	Active			636919.77	3755377.85
PTX06-ISB079	9/18/2009	Active			636854.05	3755302.76
PTX06-ISB080	9/18/2009	Active			636787.42	3755227.38
PTX06-ISB081	8/26/2009	Active			636729.13	3755162.74
PTX06-ISB082	8/26/2009	Inactive			636597.92	3755139.36
PTX06-ISB083	9/8/2009	Active			634632.29	3755455.37
PTX06-ISB084	9/8/2009	Active			634585.86	3755544.14
PTX06-ISB085A	9/17/2009	Active			634511.57	3755458.25
PTX06-ISB086	9/8/2009	Active			634452.91	3755531.59
PTX06-ISB087	07/24/14	Active			634360.64	3755523.08
PTX06-ISB088A	09/23/14	Active			634266.60	3755570.13
PTX06-ISB089	07/12/14	Active			634200.34	3755606.47
PTX06-ISB090	07/10/14	Active			634117.26	3755650.38
PTX06-ISB091	09/09/12	Active			634032.91	3755697.13
PTX06-ISB092	09/11/12	Active			633944.35	3755745.69
PTX06-ISB093	07/16/14	Active			633857.23	3755794.35
PTX06-ISB094	07/07/14	Active			633769.25	3755838.98
PTX06-ISB095	07/24/14	Active			633652.63	3755742.68
PTX06-ISB096	06/22/14	Active			633559.57	3755807.06
PTX06-ISB097	08/27/14	Active			633470.54	3755870.31
PTX06-ISB098	08/19/14	Active			633384.06	3755929.79
PTX06-ISB099	08/11/14	Active			633757.56	3755690.13
PTX06-ISB100A	09/16/14	Active			633791.28	3755646.03
PTX06-ISB101	08/07/14	Active			633899.71	3755616.85
PTX06-ISB102	07/31/14	Active			633985.55	3755572.69
PTX06-ISB103	09/02/14	Active			634073.50	3755527.39
PTX06-ISB104	08/19/14	Active			634160.38	3755482.36
PTX06-ISB105	08/06/14	Active			634245.60	3755438.20
PTX06-ISB106	07/29/14	Active			634332.49	3755393.36

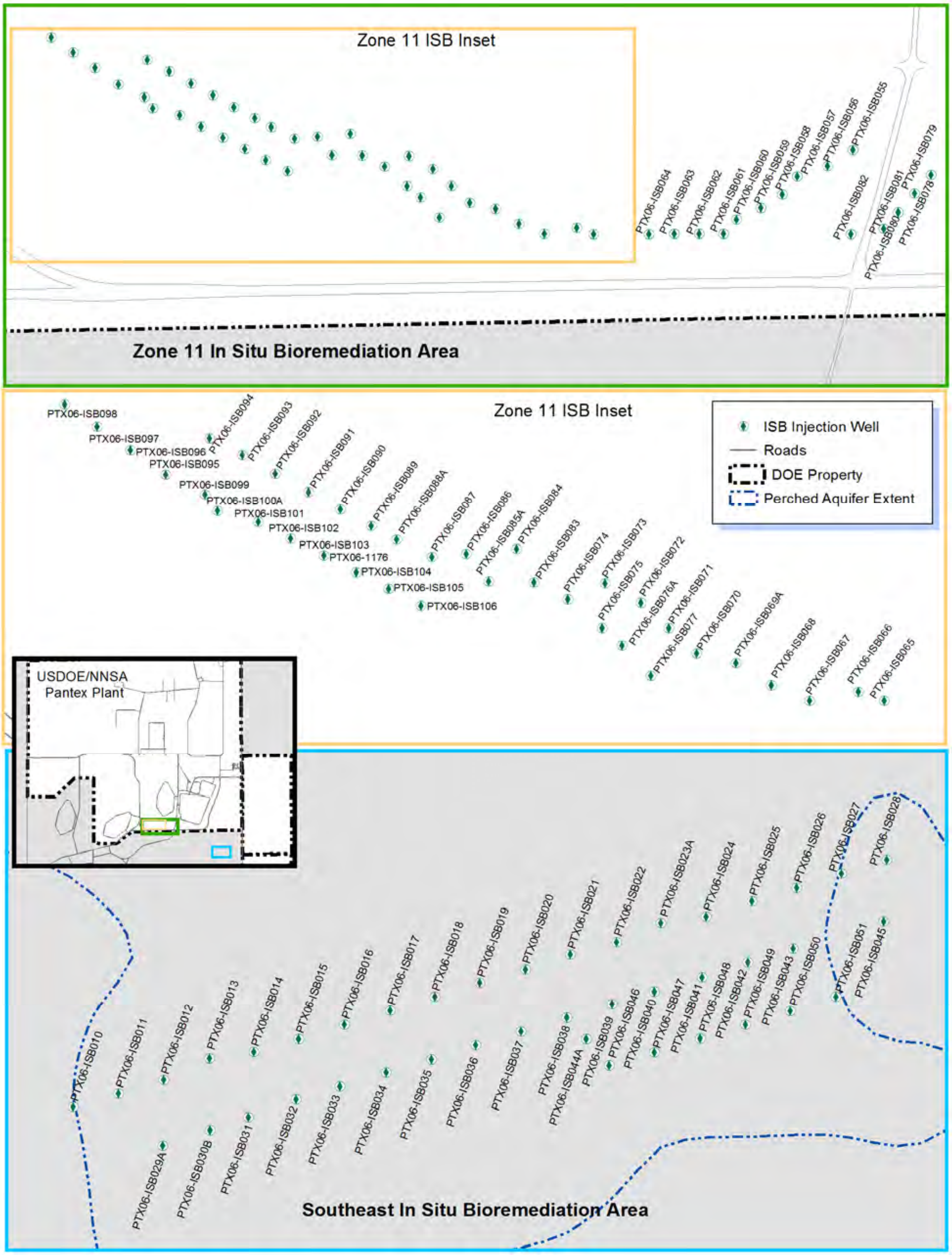

Figure 1-9. ISB System Wells

Table 1-7. Burning Ground SVE System Wells

Name	Well Depth[1]	Completion Date	Current Status	Easting	Northing
SVE-I-06	Intermediate	12/1/2001	Inactive	630006.43	3771358.79
SVE-I-11	Intermediate	12/24/2001	Inactive	630140.42	3771223.11
SVE-I-13	Intermediate	11/10/2001	Inactive	630024.96	3770909.40
SVE-I-16	Intermediate	12/10/2001	Inactive	630264.66	3770916.85
SVE-I-21	Intermediate	12/10/2001	Inactive	630142.72	3770795.37
SVE-I-26	Intermediate	11/17/2001	Inactive	630022.91	3770678.74
SVE-I-29	Intermediate	11/13/2001	Inactive	630245.81	3770680.38
SVE-S-05	Shallow	11/20/2001	Inactive	629996.81	3771361.24
SVE-S-07	Shallow	11/20/2001	Inactive	630130.43	3771359.23
SVE-S-08	Shallow	11/20/2001	Inactive	630070.51	3771300.84
SVE-S-09	Shallow	11/19/2001	Inactive	630005.69	3771220.82
SVE-S-10	Shallow	11/21/2001	Inactive	630131.84	3771220.90
SVE-S-12	Shallow	11/12/2001	Inactive	630016.08	3770920.93
SVE-S-13	Shallow	11/10/2001	Inactive	630024.96	3770909.40
SVE-S-14	Shallow	11/12/2001	Inactive	630133.76	3770915.03
SVE-S-15	Shallow	11/9/2001	Inactive	630254.26	3770915.75
SVE-S-17	Shallow	11/12/2001	Inactive	630074.42	3770855.43
SVE-S-18	Shallow	11/9/2001	Inactive	630194.14	3770855.08
SVE-S-19	Shallow	11/11/2001	Inactive	630012.77	3770795.38
SVE-S-20	Shallow	11/9/2001	Active	630133.75	3770795.37
SVE-S-22	Shallow	11/10/2001	Inactive	630254.47	3770794.59
SVE-S-23	Shallow	11/11/2001	Inactive	630074.68	3770735.48
SVE-S-24	Shallow	11/10/2001	Inactive	630194.80	3770735.89
SVE-S-25	Shallow	11/11/2001	Inactive	630015.03	3770678.85
SVE-S-27	Shallow	11/12/2001	Inactive	630134.13	3770679.10
SVE-S-28	Shallow	11/19/2001	Inactive	630238.26	3770681.91
SVE-S-30	Shallow	11/20/2001	Inactive	630077.40	3771163.35
SVE-S-31	Shallow	11/19/2001	Inactive	630005.18	3771080.74
SVE-S-32	Shallow	11/21/2001	P&A	630147.02	3771079.12
SVE-S-32A	Shallow	11/26/2001	Inactive	630153.88	3771082.13

[1]The shallow depth wells are screened from 20-45 ft and 50-90 ft bgs. The intermediate depth wells are screened from 95-180 ft and 190-275 ft bgs.

This well list represents the final configuration for the full-scale SVE system. SVE pilot test wells that were not appropriate for use in the final system were not included in this list.

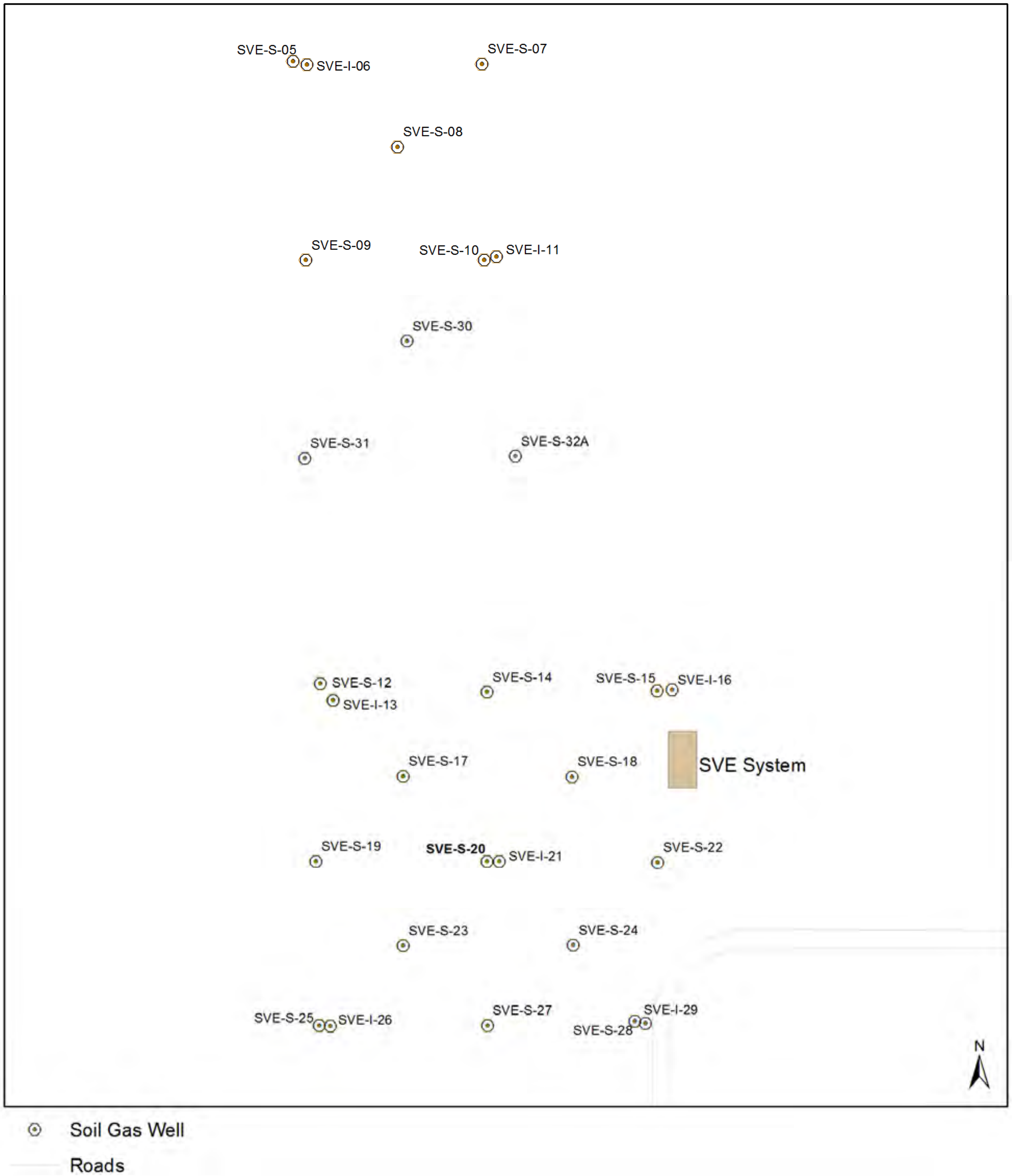

Figure 1-10. Burning Ground SVE Wells

1.5 Schedule of Activities

Pantex must meet requirements under CERCLA and RCRA, as detailed in HW-50284 and the IAG. Pantex has submitted a Site Management Plan (SMP) in accordance with the IAG that provides a list of required activities and planned dates of completion. Activities completed in 2015, in 2016 prior to publication of this report, and projected completions for July 2016-June 2017 are summarized in Table 1-8. The schedule of activities included in the 2014 report was the basis for this table. Revisions of that schedule are noted in Table 1-8 and are explained in the following text.

Pantex completed most activities related to the Five-Year Review, recommendations from previous reports, as well as completing all normally scheduled monitoring and operation of remedial actions. The significant actions completed in 2015 in relation to the Five-Year Review include:

- Phase II Review of landfills that were previously seeded was completed. Pantex has seen overall improvement in the landfill covers due to heavy rainfall in 2015, although a few areas were identified that need further recovery. Pantex has implemented a long-term contract to address holes and necessary seeding on an annual basis to address issues noted during inspections at all landfills. See discussion in Section 2.3.2.
- Pantex completed the tie-in of PTX06-EW-081A to the P1PTS. Pantex had committed to adding up to two wells to assist with the throughput goals when other wells are down. Pantex will re-evaluate the need for another well after operating the system with the new well PTX06-EW-081A.
- Pantex committed to evaluating the expanding plumes of high explosives east of FM 2373. In 2015, pump tests were conducted at two new wells installed east of FM 2373 to determine whether pump and treat operations can be extended to that area. Although pump rates were lower than expected, they are sufficient to support the Pantex recommendation to extend the SEPTS east of FM 2373. Pantex plans to install up to four additional extraction wells and will contract for the design and completion of the infrastructure to tie in the wells to the SEPTS. This recommendation is discussed in more detail in Section 5.

Pantex has also implemented several other recommendations made in the 2014 Annual Progress Report and 2015 Quarterly Progress Reports including:

- Pantex increased sampling to monthly at Ogallala well PTX06-1056 in November 2015. This increase in sampling was completed in response to a slightly elevated detection of 4-amino-2,6-dinitrotoluene above the PQL. The review of that data indicated consistent measurements near the PQL. In agreement with regulatory agencies, Pantex will continue to monitor the well quarterly to evaluate the detections over time.

- PTX06-1051 was replaced to evaluate the dry conditions west of the Southeast ISB. During regularly scheduled maintenance, it was found that the screen was grouted in at the original well. The new well drilled in 2015 confirmed dry conditions.
- The Zone 11 ISB was bioaugmented with the necessary bacteria, *Dehalococcoides* (DHC), to completely reduce TCE. Bioaugmentation occurred on the western side where reducing conditions are established.
- Pantex completed construction of a bulk water station near the SEPTS. This station will allow use of the treated water for construction and other general Plant uses in accordance with the Texas Land Application Permit.

In-progress and upcoming activities continue to focus on operation, maintenance, and monitoring of the remedial actions, operation and maintenance of soil actions, preparation for the second five-year review that will begin in 2017, completion of the Cr background study, and the tie-in of the extraction wells installed for pump testing east of FM 2373. Pantex will initiate an RDX attenuation study this year to evaluate where and what type of attenuation is occurring across the southeast plume. This study will also help with identifying a rate of attenuation. Some of the reporting and plans will require regulatory review and approval and are provided in bold in Table 1-8.

Pantex revisions to the schedule contained in the 2014 Annual Progress Report are as follows:

- The dates of completion of the chromium background study were revised due to late completion of redevelopment and sampling of wells. Heavy snowfall in December prevented access to the remaining wells to be sampled until February. The completion of the report was delayed until later in 2016.
- Pantex recommended development of a SVE Performance Monitoring Plan in the Five-Year Review to develop a path to closure for the system. The plan is reliant on results of rebound testing from the system. However, Pantex encountered problems during scheduled rebound tests in 2014 and 2015. Because Pantex has been unable to overcome problems with the PID, an alternate path to establish a Performance Monitoring Plan will be developed during 2016. Section 4 provides a detailed discussion of the 2015 rebound test and issues encountered.

Table 1-8. Complete, In-Progress and Upcoming Activities

Activity	Start Date	Scheduled Complete Date	Actual Completion	CP Provision or Requirement	Origin of Recommended Action
Completed Work					
Upgrade of P1PTS components and connection of PTX06-EW-81A to the system	May 2015	Nov 2015	June 2016	HW-50284 Provision XI.E.1.d IAG Article 8	FYR
Well Installation and Pump Test east of FM 2373	Jun 2015	Sep 2015	Dec 2015		3Q2014 & FYR
Zone 11 ISB Injection & Bioaugmentation	Apr 2015	Sep 2015	Nov 2015	IAG Article 8 HW-50284 Provision XI.E.1	
Replace PTX06-1051	Jul 2015	Nov 2015	Oct 2015	HW-50284 CP Attachment B, Item 18	3Q2014
Phased Plan to restore vegetation coverage on Landfills				IAG Article 21 and HW-50284 CP Table VII, Item 26	FYR
Phase II – Assess the effectiveness of landfill reseeding	Aug 2015	Sep 2015	Sept 2015		
2015 Rebound testing of SVE System (Preparation for SVE Performance Monitoring Plan)	May 2015	Oct 2015	July 2015	IAG Article 21 and HW-50284 CP Table VII, Item 26	4Q2014
Construction of bulk water station at SEPTS	Jun 2015	Aug 2015	Nov 2015	IAG Article 8.9 HW-50284 Provision XI.E	
Southeast ISB injection	Mar 2015	May 2015	April 2015	IAG Article 8 HW-50284 Provision XI.E.1	
Cr Background Study - Field Sampling/Analysis	Mar 2015	Dec 2015	Mar 2016	HW-50284 Provision XI.F.1	4Q2013
Well Maintenance Program 2015	Jan 2015	Dec 2015	Dec 2015	HW-50284 Provision XI.F.3.d	

Activity	Start Date	Scheduled Complete Date	Actual Completion	CP Provision or Requirement	Origin of Recommended Action
Progress Reporting from Jul 2015 to Jun 2016: 2Q2015, 3Q2015, 4Q2015, 1Q2016, 2015 Annual Report	Aug 2015 Nov 2015 Feb 2016 May 2016 Mar 2016	Sep 2015 Dec 2015 Mar 2016 Jun 2016 Jun 2016	Sep 2015 Dec 2015 Mar 2016 Jun 2016 Jun 2016	HW-50284 Provision XI.F	
Semi-Annual Water Level Measurement Event	Jun 2015	Dec 2015	Dec 2015	HW-50284 Provision XI.F.3.d	
2015 Groundwater Sampling - Monitoring Wells	Jan 2015	Dec 2015	Dec 2015	HW-50284 Provision XI.F	
1st Semi-annual Groundwater Sampling – Monitoring Wells	Jan 2016	Jun 2016	Jun 2016	HW-50284 Provision XI.F	
2015 Groundwater Sampling - ISB System Wells	Jan 2015	Dec 2015	Nov 2015	HW-50284 Provision XI.F	
1st and 2nd Quarter 2016 Groundwater Sampling – ISB System Wells	Jan 2016	Jun 2016	Jun 2016	HW-50284 Provision XI.F	
Work In-Progress					
Design for erosion control at Landfill 3	Apr 2016	Aug 2016		IAG Article 8.9 HW-50284 Provision XI.E	3Q2015
Zone 11 ISB Injection	Mar 2016	Jul 2016		IAG Article 8 HW-50284 Provision XI.E.1	
Southeast ISB Injection	May 2016	Sep 2016		IAG Article 8 HW-50284 Provision XI.E.1	
Installation of new wells –1 LTM well replacement, 3 new monitoring wells, and 4 extraction wells	Jun 2016	Sep 2016		HW-50284 Provision XI.F	4Q2015, 2015A
Extending SEPTS east of FM 2373 – Design	Jun 2016	Sept 2016		IAG Article 8 HW-50284 Provision XI.E.1	2015A
Upcoming Work					
Extending SEPTS east of FM 2373 – Construction	Oct 2016	Mar 2017		IAG Article 8 HW-50284 Provision XI.E.1	2015A
Replacement of the SWMU 5/5 and 2 ditch liner	Jan 2017	Apr 2017		IAG Article 8.9 HW-50284 Provision XI.E	2015A
RDX Natural Attenuation Study	Jul 2016	Mar 2017			2015A

Activity	Start Date	Scheduled Complete Date	Actual Completion	CP Provision or Requirement	Origin of Recommended Action
Landfill 3 Erosion Control Construction	Oct 2016	Mar 2017		IAG Article 8.9 HW-50284 Provision XI.E	3Q2015
Annual Landfill Maintenance	Jul 2016	Sept 2016		IAG Article 8.9 HW-50284 Provision XI.E	4Q2015, 2015A
Closure Turf® Design and Construction	Jul 2016	Dec 2016		IAG Article 8.9 HW-50284 Provision XI.E	2015A
LiDAR study for evaluation of Pantex Landfills	Aug 2016	Nov 2016		IAG Article 21 and HW-50284 CP Table VII, Item 26	FYR
Five-Year Review contract support	Oct 2016	Jan 2018		IAG Article 21 and HW-50284 CP Table VII, Item 26	
Kick-off Meeting to review annotated outline and prepare schedule for 2nd Five Year Review	Mar 2017	Apr 2017		IAG Article 21 and HW-50284 CP Table VII, Item 26	
Annual Public Meeting	Oct 2016	Nov 2016			
Develop SVE Performance Monitoring Plan	Sep 2014* To be revised pending review of methods for evaluating SVE performance	Dec 2014* To be revised pending review of methods for evaluating SVE performance		IAG Article 21 and HW-50284 CP Table VII, Item 26	FYR
Phased Plan to restore vegetation coverage on Landfills				IAG Article 21 and HW-50284 CP Table VII, Item 26	FYR
Phase II – Assess the effectiveness of landfill reseeding	Aug 2016	Sep 2016			
Phase III – Additional seeding of targeted areas	Jul 2017	Sep 2017			
2nd Quarter 2016 Progress Report	Aug 2016	Sep 2016		HW-50284 Provision XI.G.3 and IAG Article 16.4	

Activity	Start Date	Scheduled Complete Date	Actual Completion	CP Provision or Requirement	Origin of Recommended Action
3rd Quarter 2016 Progress Report	Nov 2016	Dec 2016		HW-50284 Provision XI.G.3 and IAG Article 16.4	
4th Quarter 2016 Progress Report	Feb 2017	Mar 2017		HW-50284 Provision XI.G.3 and IAG Article 16.4	
1st Quarter 2017 Progress Report	Apr 2017	Jun 2017		HW-50284 Provision XI.G.3 and IAG Article 16.4	
2016 Annual Progress Report	Mar 2017	Jun 2017		HW-50284 Provision XI.G.3 and IAG Article 16.4	
2nd Semi-Annual 2016 Groundwater Sampling - Monitoring Wells	Jul 2016	Dec 2016		HW-50284 Provision XI.F	
3Q2016 Groundwater Sampling - ISB System Wells	Jul 2016	Sep 2016		HW-50284 Provision XI.F	
4Q2016 Groundwater Sampling - ISB System Wells	Oct 2016	Dec 2016		HW-50284 Provision XI.F	
1st Semi-Annual 2017 Groundwater Sampling - Monitoring Wells	Jan 2017	Jun 2017		HW-50284 Provision XI.F	
1Q2017 Groundwater Sampling - ISB System Wells	Jan 2017	Mar 2017		HW-50284 Provision XI.F	
2Q2017 Groundwater Sampling - ISB System Wells	Apr 2017	Jun 2017		HW-50284 Provision XI.F	
CR(VI) and Total Cr Groundwater Background Study				HW-50284 Provision XI.F.1	4Q2013
Prepare Draft Final Cr Groundwater Background Report	May 2016*	Nov 2016*			
Regulatory Meeting/Review of Background Report	Nov 2016*	Dec 2016*			
Prepare Final Cr Groundwater Background Report	Jan 2017*	Feb 2017*			

Origin of Recommended Actions refers to the report the recommendation to complete the project was first provided. Year plus "A" refers to the specific yearly annual progress report, while the quarter and year refers to the specific quarterly progress report the recommendation was included in FYR=Five-Year Review

Activities in bold require regulatory interaction and/or review/approval.

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2.0 Operation and Maintenance of Remedial Actions

Operation of the remedial actions is critical to meeting the remedial action objectives established in the ROD. Maintenance activities (routine and unscheduled) ensure that the systems continue to operate optimally. A summary of the operation and maintenance (O&M) of the remedial action systems is provided to aid in understanding the effectiveness of the remedy.

2.1 Pump and Treat Systems

As part of the Remedial Action, Pantex installed two pump and treat systems, with 71 operating extraction wells and 3 injection wells that are currently treating up to a total of 550 gallons per minute (gpm) of contaminated perched groundwater. The systems address contamination in areas where there was generally greater than 15 ft of saturation in the perched aquifer at the time of installation. These systems were designed to remove and treat groundwater to achieve contaminant mass reduction and reduction in the saturated thickness of the perched aquifer. Reduction in saturated thickness will significantly reduce the migration of contaminants both vertically and horizontally so that natural attenuation processes can occur over time. To achieve mass reduction and reduction in saturated thickness, the pump and treat systems treat the extracted water to remove contaminants from the water before the effluent is sent to the WWTF and irrigation system for beneficial use. Pantex also uses the water beneficially for ISB injection and has been approved to use the treated water for various purposes, including dust suppression, firefighting, washing, and make-up water. Pantex has installed a bulk water station at the SEPTS that will begin operating during 2016 to allow beneficial use in accordance with the Texas Land Application Permit. While the primary use option is irrigation, the SEPTS retains the capability for injection back into the perched zone, as necessary.

The P1PTS began operating in late 2008, and the system became fully operational in January 2009. The SEPTS has been operating since 1995 when it started as a treatability study. It has been expanded with more extraction wells and the capacity to treat boron and hexavalent chromium to become part of the final Remedial Action for the southeastern portion of the groundwater plumes. A list of the extraction and injection wells and their status is included in Section 1 of this report. Appendix B contains the monthly flow calculations for each active well.

Pump and Treat Systems Milestones

2015

- 179.6 million gallons treated
- 98% of treated water beneficially used
- 552 lbs of contaminants removed

Since Startup

- 2.2 billion gallons treated
- 1.4 billion gallons beneficially used
- 12,917 lbs contaminants removed

The pump and treat systems continued to impact saturated thickness and contaminant mass in the southeast perched groundwater during 2015 as depicted above. These milestones demonstrate the systems are effective at removing mass and water from the perched aquifer and system operation continues to move towards meeting remedial action objectives for Pantex.

2.1.1 Playa 1 Pump and Treat System

The P1PTS extracts water from ten wells near Playa 1 and treats the water through a series of granular activated carbon (GAC) beds and ion exchange process units to reduce HEs and metals below the GWPS established in the ROD and HW-50284. This system focuses on reducing the mound of perched groundwater associated with Playa 1, affecting the movement of the southeast plume by reducing the hydraulic head, as well as achieving mass removal.

P1PTS beneficially uses all treated water by sending it through the WWTF to the irrigation system. Because this system does not have the capability to inject the treated water back into the perched aquifer, the treatment throughput must be temporarily adjusted or discontinued based on the demands of the WWTF or irrigation system.

P1PTS Operational Goals

1. 90% Operation Time with no injection when WWTF/Irrigation System can receive all treated water.
2. When the WWTF/Irrigation system is limiting flow, no injection at SEPTS with minimum flow rates (125 gpm) maintained at both systems. Injection is used at SEPTS to maintain minimum flow if flow is limited below 250 gpm for the two systems.
3. 90% of system treatment or well field capacity, whichever is lower.

Figure 2-1 depicts the P1PTS wells and conveyance. Ten wells operated during 2015. Eleven extraction wells are depicted as the newest well, PTX06-EW-81A, was installed previously but was not connected to the system until June 2016.

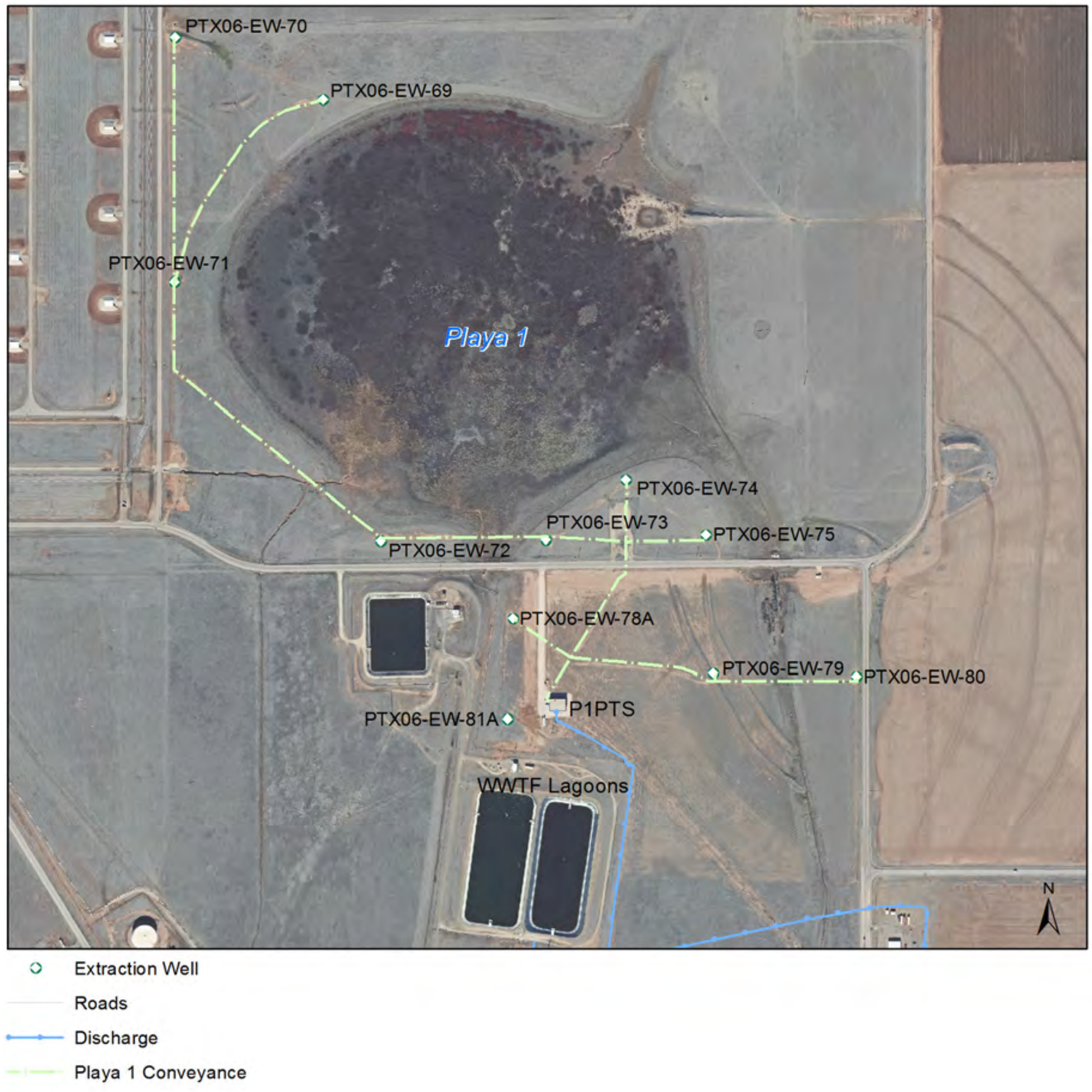

Figure 2-1. P1PTS Wells and Conveyance Lines

The operational goals for the systems were realigned in 2014 and are depicted in the highlight box at the head of this section. Goals are prioritized and will be met as conditions allow. The P1PTS was designed with a treatment capacity of 250 gpm or 360,000 gpd and could potentially treat up to 131 million gallons (Mgal) of water per year running at design capacity and 100% operation.

The P1PTS operation was near the annual system operational goal by operating 336 days during 2015 with an average annual operational rate of 89%, based on total hours operated versus total possible operation time. The actual percentage monthly system operational time versus target is depicted in Figure 2-2.

The monthly system operation was primarily affected by the WWTF/irrigation system not being able to receive the treated water in June and July. Power losses in August caused the system to be slightly below operational goals. In all other months, the system met or exceeded the operational goal of 90%.

Figure 2-3 depicts the average gpm extracted from all wells by month, the percentage of design capacity achieved, and goals for the system as a measure of well operation efficiency. While operational rate of the system was the prioritized goal after June 2014, the 90% throughput goal is still depicted in the graphs and throughput is evaluated to identify potential issues with well operation.

The P1PTS system extracted an average of 216 gpm (about 86% of design throughput) from the well field while operating during 2015. The calculated gpm accounts for water extracted from the well field during the time the system operates and is affected by the yield from each well, well downtime, or reduced flow required by the WWTF/irrigation system. Throughput was low from August through December due to problems with PTX06-EW-79. PTX06-EW-78A was also down in November and December, further affecting the throughput at the system.

Figure 2-4 reflects the well operation time by well. The loss of PTX06-EW-78A and 79 affected throughput later in the year. The average annual well field operation was about 87%. Pantex has continued to troubleshoot the issues at PTX06-EW-78A and 79. Additionally, Pantex completed the tie-

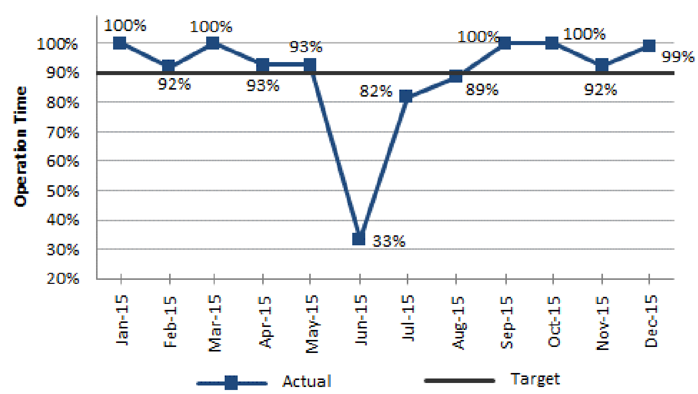

Figure 2-2. P1PTS Operation Time vs Target

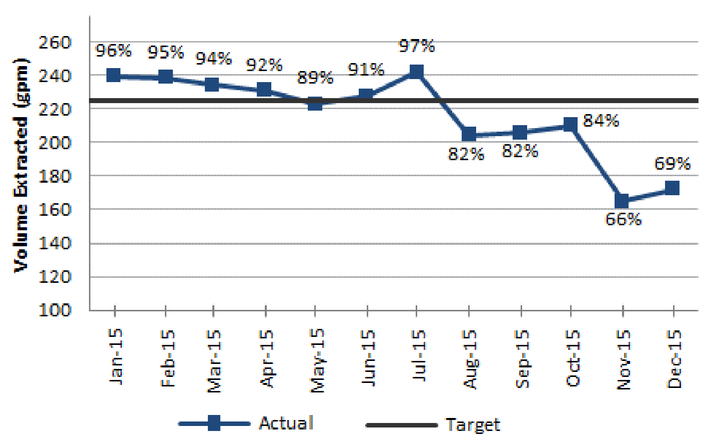

Figure 2-3. P1PTS Average GPM and % Capacity

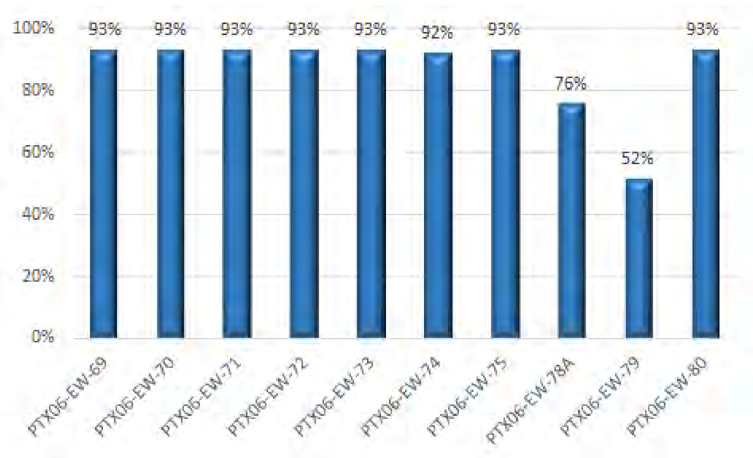

Figure 2-4. P1PTS Well Operation Time

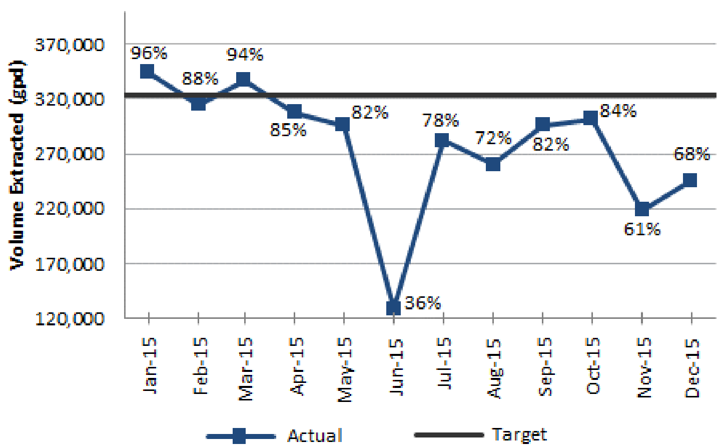

Figure 2-5. P1PTS Average GPD and % Capacity

in of PTX06-EW-81A in June 2016. It is expected that this well will help with meeting goals when other wells are down.

Figure 2-5 reflects the overall system efficiency considering system operation and well operation. The figure depicts the average gallons per day (gpd) by month, the percentage of design capacity achieved, and a 90% goal for the system. While treatment throughput was not a primary goal after June 2014, the 90% goal is still depicted in the graphs and throughput is evaluated to identify potential issues with well operation.

The system treated an average of about 278,000 gpd during 2015, about 77% of design capacity. The gpd is affected by system operational time, ability to extract water from the wells, and reduced flow to the WWTF and irrigation system. As discussed above, the overall operation and throughput was affected by shutdown due to the WWTF being unable to receive water and well downtime later in the year. Minor loss of operation occurred due to carbon change-outs, power losses, and repairs. The system was shut down due to the WWTF/irrigation system for 19 days in June and 5 days in July. The loss of PTX06-EW-78A and 79 affected the system August through December.

The system treated approximately 102 million gallons during 2015, with an average treatment volume of about 8.5 million gallons per month. The monthly treatment flow volumes are depicted in Figure 2-6. As discussed above, monthly total flow was low due to well downtime.

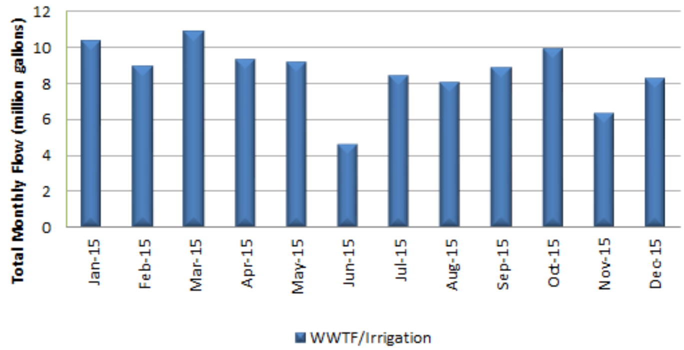

Figure 2-6. P1PTS System Monthly Total Flow

During 2015, the system removed approximately 46 lbs of RDX and 17 lbs of all other HEs (see Figure 2-7). The average removal rate of HEs was about 0.6 lbs per million gallons (lbs/Mgal) of treated water. The system has removed a total of 474 lbs of RDX and 187 lbs of all other HEs since startup in September 2008. HE mass removal is dependent on the wells operated within the system which affects the influent concentrations and throughput. The mass removal decreased throughout the year because the WWTF was unable to receive water and well downtime affected throughput. Three wells (PTX06-EW-75, 79, and 80) at the P1PTS have the greatest effect on the influent concentrations of HEs because they are in a more heavily contaminated portion of the plume. PTX06-EW-79 was not operated during November and December so this well also impacted mass removal.

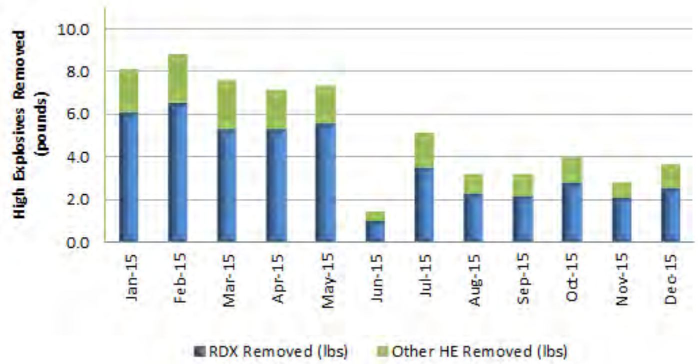

Figure 2-7. P1PTS Mass Removal by Month

Influent concentrations at P1PTS are also declining over time. The average influent concentration of RDX was 148 ug/L in 2009, while the average influent concentration in 2015 was 51.8 ug/L. The maximum influent RDX concentration in 2009 was 200 ug/L and 89 ug/L in 2015. This system primarily reduces saturated thickness and head on the southeast perched groundwater, although mass removal is also achieved.

Evaluation of effluent data indicates the system treated the recovered groundwater to concentrations below the laboratory PQL and the GWPS. The summary of effluent detections for COCs at the P1PTS is included in Table 2-1. The complete set of effluent data collected during 2015 is included in Appendix D electronic data tables.

Table 2-1. Summary of Effluent Detections at P1PTS

Sample Date	Analyte	Measured Value (ug/L)	Bkgd (ug/L)	> Bkgd?	PQL (ug/L)	> PQL?	GWPS (ug/L)	> GWPS?
6/1/2015	Chloroform	1.4J	NA	NA	3	N	80	N
11/2/2015	Chloroform	0.37J	NA	NA	3	N	80	N

J - Estimated value representing a concentration detected less than the practical quantitation limit and equal to or greater than the method detection limit (MDL).

Chloroform was detected in the effluent of the P1PTS. Pantex evaluated the laboratory data but found no errors in the reporting or analysis. Chloroform was not detected in the influent of those samples collected that month. The lab reported this value with a J-flag due to the value being reported between the MDL and PQL. Because chloroform was not detected in the influent sample collected at the same time, these detections are likely false positives.

Pantex also evaluates three extraction wells for evidence of contamination from the SWMU 5-12 ditch that could impact P1PTS. Wells in that area indicate the presence of perchlorate and 1,4-dioxane, which are not treatable by GAC. The data collected at the extraction wells does not indicate that those COCs are entering the system as the data were non-detect.

During 2015, the P1PTS was in its seventh year of operation. Operational performance was below goals for portions of the year. Performance was primarily affected by the WWTF/irrigation system due to heavy rainfall in 2015, with carbon change-outs and minor maintenance also affecting the system for short periods. Pantex reevaluated goals for the pump and treat systems to emphasize beneficial use of treated water while continuing to meet remedial action goals. These goals first emphasize meeting the 90% operational goal. However, when flow is restricted to the WWTF/irrigation system, flow is restricted at both systems to avoid injection. In portions of June and July 2015, the WWTF completely restricted flow, rather than partially restricting flow, so the operational goal could not be met during that time period. Pantex had previously drilled an additional extraction well to help address decreased throughput when wells were down. That well was tied into the system in June 2016 and should help increase throughput at the system.

2.1.2 Southeast Pump and Treat System

The SEPTS was originally installed at Pantex in 1995 as part of a treatability study. Since then, the pump and treat system has been expanded to meet the objectives of the environmental restoration project and final remedy established in the ROD and HW-50284. The SEPTS currently consists of a treatment building, 61 extraction wells, and 3 injection wells (see Figure 2-8). This system treats the water through a series of GAC vessels and ion exchange resin beds to reduce concentrations below the GWPS established in the ROD and HW-50284.

> **SEPTS Operational Goals**
>
> 1. 90% Operation Time with no injection when WWTF/Irrigation System can receive all treated water.
> 2. When the WWTF/Irrigation system is limiting flow, no injection at SEPTS with minimum flow rates (125 gpm) maintained at both systems. Injection is used at SEPTS to maintain minimum flow if flow is limited below 250 gpm for the two systems.
> 3. 90% of system treatment or well field capacity, whichever is lower.

The objective of the SEPTS is to remove contaminated perched groundwater and treat it for industrial and/or irrigation use. While the capability is being maintained for injection of treated water back into the perched zone, the intent is to permanently remove perched groundwater to gradually reduce the saturated thickness in this zone. This will achieve two important objectives:

1. Gradual reduction of the volume of perched groundwater (and contamination) moving downgradient toward the extent of the perched aquifer, and
2. A reduction in the head (driving force) for vertical migration of perched groundwater into the fine-grained zone (FGZ) and to the drinking water aquifer.

To meet these objectives, operational goals for this system were established, as presented in the highlight box. Goals are prioritized and will be met as conditions allow. The system is designed to treat up to 300 gpm or 432,000 gpd. The system has the capability to treat up to about 158 Mgal annually, if operated at 100%.

Figure 2-8. SEPTS Wells and Conveyance Lines

The SEPTS was shut down for upgrades starting September 29, 2014, with the system resuming operation May 11, 2015. The goals here are only applied during the months that the system operated.

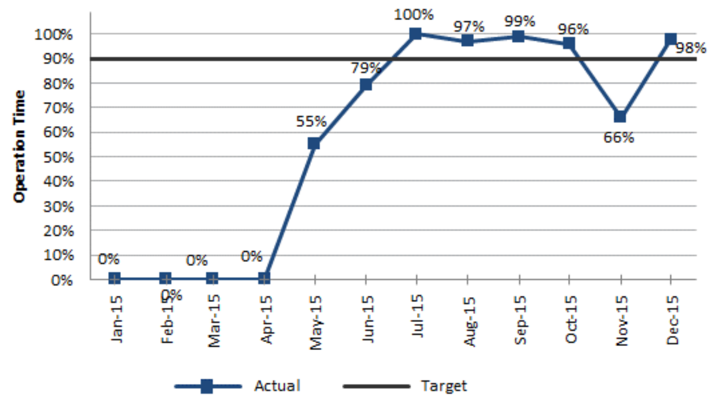

Figure 2-9. SEPTS Operation Time vs Target

The SEPTS met the system operational goal of 90% for the year by operating all or part of 221 of 235 days during 2015 with an average operational rate of 90% based on total hours operated versus total possible operation time. The percent operation time (hours/day) versus target is depicted in Figure 2-9. The system operation was affected in November to complete scheduled maintenance.

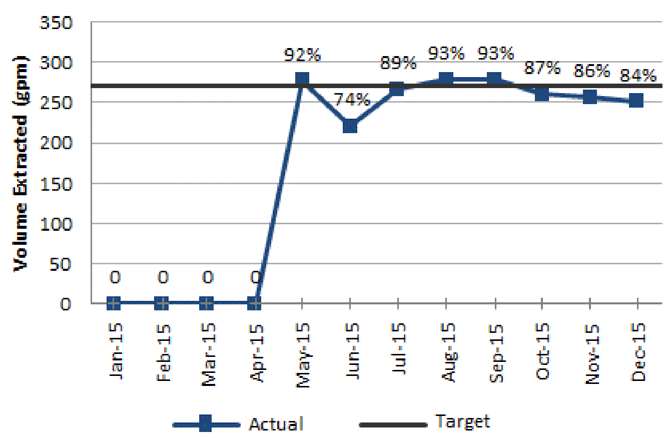

Figure 2-10. SEPTS Average GPM and % Capacity

Figure 2-10 depicts the average gpm extracted from all wells by month, the percentage of design capacity achieved, and goals for the system as a measure of well operation efficiency. While operational rate of the system was the prioritized goal after June 2014, the 90% throughput goal is still depicted in the graphs and well throughput is evaluated to identify potential issues.

The system extracted an annual average of 259 gpm (about 86% of design capacity) from the well field while operating. The calculated gpm accounts for water extracted from the well field during the time the system operated and is affected by the yield from each well, well downtime, or reduced flow required by the WWTF/irrigation system. Throughput was affected in June, October, November, and December. The WWTF/irrigation system was unable to receive full flow from the pump and treat systems during June, so flow was reduced to avoid excessive injection into the perched aquifer and still allow supply for the ISB injection. Many wells were down during October, November, and December.

Because the SEPTS has 61 operating wells, it is currently capable of extracting more water than the maximum treatment capacity of the system. For this reason, not all wells are pumping within the SEPTS on a daily basis. Estimated flow volumes for each well in the SEPTS are included in Appendix B.

Although perched groundwater levels are declining, the extractions rates from the well field currently exceed the capacity of the treatment system. Pantex extracts from the well field according to set priorities that best meet long-term objectives. The well extraction priorities are depicted in Figure 2-11. Seven priorities were set:

- Priority 1 Wells: Wells along the eastern edge of the well field (along the eastern fence line) to control the continued movement of water and contamination to thinner saturated zones at the margin of the perched aquifer where pump and treat technology is ineffective.
- Priority 2 Wells: Wells along the southern edge of the system that were installed to capture the highest concentrations of hexavalent chromium and to prevent further migration of the plume into areas where the FGZ is more permeable or to thinner saturated zones.
- Priority 3 Wells: Wells along the southeastern edge of the system that capture the highest concentrations of RDX and prevent further migration of the plume into areas where the FGZ is more permeable or to thinner saturated zones.
- Priority 4 Wells: Wells along the northern edge of the hexavalent chromium plume from the Zone 12 South area.
- Priority 5 Wells: Wells close to the highest concentrations of RDX. These wells will continue to capture movement of the RDX plume when the priority 3 wells are not pumping.
- Priority 6 Wells: Wells that capture the center of the hexavalent chromium plume from the former cooling tower on the eastern side of Zone 12.
- Priority 7 Wells: All other wells in the SEPTS. With the exception of EW-6 and 49, these wells will help with reducing saturated thickness in the perched aquifer and removing head that pushes the groundwater horizontally and vertically, but will not be as effective at controlling plume movement. EW-6 and 49 are in a low-transmissive zone so are very low-producing wells. For this reason, they were not placed in a high priority for pumping.

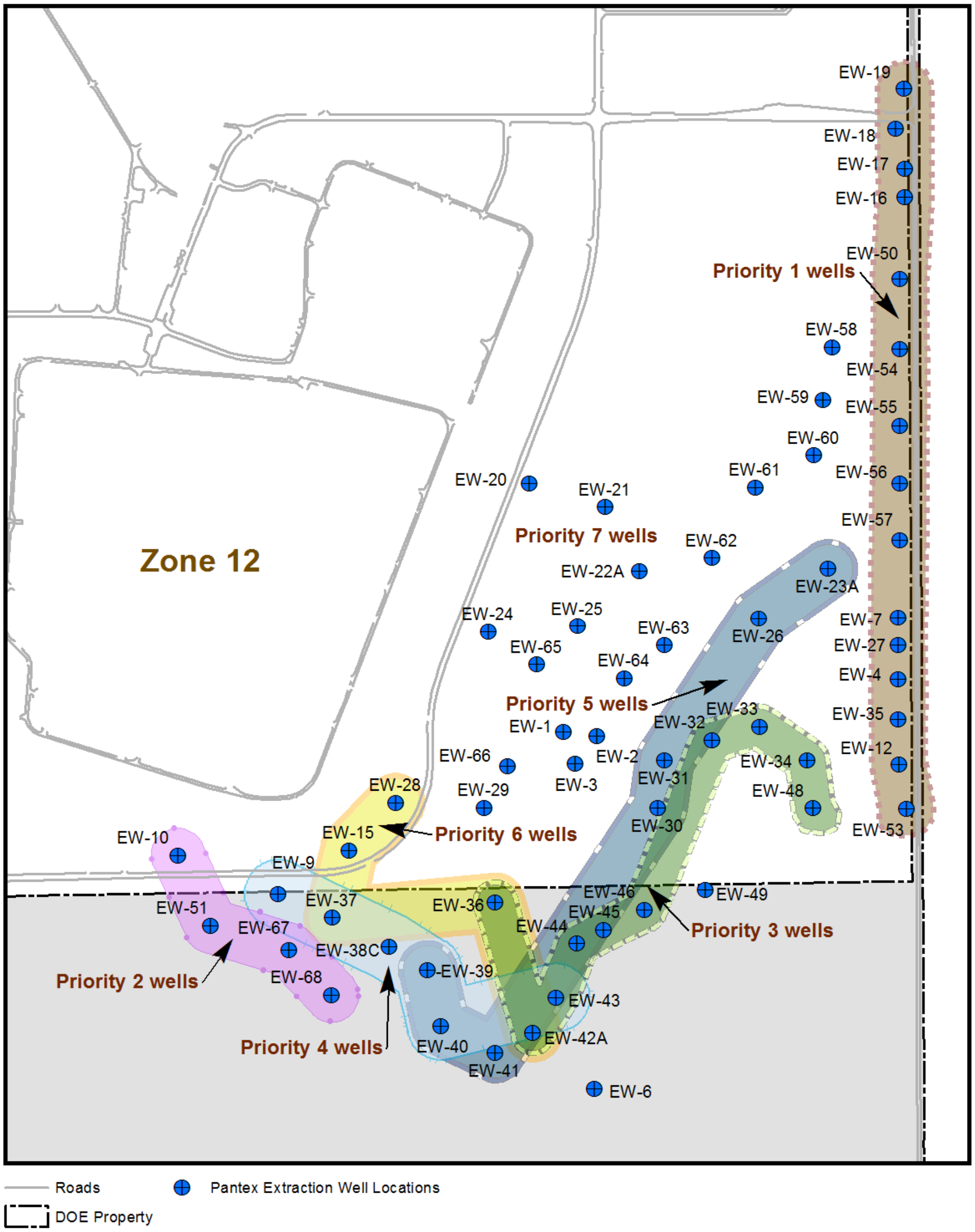

Figure 2-11. SEPTS Well Field Extraction Prioritization

This prioritization was implemented in 2009 after the newly installed extraction wells were placed into operation. Figure 2-12 provides the percentage of days wells were operated in the SEPTS. Priority 1-5 wells are operated at a higher frequency with the exception of a few wells that experience electrical, mechanical, or pumping problems that affected operation of the well. Priority 6 and 7 extraction wells are operated periodically to ensure that wells are operational. Priority 6 and 7 wells within the highest saturated zones are also operated at a

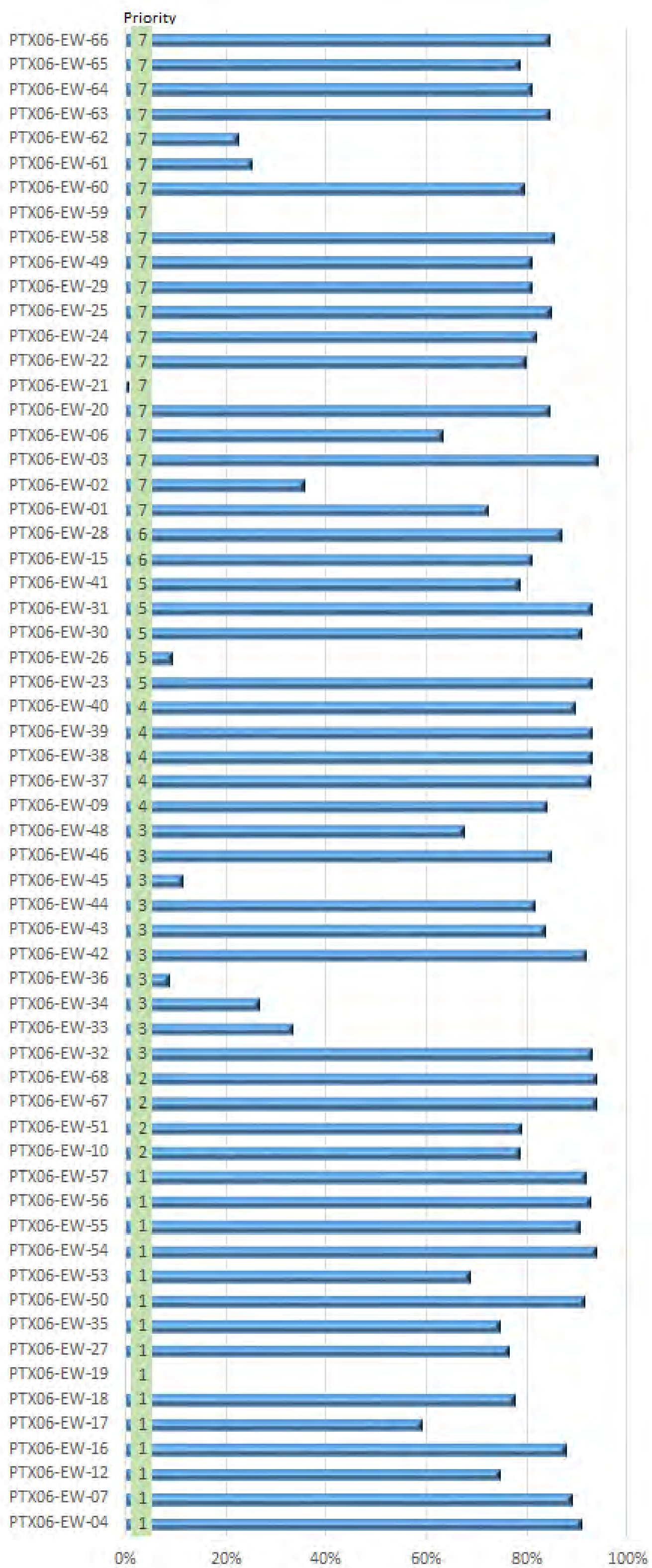

Figure 2-12. 2015 SEPTS Well % Operation

higher frequency to meet the goal of reducing the saturated thickness in those areas and to meet throughput goals for the system. Some of the high priority wells are in areas that have rapidly declining water levels and/or are in low-yield portions of the formation so pumps are cycling on and off causing the well to be operated intermittently. This effect is becoming more prominent in many of the wells in thin saturated portions of the perched aquifer as the system continues to remove water from the perched aquifer. PTX06-EW-21 has gone dry and was not used in 2014 or 2015 and will be evaluated for plugging. The prioritization of the well pumping is expected to be discontinued in the future as the capacity of the pump and treat system will exceed extraction rates.

Figure 2-13 reflects the overall system efficiency considering system and well operation. The figure depicts the average daily treatment rate (gpd) by month, target, and percentage of total capacity achieved at the SEPTS. The SEPTS treated an annual average of about 323,000 gpd (about 75% of design capacity) from May to December 2015 based on total possible hours of operation and total inflow from the well field.

The gpd is affected by system operational time, ability to extract water from the wells, and reduced flow to the WWTF and irrigation system. As discussed above, the system was affected by reduced throughput to the WWTF/irrigation system in June. Operational time was affected by the upgrades, maintenance (carbon and ion exchange change-out), floor maintenance, and power losses.

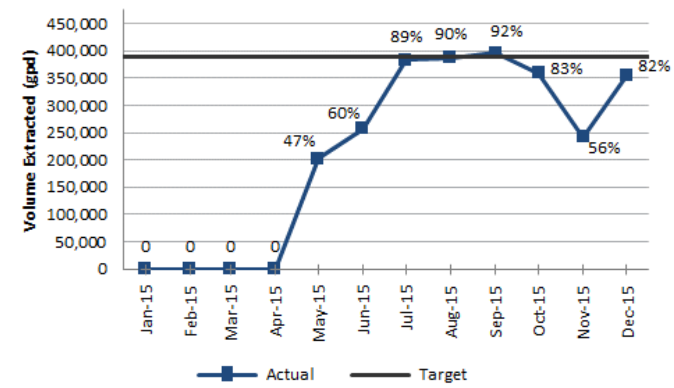

Figure 2-13. SEPTS Average GPD and % Capacity

The system treated over 80 million gallons of extracted water during 2015. The total volume treated by month and the final disposition of the treated water is depicted in Figure 2-14. This system released about 93% of the treated water to the WWTF for use in the irrigation system, injected about 4% into the perched zone, and the remainder was beneficially used for injection of amendment in the ISB systems. Pantex used injection for a limited time in June and July when the WWTF/irrigation system was unable to accept water and water was needed for the ISB injection. With the implementation of the new goals, Pantex expects to continue minimizing injection and reducing saturated thickness.

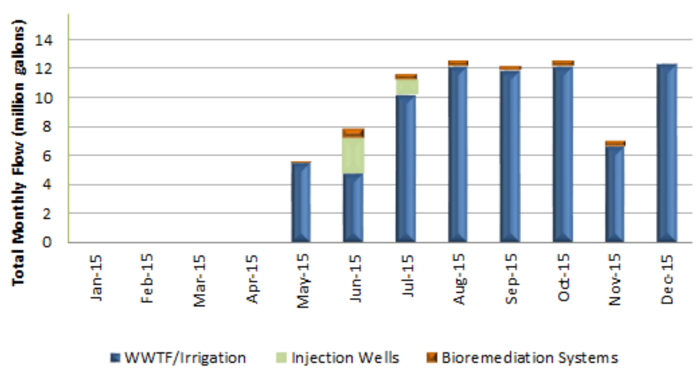

Figure 2-14. SEPTS Total Flow Volume and Disposition of Effluent

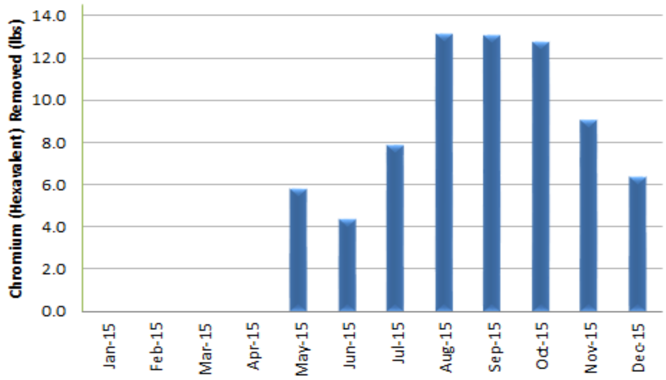

Figure 2-15. SEPTS Chromium Mass Removed by Month

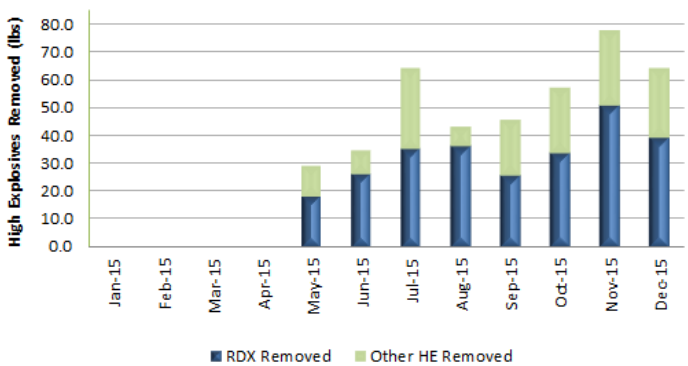

Figure 2-16. SEPTS High Explosive Mass Removed by Month

The SEPTS primarily removes RDX and hexavalent chromium from the perched groundwater. The system removed about 74 lbs of hexavalent chromium, 265 lbs of RDX, and 151 lbs of all other HEs during 2015. The total mass removed by month is depicted in Figure 2-15 and Figure 2-16. The average removal rate of hexavalent chromium was 0.9 lbs/million gallons (Mgal) of water, and the average removal rate for HEs was 5.4 lbs/Mgal of water. Mass removal was affected primarily by the shutdown of the system from January to May so these totals reflect mass removal for 7.6 months. Hexavalent chromium mass removal is declining because concentrations in PTX06-EW-51 are declining over time. This well was located in the heart of the hexavalent chromium plume south of Zone 12 and contributes heavily to the hexavalent chromium influent concentrations at the SEPTS. HE mass removal is affected by the wells that operate in the higher concentration portions of the RDX plume. Overall, the average concentrations of RDX in the SEPTS influent has declined with concentrations about 570 ug/L in 2009, the first year of the full remedial action to about 417 ug/L in 2015. Hexavalent chromium average influent concentrations in 2009 were about 214 ug/L while they were about 117 ug/L in 2015.

This system has treated approximately 10,858 lbs of HEs and 1,397 lbs of hexavalent chromium since it started operating. Evaluation of effluent data indicates the system treated the recovered groundwater to concentrations below the background or PQL and the GWPS provided in the SAP.

The summary of COC effluent detections at the SEPTS is included in Table 2-2. The complete set of effluent data collected during 2015 is included in Appendix D.

Table 2-2. Summary of Effluent Detections at SEPTS

Sample Date	Analyte	Measured Value (ug/L)	Bkgd (ug/L)	> Bkgd?	PQL (ug/L)	> PQL?	GWPS (ug/L)	> GWPS?
12/2/2015	Total Chromium	1.1J	31.8	N	10	NA	100	NA

J = Estimated value representing a concentration detected less than the practical quantitation limit and equal to or greater than the method detection limit (MDL).

In accordance with the *Contingency Plan*, Pantex also evaluates five extraction wells for evidence of contamination from the Zone 11 area that could impact SEPTS. Due to removal of perched water, flow directions are changing along the eastern side of Zone 11; therefore, it is possible that perchlorate and 1,4-dioxane, which are not treatable by GAC, could move into the southwestern portion of the SEPTS extraction well field. The data collected at the extraction wells do not indicate that those COCs were entering the SEPTS well field during 2015 as the data were non-detect. Upgradient data at monitoring well PTX08-1008 indicates the presence of perchlorate, but it is expected that it will take some time for perchlorate to move downgradient to the extraction wells.

Overall the SEPTS continues to remove and treat water from the well field. Operational time and treatment throughput was near or exceeded goals when operating. The system was primarily affected by the system upgrades completed in May 2015, regular maintenance, and restrictions from the WWTF. However, the system was operated with a low injection rate, with only 4% of the total treated water injected. The upgrade completed in May provides for redundancy resulting in consistent operation over time and increases overall throughput of the system by allowing water to be routed through two chromium vessels at the same time when greater throughput is needed to support irrigated crops. With the changes in chromium treatment process, the system can exceed the original design criteria of 300 gpm when required.

2.2 ISB Systems

Pantex has installed and operates two ISB systems as part of the final Remedial Action for groundwater. One system is southeast of Pantex Plant on TTU property and one is south of Zone 11. In 2015, the ISB systems consisted of 94 treatment zone injection wells and 12 in situ performance monitoring wells.

The objective of the ISB systems is to establish an anaerobic biodegradation treatment zone capable of reducing COC concentrations to the GWPS by injecting the necessary amendments and nutrients to stimulate resident bacteria. The bacteria first consume oxygen and then in turn consume other electron acceptors, creating reducing geochemical conditions. Under reducing conditions, biotic and abiotic treatment mechanisms are carried out to remove contaminant mass from groundwater. Regular injections of amendment are essential to maintaining the health of the treatment zone.

2.2.1 Zone 11 ISB

2.2.1.1 History of Zone 11 ISB

The Zone 11 ISB system is on Pantex Property, south of Zone 11 (see Figure 2-17). The system, as operated in 2015, consists of 51 injection wells and 6 downgradient performance monitoring wells installed in a zone of saturated thickness of approximately 15-20 ft. The system, originally consisting of 23 wells, was installed by March 2009. An additional nine wells were installed in September 2009 to better treat the perchlorate plume on the eastern side and the TCE plume on the western side of the ISB. One of the original wells was removed from active injection in 2013 (PTX06-ISB082). Pantex expanded the system in late 2014 to include an additional 20 injection wells (18 new wells and 2 previously installed pump test wells), 2 new downgradient ISPM wells, and 3 treatment zone monitoring wells (TZM) (1 TZM well was previously installed as a pump test well) that will not receive injection. Two additional TZM wells were also installed in the original system, on the TCE side. The two wells are expected to eventually replace the monitoring of injection wells on that side of the system. The expansion was installed to address the plume that extended northwest of the system.

The injection wells were drilled in a line perpendicular to the hydraulic gradient so water flowing through this zone will be treated before it reaches the area beneath Texas Tech property near Playa 4. Based on the rate of perched groundwater flow and estimated amendment longevity, injections were estimated to be necessary about every 12 to 18 months. Pantex is currently scheduling rehabilitation and injection activities every 12 months based on data collected in the treatment zone. Seven injection events have been completed for this system. Table 2-3 provides the list of injection events and date of completion.

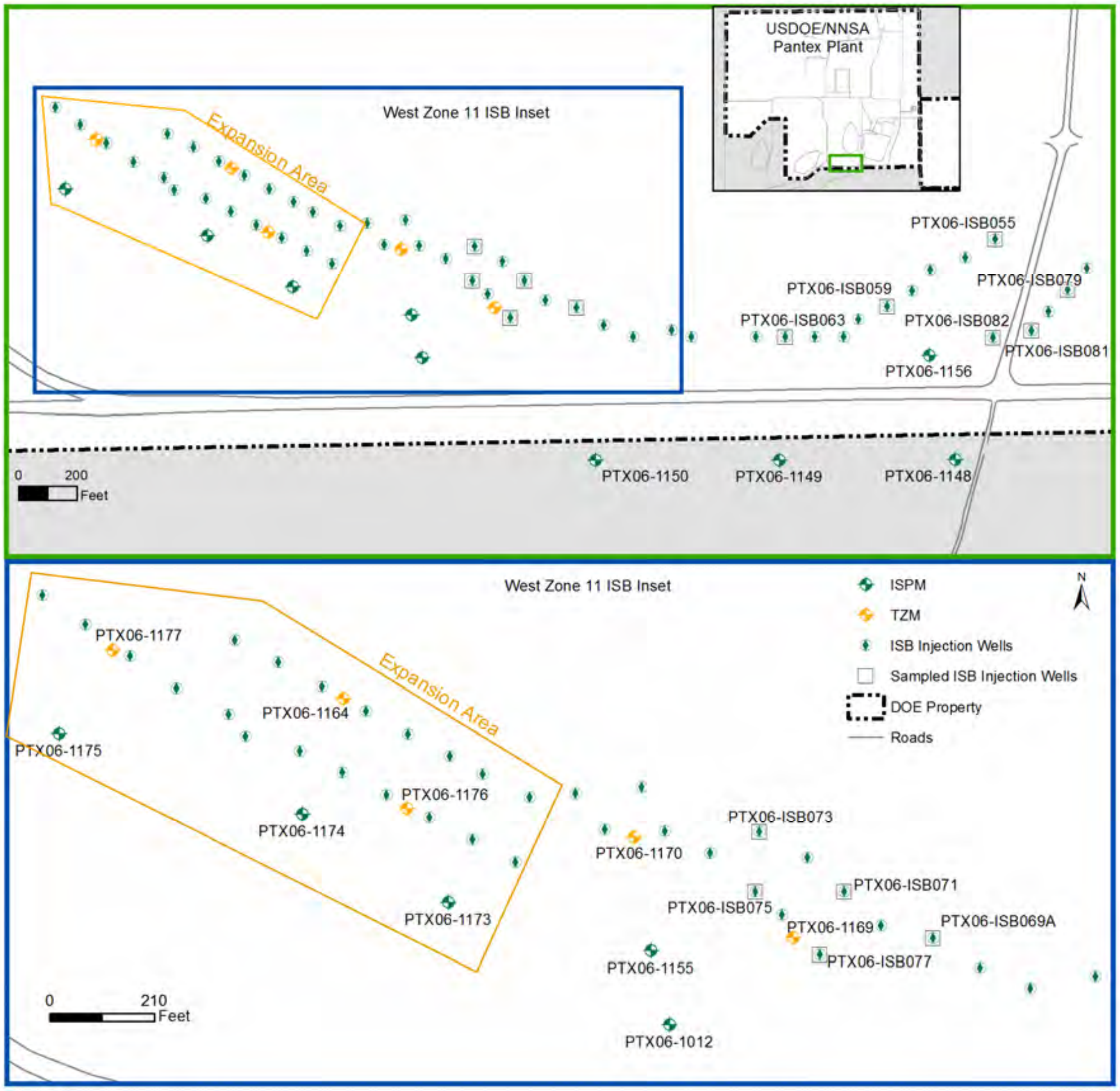

Figure 2-17. Zone 11 ISB Treatment Zone and Performance Monitoring Wells

Table 2-3. Zone 11 ISB Injection Events

Injection Event	Completion Date
1	June 2009 (original 23 wells) November 2009 (9 new wells)
2	September 2010
3	October 2011
4	September 2012
5	July 2013 (31 wells)
6	July 2014 (31 wells + 2 converted pump test wells)
7	November 2015 (51 wells)

During 2015, Pantex monitored four treatment zone (TZM) wells, seven injection wells and three downgradient performance monitoring wells to evaluate the Zone 11 ISB (see Figure 2-17). Pantex also monitors three treatment zone wells in the second row to better evaluate conditions in higher concentration and/or flow areas. An additional treatment zone well (PTX06-1169) was installed to potentially replace nearby monitored injection wells PTX06-ISB071 and PTX06-ISB077. However, these two injection wells are defined as monitoring points in the SAP. Therefore, PTX06-1169 will be sampled concurrently with the monitored injection wells and a SAP revision will be requested if the data collected in the new well more accurately represents treatment zone conditions. Pantex will collect baseline data from the three new downgradient wells in 2016 and begin monitoring those regularly in 2017.

One of the monitored treatment zone wells (PTX06-ISB075) is a replacement of the original ISB injection well but is not currently used for injection. The original PTX06-ISB075 well continues to receive amendment and will be used until the well fails.

Based on a previous recommendation, Pantex discontinued injection into PTX06-ISB082 after the fifth injection event in 2013 to evaluate the need for continued injection into the second row wells. Because mild reducing conditions are required for treatment of perchlorate, the eastern side of the ISB may require less amendment injection to continue to treat the plume. PTX06-ISB082 was rehabilitated to remove excessive biogrowth during the sixth injection event and was sampled in 4^{th} quarter 2014 for the first time in two years. Pantex evaluated the well in the *4th Quarter 2015 Progress Report*. Pantex recommended discontinuing injection into the second row of wells on the perchlorate side based on information collected at PTX06-ISB082 and PTX06-1156.

Data collected since 2014 indicate that PTX06-ISB082 maintains deep reducing conditions and has ample food source for the continued degradation of perchlorate, even without injection for two events. The current downgradient ISPM well, PTX06-1156, continues to indicate that perchlorate is treated, even though it is downgradient of a single row of injection wells. The *Design Basis Document* (Aquifer Solutions, 2008) did not include a second row of wells for the perchlorate portion of the Zone 11 ISB. Pantex installed those wells to capture a high-concentration portion of the plume that had moved past the first row of wells. Those wells have adequately reduced perchlorate and based on data evaluated in PTX06-ISB082 and PTX06-1156, treatment can be discontinued in those wells. Pantex currently monitors PTX06-ISB082 in accordance with the SAP. Although not included in the SAP, a second well (PTX06-ISB081) has been monitored to evaluate the effectiveness of the treatment zone. Pantex will change that monitoring point to PTX06-ISB079 to provide better coverage of the monitoring of the treatment zone on the perchlorate side. These changes are planned for implementation in 2016. However, Pantex will rehabilitate the second row wells in 2016 to provide continued sampling opportunities in those wells.

The *In Situ Bioremediation Corrective Measures Construction Zone 11 South Implementation Report* (Aquifer Solutions, 2009a) documents the implementation of the Zone 11 ISB. That report was included with the *Final Pantex Interim Remedial Action Report* (IRAR) (Pantex, 2010a). The installation of the nine new wells is documented in the *Well Installation Implementation Report Perched Aquifer Injection Wells for the In Situ Bioremediation System* (Stoller, 2009) that was included in the *2009 Annual Progress Report* (Pantex, 2010b). Pantex expanded the Zone 11 ISB in 2014 and the design report for the equipment pad, road, and water supply was included in the *2014 Annual Progress Report* (Pantex, 2015). The well design followed the original design document for the Zone 11 ISB (Aquifer Solutions, 2008). The well installations are documented in the *Well Drilling Implementation* Report (Trihydro, 2014) also included in the *2014 Annual Progress Report*. The as-built drawings for the pad, road, and water supply lines completed in 2015 are included in Appendix H of this report. The *Bioaugmentation Implementation Plan* (Trihydro, 2015) provides the detailed plan for injection of DHC.

2.2.1.2 Operation of Zone 11 ISB

Pantex completed a seventh injection event at the Zone 11 ISB during 2015 which included amendment injection and bioaugmentation with DHC. Rehabilitation of wells was performed from April to June and injection was performed from May to November. The injection was lengthy during this event due to the process of setting up a bioreactor-type approach for injecting the DHC with reduced water.

The well maintenance and post-injection reports for the Zone 11 ISB can be found in Appendix H of this report. Information regarding the effectiveness of treatment is provided in Section 3. A summary of the maintenance and injection is provided here.

To prepare for the injection, several activities were performed to determine if the well screens and/or the sand filter pack may be impaired due to biofouling. The following rehabilitation activities were performed from April to June 2015:

1. Pre-maintenance hydraulic testing of 33 wells to quantify the transmissivity of the formation immediately surrounding injection wells. The wells tested included the original 31 wells receiving injection and the 2 converted pump test wells (now PTX06-ISB091 and ISB092). Constant-rate injection testing was used to calculate transmissivity.
2. Well maintenance at 34 injection wells including Welgicide® reagent application followed by physical development using surging/brushing and airlifting techniques. The old PTX06-ISB075 well was maintained as it will continue to be used for injection until the well fails. The newly installed replacement well is used to monitor the treatment zone. PTX06-ISB082 was maintained a second time to prevent further

biofouling and to ensure continued sampling. Since no injection occurs in this well, no hydraulic testing was performed.

3. Jetting was performed at seven wells to evaluate more aggressive means of physical maintenance rather than use of airlifting techniques. These wells were selected based on declining trends in historical amendment injection rates or hydraulic conductivity and specific capacity during the post-maintenance injection tests.
4. Follow-up hydraulic testing was performed at the 31 wells where maintenance was performed.

Overall, hydraulic testing results indicate transmissivity to be stable or increasing at 20 of 31 wells with a four-year data record, and is decreasing at 11 of 31 wells. After evaluation, eight wells were identified for more aggressive maintenance methods for future maintenance, such as jetting. Jetting produced mixed results for improvement of the well performance. However, Pantex will continue to use this method to more aggressively maintain wells that are declining in performance and will evaluate the results based on a larger implementation of the method.

After rehabilitation was complete at each well, injection activities were started at the wells. Of the 52 injection wells, 51 received amendment injection during the 2015 injection event. PTX06-ISB082 no longer receives injection. Dosing of amendment was calculated according to the volume of groundwater to be treated and a target amendment concentration of at least 5% per the design basis. To optimize the amendment injection, a ranking procedure was used at each well that considered groundwater flux and COC concentration. A higher ranking represented higher flux and COC concentration. Since the flux and COC concentration would dictate potentially faster rates of amendment consumption, the amendment dosage was optimized considering these parameters. Additionally, the volume of mixed amendment was increased in the western portion of the well field where the system treats TCE. Since the Southeast ISB is declining in water levels and less amendment is needed for injection in that system, additional amendment from that area was used in the Zone 11 ISB expansion area to boost distribution of the amendment and establishment of the reducing zone.

Bioaugmentation occurred at 14 of the 51 wells. Wells on the western side of the established ISB received the DHC culture and amendment. The 20 newer wells in the expansion zone were not bioaugmented in 2015. These wells will be bioaugmented once conditions conducive to growth and survival of the DHC are established.

Injection activities at each well consisted of the injection of mixed amendment, targeted at the concentration calculated as described, followed by a period of a water-only flush. The flush water represented approximately 10% of the target injection volume at each well. The intent of the water-only flush is to increase the radius of influence of the amendment delivery and to transport more of the amendment away from the direct vicinity of the well to potentially lessen the degree of biofouling. The target percentages and volumes also accounted for the water-only flush.

The target amendment concentration was optimized and increased as described above and the target dosage for the wells ranged from 6.0% to 8.7%. As calculated after completion of injection, the actual dosage range for most wells were very close (within 5%) or on target, with a range of 5.0% to 9.3% in all wells. While the Design Basis target was achieved in all wells, there were problems encountered during injection. Pantex is continuing to see a decline in the injection rate across most of the original injection wells. The injection rate at one well (PTX06-ISB060A) dropped so low that the injection equipment could not continue to operate at the low rates (less than 5 gpm). Therefore, the target amount for this injection event could not be achieved in that well. It is likely that the well will not recover for the 2016 injection, even after rehabilitation. Several other wells were observed to only have injection flow rates of less than 6 gpm during the 2015 injection event.

The bioaugmentation wells were injected with amendment and anaerobic makeup water to preserve the DHC culture that was injected. KB-1® microbial culture from SiREM laboratories was used for injection. To preserve the DHC culture, the makeup water was used when geochemical ranges of less than 0.2 mg/L DO, less than or equal to -75 mV oxidation reduction potential (ORP), and pH between 6.0-8.5 was achieved. These parameters were maintained during the complete injection. The inoculation of KB-1® occurred at two select volume intervals, the first interval delivered after 5-10% of total volume and the second interval delivered at 80 to 90% of the total injected volume. Flow rates for bioaugmentation wells were lower than perchlorate injection wells to accommodate higher residence time for newly introduced makeup water to reduce to geochemical specifications. The flush volume of the anaerobic water was reduced to 300 gallons at bioaugmentation wells to ensure the final dose of microbial culture was in the presence of amendment within the formation.

As discussed in the *Bioaugmentation Implementation Plan* (Trihydro, 2015), there is uncertainty regarding transport of DHC cells away from the well during bioaugmentation. Therefore, there is some uncertainty with the degree to which DHC cell density were diluted by anaerobic amendment injection. The DHC cell density in the KB-1® culture ranged from $2x10^{11}$ to $3x10^{11}$ DHC cells per liter. Assuming complete dilution of culture with makeup water based on the approximately 10 liters of bioaugmentation culture added versus the approximately 50,000 gallons of anaerobic mixed amendment that was injected, the DHC cell density may have been diluted to approximately $2x10^{7}$ DHC cells/liter. Because of mixing of injected fluids and groundwater, further dilution likely occurred. The bioaugmentation design basis assumed that 2×10^6 DHC cells/liter would be emplaced in the treatment zone during injection, and that growth of DHC populations over time would lead to the target cell density of 1×10^7 DHC cells/liter in groundwater. This basis assumes even distribution through the formation during injection. However, there will be some heterogeneity based on the delivery at two different intervals and the capability of the culture to be pushed out into the formation.

2.2.1.3 Future Operation of Zone 11 ISB

Pantex has observed problems with sampling and continued injection of some wells in the Zone 11 ISB established system. In early 2016, PTX06-ISB071 and PTX06-ISB077 had viscous amendment/biomass in the well which causes the sampling equipment to become blocked and samples are difficult or impossible to obtain. As discussed above, injection flow rates are declining in most of the wells in the original ISB system. Pantex is exploring possible options for continuing injection and sampling at those wells. The options considered at this time include:

- Pausing injection at some wells to allow the amendment and biogrowth to dissipate. These wells would continue to be rehabilitated to assist with continued dissipation of biomass and amendment. This approach worked at PTX06-ISB082 to allow sampling to continue. The pausing of injection could be staggered throughout the well field to ensure that the treatment zone receives injection each year. The Remedial Design/Remedial Action (RD/RA) Work Plan provides for injection every 12-24 months and this approach would be in-line with those requirements.
- Lengthening injection on the perchlorate side of the ISB. Mild reducing conditions (approximately 0 mV) are required for treatment of perchlorate. Currently, Pantex has achieved deep reducing conditions (less than -75 mV since 2011 in the injected wells) that are appropriate for reducing TCE. However, Pantex will also continue researching the possibility that these conditions may be allowing some break down of 1,4-dioxane as evidenced by downgradient data. Breakdown of 1,4-dioxane is only observed on the eastern side of the ISB at this time.
- Minimizing/removing lactate in the amendment. This was originally used to help boost the reducing conditions when the ISB was first installed. However, the lactate may be causing some of the biomass/amendment mass that could be interfering with sampling and injection. The system may not need continued lactate injection to maintain the reducing conditions once the system is established. The *Design Basis* requires the use of lactate at concentrations between 0 and 4%.
- Pantex has moved to sampling of treatment zone monitoring (TZM) wells that do not receive injections on the TCE (west) side of the ISB. One well, PTX06-1169 is not

currently used for monitoring. Once the SAP can be updated, Pantex will move the sampling from nearby injection wells to that TZM well. Pantex collected data from that well for the first time in early 2016 and will monitor that well periodically for comparison to other TZM well data until the SAP is modified.

For the 2016 injection event, Pantex will implement the following to possibly continue the use of the current injection wells.

- Pause injection at two wells on the perchlorate (eastern) side of the Zone 11 ISB for the 2016 injection event. PTX06-ISB058 and PTX06-ISB060A experienced problems with injection flow rates during 2015. It is unlikely that PTX06-ISB060A will be able to receive injection this year. However, these wells will be rehabilitated to assist with dissipation of amendment and biomass from the well and filter pack. Those wells are also scheduled for more aggressive rehabilitation using jetting techniques. Additionally, Pantex has collected field data to aid in determining the impact to the reducing conditions at the well. ORP, dissolved oxygen, and pH were collected prior to rehabilitation and will be collected until the next injection event to monitor changes in the reducing conditions. These wells will be used as a test case for pausing injection in other parts of the system in the future.
- Continue injecting into all other wells to provide as much amendment as possible to the treatment zone. Several wells on the perchlorate side and a few wells on the TCE side where bioaugmentation occurred are demonstrating problems with injection. Pantex will deliver as much amendment as possible into these wells. The wells will be evaluated, along with the data collected at wells where injection has been paused to determine if pausing injection for one year will assist with continuing injection. If the data do not support pausing injection, Pantex will begin replacing injection wells, as necessary.
- Minimize the use of lactate in the amendment in select wells in the Zone 11 ISB. To comply with the *Design Basis*, lactate will continue to be used, but will be minimized (0.2%) in wells that have been bioaugmented and select wells on the perchlorate side of the ISB where the treatment zone is established. This will allow Pantex to evaluate whether this will minimize the amendment/biomass that is affecting the injection wells. Additionally, Pantex will use this opportunity to evaluate the effect of lactate on pH immediately following injection. It is believed that the use of lactate may cause a drop in pH immediately following injection and may affect the DHC that were injected in 2015. pH drops below 5 can be detrimental to the DHC.
- Use anaerobic makeup water for amendment injection in the wells that have been bioaugmented. Initial DHC counts reported by the laboratories indicate that the DHC counts were lower than expected (in the $1x10^3$ to $1x10^4$ cells/L range). Use of

anaerobic amendment water could avoid the loss of the DHC that have been established.

2.2.2 Southeast ISB

2.2.2.1 History of Southeast ISB

The Southeast ISB System is on TTU property south of Pantex. The system was installed in 2007 as an early action and consists of 42 injection wells within the treatment zone and 6 performance monitoring wells (see Figure 2-18). The injection wells were drilled in a line perpendicular to the hydraulic gradient so the water flowing through the treatment zone will be treated before reaching the area beneath Texas Tech property where the FGZ becomes less resistant to vertical migration.

Figure 2-18. Southeast ISB Treatment Zone and Performance Monitoring Wells

Based on the rate of perched groundwater flow and estimated amendment longevity, injections were estimated to be necessary about every 12 to 24 months. Pantex has currently scheduled injections about 18 months apart. Five injection events have been completed for the Southeast ISB as provided in Table 2-4.

Table 2-4. Southeast ISB Injection Events

Injection Event	Completion Date
1	March 2008
2	April 2010
3	May 2012
4	September 2013
5	April 2015

Areas within and surrounding the Southeast ISB continue to demonstrate that water conditions are changing. ISPM wells PTX06-1045- and PTX06-1118 have not been sampled since 2009 and 2010, respectively, as water levels have declined in the wells. Downgradient ISPM well PTX06-1123 has not been sampled since late 2015 because of declining water levels. PTX06-1167, installed to the north of the system in July 2013 to evaluate the water and COCs entering the western side of the system remains dry. As depicted in Figure 2-18, several areas inside the treatment zone are dry and injection does not typically occur in those wells. Other treatment zone wells also indicate changes in the system either due to the influence of the pump and treat systems or impacts to the well or formation. PTX06-ISB019 has not been sampled since late 2013 because there is not enough water to sample. PTX06-ISB030B was sampled early in 2015 but could not be sampled after injection. PTX06-ISB042 could not be sampled for most of 2015. PTX06-ISB048 could not be sampled following injection. It is expected that areas of the Southeast ISB may no longer require injection and/or that the period of time between injections may be increased in the future.

As provided in the SAP, eight treatment zone wells, five downgradient performance monitoring wells, and one upgradient performance monitoring well are used to evaluate the Southeast ISB. Two performance monitoring wells (PTX06-1045 and PTX06-1118) for the Southeast ISB have gone dry and have not been monitored since 2009 and 2010, respectively. A third ISPM well, PTX06-1123, has not been sampled since late 2015 due to declining water levels.

The *Revised Implementation Report, Southeast Plume In Situ Bioremediation Corrective Measures Design and Construction* (Aquifer Solutions, 2009b) documents the design and construction of the Southeast ISB. That report was included in the *Final Pantex Interim Remedial Action Report* (IRAR) (Pantex, 2010a).

2.2.2.2 Operation of Southeast ISB

Pantex completed a fifth injection event for the Southeast ISB in 2015. Rehabilitation of wells was performed from October 2014 to April 2015 and injection was performed from March to April 2015.

The well maintenance and post-injection reports for the Southeast ISB can be found in Appendix H of this report. Information regarding the effectiveness of treatment is provided in Section 3. A summary of the maintenance and injection is provided here.

To prepare for the injection, several activities were performed to determine if the well screens and/or the sand filter pack may be impaired due to biofouling. Rehabilitation started early at most wells, in October 2014 and was finished in December. The three jetted wells were completed in April to correspond to the jetting activities at the Zone 11 ISB. The wells that were rehabilitated early were sampled between rehabilitation and injection. The following rehabilitation activities were performed from October to December 2014 and in April 2015:

1. Pre-maintenance hydraulic testing of 36 wells to quantify the transmissivity of the formation immediately surrounding injection wells. Constant-rate injection testing was used to calculate transmissivity.
2. Well maintenance at 34 injection wells including Welgicide® reagent application followed by physical development using surging/brushing and airlifting techniques.
3. Jetting was performed at three wells to evaluate more aggressive means of physical maintenance rather than use of airlifting techniques. One well received Welgicide® reagent and jetting while the other two were evaluated for jetting only. These wells were selected based on declining trends in historical amendment injection rates or hydraulic conductivity and specific capacity during the post-maintenance injection tests.
4. Follow-up hydraulic testing was performed at the 36 wells where maintenance was performed.

Post-maintenance injection tests were compared from maintenance events from 2012 to 2015. Based upon constant-rate injection results, there appears to be an overall decrease in transmissivity in 2015 relative to post-maintenance tests from previous maintenance events. Jetting successfully increased transmissivity at one well, PTX06-ISB037, which was treated only using jetting. However, the other two wells transmissivity declined further after testing. This method produced mixed results at the Zone 11 ISB as well. However, the data indicate that PTX06-ISB030B, also treated by jetting and Welgicide®, was able to be sampled after rehabilitation. The well was not sampled in 2014 as there was not enough water present.

After rehabilitation was complete at each well, injection activities were started at the wells. Of the 42 injection wells, 36 received amendment injection during the 2015 injection event. PTX06-ISB033 and PTX06-ISB034 have been dry previously, but injection was completed in 2013 and was continued in 2015 to attempt to influence the downgradient well PTX06-1153.

Dosing of amendment was calculated according to the volume of groundwater to be treated and a target amendment concentration of at least 5% per the design basis. To optimize the amendment injection, a ranking procedure was used at each well that considered groundwater flux and COC concentration. A higher ranking represented higher flux and COC concentration. Since the flux and COC concentration would dictate potentially faster rates of amendment consumption, the amendment dosage was optimized considering these parameters. Since the Southeast ISB is declining in water levels, additional amendment from that area was used in the Zone 11 ISB expansion area to boost distribution of the amendment and establishment of the reducing zone.

Injection activities at each well consisted of the injection of mixed amendment, targeted at the concentration calculated as described, followed by a period of a water-only flush. The flush water represented approximately 10% of the target injection volume at each well. The intent of the water-only flush is to increase the radius of influence of the amendment delivery and to transport more of the amendment away from the direct vicinity of the well to potentially lessen the degree of biofouling. The target percentages and volumes also accounted for the water-only flush.

A minimum injection volume of 10,000 gallons was specified at each injection well location irrespective of the apparent saturated thickness. This change was made because of uncertainty in how injection volume relates to radius of influence when saturated thickness is very low. A second change was to increase the total volume of fluids injected into the SEISB System as a whole so that the total volume would be comparable to historical injection events (approximately 750,000 gallons), rather than the volume calculated from saturated thickness (approximately 600,000 gallons).

The target amendment concentration was optimized and increased as described above and the target dosage for the wells ranged from 5.5% to 6.8%. As calculated after completion of injection, the actual dosage range for most wells were very close or on target, with a range of 5.4% to 7.1% in all wells. While the design document (Aquifer Solutions, 2009b) target was achieved in all wells, there were problems encountered during injection. Pantex is also observing a decline in the injection flow across some injection wells. The four wells that have the greatest decline in injection rates have decreased by over 80% since baseline and had injection rates of 4 gpm or less. As with the Zone 11 ISB, Pantex will need to consider pausing injection or replacing wells to continue injection. However, the Southeast ISB also has declining water levels, so some wells may no longer require injection in the future. The future consideration and approaches are provided in the section below.

The next injection event will start in August 2016 and will be reported in the 2016 annual report.

2.2.2.3 Future Operation of Southeast ISB

Pantex has observed problems with sampling and continued injection of some wells in the Southeast ISB system. As discussed above, injection flow rates are declining in some wells. Pantex is exploring possible options for continuing injection and sampling at those wells. The options considered at this time include:

- Pantex is currently updating the conceptual site model for the Southeast ISB. This will help evaluate the areas where groundwater flux is still occurring and areas that may no longer be receiving much water. This will be a first step in evaluating the timing of future injections. Portions of the system may be injected at varying timeframes based on the conceptual site model. Although the timing of injections is generally framed as 12-24 months in the *Remedial Design/Remedial Action Work* Plan (Pantex, 2009c), there is flexibility provided for the timing of injections once the system is established and water flux is affected by upgradient removal. Additionally, the need for flexibility in timing of injections is also recognized in the design document for the Southeast ISB (Aquifer Solutions, 2009b).

- Pausing injection at some wells to allow the amendment and biogrowth to dissipate. These wells would continue to be rehabilitated to assist with continued dissipation of biomass and amendment. This approach may be useful in areas where there is minimal groundwater flux from the upgradient areas.
- Pantex will evaluate the timing of injection with regard to data that have been collected at the Pilot Study for the ISB systems. The Pilot Study wells are located to the northwest of the current Southeast ISB system and were used as the basis for the current ISB design. Pantex has continued to collect data at monitoring wells within the treatment zone, downgradient of the injection wells. The data indicate that HEs and chromium continue to be reduced below the GWPS in three of four wells, even though the last injection occurred in 2006 and only two injections occurred at that system. This indicates that there may be recycling of biomass within the system so that continual amendment injections are not required to maintain the treatment zone.

For the 2016 injection event, Pantex will implement the following:

- To evaluate flux into and around the Southeast ISB, Pantex has identified a select set of wells to evaluate using passive flux meters. Those meters will be installed during 2016 to provide information for the update of the conceptual site model.
- Pantex will not inject into wells that have no water after rehabilitation efforts have been completed. Pantex is anticipating injecting only 20 of the 42 wells at the Southeast ISB during 2016.

2.3 Soil Remedial Actions

Soil remedial actions at Pantex include the Burning Ground SVE system, landfill covers, ditch liners, and institutional controls (see Section 1.2.1). The O&M of the soil remedies are discussed in these sections.

2.3.1 Burning Ground SVE

The Burning Ground SVE system was installed in February 2002 as an interim remedial action and became the final remedial action with the issuance of the ROD and HW-50284. The SVE system was installed to address the remediation of VOCs present in the shallow and intermediate depth vadose zone at the Burning Ground (SWMUs 47 and 38). The system was designed to remediate soil gas in the areas beneath the solvent evaporation pit/chemical burn pit (SEP/CBP) and the Landfills north of the SEP/CBP. From the RCRA Facility Investigations, original VOC concentrations at the Burning Ground were as high as 962 parts per million by volume (ppmv) in the shallow zone (20-90 ft bgs), based on wells in place at that time. However, higher concentrations were found in well SVE-S-20 when the SVE system was installed in 2001. Concentrations in the intermediate zone (95-275 bgs) were as high as 1845 ppmv (Stoller, 2002). The remedial goal was to reduce the mass of VOC contaminants in soil gas significantly, thus mitigating impacts to the underlying groundwater. That goal has been achieved in all but a single extraction well, SVE-S-20. Rebound testing conducted in October 2005 indicated that all wells, except SVE-S-20, yielded field-measured VOC concentrations less than 100 ppmv. A small-scale SVE was installed at the Burning Ground in late 2006 after the large-scale catalytic oxidation and scrubber system became inefficient at continued removal of soil gas and residual NAPL within the soil pore space once the larger area had been remediated. The small-scale system focused on treating residual NAPL and soil gas at a single soil gas well (SVE-S-20), where soil gas concentrations continue to remain above 100 ppm. The system consisted of a series of activated carbon drums and a smaller blower motor for extraction. The activated carbon system was shut down at the end of January 2012 to allow installation of a small-scale CatOx system that continues to focus remediation on SVE-S-20. The new system is more cost efficient and will effectively treat all detected COCs at the Burning Ground. System construction and installation began in February 2012. System startup and testing began on April 5, with normal operations commencing on April 19, 2012.

Figure 2-19 depicts the SVE system operation for 2015. The system was intermittently operated with shutdowns for maintenance, repairs, freezing weather, and a water main break at the Burning Ground. Repairs and freezing weather impacted the system in February and March. The water main break affected the system beginning in May and extending into July when the rebound test was conducted. The rebound test was unsuccessful due to various problems encountered (see Section 4 for detailed description). Pantex has continued to face problems with rebound testing, indicating that this may not be a viable method for evaluating closure of the system. Pantex will develop a performance monitoring plan after evaluating other options.

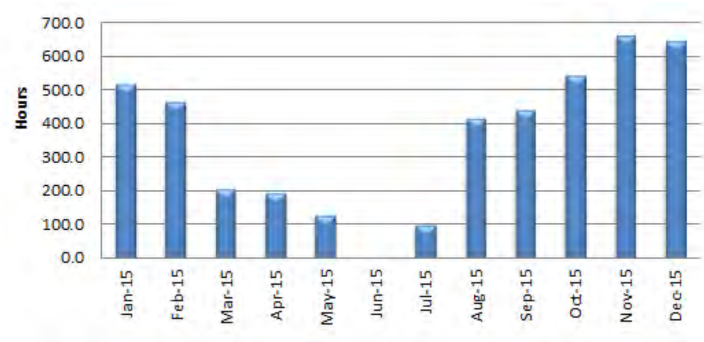

Figure 2-19. SVE System Operation

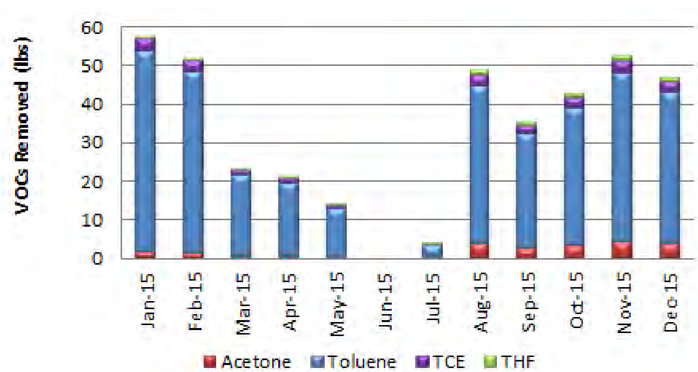

Figure 2-20. Burning Ground SVE Mass Removal

Calculated mass removal for 2015 is presented in Figure 2-20. Mass removal was estimated based on concentrations reported from analytical sampling, system operation time, and system flow rates. VOC constituents contributing more than 1% of the total VOC concentration were included in the calculation. Mass removal has been impacted by the shutdowns and inflow concentrations, with the greatest impact occurring from the rebound testing.

The SVE system has been effective at removing VOCs from soils. The system removed about 398 lbs of VOCs during 2015. Since inception, the SVE system has removed over 18,100 lbs of VOCs.

As reported in the monthly Air Quality Monitoring Reports to the Regional TCEQ office, all 2015 effluent PID readings for the new system indicate that destruction efficiency was 97% or greater, exceeding the permit-by-rule limit of 90%.

2.3.1.1 Soil Remedial Action Inspections

During 2015, Pantex conducted quarterly inspections of landfills as well as after rainfall events of greater than ½ inch. Inspections were also conducted for the ditch liner and SWMU signs and postings at various times during 2015. The FS-5 fence was installed during 2009 and the fencing is inspected quarterly. Key findings of the landfill inspections and resulting actions are included in Table 2-5.

2.3.2 Engineered and Institutional Controls

The soil remedial actions at Pantex are discussed in Chapter 1. The SVE system is the only active soil remedy; however, other soil remedies require long-term stewardship to maintain controls. Pantex drafted all deed restrictions required as part of the final remedy during 2009 and submitted them to TCEQ and EPA as part of the draft final Interim Remedial Action Report (IRAR). Those deed restrictions were filed in 2010 in conjunction with the approval of the final IRAR (Pantex, 2010a). All remedial action units at Pantex are restricted to industrial use. To support the deed restrictions, Pantex maintains long-term control of any type of soil disturbance in the SWMUs to protect human health and to prevent spread of contaminated soils. Pantex also regularly inspects and maintains soil covers on landfills to prevent infiltration of water into the landfill contents and migration of impacted water to groundwater. Pantex installed and inspects and maintains a fence around FS-5 to control access and use of an area that is impacted by depleted uranium. Pantex installed a synthetic liner along a ditch system in Zone 12 where investigations indicate that the ditches continue to act as a source to perched groundwater. Installation of the ditch liner will minimize migration of contaminants because it prevents rain water from infiltrating into soils. Pantex regularly inspects this ditch liner. Maintenance is either contracted, as necessary, or work orders are placed with the onsite Maintenance Department.

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Many of the findings at the landfills are related to wildlife activities that disturb soils in the landfill covers. It is expected that Pantex will have ongoing activities at many of the landfills due to small holes/voids from wildlife. In the past, these smaller issues were addressed using Pantex personnel and equipment. However, to ensure long-term support with the landfill covers, Pantex is currently contracting for long-term maintenance of the landfills. The landfills will be inspected each year and then maintenance will be contracted based on the evaluation conducted during the year. Larger issues such as those identified during the 2015 inspections (Landfill 3 erosion) will be contracted separately for design and construction. Each contracting effort will be followed-up with inspections to evaluate the effectiveness of the actions. The key findings from soil inspections is included in Table 2-5.

Table 2-5. 2015 Key Findings and Corrective Actions for Soil SWMUs

Findings	Corrective Actions
SWMU 57 Landfill 6 has large holes and areas that require reseeding	Will be addressed through new landfill maintenance contract. Seeding will also be conducted after filling of holes.
SWMU 60 and 61 (Landfill 9 and 10, respectively) had low areas where ponding and infiltration could occur.	Will be addressed through new landfill maintenance contract. Seeding will also be conducted after filling of low areas.
SVS 5 has small depressions.	Will be addressed through new landfill maintenance contract. Seeding will also be conducted after filling of depressions.
SWMU 66 (Landfill 15) has holes and depressions.	Will be addressed through new landfill maintenance contract. Seeding will also be conducted after filling of holes and depressions.
Unassigned Zone 10 Landfills had holes and depressions.	Will be addressed through new landfill maintenance contract. Seeding will also be conducted after filling of holes.
SVS 7a/7b numerous small landfills with holes and depressions.	Will be addressed through new landfill maintenance contract. Seeding will also be conducted after filling of holes.
SVS 8 Abandoned Zone 10 Landfill has holes	Will be addressed by onsite personnel.
Zone 10 landfills (Sanitary and Abandoned Zone 10) had numerous holes and areas need to be reseeded.	Will be addressed through new landfill maintenance contract. Seeding will also be conducted after filling of holes.
SWMU 54, Landfill 3 has extensive erosion in areas along the nearby ditch. Heavy rainfall in 2015 caused erosion of those areas. Erosion of areas near parking areas and culverts also need to be addressed.	Pantex has started contracting for design and construction of a remedy for the erosion and to address improvement of the cover where needed.
SWMU 63 Landfill 12 has depressions	Will be addressed through new landfill maintenance contract. Seeding will also be conducted after filling of depressions.

Findings	Corrective Actions
SWMU 68c, SWMU 54, SWMU 64, SWMUs 37-44, and SVS 6 landfills (Landfills 2, 3, 13, Burning Ground, and Zone 7, respectively) had low spots and distressed vegetation when inspected for the First Five-Year Review. Review of the landfills during 2015 indicated that the landfills had a few holes that need to be filled. The vegetation is still sparse in the reseeded areas. Side slope erosion was noted on Landfill 3. Landfill 13 has holes/voids on the north and southwest edges of the landfill.	These areas were identified during the Five-Year Review as needing erosion control. The work was contracted and low areas were backfilled, seed applied per the landfill reseeding plan, and erosion control mats were applied on sloped areas in 2013. Pantex continues to evaluate the effectiveness of the maintenance. Based on the 2015 review, most of the landfill vegetation has recovered due to heavy rainfall that occurred during 2015. However, there are small areas that require seeding. Those areas will be addressed through the long-term maintenance contract that is underway in 2016. The Burning Ground Landfills will be addressed through a separate contract to fill holes/depressions and place Closure Turf® on the landfills.
SWMUs 5-05 and 2 – Ditches. The liner in the ditches has pulled away from the top trench anchoring and has a few small tears.	Due to the age of the liner and expected life cycle, Pantex plans to replace the liner in 2017. Pantex plans to replace the liner using a more UV resistant and heavier liner, allowing for a longer life cycle.

During 2015, Pantex conducted inspections to evaluate the effectiveness of seeding conducted in accordance with recommendations from the *First Five-Year Review* (Pantex, 2013d). The bare ground/stressed vegetation at the landfills was noted during the inspection for the Five-Year Review. Drought conditions in the Texas Panhandle from 2011 through 2013 caused considerable loss of vegetation on the covers. As part of the recommendations from the *Draft Final Five-Year Review*, Pantex developed and implemented a plan to control erosion on the landfill. The plan was detailed in the *2012 Annual Progress Report* (Pantex, 2013b). The reseeding of the landfills was complete in October 2013, with the recommendation to review the landfills in 2014. However, no rainfall occurred after seeding, so significant changes were not expected. Pantex applied the seed at double the recommended minimum rate and the seed is viable for two to three years. Therefore, Pantex requested that the evaluation of reseeded landfill covers continue annually through 2016. The 2015 review indicates that most areas have responded well to heavy rainfall throughout 2015. The few areas that continue to require seeding will be addressed through the new landfill maintenance contract that will be in place during 2016.

The rainfall that occurred in 2015 significantly improved vegetative cover at all landfills. However, the heavy rainfall also caused erosion in some areas, with the largest problems identified at Landfill 3. Pantex is currently contracting for design and construction of improvements to address the erosion at Landfill 3.

To provide long-term erosion and infiltration control at the landfills, Pantex has received additional funding to install Closure Turf® on a select amount of landfills. Pantex will evaluate the landfills to identify the most appropriate landfills to be lined. Contracting for this effort will begin in 2016, with the installation expected to be complete in 2017. To more effectively cover the landfills, old soil gas investigation and soil gas vapor extraction wells will be plugged and abandoned.

Pantex will continue to evaluate the landfills annually and report the findings of the review and any plans that are developed to address remaining bare areas. Problems identified will be addressed annually through the landfill maintenance contract and larger issues, such as erosion, will be addressed through separate contracts. The active landfill area at Pantex is continually maintained by the Waste Operations Department and old landfills in that area will be addressed by onsite Waste Operations personnel.

Pantex also noted during inspection that the ditch liner in Zone 12 was degrading, pulling away from the top anchor trenching, and had a few small tears. Because the liner is near the end of its life cycle, Pantex will contract to replace the liner in 2017. The new liner will be more resistant to UV light and will be heavier to provide a longer life cycle for the liner.

2.3.2.1 Review of Soil Disturbance

Pantex also conducts reviews of projects (referred to as SWMU interference) that will disturb SWMU soils. Project plans or work requests for repairs were reviewed to ensure that workers used necessary protective equipment and that soils were managed appropriately during execution of the work. Older listed projects from the completed project areas were inspected after completion of work to ensure all soils were returned to the excavation or kept within the contamination extent. Long-term projects are reviewed periodically to ensure that contractors are adhering to SWMU interference permit requirements. Table 2-6 provides information on projects that were not complete by the last annual report as well as new SWMU interference projects from 2015. One in-progress project from 2014 was completed by the end of 2015. Three new permits were issued in 2015 with all completed in 2015.

Table 2-6. SWMU Interference Log

Log #	State Approval Date	SWMU #	Explanation of Work
Current Projects			
SIN14-002	8/21/2014	WMG 11 and 6/7 (SWMU 54, 5/13a, 5/14, 5/15a, and 5/12b)	Barrier Scope: A continuous barrier system will be installed in select locations of the plant. Posts will be directly driven into the ground. Posts that are driven through Landfill 3 will have a concrete cap placed over the penetration to prevent the infiltration of water into the landfill. The soil for the larger excavations will not be returned to the SWMU and will be disposed as Class 2 waste for offsite disposal as indicated in this SWMU permit and the contractors Waste Management Plan (WMP). All other soil from excavations within the SWMU is expected to be returned to the SWMU as backfill. Status: Complete 2015. Soil was removed and managed as Class 2 waste.
SIN15-001	4/27/2015	SWMU 58 and AOC 11	16-8, Fire Training Tower hydrant repair/replacement: The plant yard group will excavate around a fire hydrant located south of the fire training building. The hydrant will then be repaired or replaced with new equipment. All scrap material will be free of any SWMU soil before disposal through waste operations. The area of interference is a 30 foot radius around the existing hydrant and no deeper than 10 feet below ground surface. Once the repairs have been made, the excavated soil will be returned to the excavation as backfill. Status: Complete 2015. Soil was returned to the SWMU.
SIN15-002	4/27/2015	SWMU 5/01 and unassigned 12-5b concrete sump	12-5A Drainage Work: Regrading of soils and installation of a culvert was required to address standing water. The Pantex Yard group performed the work and the estimated soil disturbance work boundary was approximately 400 feet long by 3 feet wide and a depth of 3 feet. Hand tools and a loader were used for the excavation and a hydro excavator used to identify buried utilities in the work boundary. The plan was to remove the existing culvert and trench the entire length of the ditch and install an underground culvert. The excavated soil was to be placed on top of the culvert and gravel brought in to cover all the soil in the area to form a parking lot for the occupants of 12-5. Status: Complete 2015. Soil was returned to the SWMU.
SIN15-003	12/10/2015	SWMU 5/2/ Ditch	Repair of domestic water mainlines near Building 12-67: Project to repair lines to restore water to Z12 North. The maximum excavation is expected to be 40'x40' with a maximum depth of 10'. The lines will be excavated using heavy equipment and hand tools. All soils are expected to be returned to the excavation. Status: Complete 2016. Soil was returned to the SWMU.

2.4 Long-Term Monitoring Well Network

2.4.1 Well Maintenance

As recommended in the *First Five-Year Review* (Pantex, 2013d), the *Well Maintenance Plan* (Pantex, 2013c) was completed in October 2013 and was implemented in January 2014.

This plan formalized the well surveillance and inspection process already in place, and incorporated analytical and empirical data collected over time to develop a well maintenance schedule. Significant components of the plan include:

- Assigning an inspection and maintenance frequency of three years to all active Ogallala Aquifer monitoring wells as recommended in the *Ogallala Aquifer Sampling Improvement Plan* (Pantex, 2013a).
- Assigning a maintenance frequency of two years for all wells with stainless steel screens that have documented well corrosion and elevated chromium concentrations.
- Assigning a default inspection frequency of five years for all perched aquifer LTM wells to comply with total depth measurement requirements in the Compliance Plan.

Additional program activities, such as redevelopment, down-hole videos, pump and tubing bundle replacements, vegetation control, and other associated tasks, are completed when requested by the groundwater media scientist or identified by the field technicians. Water levels are measured at each sampling event and twice annually and total well depths are only measured when dedicated equipment is not present in the well.

The 2015 maintenance log for groundwater wells is included in Appendix C. This log contains all entries for well inspections, redevelopment of wells, changes in sample intake depths, and Bennett pump servicing at the wells. The log also contains the water depths and total well depths measured at wells when equipment was removed. The disposition of the purge water from well activities is also provided.

Pantex has identified, through well videos, evidence of bacteria in many of the stainless steel wells. This condition is common in monitor wells, especially in wells with lower groundwater velocity. This is occurring in both newly installed wells and older wells, in both the perched aquifer and Ogallala Aquifer, although the perched wells experience greater problems. The bacteria may be the source of stainless steel corrosion indicators (chromium, manganese, molybdenum, and nickel) that become elevated in wells. Well videos recorded during routine well inspections indicate that a large percentage of wells have some biofouling. Pantex continues to evaluate rehabilitation methods for the biofouling. Pantex plans to implement a chemical rehabilitation program in 2016 to address the perched wells as the growth has completely blocked portions of the screens in some wells. New perched wells are now installed with PVC materials, rather than stainless steel, to avoid corrosion issues associated with well materials; however, pumps still consist of stainless steel that is subject to corrosion.

Pantex has redeveloped wells, including brushing, bailing, and pumping, as necessary, when screens were impacted by biofouling, calcium deposits, or sedimentation, or elevated chromium levels were observed (e.g., PTX06-1068). Based on well videos and total depth measurements, some wells were observed to have sediment in the sump, with a few wells having sediment built up into the bottom of the screen. None of the wells had more than 20% of the effective screen (saturated screen) silted in. Efforts were focused on cleaning or redeveloping wells to ensure that representative samples can be collected from the wells and to address wells that exhibited some loss of screen due to silting. Pantex also focused on re-development of Ogallala wells that were used in the chromium background study. Most of the background study wells were re-developed and sampled in 2015.

Pantex performed the following well maintenance activities in 2015:

- Performed 66 well videos to evaluate the condition of wells and determine if re-development or other maintenance was required.
- Performed pump service (removal/installation of pump and tubing bundles) to prepare for well videos, re-development, special sampling, measurement of pump and tubing bundle length, lengthen sampling depths due to declining water levels, install diverters, and replace pumps.
- Re-developed 56 wells to reduce silting and clean the well screens.
- Performed chemical treatment at one well, using chlorine, to remove iron bacteria.

2.4.2 Well Casing Elevations

In accordance with HW-50284, Pantex periodically surveys top of casing elevations at wells. This must be performed every 10 years, at a minimum, for wells included in the monitoring network. Pantex also maintains wells not included in the monitoring network to evaluate water levels. These additional wells are also surveyed to ensure that water table maps developed from water level readings will be correct.

Pantex resurveyed all wells in 2010 using Pantex's real-time kinetic GPS system that is calibrated to the National Geodetic Survey. This system will be consistently used for surveying wells in the future. Those well elevations were included in the *2010 Annual Progress Report* (Pantex, 2011a).

PTX06-1051 was replaced to confirm dry conditions after a well video indicated the original well screen contained grout. Although one other well was installed in 2015, it will not be included in the long-term network at this time. The surveyed well elevation for the new PTX06-1051 is included in Table 2-7.

Table 2-7. Well Elevations

Well	Northing	Easting	Ground Surface Elevation (amsl)	TOC Elevation (amsl)
		Wells Installed in 2015		
PTX06-1051	640325.13	3752259.66	3530.24	3532.29

amsl – above mean sea level TOC - top of casing

2.4.3 Water Level Elevations and Total Depths

In accordance with requirements in Provision XI.F.3.d and CP Table VII of the HW-50284, Pantex is to measure water level elevations at each well during each sampling event and total well depths when dedicated pumps are removed or when the well is sampled if no dedicated pump is installed. Pantex also measures water levels at all wells twice per year to provide consistent measurements for mapping of the water table. Water level measurements are also taken during any well maintenance activities. The measurements and corresponding water elevations and total depth elevations are included in Appendix C.

2.5 Management of Recovered/Purged Groundwater

All 2015 purged contaminated groundwater exceeding GWPS from sampling events and maintenance activities was containerized, then the volume of water was logged and the water treated through SEPTS in accordance with Provision XI.B.8 of the HW-50284, with a few exceptions. Purge water from one designated perched monitor well and all ISB system wells was containerized and disposed of by the Pantex Plant Waste Operations Department due to the water being characteristically hazardous or the water contained contaminants that were not treatable by the pump and treat systems. Ogallala Aquifer wells are unaffected and are not required to be managed or volumes tabulated so the water is released to nearby ditches. Because Ogallala well PTX06-1056 had low-level detections of HEs (below GWPS) in 2015, Pantex containerized the purge water from sampling events, and then the water was logged and treated through SEPTS.

In accordance with Provision XI.B.8 of HW-50284, all recovered perched groundwater from extraction wells is treated through the P1PTS or SEPTS. All treated water from the P1PTS and the majority of the SEPTS treated water is sent through subsurface lines to the WWTF storage lagoon. The lagoon water is then sent through the WWTF filter building and subsequently released to the Plant's subsurface irrigation system, as needed. Pantex Plant has been authorized by permit (TLAP #04397, issued April 2012) to release treated wastewater for irrigation of crops. Provisions were added in the latest permit renewal allowing treated water to be used in other ways, such as for construction projects, as long as the treated water meets GWPS and criteria specified by the State of Texas. Pantex has completed construction of a bulk water station at SEPTS for delivery of treated water for beneficial use at Pantex. Pantex is working to set up procedures and record keeping for the bulk water station. The station is expected to be operational by August 2016.

As authorized by the Underground Injection Control, Authorization No. 5X2600215, Pantex injects treated water into select wells at Pantex. Portions of the SEPTS treated water is injected through injection wells PTX06-INJ-10, PTX06-INJ-11, and PTX06-INJ-12A, when needed. Portions of the SEPTS treated water are used for the Southeast ISB and Zone 11 ISB amendment injections. Treated water is mixed with the amendment and injected into the treatment zone. The volumes of treated water injected, sent to the WWTF, or sent to the ISB system is provided in Section 2.2.

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3.0 Groundwater Remedial Action Effectiveness

In this section, the groundwater remedial action is evaluated for overall effectiveness during 2015 operations. This evaluation focuses on the following four aspects of monitoring associated with the remedy for perched groundwater:

1. Plume stability
2. Remedial Action effectiveness
3. Uncertainty management/early detection
4. Natural attenuation

In addition, POC and POE wells are evaluated against GWPS to determine compliance with HW-50284.

3.1 Plume Stability

Plume stability is evaluated through examination of water level and concentration data. Water levels are used to generate hydrographs and trends for individual wells and contour maps of water elevations. Data from dry wells (e.g., continuing dry conditions or influx of water) also support this analysis.

Concentration data are used to perform concentration trend analysis. Concentration trend data are mapped for the four major COCs to identify trends in the spatial distribution of COCs. The concentration data are used to generate plume maps for each COC. The maps and trends together will form the basis for an evaluation of overall plume stability.

In order to satisfy the objectives of the LTM design, expected conditions and trends were developed for each LTM network well in the *Update to the Long Term Monitoring System Design Report* (Pantex, 2014a). Therefore, a comparison of observed versus expected conditions was conducted as part of the evaluation process. Appendix E includes the LTM expected conditions as well as current conditions based on 2015 analytical and water level data.

3.1.1 COC Concentration Trending

COC concentration trends were calculated using both the non-parametric Mann-Kendall and parametric linear regression statistical methods adapted from the AFCEE Monitoring and Remediation Optimization System (MAROS) Software. Trends were calculated for the entire dataset for each LTM network well (long-term), data from the four most recent sampling events (short-term), and data collected since the start of remedial actions in 2009. The results of these analyses can be found on the concentration trend graphs located in Appendix E. In addition, the Mann-Kendall trending results since the remedial actions began for RDX, TCE, perchlorate, and hexavalent chromium are depicted in Figure 3-1, Figure 3-2, Figure 3-3, and Figure 3-4, respectively, to illustrate the effectiveness of the groundwater remedial actions.

Linear regression is a parametric statistical procedure that is typically used for analyzing trends in data over time. However, with the usual approach of interpreting the log slope of the regression line, concentration trends may often be obscured by data scatter arising from non-ideal hydrogeologic or sampling and analysis conditions. The Mann-Kendall test is a non-parametric statistical procedure that is well suited for analyzing trends in data over time (Gilbert, 1987). The Mann-Kendall test can be viewed as a nonparametric test for zero slope of the first-order regression of time-ordered concentration data versus time. The Mann-Kendall test does not require any assumptions as to the statistical distribution of the data (e.g. normal, lognormal, etc.) and can be used with data sets which include irregular sampling intervals and missing data (i.e., non-detects). More information on these statistical methods can be found in the *LTM System Design Report* (Pantex, 2009a).

3.1.1.1 RDX Trends

Evaluation of concentration trends for RDX indicates that RDX is decreasing, stable, or does not demonstrate a trend at all monitoring points near source areas (Playa 1 and the ditch along the eastern side of Zone 12). This condition is expected as the source areas are predicted to continue contributing to the perched aquifer for up to 20 years, but at much lower concentrations than in the past (Pantex, 2006). The SEPTS has had some effect on the plume as the majority of COC concentrations are declining or exhibit no trend within the boundaries of the well field. The Southeast ISB has had some effect on wells to the south on TTU property as concentrations in downgradient wells are stable or declining, with the exception of PTX06-1153. This is a key area for declining concentrations because portions of that area are potentially more sensitive to vertical migration to the deeper drinking water aquifer. The trends are depicted in Figure 3-1.

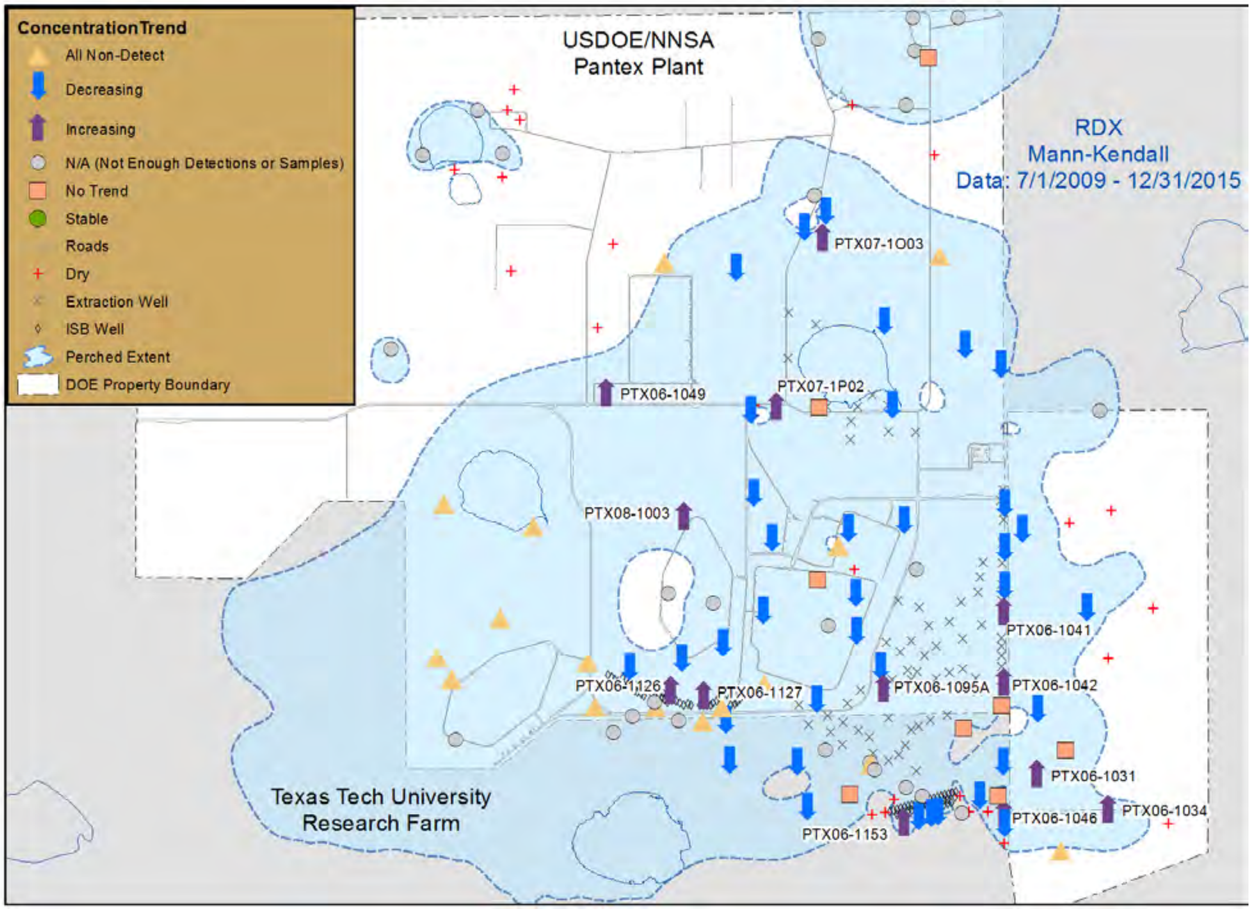

Figure 3-1. RDX Trends in the Perched Aquifer

Overall, 13 monitoring wells exhibited increasing trends in RDX using data since the start of remedial actions, as depicted in Figure 3-1:

- RDX was first observed at low concentrations in PTX06-1049 in 2011 and has steadily increased until 2014 and have fluctuated just above the GWPS since that time. This well is located in the far western side of the perched aquifer which is outside the influence of a remedial action and these trends are likely due to groundwater flow from the Playa 1 vicinity.
- PTX07-1O03, located north of Playa 1, is exhibiting an increasing trend in RDX. However, this well exhibited higher historic RDX concentrations and exhibits a decreasing trend considering all data. In addition, concentrations have been stable for the last three years. The increasing trend may be due to P1PTS effects as system operations have dramatically affected water levels and gradients in this region of perched groundwater.
- Two wells, PTX06-1126 and PTX06-1127, located south of Zone 11 outside the effects of a remedial action, are exhibiting slight increasing RDX trends at

concentrations below the GWPS. These wells are located upgradient of the Zone 11 ISB system, and based on the data collected in the Southeast ISB system, RDX will be effectively treated in the system.

- Three wells located in the far southeast lobe of perched groundwater (PTX06-1031, PTX06-1034, and PTX06-1046) are exhibiting increasing trends in RDX, likely due to plume movement into these wells. This area has been identified as a region that is not currently under the effect of a remedial action.

- Two wells installed along the eastern edge of the extraction well field (PTX06-1041 and PTX06-1042) are exhibiting increasing or probable increasing trends in RDX, but are under the direct influence of nearby extraction wells. Both long-term and short-term trends do not indicate increasing concentrations and these variable trends may be due to affected water from the east being pulled back into the well field or other pumping effects.

- PTX06-1095A is within the influence of the SEPTS well field, but is also located less than 50 feet downgradient of the PRB pilot study wells PTX06-PRB01A and PTX06-PRB02. The increasing trend is likely due to the PRB losing treatment effectiveness and concentrations returning to baseline conditions.

- PTX06-1153, which is a downgradient ISPM well for the Southeast ISB system, is exhibiting an increasing but highly variable trend in RDX. This well is discussed in detail in Section 3.2.3.2.

- PTX07-1P02, located southwest of Playa 1, is exhibiting a slight increasing trend just above the GWPS, but concentrations remain far below historical levels for this well. The increasing trend may be due to P1PTS effects as system operations have dramatically affected water levels and gradients in this region of perched groundwater.

- PTX08-1003, is exhibiting a probable increasing trend, but all values are near the sample detection limit and well below the GWPS.

A comparison of current trends to expected conditions for specific wells in the LTM network is included in Section 3.1.2.

3.1.1.2 TCE Trends

As depicted in Figure 3-2, 15 monitoring wells are exhibiting increasing trends in TCE concentration since the start of remedial actions:

- PTX06-1035, PTX06-1148, PTX06-1150, and PTX06-1159 which are downgradient of the Zone 11 ISB, are exhibiting increasing trends in TCE concentration due to general plume movement downgradient. However, the ISB system conceptual site model predicted treated water would not reach these wells for many years and these wells are not expected to demonstrate TCE treatment until 5 – 10 years or longer after system operations began. TCE concentrations in PTX06-1035, PTX06-1148, and PTX06-1150 remain below the GWPS, and recent data from the last two years indicate a decreasing trend in PTX06-1148.

- TCE is exhibiting an increasing trend in PTX06-1049, located west of Playa 1 which is not historically nor expected to be under the effect of a remedial action. TCE was first detected in this well in 2006 and has been slowly increasing, but remains below the GWPS. This trend is likely due to groundwater flow from the Playa 1 vicinity.
- PTX06-1048A and PTX07-1O02, located north of Playa 1, have had variable low-level TCE concentrations since 1996 and 2000, respectively. However, no concentrations have exceeded GWPS. As discussed in Section 3.1.1.1, the area north of Playa 1 is affected by P1PTS operations.
- The apparent increasing TCE trend in PTX06-1005 is likely caused by the return of unaffected conditions in this area following the cessation of injection of treated water at SEPTS injection well PTX06-INJ-12A, which is located approximately 200-feet to the east. Almost 70 million gallons of treated water were injected into the perched aquifer at PTX06-INJ-12A from the time it was installed in 2008 through 2012 when injection into this well was ceased because of failure of the well.
- The increasing trend in PTX08-1006, which is located downgradient from the identified sources in Zone 11, is likely due to general plume movement to the southeast, which may also be influenced by SEPTS operations.
- An apparent increasing trend was identified for PTX06-1002A located adjacent the ditch running to Playa 1 northeast of Zone 12; however, evaluation of recent data shows that the last four samples collected in 2014 and 2015 were non-detect. This trend is the result of low-level detections and use of one-half the detection limit in the trending and does not indicate actual increasing concentrations in this area.
- Slightly increasing trends were identified for PTX06-1010 and PTX06-1088 in the eastern part of Zone 12. TCE concentrations in PTX06-1088 are only slightly increasing and reflect general movement of the plume in this area. TCE concentrations in PTX06-1010 have been below the GWPS since 2009.
- Increasing trends were identified for PTX06-1031 and PTX06-1047A in the extreme southeastern portion of perched groundwater. All sample results in both wells have been below the sample PQLs, and samples from PTX06-1047A have been non-detect for the past three years. These trends are the result of low-level detections and use of

one-half the detection limit in the trending and do not indicate actual increasing concentrations in this area.

- An apparent increasing trend was identified for PTX06-1101 based on the most recent sample, the first sample result with TCE exceeding the GWPS. This well is located on the downgradient side of the Southeast ISB pilot study well field, and this result corresponds to a decrease in *cis*-1,2-DCE to below the sample detection limit. Therefore, the increase in TCE may indicate a reduction in the treatment provided by the ISB pilot system.

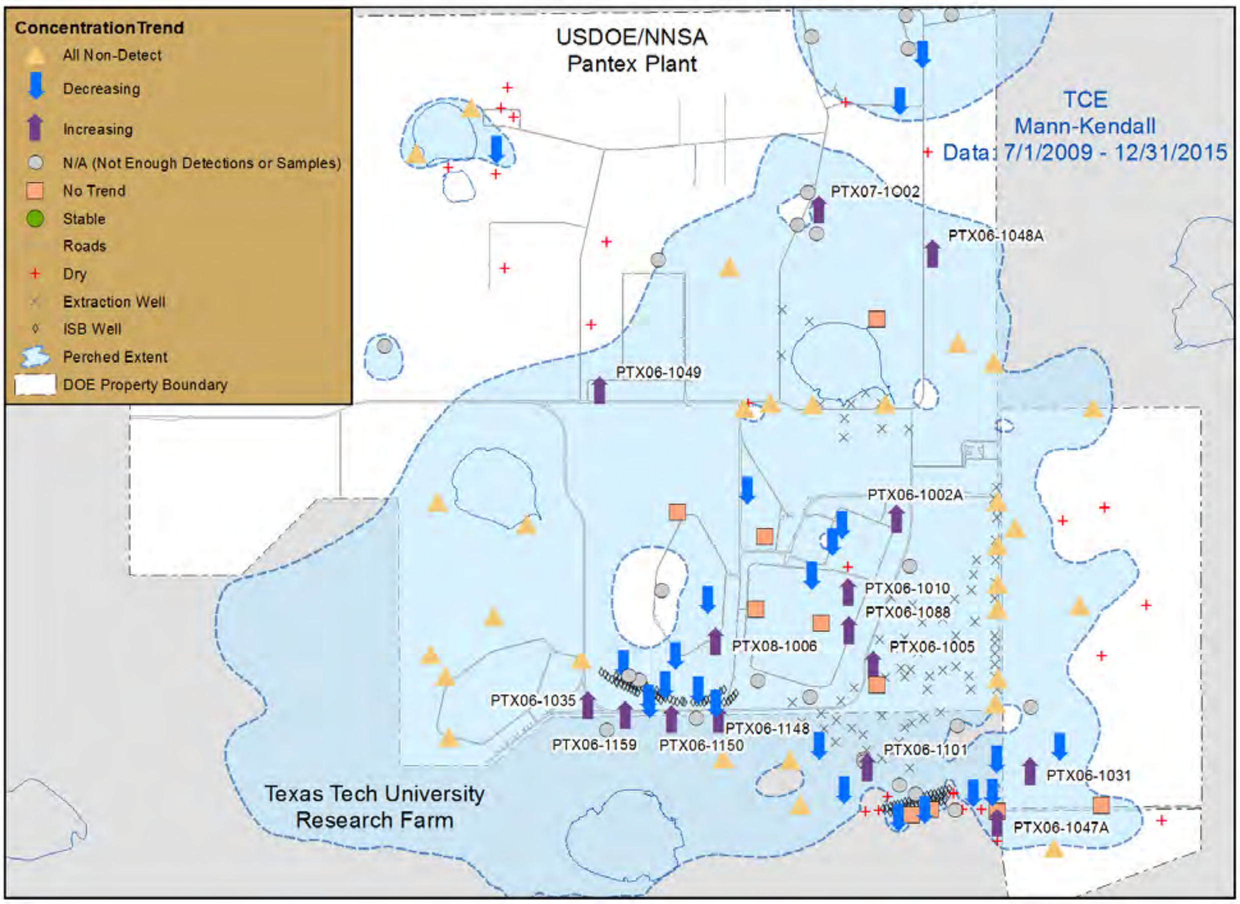

Figure 3-2. TCE Trends in the Perched Aquifer

3.1.1.3 Perchlorate Trends

As depicted in Figure 3-3, seven monitoring wells are exhibiting increasing trends in perchlorate concentration:

- PTX06-1035 and PTX06-1159, which are located southwest of the Zone 11 ISB system, are demonstrating increasing trends in perchlorate concentrations likely due to general plume movement downgradient. While both wells are located downgradient of the current Zone 11 ISB system, treated water is not expected to reach these wells for many years.

- PTX06-1134, located southwest of Zone 11 and downgradient of the Zone 11 ISB system, indicated an increasing trend with both samples collected in 2015 having detections above the sample PQLs. The increase in perchlorate in this well likely indicates the leading edge of the perchlorate plume moving downgradient.

- PTX06-1007 was exhibiting a slight decreasing trend in perchlorate from the time it was installed in 2000 until 2008, then began exhibiting increasing trends. However, the most recent sample indicates a substantial decrease in perchlorate to levels observed in 2010 and 2011. These fluctuations could be caused by changes in gradients and plume movement from the SWMU 5-13A ditch. Another possible cause of these shifting trends could be caused by historic injection and the resulting return to unaffected perchlorate concentrations after injection ceased. As discussed in several prior Annual Progress Reports, historic injection at SEPTS injection well PTX06-INJ-02 (1996 – 2006) affected COC concentrations and trends in wells installed east of PTX06-1007.

- 1114-MW4 is exhibiting an increasing trend in perchlorate concentrations since the start of remedial actions in 2009. This well had concentrations in the range of 300 ug/L when installed in 2002, which steadily declined until 2010 then exhibited a slow increasing trend. These shifting trends could be due to changes in gradients or general plume movement downgradient. Regardless, 1114-MW4 is installed upgradient of the Zone 11 ISB system and the perchlorate will be treated as it flows through the system.

- An apparent increasing trend was identified for PTX06-1077A. However, samples collected in the past two years have been non-detect, and the apparent trend is caused by using one-half the sample detection limit in the trend analysis.

- Samples collected in 2015 have confirmed the increasing trend in PTX08-1008 that began with the November 2014 sampling event. The observed increase in perchlorate in this well may be due to general plume movement to the southeast in this area, which may also be influenced by SEPTS operations.

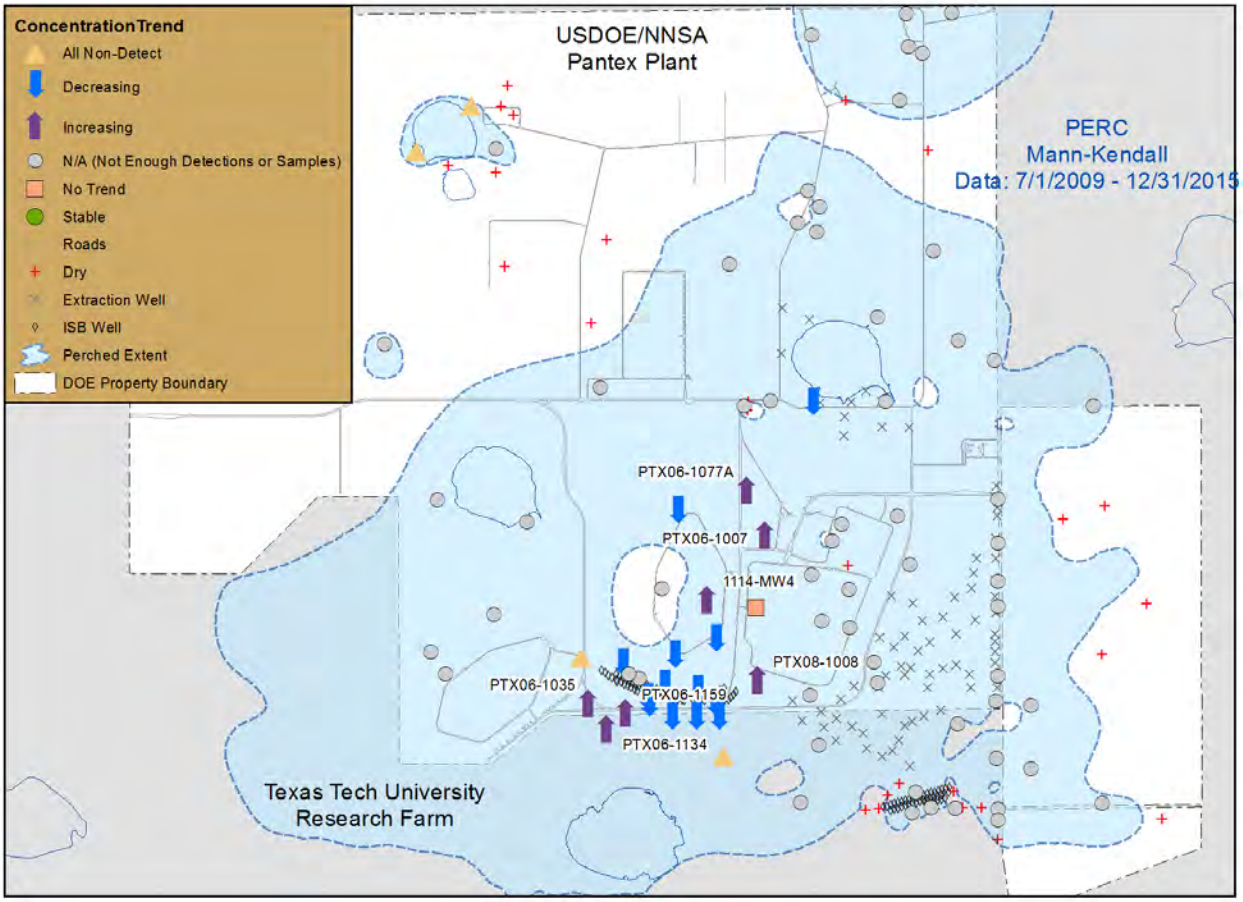

Figure 3-3. Perchlorate Trends in the Perched Aquifer

3.1.1.4 Hexavalent Chromium Trends

As depicted in Figure 3-4, six perched aquifer wells are exhibiting increasing trends in hexavalent chromium since remedial actions began:

- Hexavalent chromium was detected in PTX06-1046 for the first time above the current sample detection limit of 10 ug/L in the most recent sample resulting in an apparent increasing trend. However, hexavalent chromium in the duplicate sample was below the 10 ug/L detection limit and the total chromium result for this sample was less than 10 ug/L. Therefore, an increasing trend for hexavalent chromium is not occurring in this well.

- An apparent increasing trend was identified for PTX06-1095A. However, concentrations have been decreasing from the high observed in early 2014, and the most recent sample result was below the sample PQL. This well is within the influence of the SEPTS well field, but is also located less than 50 feet downgradient of the PRB pilot study wells PTX06-PRB01A and PTX06-PRB02. The observed fluctuations may be due to the PRB losing treatment effectiveness and general plume movement in this area.

- An apparent increasing trend was identified for PTX06-1120 with concentrations increasing from 2012 to 2015; however, the most recent sample collected in 2015 indicates a sharp decline to near the sample PQL. Concentrations of total chromium in this well have also fluctuated over the past several years; however, the most recent sample showed an increase. The observed fluctuations in hexavalent chromium may be due to corrosion of the stainless steel casing of the well.

- An apparent increasing trend was identified for PTX06-1146; however, samples collected during the past two years have been below the sample PQL. Similar to PTX06-1120, concentrations of total chromium in this well have also fluctuated over the past several years; therefore, observed fluctuations in hexavalent chromium may be due to corrosion of the stainless steel casing of the well.

- PTX06-1153, which is a downgradient ISPM well for the Southeast ISB system, is exhibiting an increasing trend in hexavalent chromium. This well is discussed in detail in Section 3.2.3.2.

- An apparent increasing trend was identified for PTX08-1009 with the last three sample results indicating relatively stable concentrations below the GWPS. This well is located along the northern edge of the hexavalent chromium plume and historically exhibited very high concentration. The recent detections may indicate general plume movement to the southeast and the influence of the SEPTS well field.

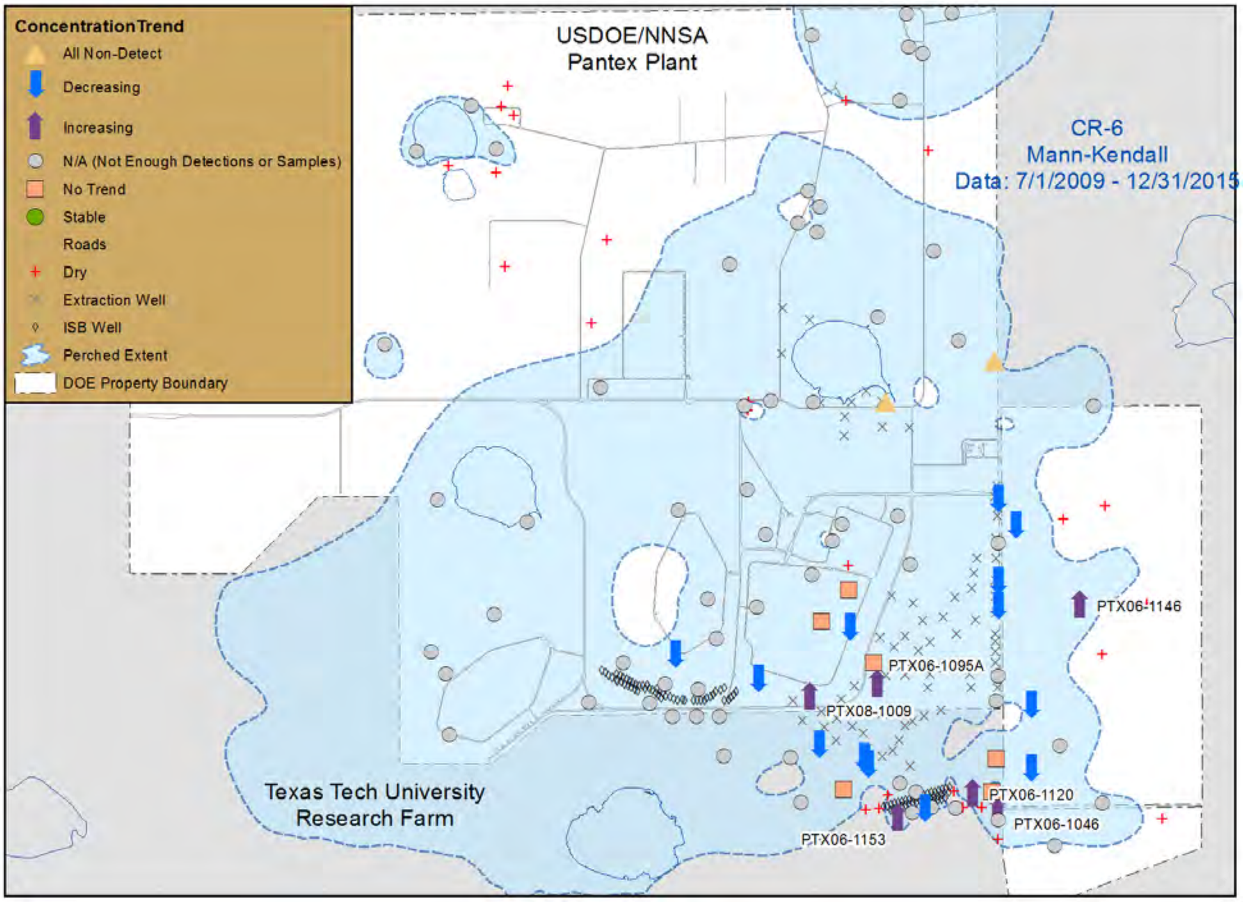

Figure 3-4. Hexavalent Chromium Trends in the Perched Aquifer

3.1.2 Concentration Trends Compared To Expected Conditions

Of the 103 monitor wells with expected COC concentration conditions defined in the LTM Design Report, 32 wells did not exhibit trends (since the start of remedial actions) consistent with the expected conditions. Fourteen wells, including 1114-MW4, PTX06-1002A, PTX06-1010, PTX06-1031, PTX06-1041, PTX06-1042, PTX06-1047A, PTX06-1048A, PTX06-1077A, PTX06-1088, PTX07-1O02, PTX07-1O03, PTX07-1P02, and PTX08-1009 had expected conditions of long-term stable or decreasing trends in concentration, but indicated increasing trends since the start of remedial actions. However, their long-term trends were decreasing or stable, so the expected conditions are met and the trends in these wells are not discussed. Currently, the smaller size of the comparative dataset (covering approximately 5 ½ years since remedial actions began) limits its effectiveness to represent long-term trends. It is expected that, as remedial actions continue to operate and the dataset continues to grow, these trends will become more representative of long-term conditions in the perched aquifer.

The following 18 monitoring wells (depicted in Figure 3-5), PTX06-1005, PTX06-1007, PTX06-1034, PTX06-1035, PTX06-1046, PTX06-1049, PTX06-1095A, PTX06-1101; PTX06-1120, PTX06-1127, PTX06-1134, PTX06-1146, PTX06-1148, PTX06-1150, PTX06-1153, PTX06-1159, PTX08-1006, and PTX08-1008, exhibited trends that were not consistent with the expected conditions and were previously discussed in Section 3.1.1. Additional detail on all LTM wells is located in Table E-1 in Appendix E.

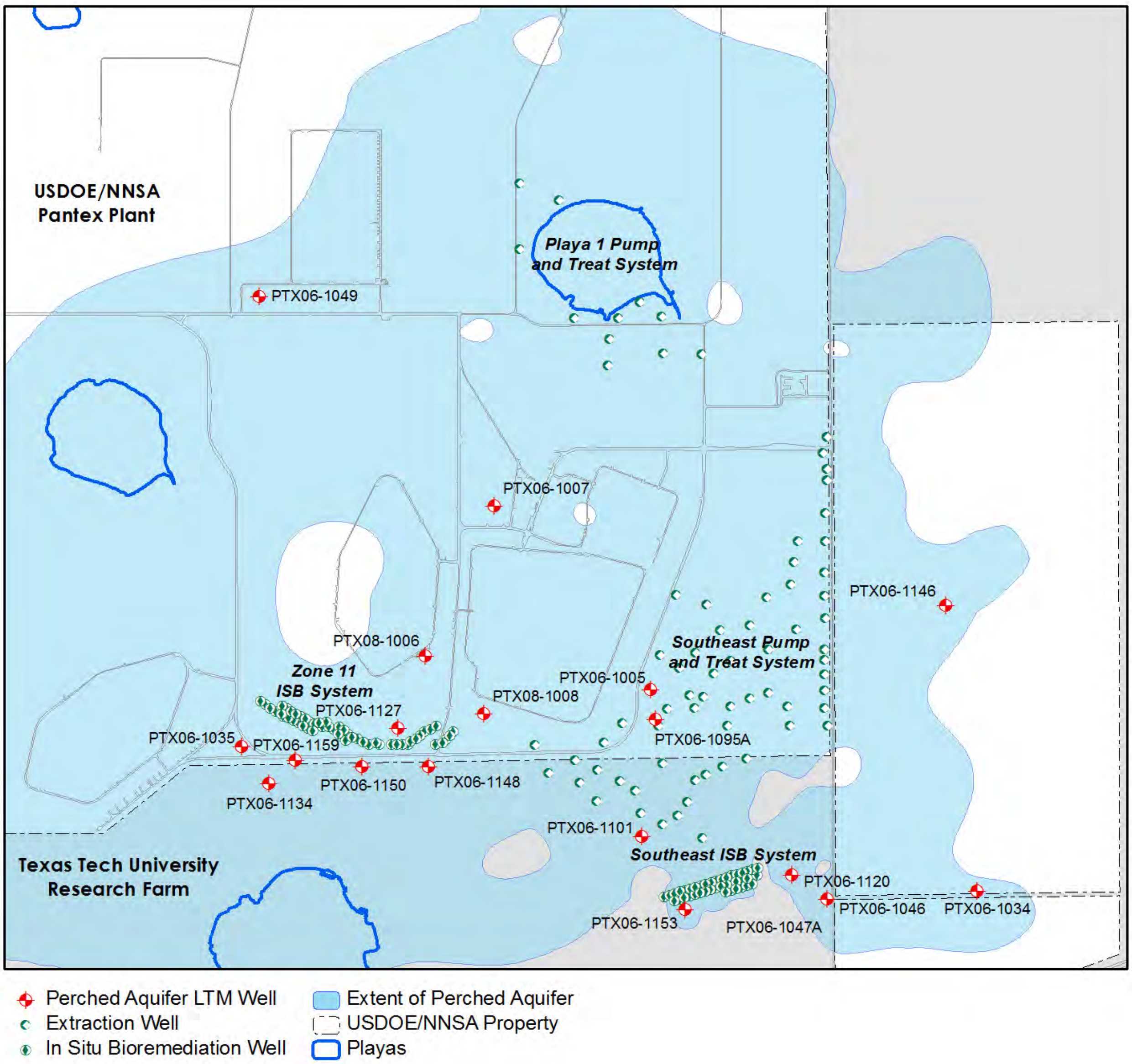

Figure 3-5. Perched Wells with Unexpected COC Trends

3.1.3 Water Level Trending

MAROS linear regression methodology outlined in the LTM Design Report was used to trend water levels at each well. Trends were calculated for the entire dataset of water levels for each well, in addition to the most recent two years of data at each well. The recent trends are expected to give a more accurate measurement of the effectiveness of the two pump and treat systems as the P1PTS began operating in late 2008 and the SEPTS began operating near full capacity by April 2009. Figure 3-6 depicts the water level trends in all LTM perched aquifer wells. Well hydrographs are included in Appendix F.

Trending results are showing positive effects of the remedial actions as all wells currently recognized to be under the influence of the SEPTS are exhibiting short-term decreasing trends in water levels. Above normal precipitation during the spring and summer of 2015 filled the playas, and a resulting increase in water levels was observed in several wells near Playa 1. The apparent recharge through the playa was much greater than the volume extracted by the P1PTS causing short-term increasing trends to be observed in these wells. Similar short-term increases have been observed in these wells in the past, and decreasing trends are expected to resume with a return to normal precipitation. Away from Playa 1, comparison of the short-term and long-term trends for wells located in Zone 11 and Zone 12 shows that many wells in this region have begun to exhibit short-term decreasing trends in water level. These trends could be an indication of expansion of the zone of influence of the pump and treat systems as the perched aquifer saturated thickness below Playa 1 is reduced.

A discussion of the remedial action effectiveness is included in a later section.

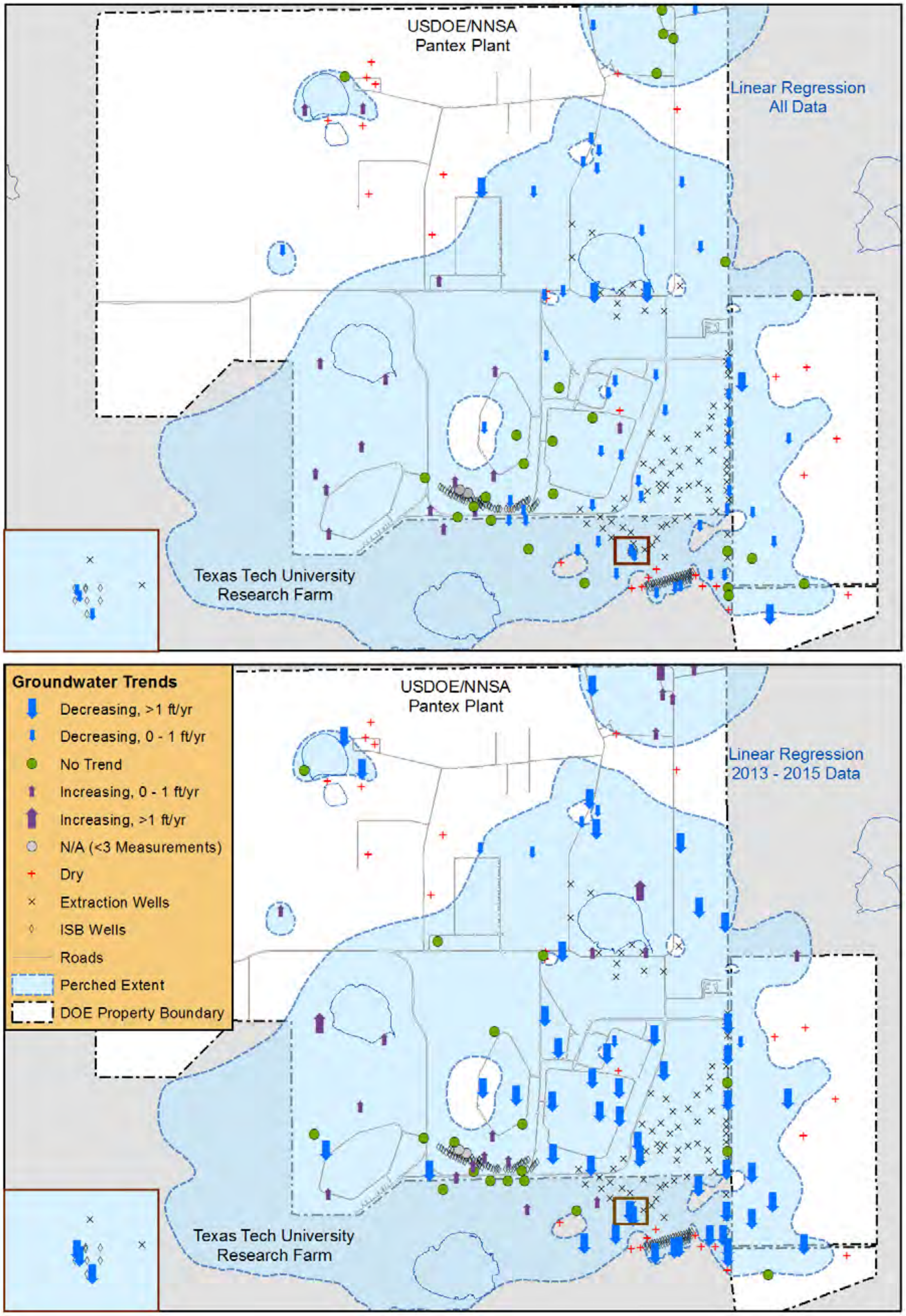

Figure 3-6. Water Level Trends in the Perched Aquifer

3.1.4 Water Level Trends Compared To Expected Conditions

Overall, calculated groundwater level trends are consistent with expected conditions defined in the LTM Design Report summarized in Appendix E. Of the 43 monitor wells with expected decreasing water level trends defined in the *Update to the LTM System Design Report* (Pantex, 2014a) only five wells (depicted in Figure 3-7) exhibited conditions inconsistent with the current expected conditions or trends. Water levels rose up to several feet in three wells around Playa 1, OW-WR-38, PTX08-1001, and PTX08-1002, between June and December in response to above normal precipitation during the spring and summer of 2015.

Recent water level data for PTX06-1014 indicates no trend; measurements in this well have been relatively stable since December 2013. This well has less than four feet of saturated thickness and is located in the southeast corner of the main Pantex property near a zone of limited perched saturation. The limited saturated thickness in this well may limit the effects of the SEPTS in this area.

Water was measured in the sump at PTX06-1089 in 2013. This well had been historically dry until 2011, when water was first measured in the sump. Water was measured in the sump during 2015, but no discernable trend could be calculated at this location. However, PTX06-1093, which is located between the current estimated perched extent and PTX06-1089, has remained dry. Water levels will continue to be monitored at this well to determine if a trend emerges.

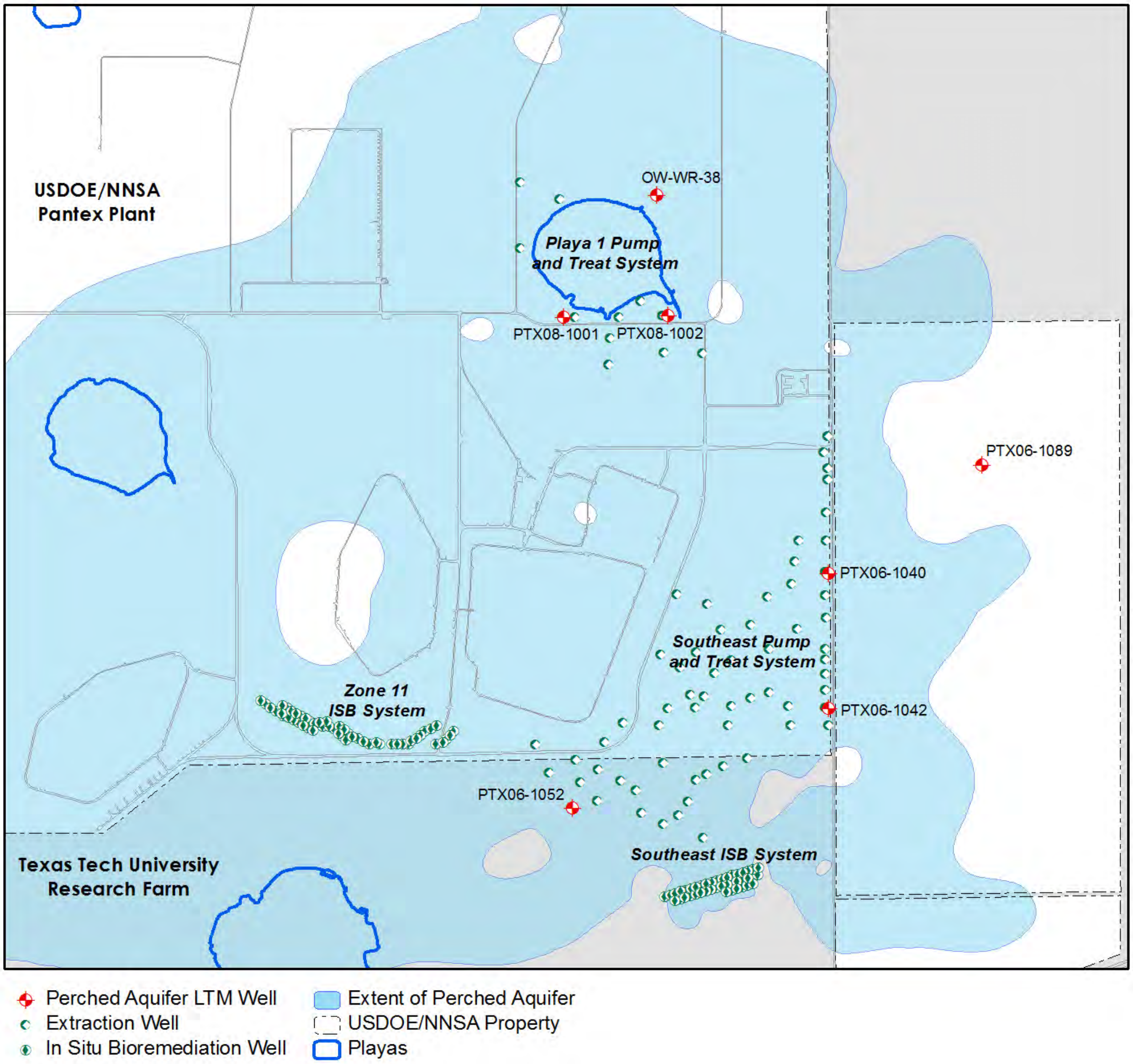

Figure 3-7. Perched Wells with Unexpected Water Level Trends

3.1.5 Water Level Mapping

Groundwater beneath the Pantex Plant and vicinity occurs in two stratigraphic horizons within the Ogallala Formation. The most significant quantities of groundwater in the vicinity of the Plant are found in the Ogallala Aquifer system. Considerably less water occurs in the upper Ogallala Formation, as perched groundwater overlying a fine-grained zone.

Presented in this section are water table maps of the Ogallala Aquifer and the primary perched aquifer underlying Pantex Plant. Water level measurements used to create these maps were collected primarily during December 2015 from Pantex Ogallala and perched aquifer investigative wells. These data were supplemented with recent water level measurements in the Ogallala Aquifer collected by other agencies and published by the Texas Water Development Board (TWDB). Figure 3-8 presents the Ogallala Aquifer water levels. Figure 3-9 and Figure 3-10 present perched aquifer water levels.

3.1.5.1 Ogallala Aquifer

As shown in Figure 3-8, flow in the Ogallala Aquifer underlying Pantex Plant is to the northeast. The northeast hydraulic gradient results from agricultural pumping as well as from the City of Amarillo well field to the north and from the Pantex water supply wells in the northeastern part of the Plant. The Amarillo well field produces approximately 12.7 million gallons per day from the Ogallala Aquifer, based on 2013 City of Amarillo data. The hydraulic gradient in the Ogallala Aquifer underlying the northern part of Pantex Plant is approximately 0.007 ft/ft.

3.1.5.2 Perched Aquifer

As shown in Figure 3-9 and Figure 3-10, perched groundwater occurs as a number of separate flow systems beneath Pantex Plant. Each of these flow systems is associated with an area of focused recharge, usually a playa lake. The main perched aquifer is associated with natural recharge from Playas 1, 2, and 4, past treated wastewater discharge to Playa 1, and historical wastewater releases to the ditches draining Zones 11 and 12. Small areas of perched groundwater occur in the vicinity of Playa 3, the Old Sewage Treatment Plant (OSTP) area, and Zone 6. Because of the limited extent and saturated thickness of these separate areas, water table contours for these areas are omitted from the perched aquifer contour map. The extents of saturation for the main perched aquifer and perched groundwater beneath the OSTP area show that these two bodies of groundwater are separated by only a short distance. However, observed water levels in both areas indicate that hydraulic interaction between these two areas is limited, even if the extents of saturation overlap. Perched groundwater has also been observed beneath the southern side of Pantex Lake, located about 2.5 miles northeast of the Plant property boundary, but this body of groundwater is not hydraulically connected to the perched aquifer underlying the Pantex Plant.

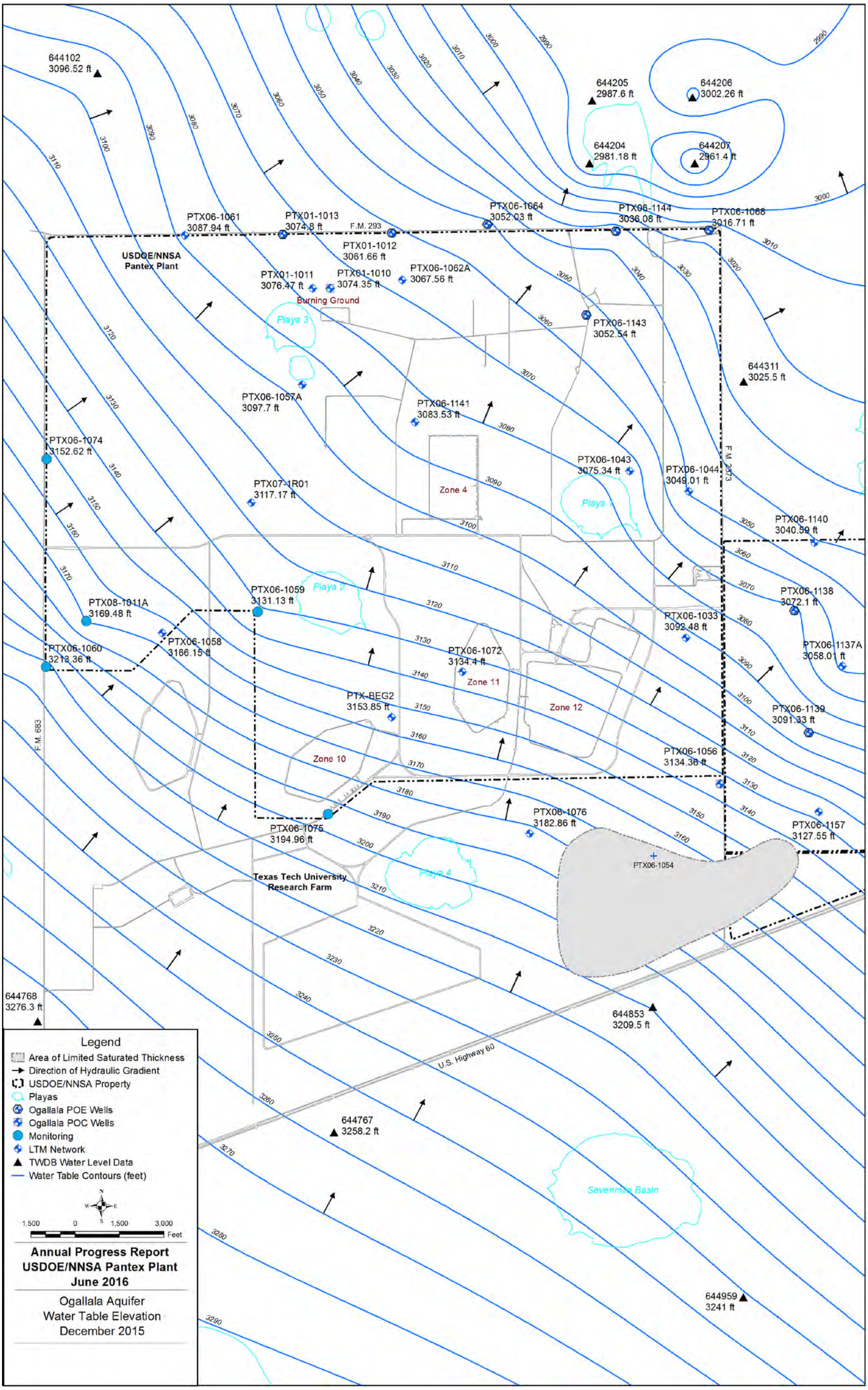

Figure 3-8. Ogallala Aquifer Water Levels

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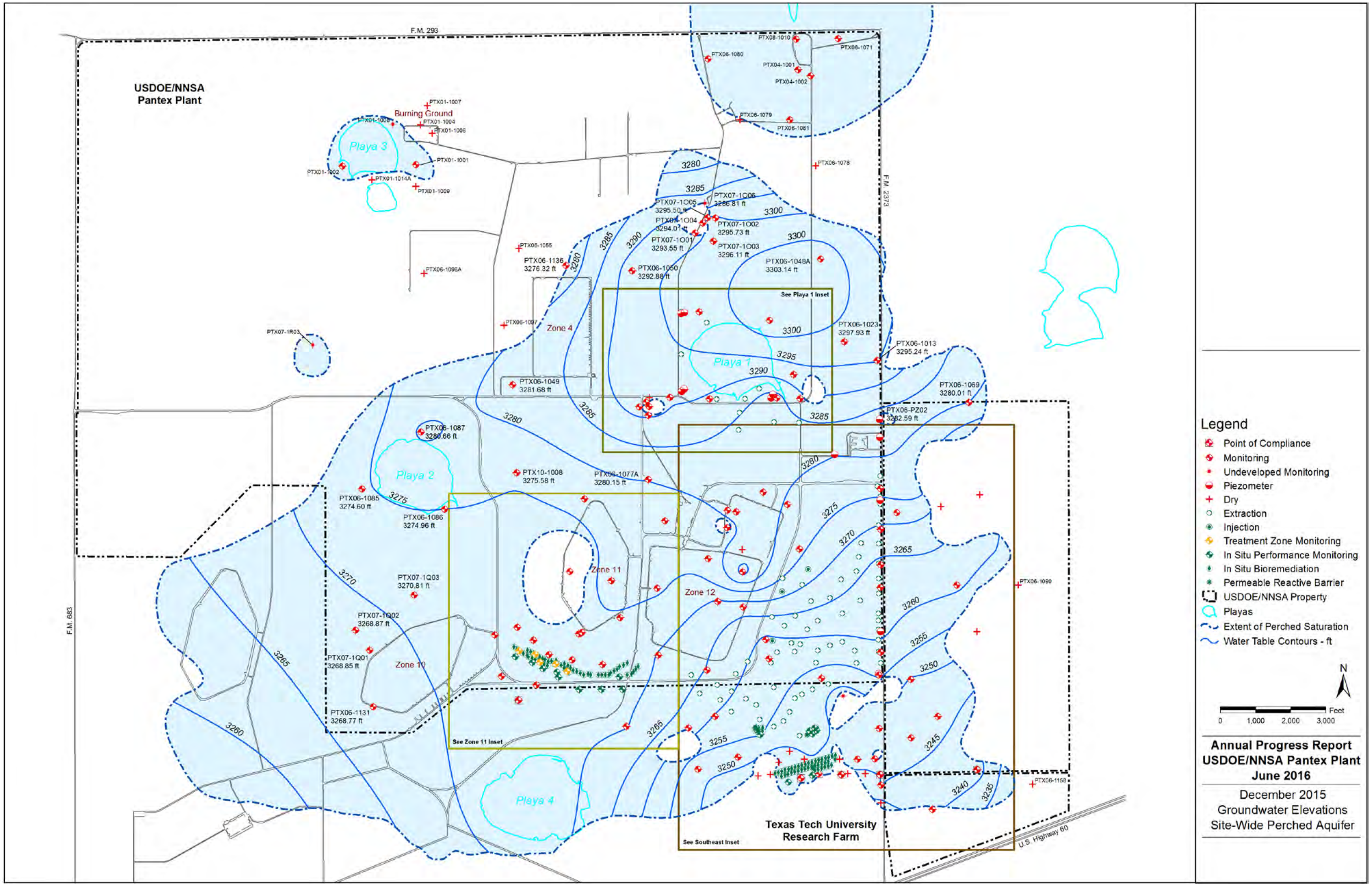

Figure 3-9. Perched Aquifer Water Levels

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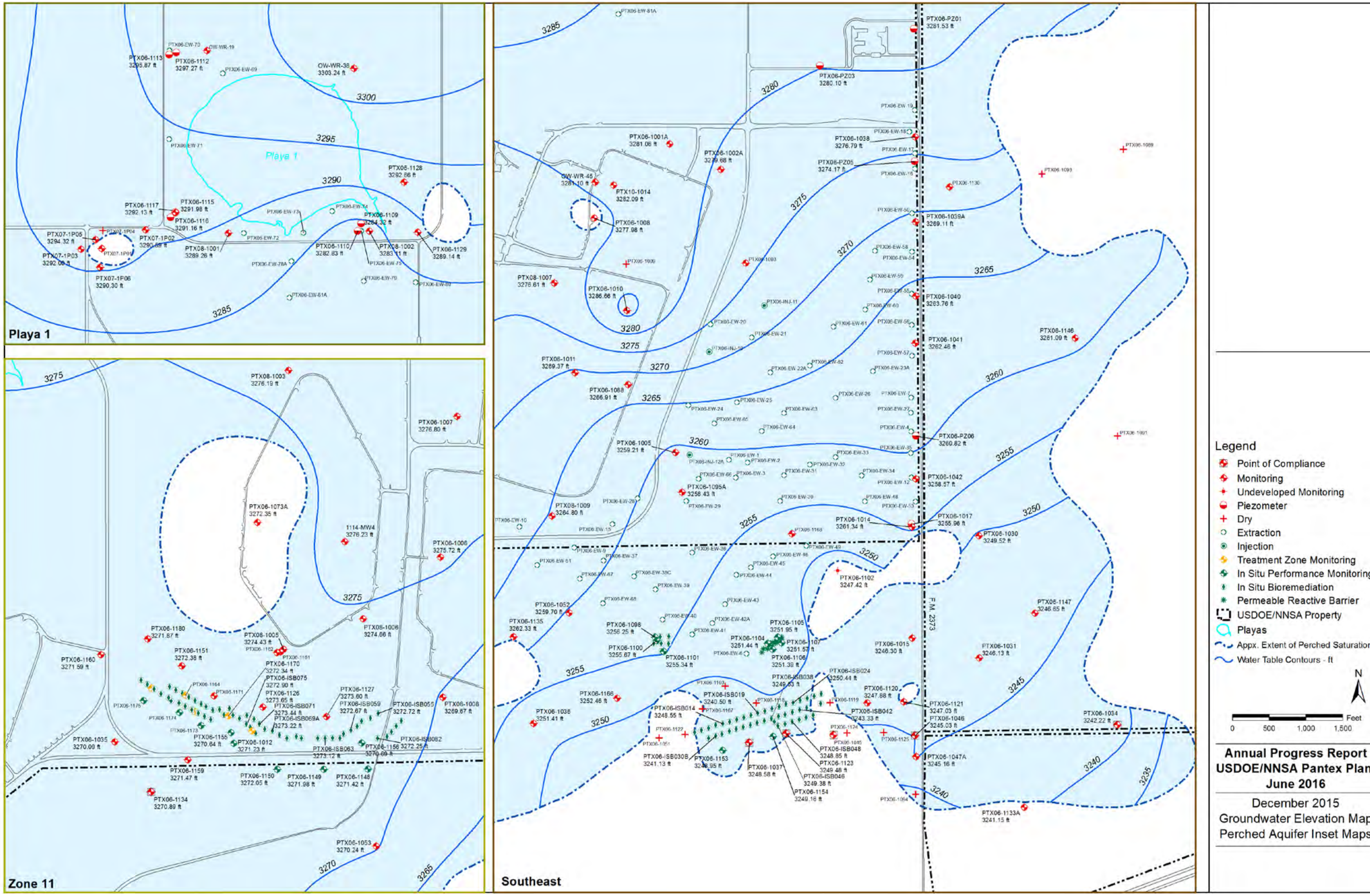

Figure 3-10. Perched Aquifer Water Levels, Inset Maps

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Historically, groundwater in the perched aquifer tended to flow radially away from Playa 1, but extraction of perched groundwater beneath Playa 1 by the P1PTS has shifted the highest elevations of perched groundwater northeast of the playa. Flow to the north and directly east of Playa 1 is limited by the structure of the FGZ. Flow to the south and southwest has extended several miles from Playa 1 and has been enhanced by recharge through Playas 2 and 4. Additionally, the large area of contaminated groundwater in the southeast corner of the USDOE/NNSA property occurred as a result of historical discharges of treated and untreated process waters from Zone 12. Two perched groundwater pump and treatment systems are currently removing water and contaminants from the perched aquifer thus limiting the further migration of contaminated groundwater to the east and south.

The horizontal hydraulic gradient of the perched aquifer varies spatially across the Plant. The hydraulic gradient is 0.005 ft/ft near Playa 1, 0.002 ft/ft near Playa 2, 0.005 ft/ft downgradient of Zone 12, and 0.002 ft/ft south of Zone 11.

3.1.6 Plume Mapping

Isoconcentration maps of indicator constituents (COCs and breakdown products of RDX and TCE) in the perched aquifer are presented in this section. Perched aquifer indicator parameters were proposed in the SAP. Isoconcentration maps for this annual report were produced from groundwater data collected in 2015. Each isoconcentration map presents the highest detected concentration for each constituent using validated analytical data from January to December 2015. The COC plumes were delineated to the approved GWPS as was done for the 2014 Annual Progress Report. The GWPS isoconcentration contour is highlighted by a yellow line outlined in black.

Constituent concentrations for samples from the extraction wells located within the two extraction well fields were used in generating the isoconcentration contours, but the analytical concentration data from these wells may differ from investigative wells because of the different sampling techniques used for the extraction wells. The extraction wells are clearly identified on the figures with an “EW” in the well identification label and a distinct symbol. Pump and treat system injection wells are identified on the figures with an “INJ” and ISB injection wells are identified with an “ISB” in their respective well identification labels.

Figure 3-33 and Figure 3-34 present total chromium isoconcentrations for the perched aquifer. Well locations shown surrounded by an orange circle were constructed with a stainless steel well screen and casing. Extraction wells, ISB injection wells, and dry wells were not depicted with these symbols. Several of these wells have been shown by video observation to be corroded and/or have bacterial growth present, and statistical analysis of the concentrations of chromium and other components of stainless steel (manganese, molybdenum, and nickel) shows strong correlations among the concentrations of these metals in samples obtained from these wells. This evidence indicates some degree of corrosion occurring in all perched aquifer stainless steel wells at Pantex. Therefore, the chromium concentrations for these wells were not included in the kriging of the isoconcentration lines unless the well is associated with the hexavalent chromium plume. The maximum observed concentration for the year is posted on the map for each of these wells.

Constituent concentrations for samples from the Southeast ISB injection wells were generally used in generating the isoconcentration contours; however, for some constituents, including metals and HEs, these data were not used because the concentrations were indicative of the ISB treatment zone rather than the surrounding formation. Additionally, most downgradient ISPM wells are now indicating treatment effects of the ISB treatment zone, as well as effects of expansion of the treatment zone. When these effects resulted in concentrations that were not believed to be representative of the surrounding formation and the overall plume shape, these results were not included in the contouring process. The estimated downgradient areas under the influence of the ISB systems are now depicted on plume maps, where appropriate. COC data obtained from the wells immediately downgradient from the three in situ remediation pilot project areas were not used in generating the isoconcentration contours. Concentrations observed at these wells are typically much lower than surrounding plume concentrations and represent the localized influence of the pilot-scale remediation projects.

Table 3-1 identifies all indicator constituents for the perched aquifer. Figure 3-11 through Figure 3-44 are isoconcentration maps for RDX, MNX, DNX, TNX, TNT, 2-amino-4,6-dinitrotoluene, 4-amino-2,6-dinitrotoluene, 2,4-dinitrotoluene, 1,3,5-trinitrobenzene, chromium, hexavalent chromium, perchlorate, 1,2-dichloroethane, *cis*-1,2-dichloroethene, 1,4-dioxane, PCE, and TCE.

Table 3-1. Perched Aquifer Indicator Parameters

HEs	Metals	Inorganics	Volatile Organics
RDX	Boron	Perchlorate	1,2-Dichloroethane
HMX	Chromium		1,4-Dioxane
MNX	Hexavalent Chromium		*cis*-1,2-Dichloroethene
DNX			*trans*-1,2-Dichloroethene
TNX			PCE
TNT			TCE
1,3-Dinitrobenzene			Chloroform
2-Amino-4,6-dinitrotoluene			Vinyl Chloride
4-Amino-2,6-dinitrotoluene			
2,4-Dinitrotoluene			
2,6-Dinitrotoluene			
1,3,5-Trinitrobenzene			

Isoconcentration maps for the other indicator constituents (HMX, 1,3- dinitrobenzene, 2,6-dinitrotoluene, boron, *trans*-1,2-dichloroethene, chloroform, and vinyl chloride) were not prepared because none of the measured concentrations exceeded the GWPS or detections were isolated to only a few wells and could not be used to map a distinct plume. The following sections provide specific information detailing the reasons maps were not prepared for these constituents.

Boron

Boron did not exceed the GWPS of 7,300 ug/L in any perched aquifer well sampled in 2015. Therefore, an isoconcentration map was not prepared for this compound.

HMX

HMX did not exceed the GWPS of 360 ug/L in any perched aquifer well sampled in 2015. Therefore, an isoconcentration map was not prepared for this compound.

1,3-Dinitrobenzene

1,3-Dinitrobenzene was not detected above the PQL in any perched aquifer well sampled in 2015. Therefore, an isoconcentration map was not prepared for this compound.

2,6-Dinitrotoluene

2,6-Dinitrotoluene was detected above the GWPS of 1 ug/L in three perched aquifer wells sampled in 2015. These isolated exceedances could not be used to map a distinct plume. Therefore, an isoconcentration map was not prepared for this compound.

Trans-1,2-Dichloroethene

Trans-1,2-dichloroethene did not exceed the GWPS of 100 ug/L in any perched aquifer well sampled in 2015. Therefore, an isoconcentration map was not prepared for this compound.

Chloroform

Chloroform did not exceed the GWPS of 80 ug/L in any perched aquifer well sampled in 2015. Therefore, an isoconcentration map was not prepared for this compound.

Vinyl Chloride

Vinyl chloride was detected below the PQL of 1 ug/L in two perched aquifer wells in 2015. However, both wells are downgradient ISPM wells under the influence of the Zone 11 ISB system where low-level vinyl chloride is expected. Therefore an isoconcentration map was not developed for this compound.

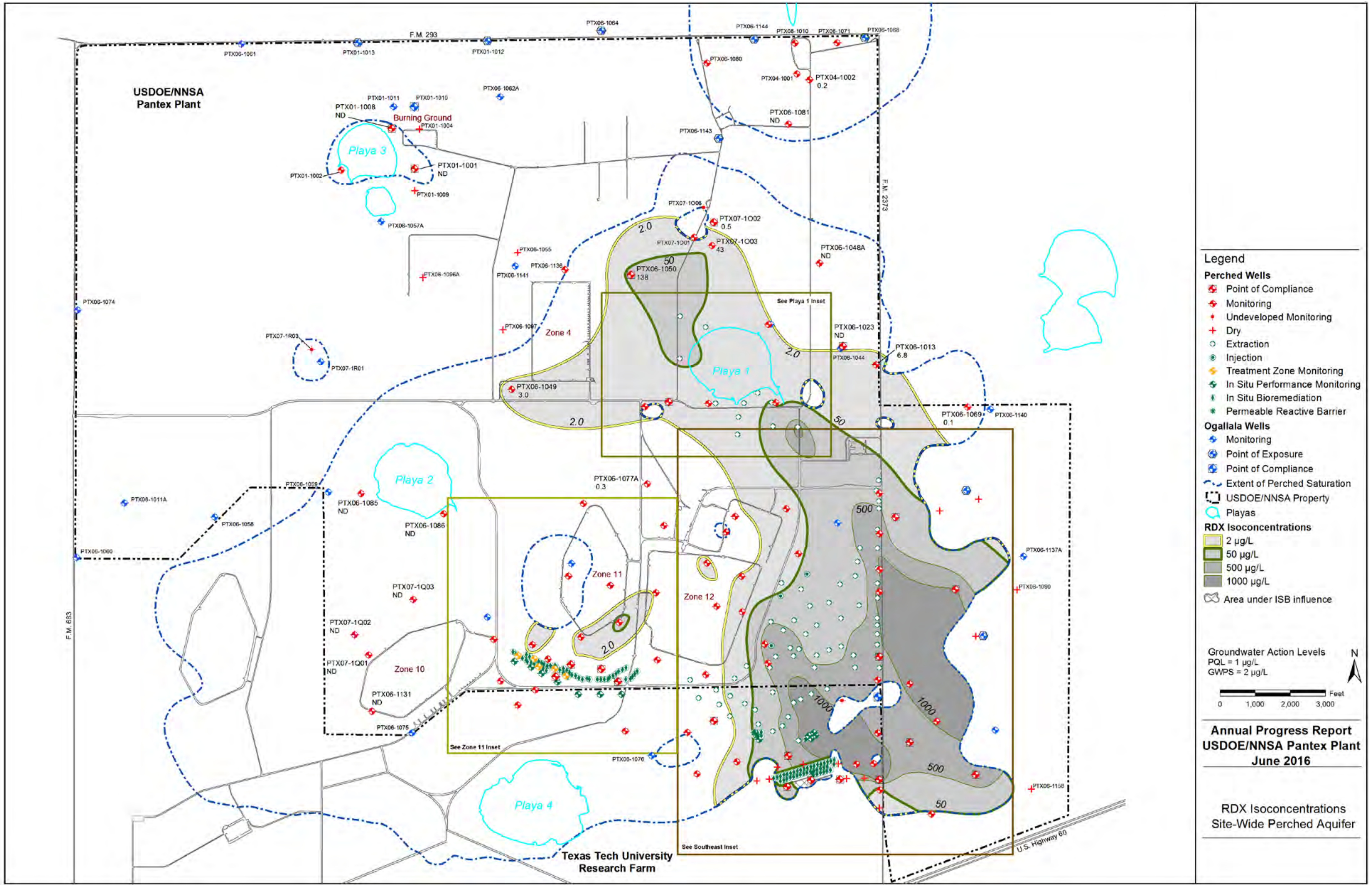

Figure 3-11. RDX Isoconcentration Map

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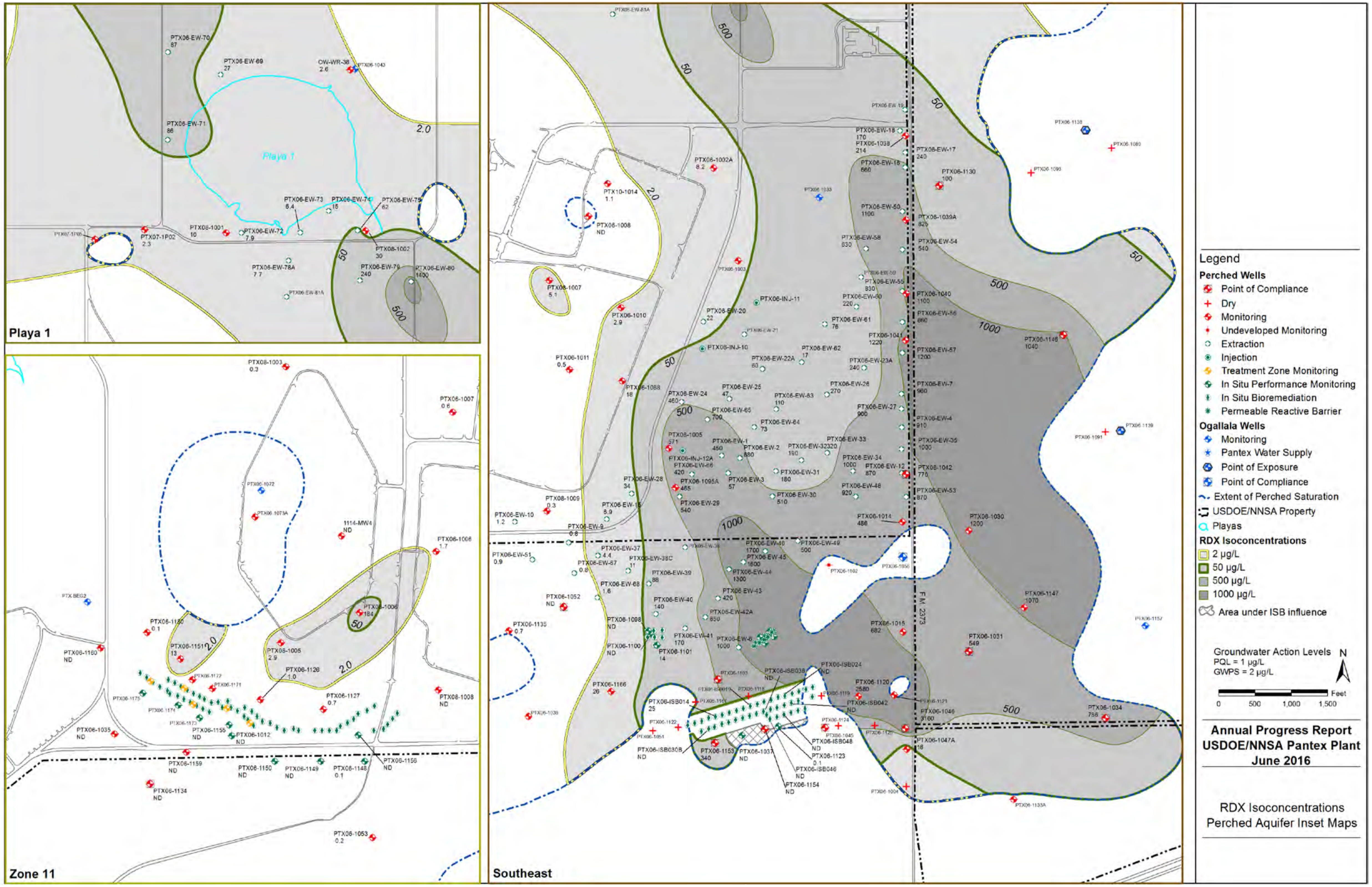

Figure 3-12. RDX Isoconcentration Inset Map

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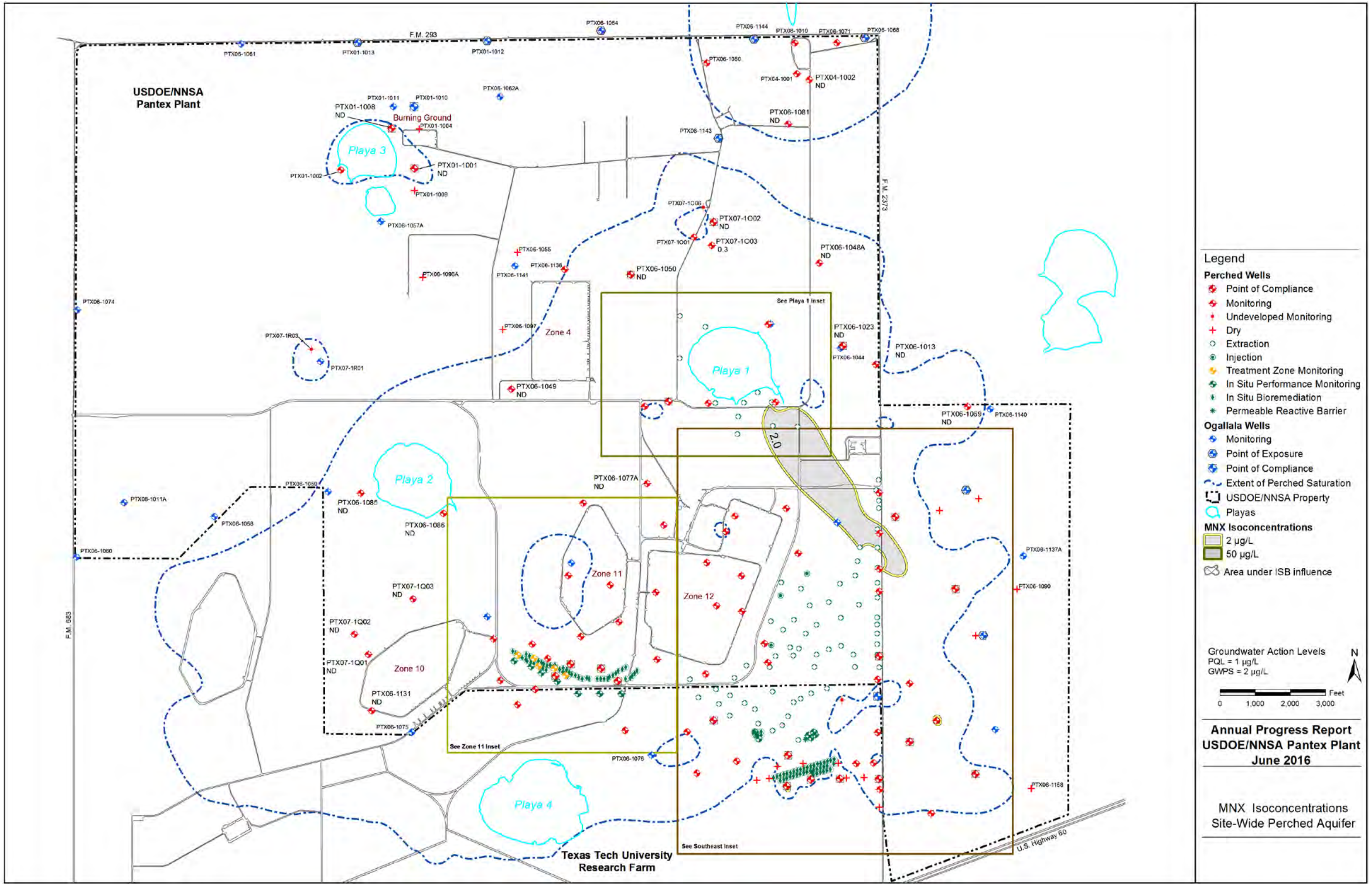

Figure 3-13. MNX Isoconcentration Map

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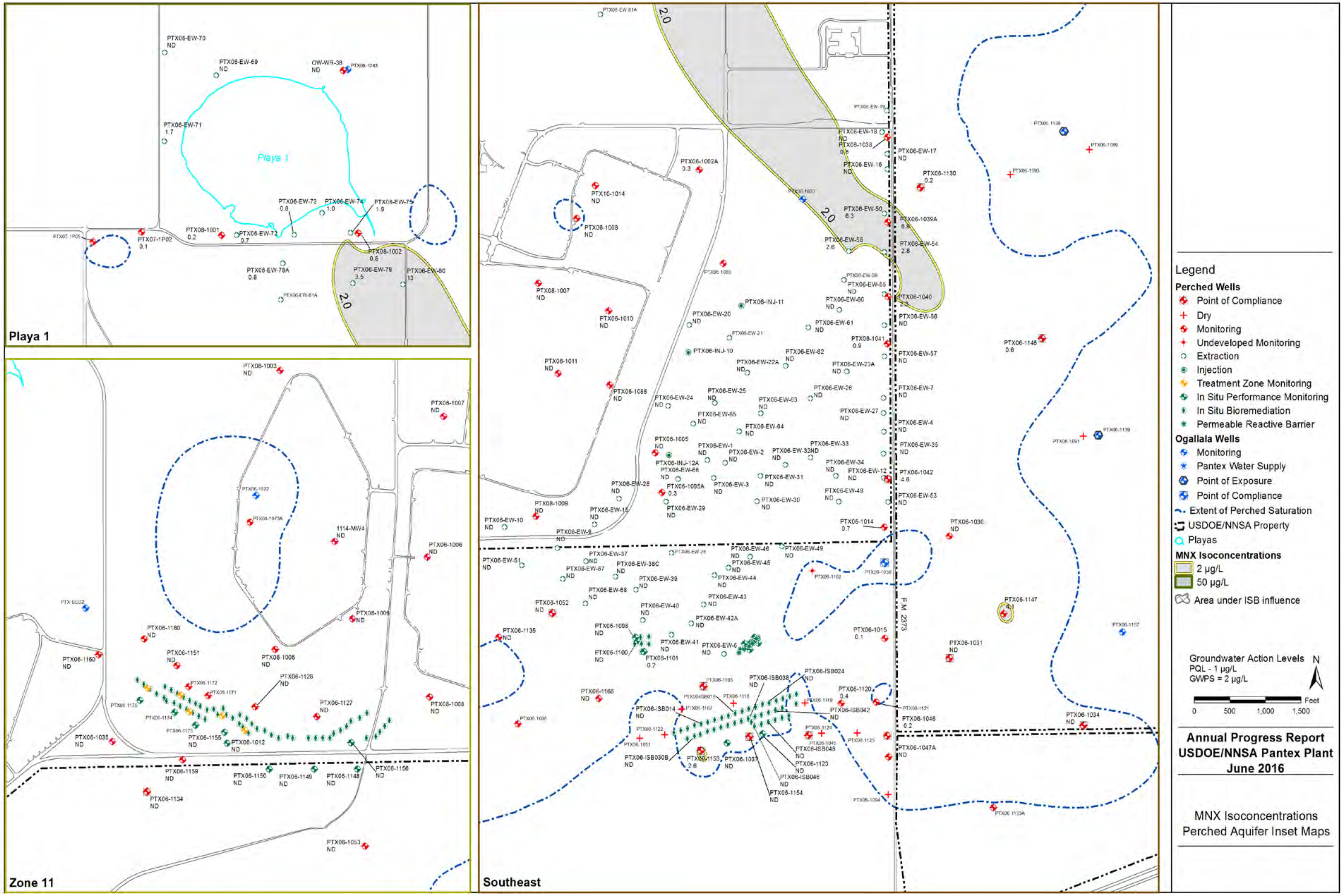

Figure 3-14. MNX Isoconcentration Inset Map

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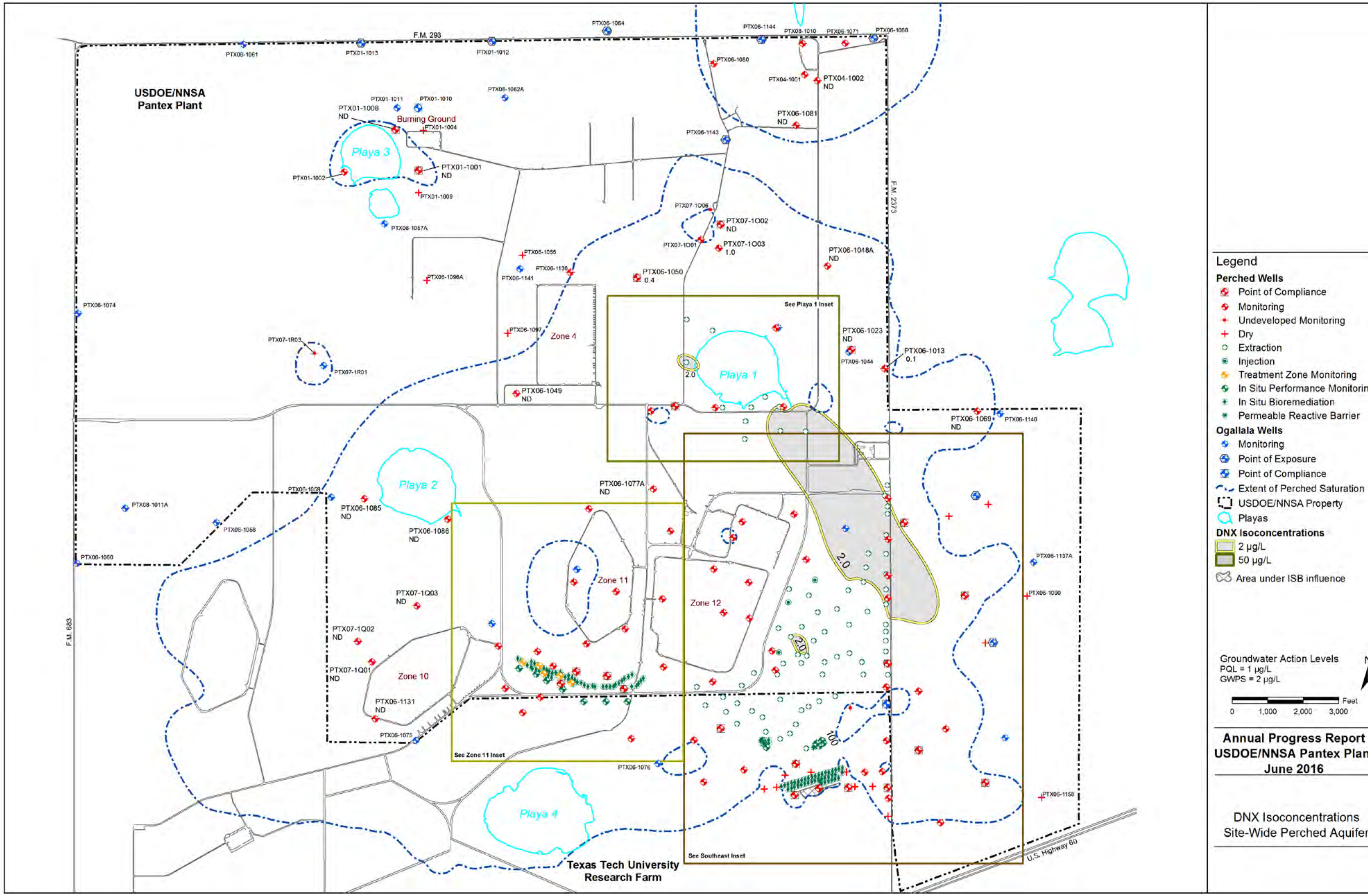

Figure 3-15. DNX Isoconcentration Map

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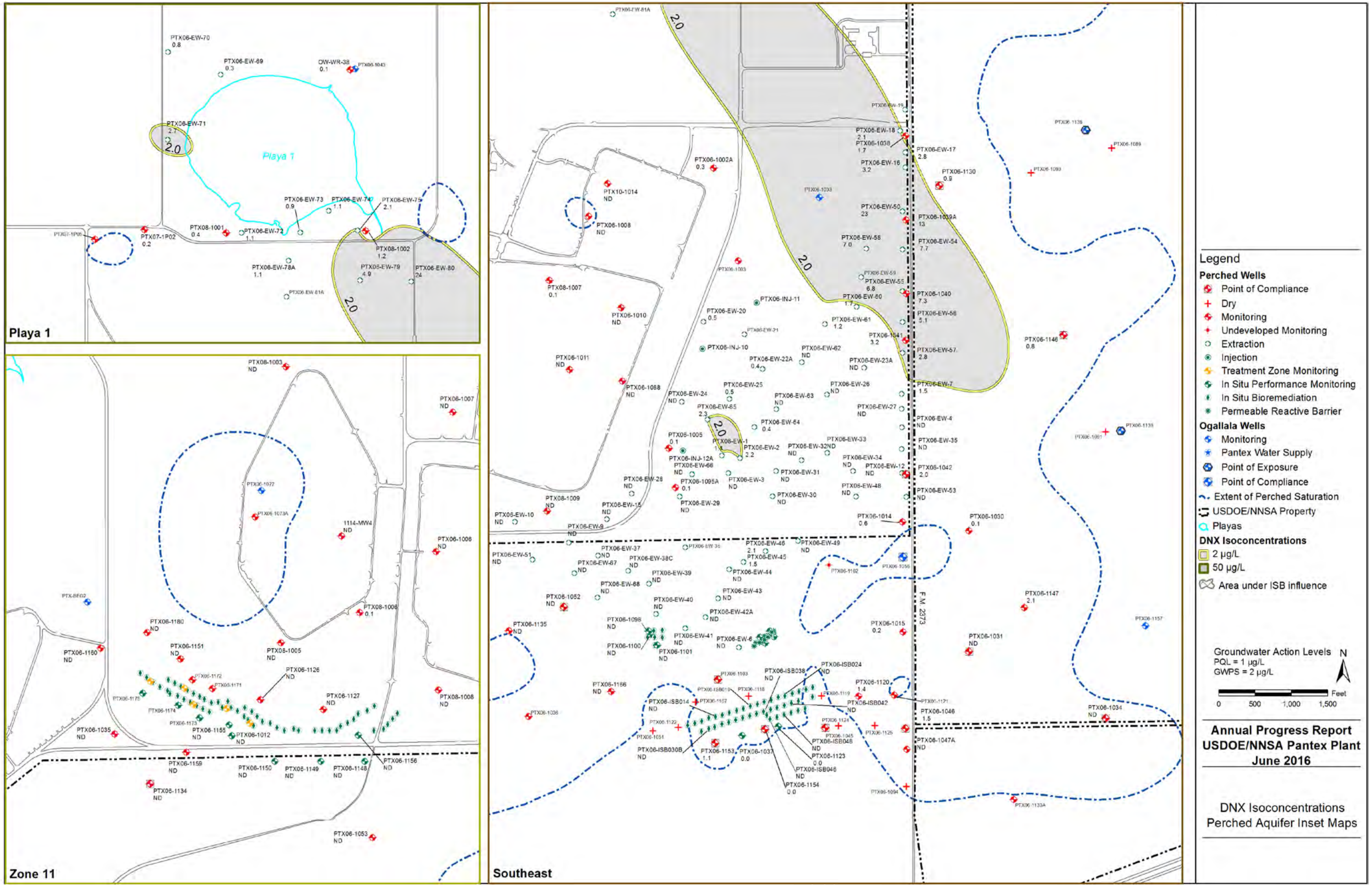

Figure 3-16. DNX Isoconcentration Inset Map

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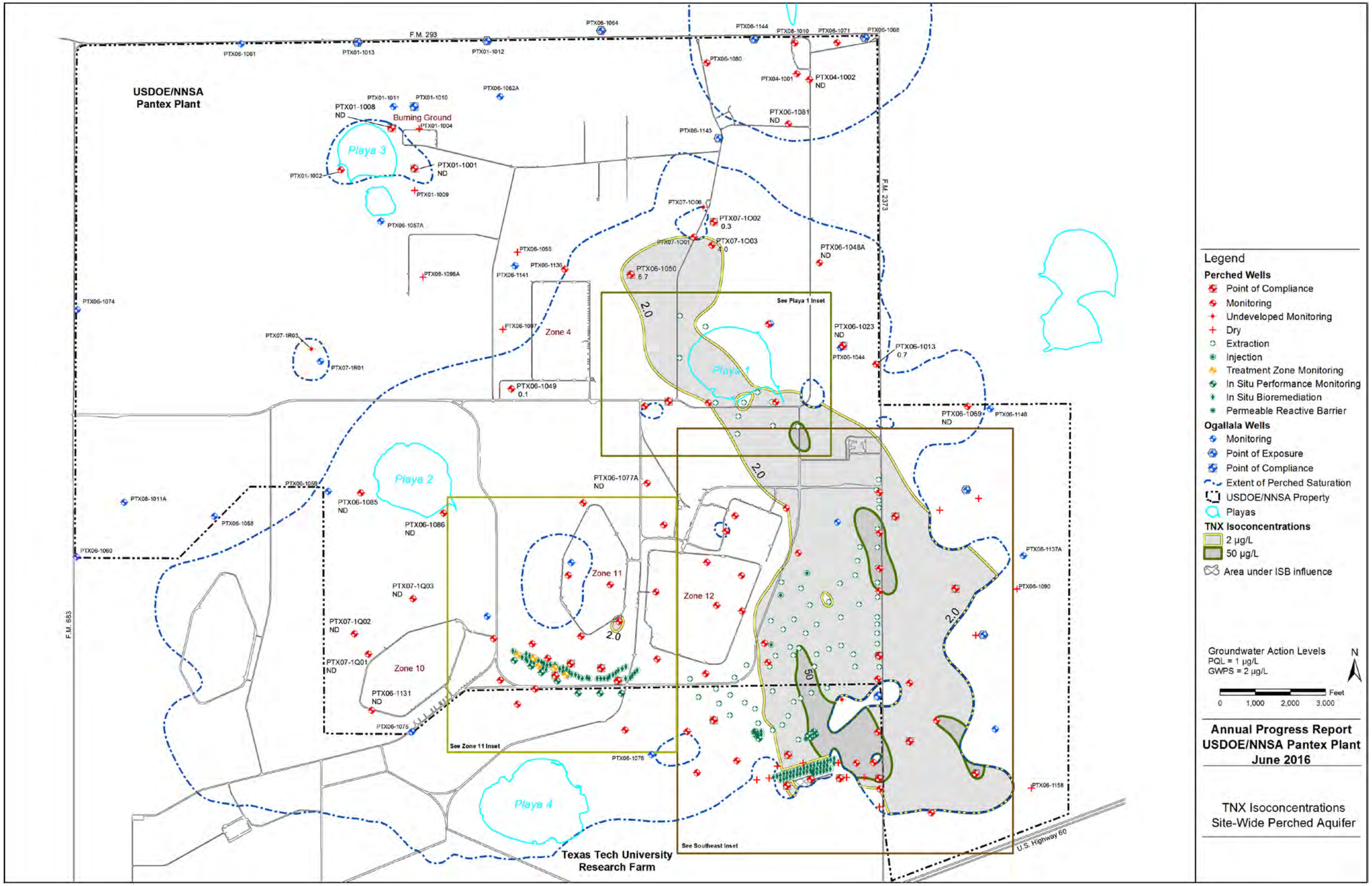

Figure 3-17. TNX Isoconcentration Map

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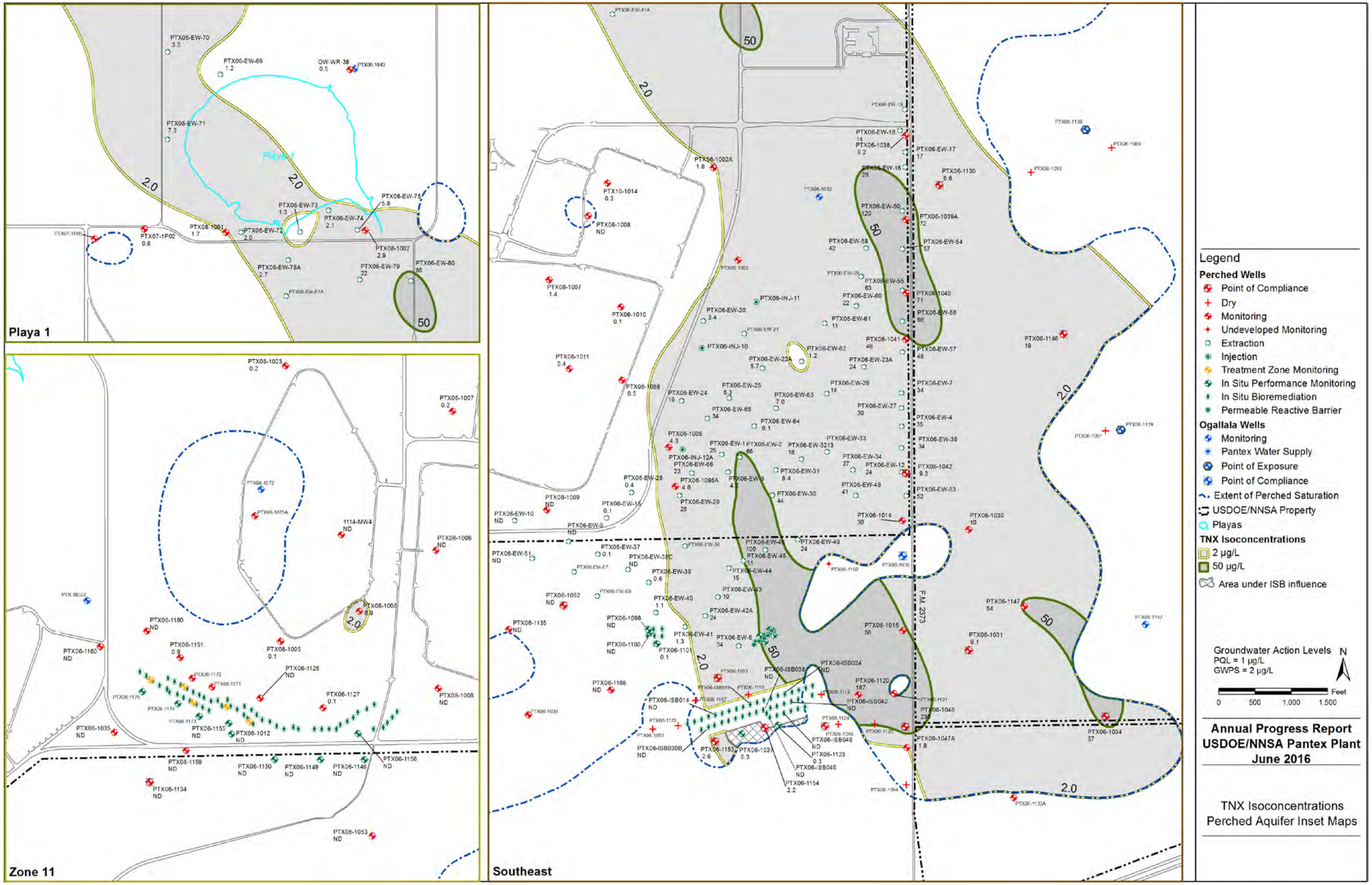

Figure 3-18. TNX Isoconcentration Inset Map

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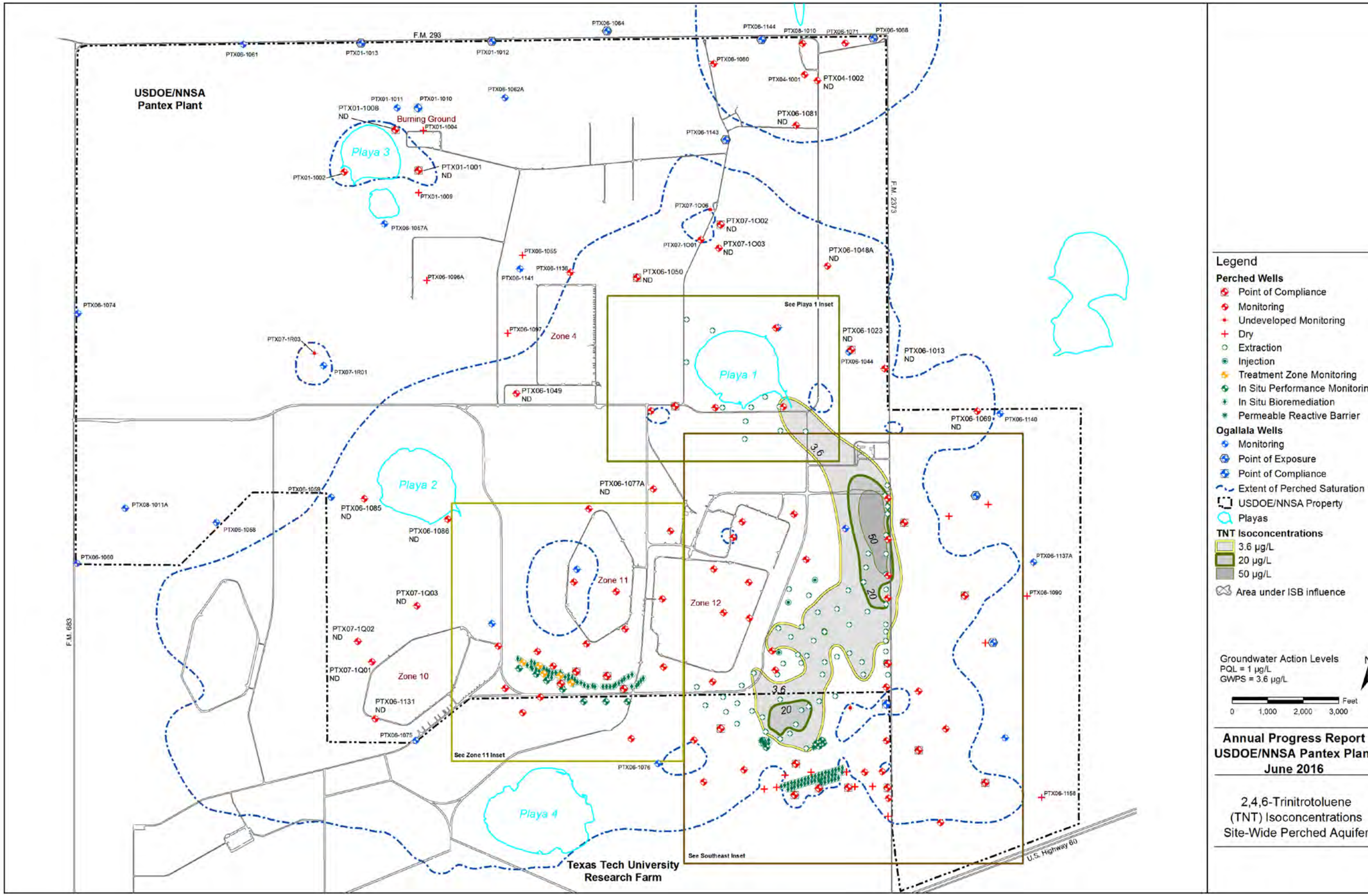

Figure 3-19. TNT Isoconcentration Map

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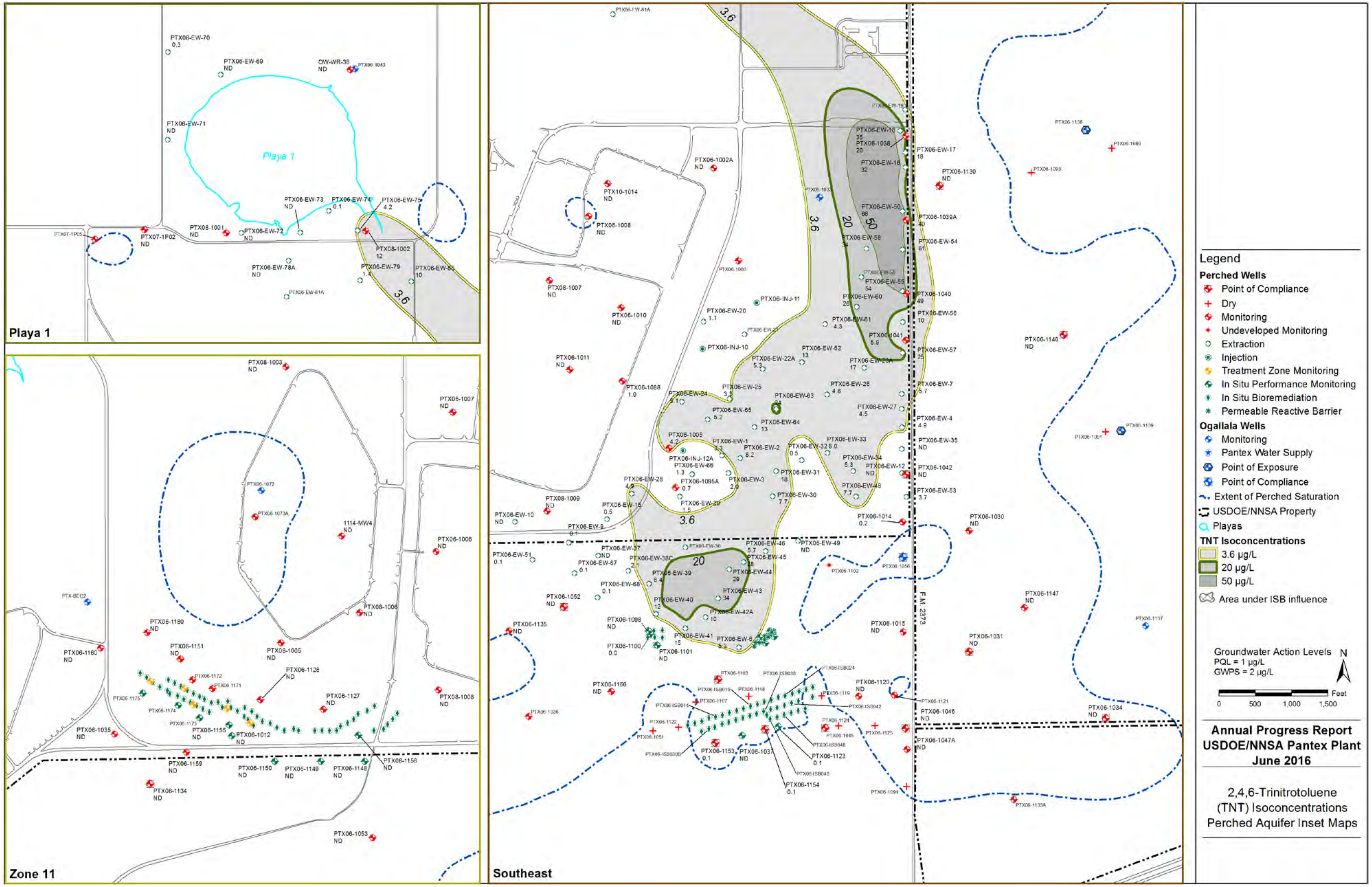

Figure 3-20. TNT Isoconcentration Inset Map

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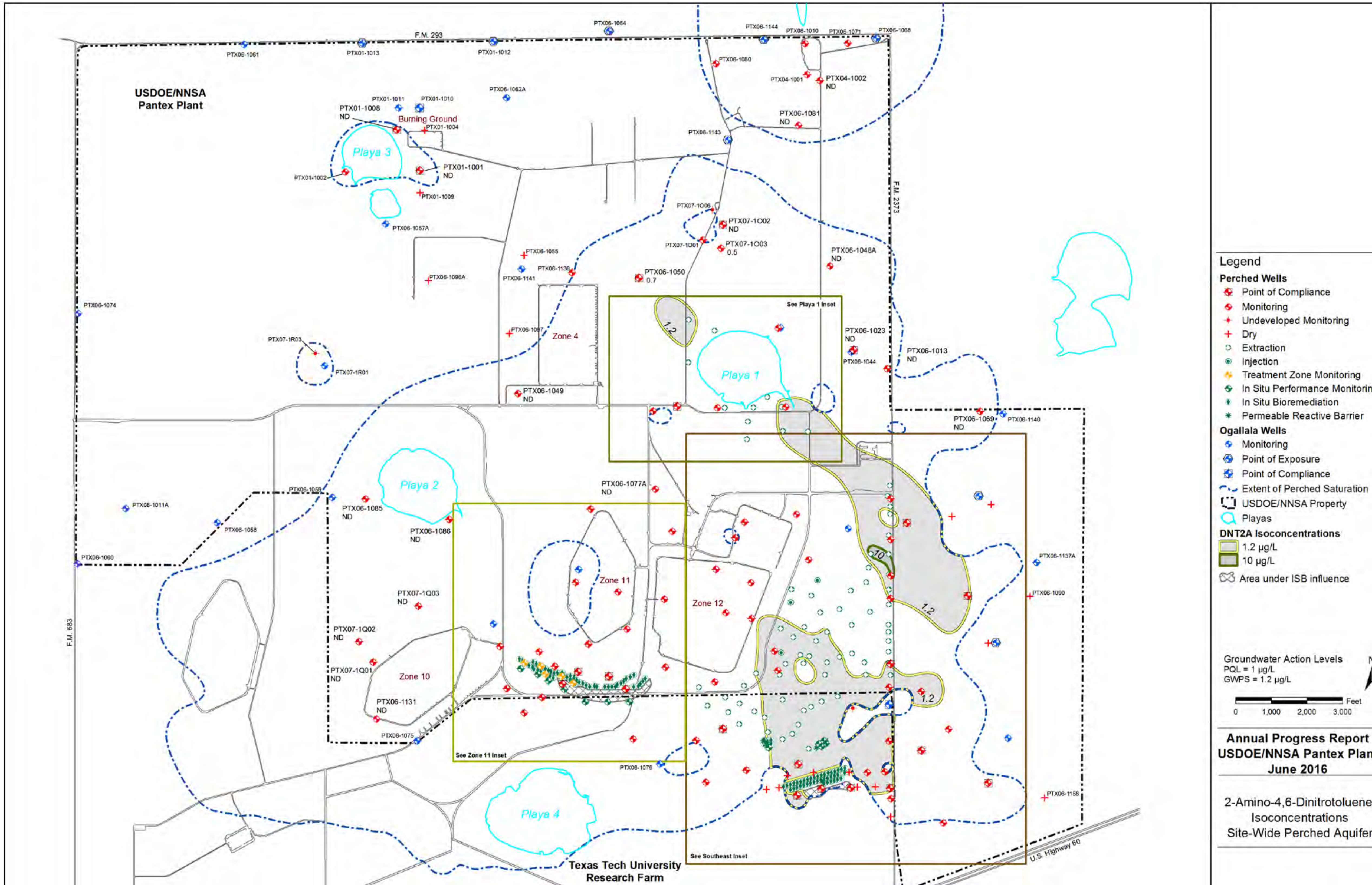

Figure 3-21. DNT-2A Isoconcentration Map

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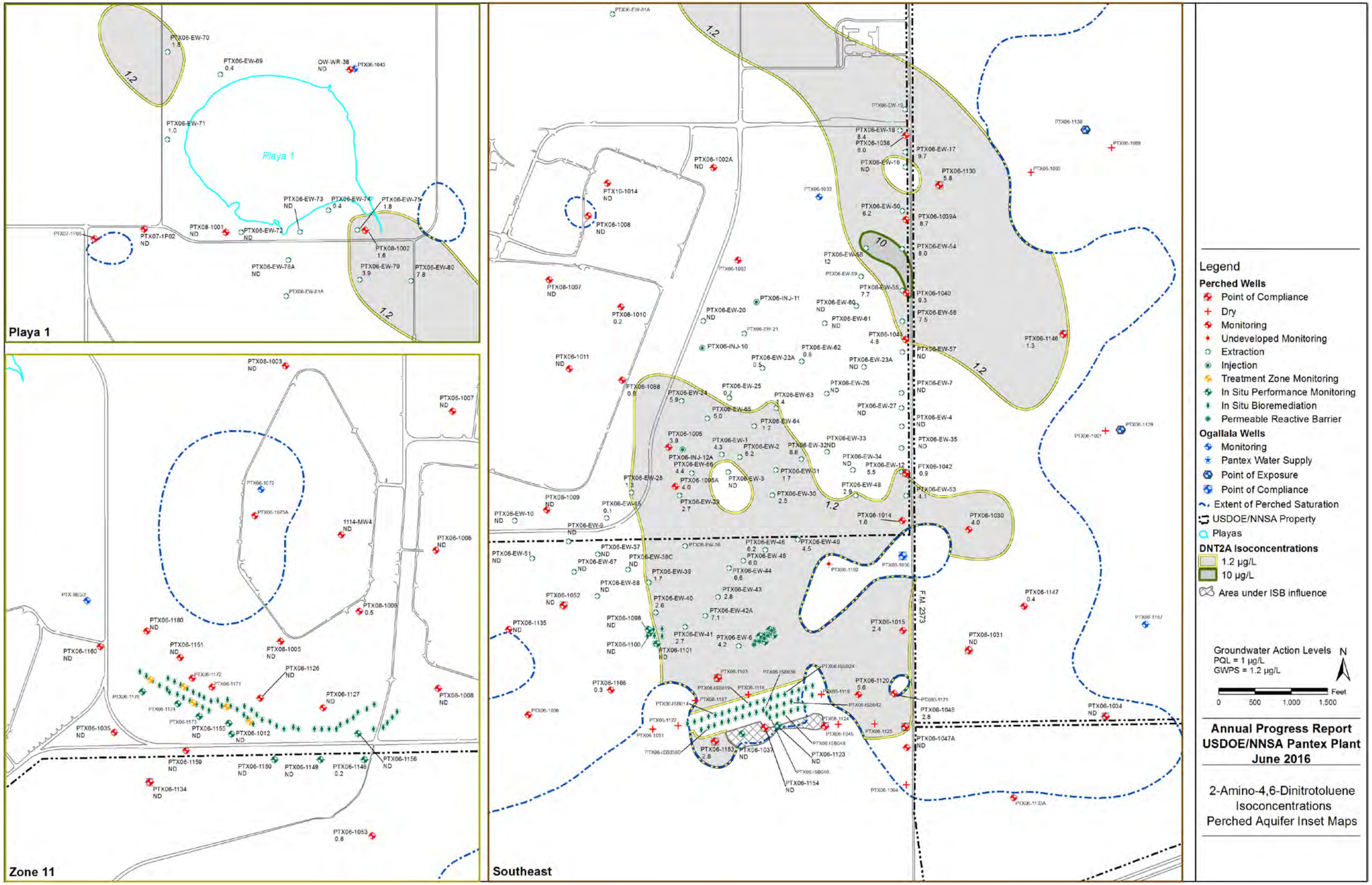

Figure 3-22. DNT-2A Isoconcentration Inset Map

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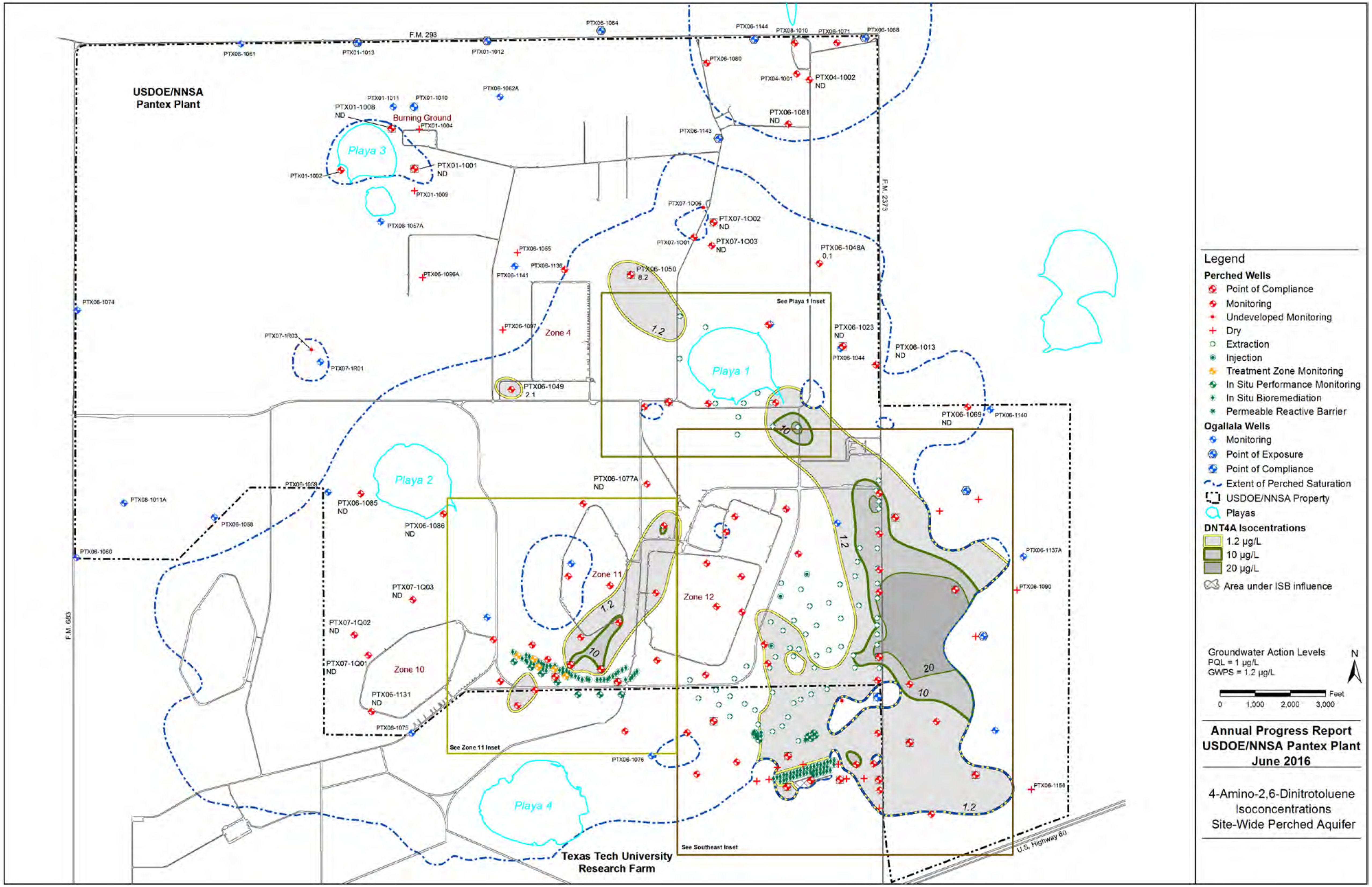

Figure 3-23. DNT-4A Isoconcentration Map

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Figure 3-24. DNT-4A Isoconcentration Inset Map

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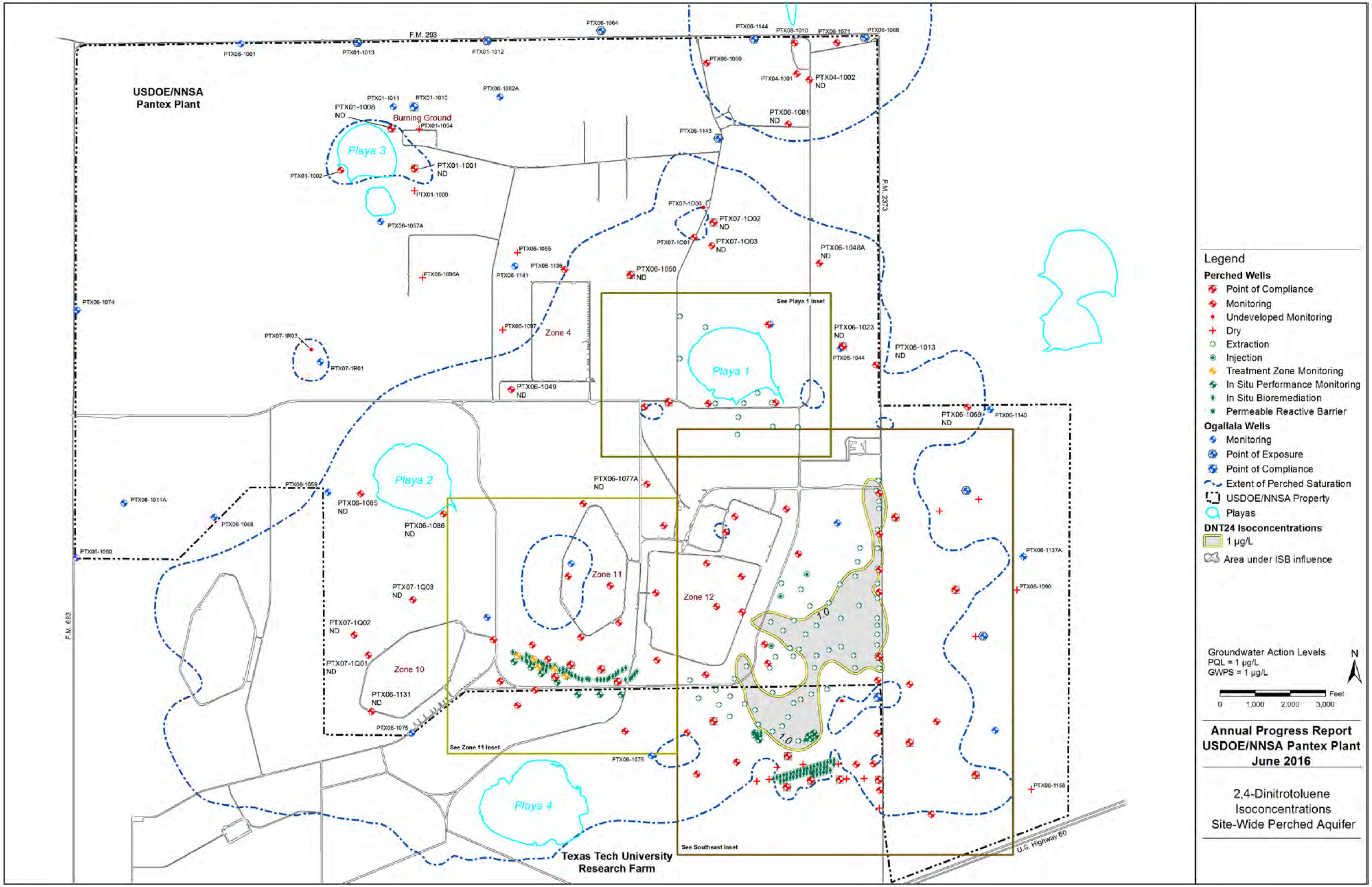

Figure 3-25. 2,4-DNT Isoconcentration Map

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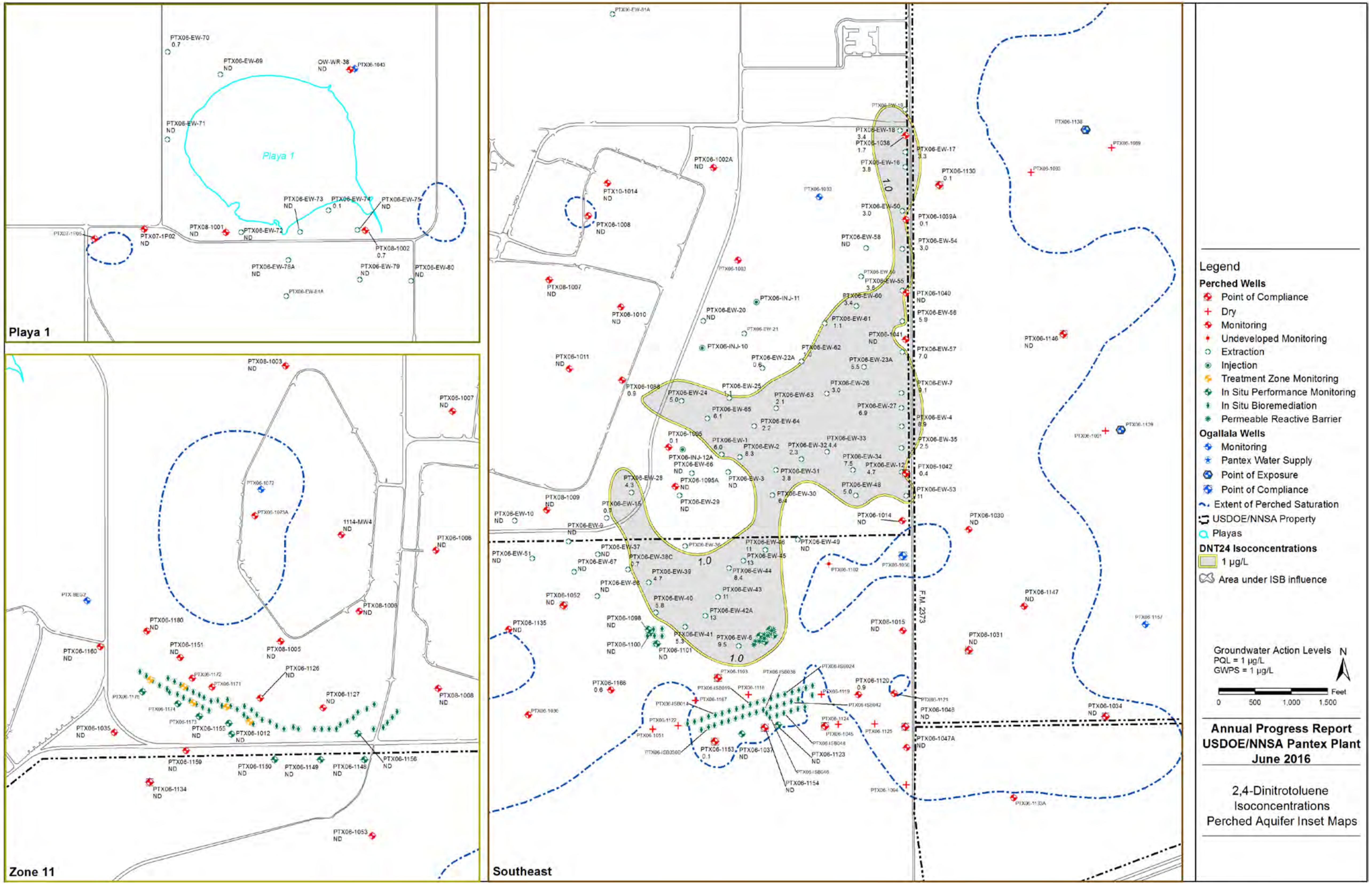

Figure 3-26. 2,4-DNT Isoconcentration Inset Map

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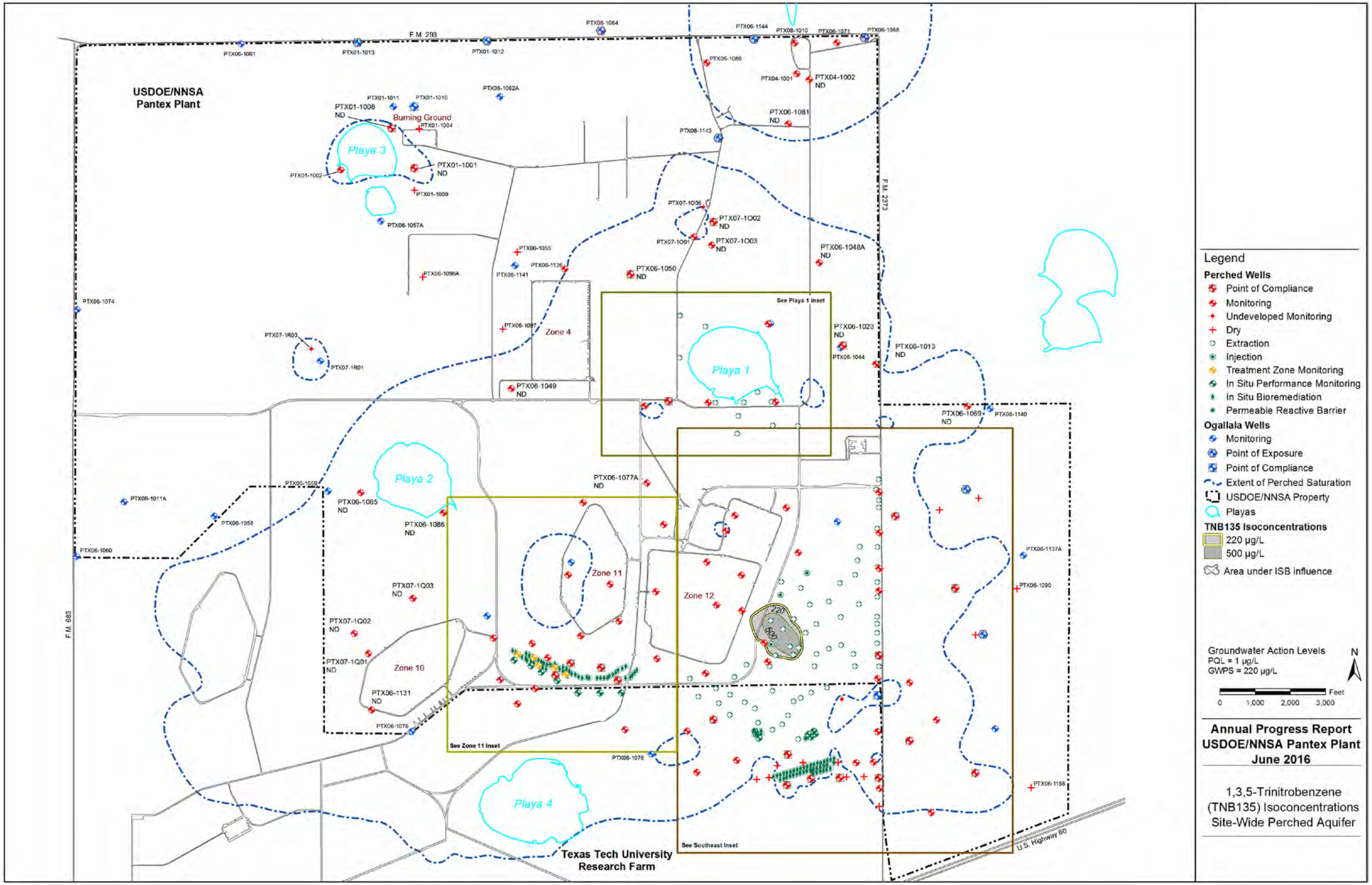

Figure 3-27. 1,3,5 - Trinitrobenzene Isoconcentration Map

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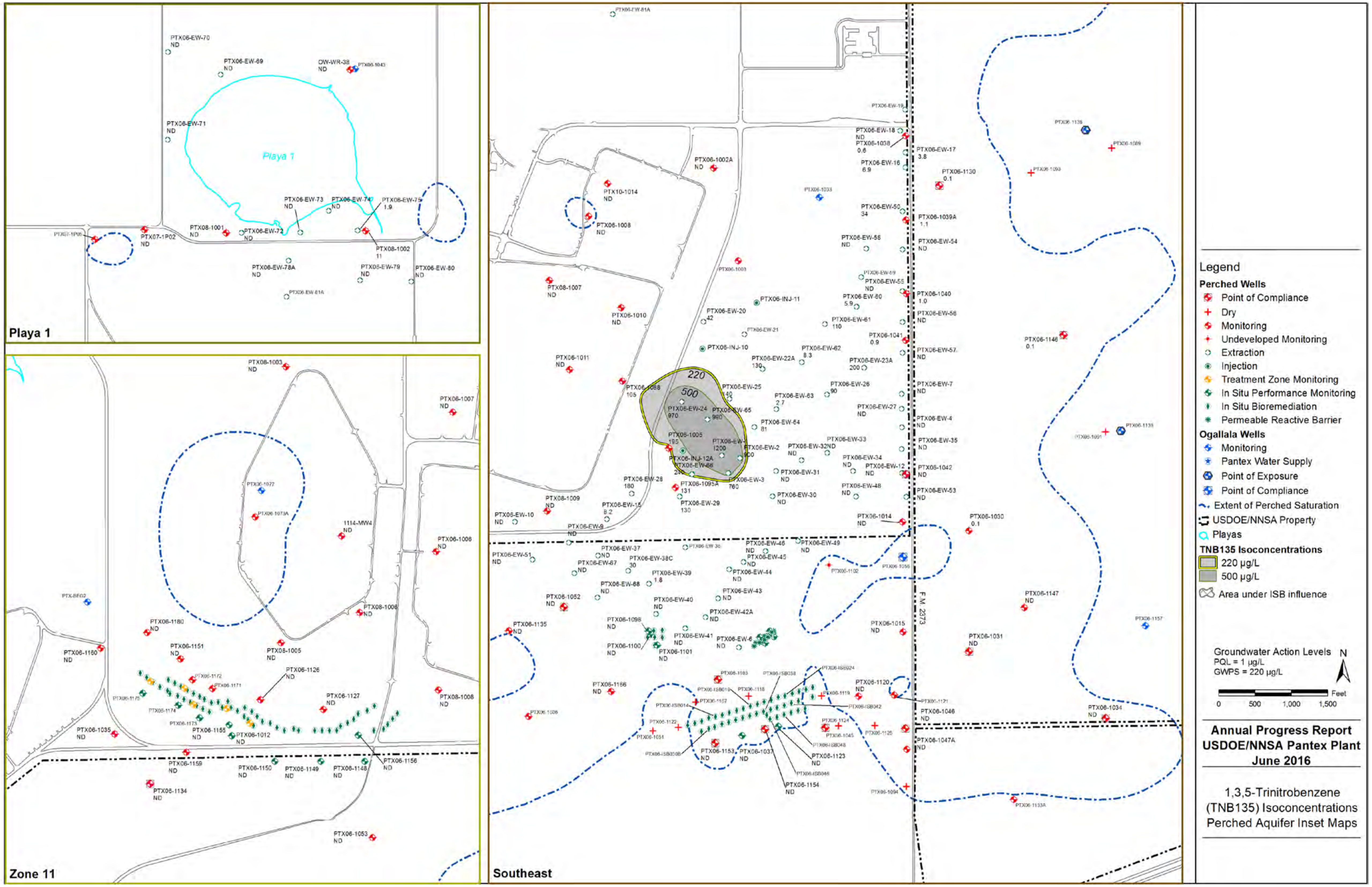

Figure 3-28. 1,3,5 - Trinitrobenzene Isoconcentration Inset Map

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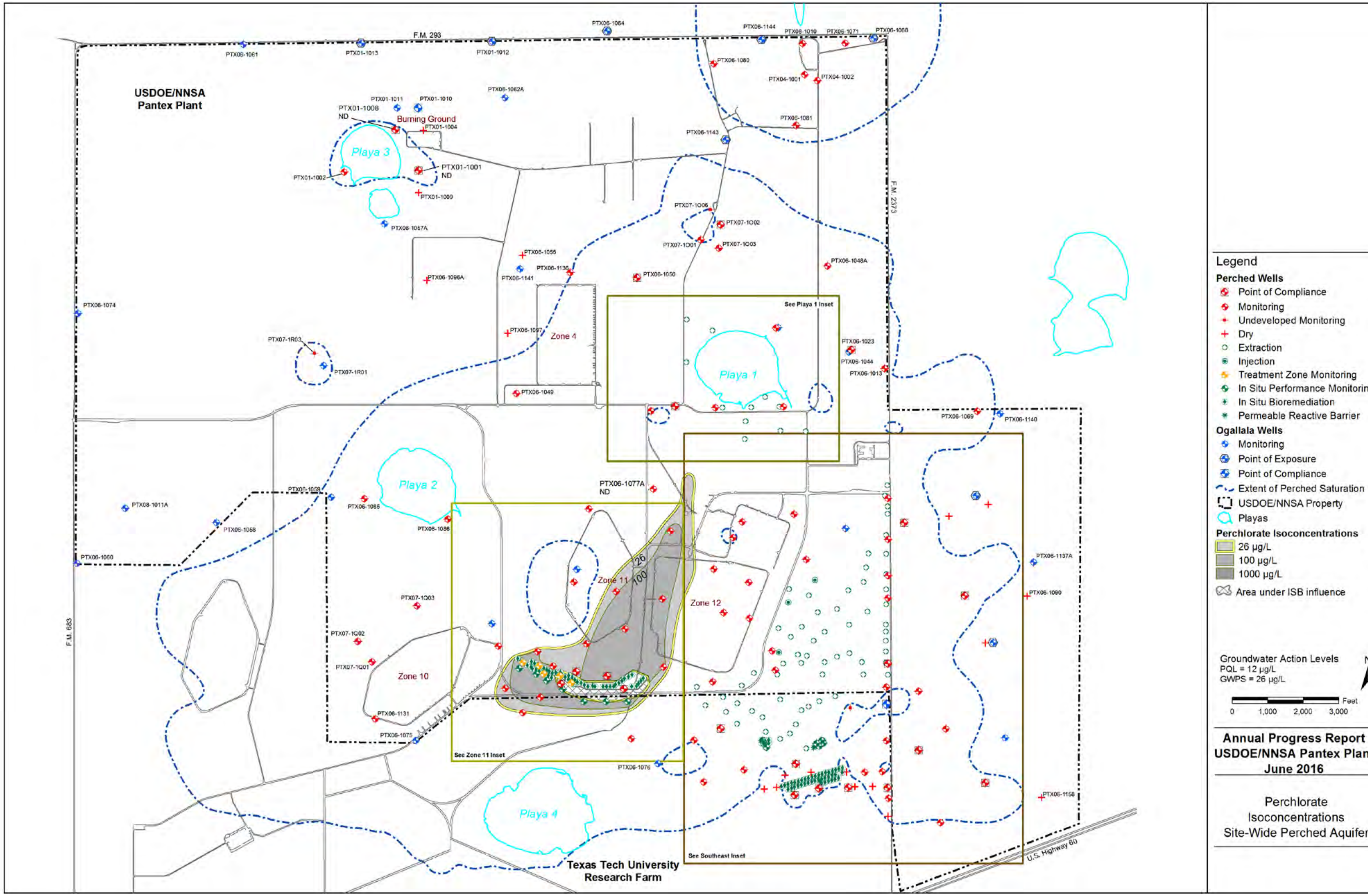

Figure 3-29. Perchlorate Isoconcentration Map

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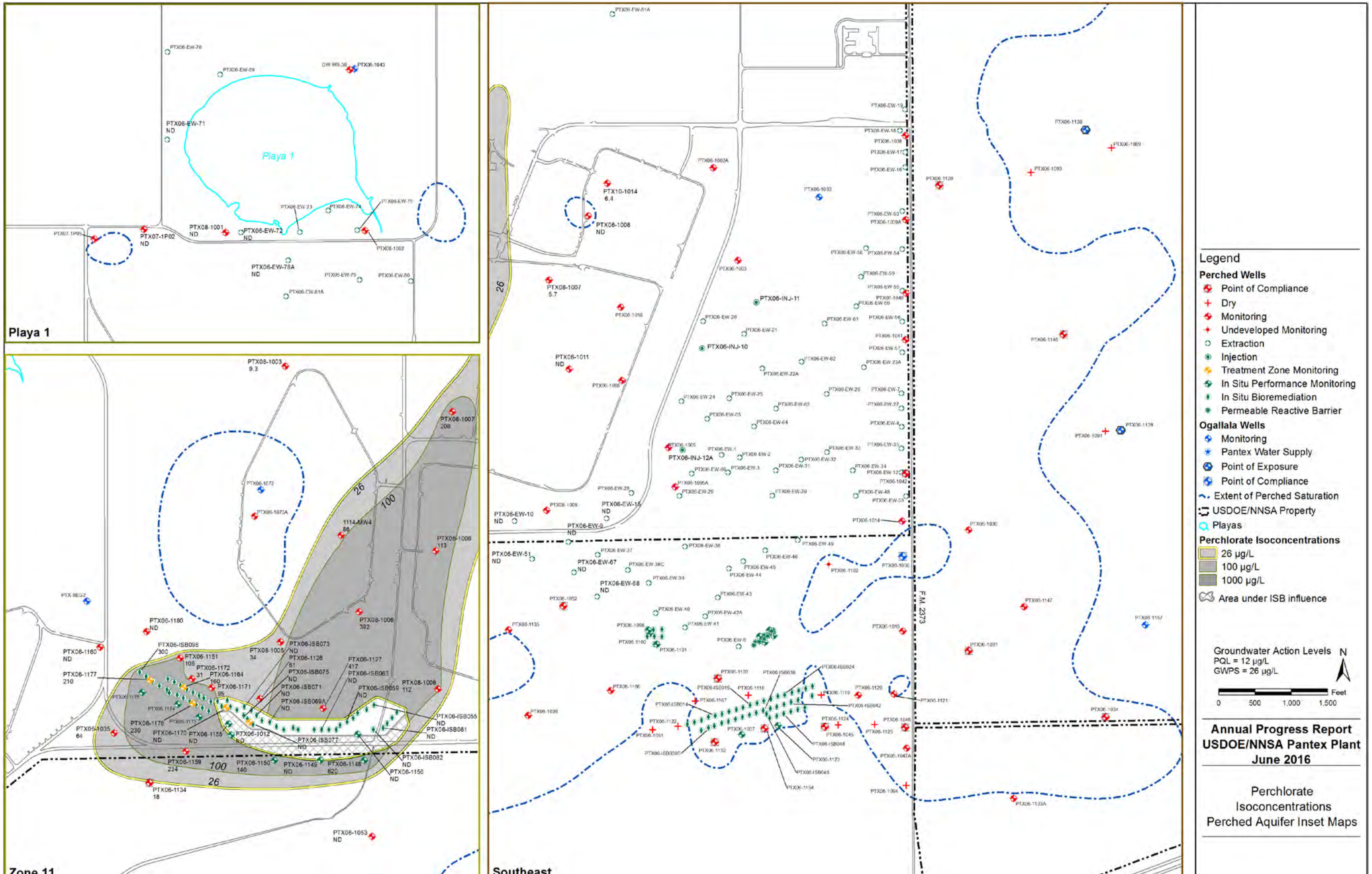

Figure 3-30. Perchlorate Isoconcentration Inset Map

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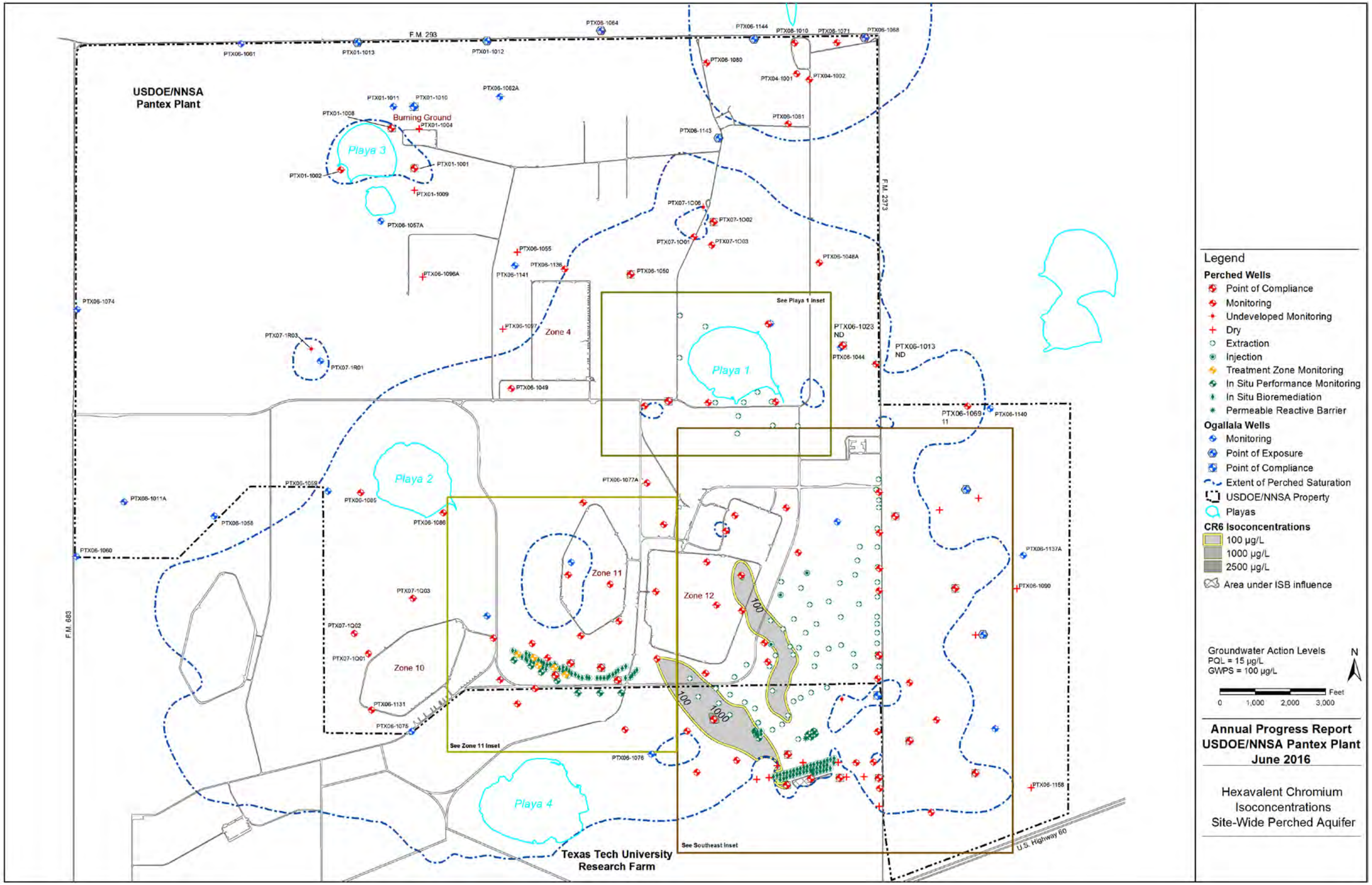

Figure 3-31. Hexavalent Chromium Isoconcentration Map

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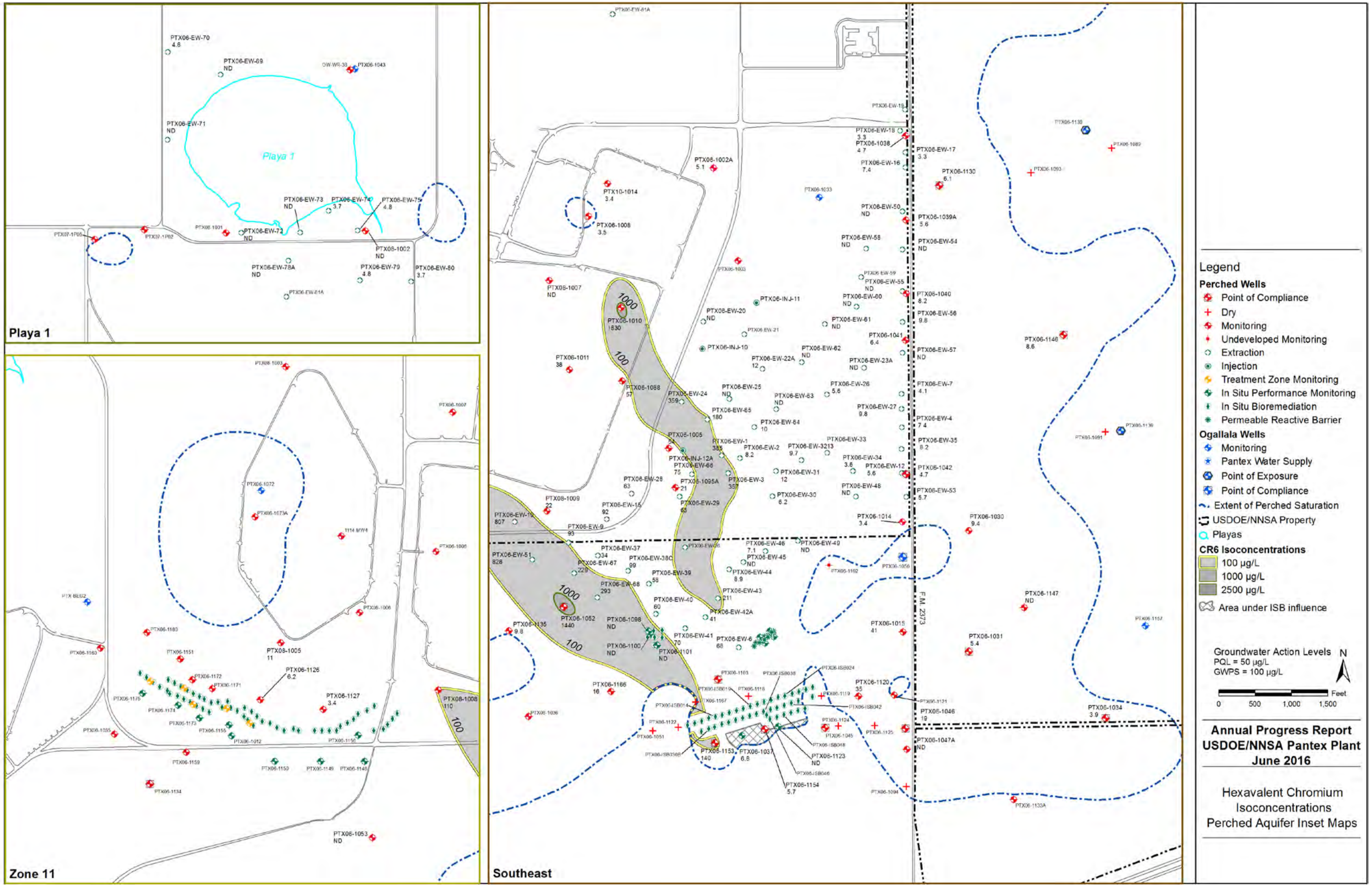

Figure 3-32. Hexavalent Chromium Isoconcentration Inset Map

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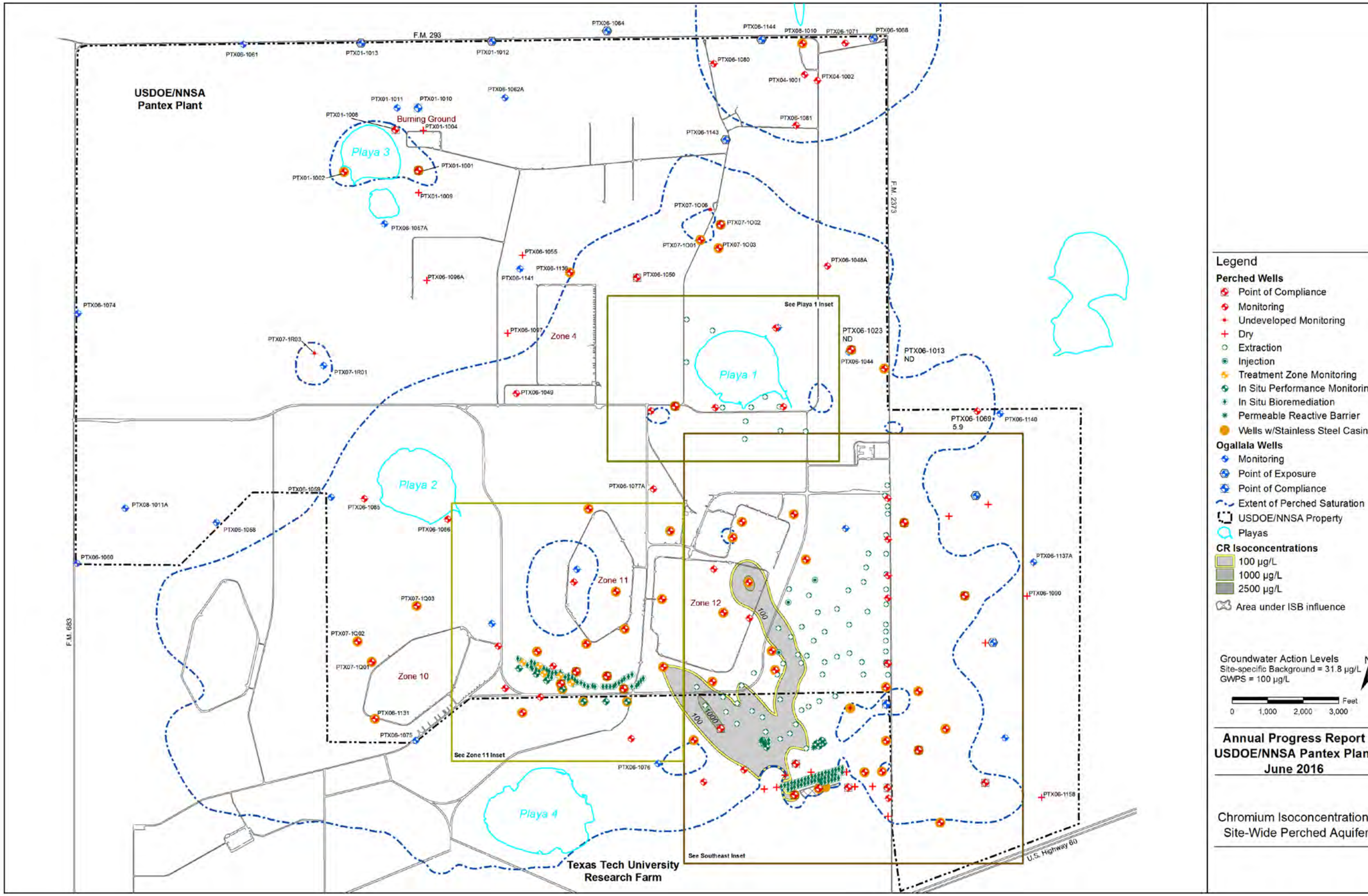

Figure 3-33. Chromium Isoconcentration Map

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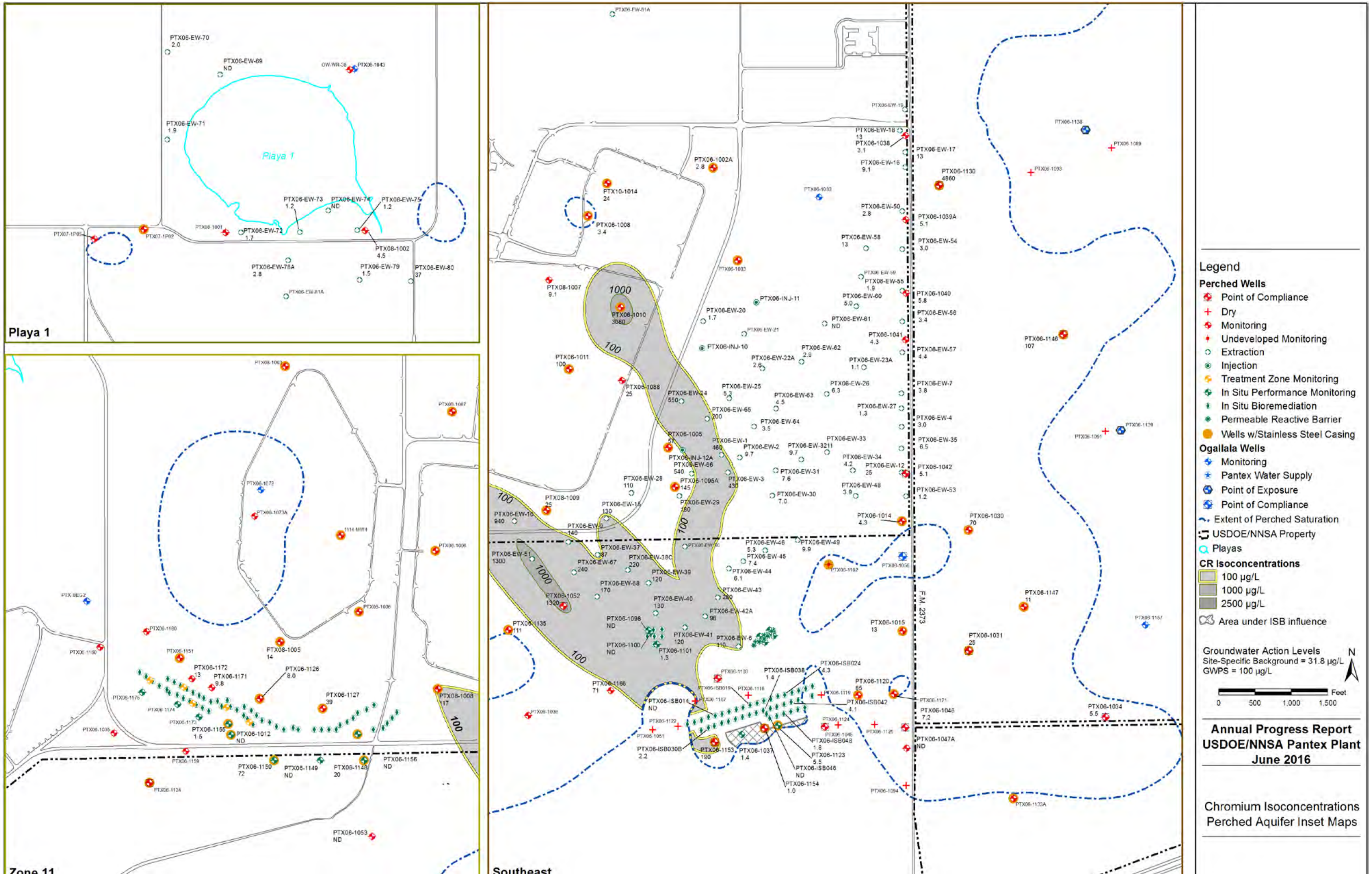

Figure 3-34. Chromium Isoconcentration Inset Map

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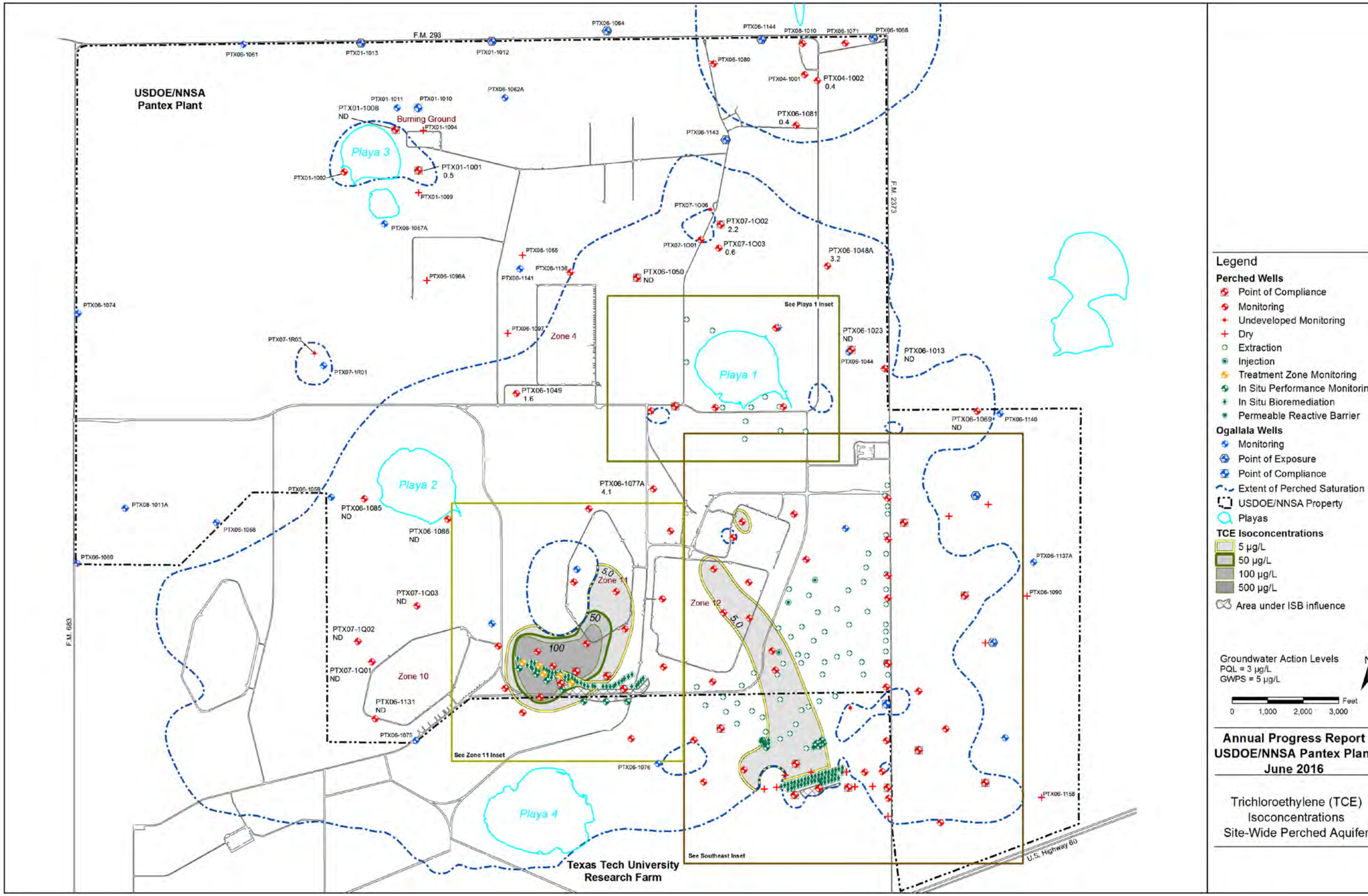

Figure 3-35. TCE Isoconcentration Map

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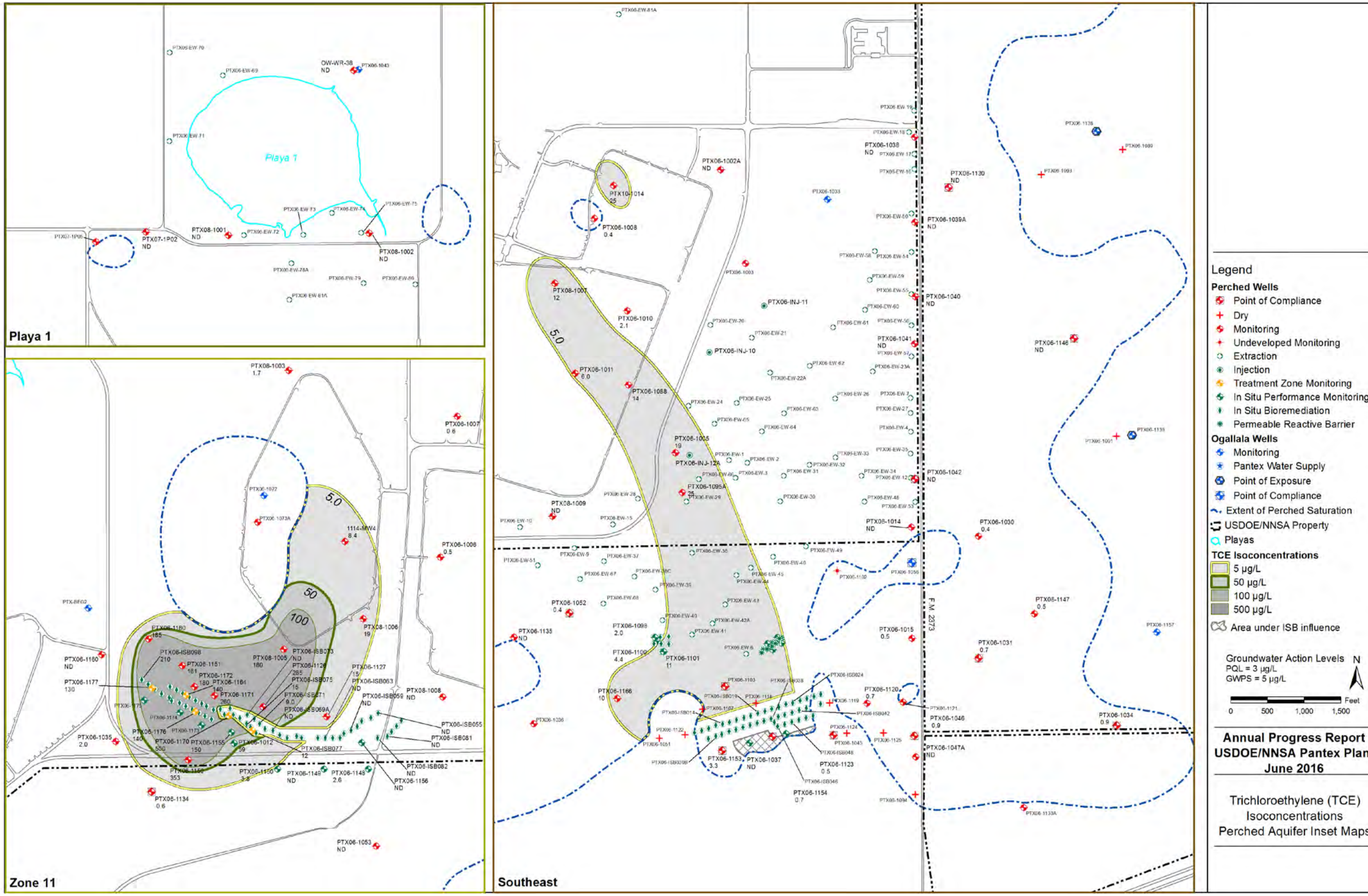

Figure 3-36. TCE Isoconcentration Inset Map

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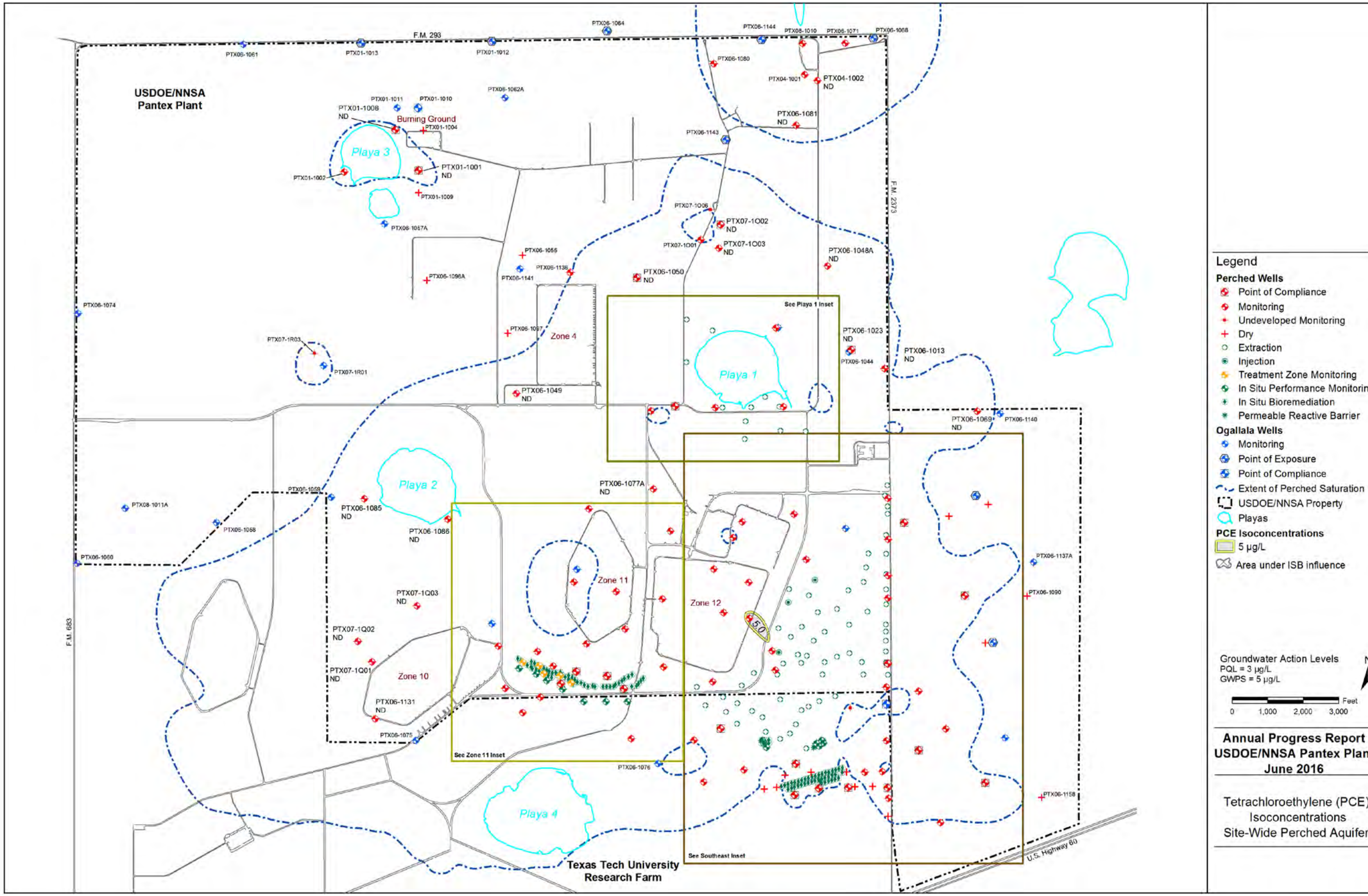

Figure 3-37. PCE Isoconcentration Map

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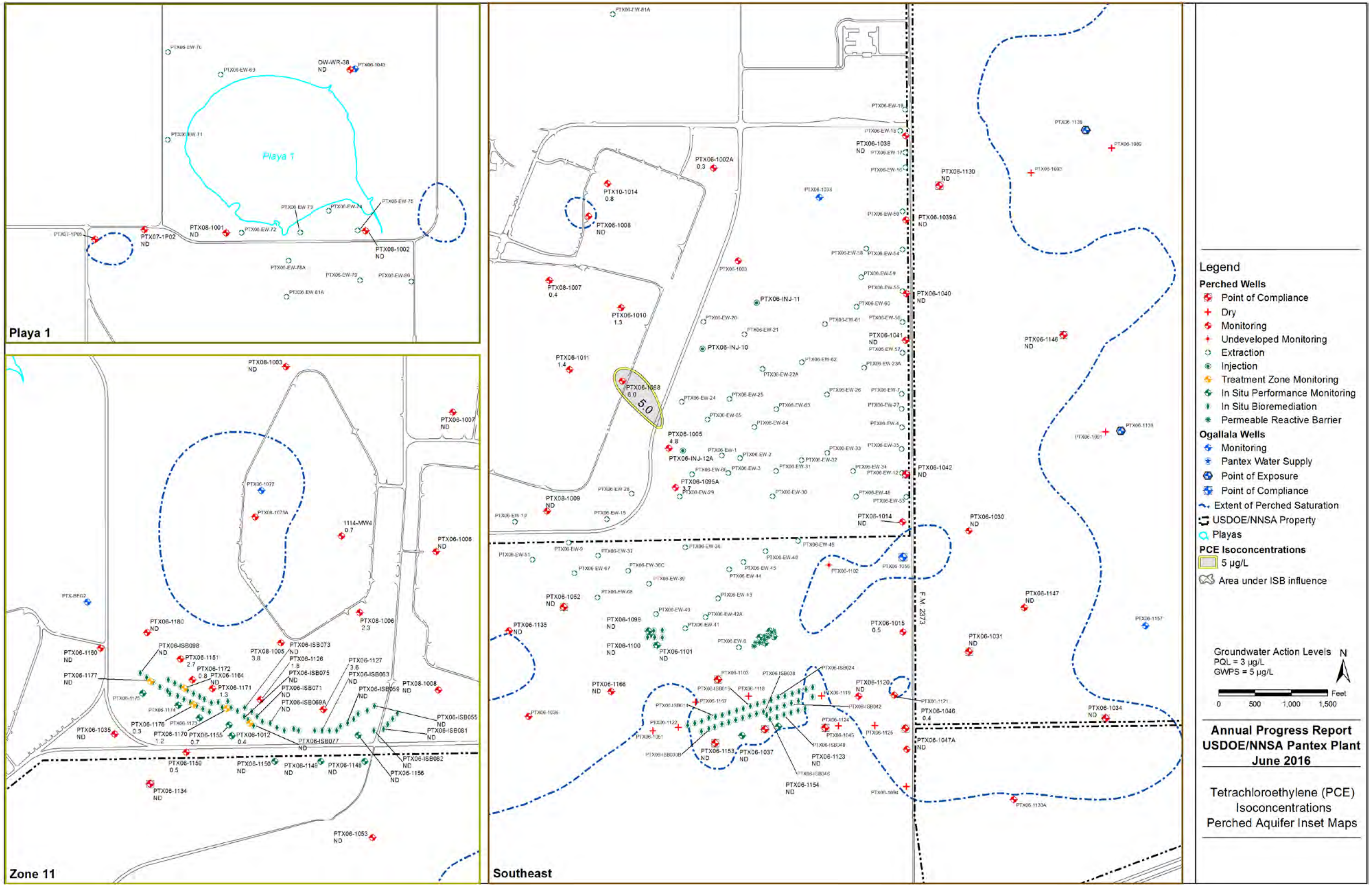

Figure 3-38. PCE Isoconcentration Inset Map

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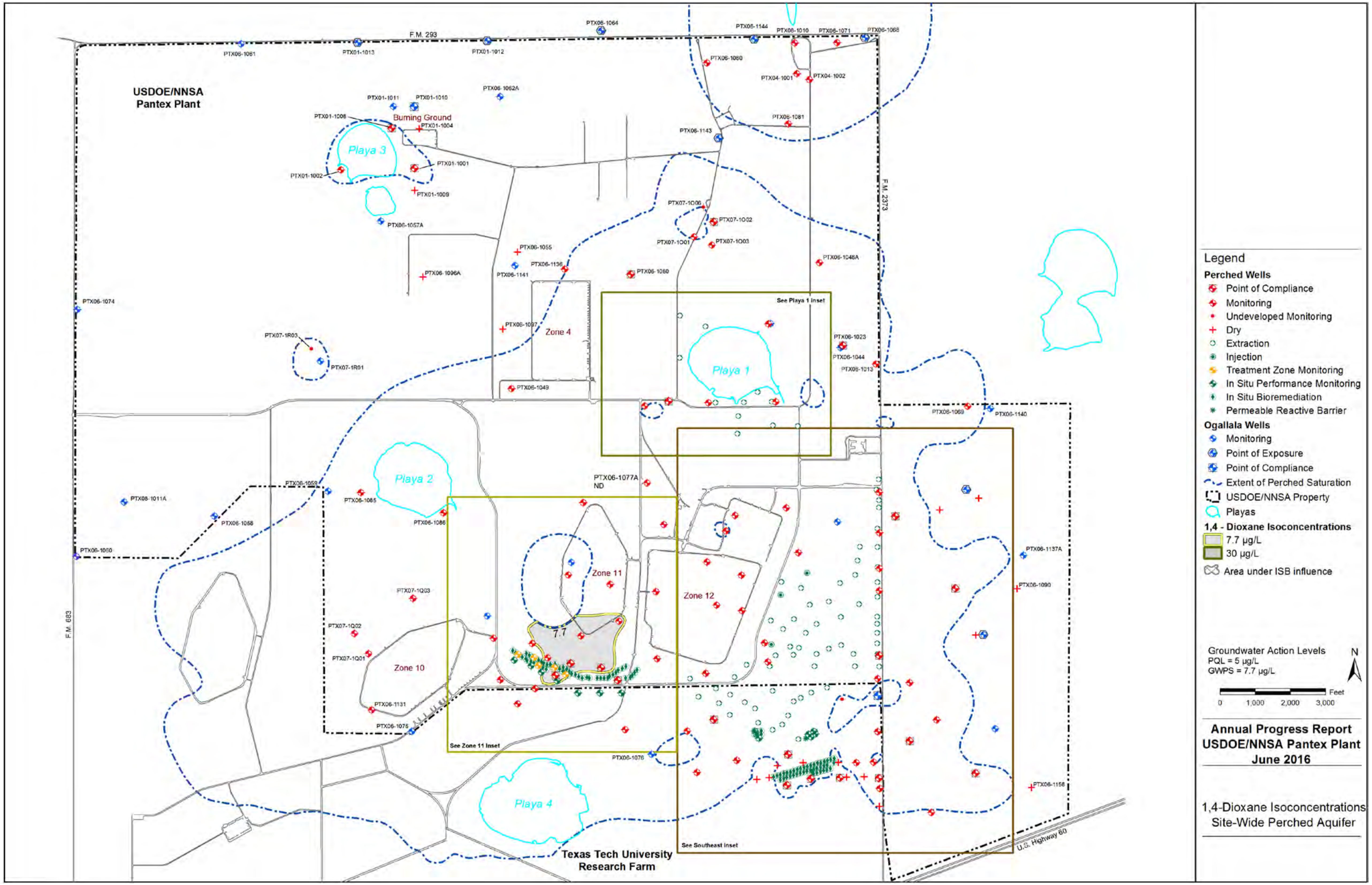

Figure 3-39. 1,4-Dioxane Isoconcentration Map

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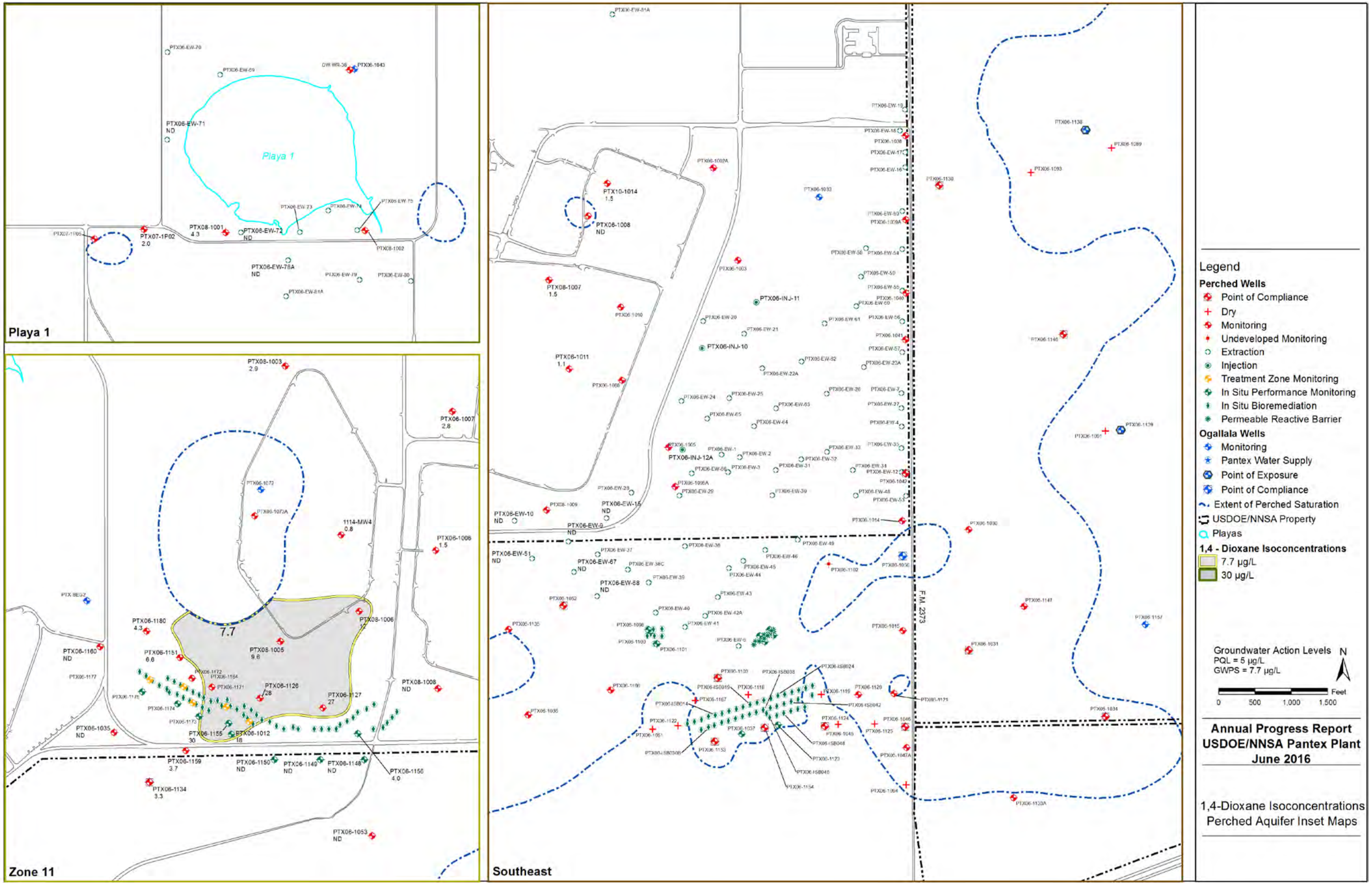

Figure 3-40. 1,4-Dioxane Isoconcentration Inset Map

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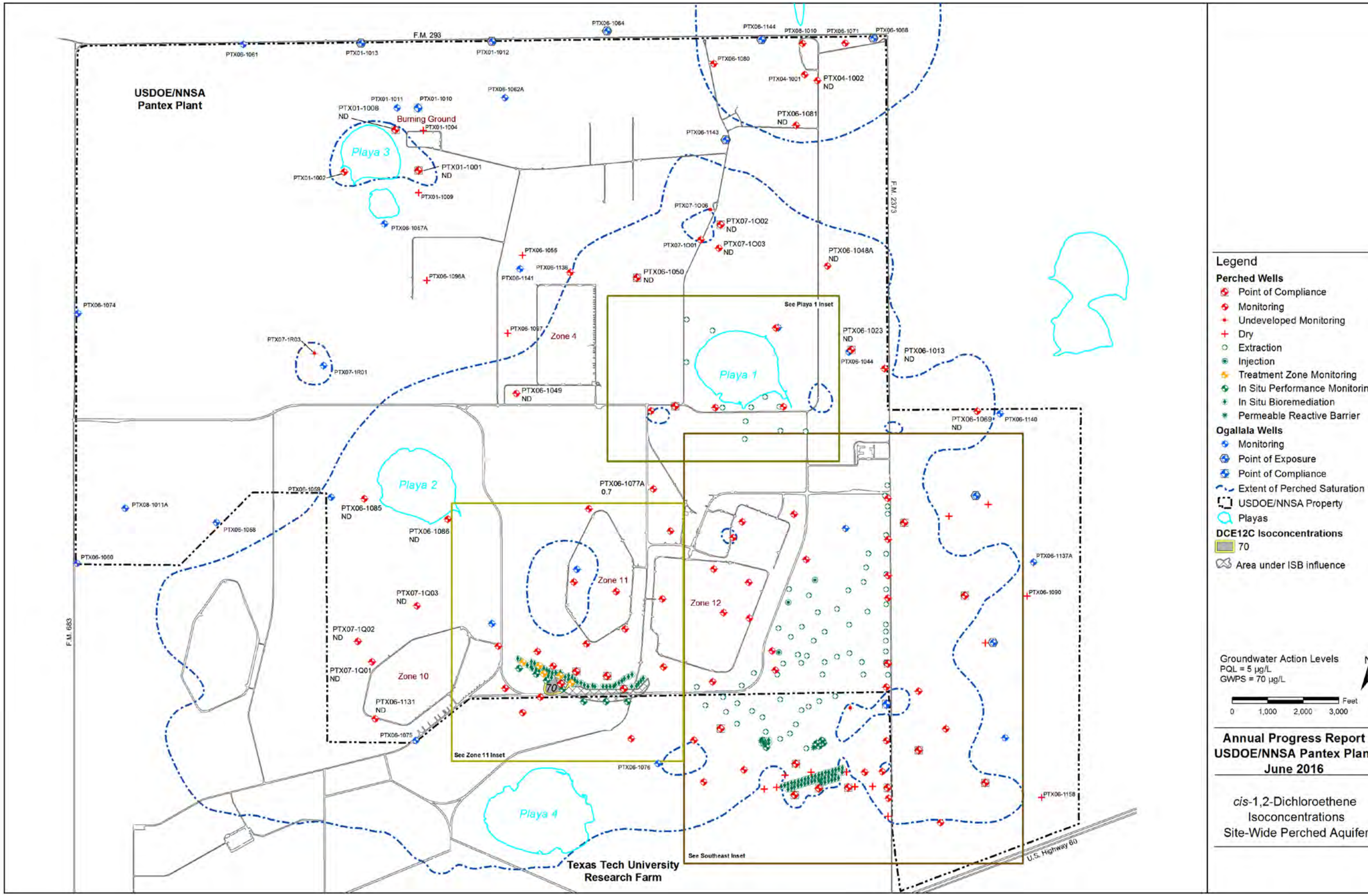

Figure 3-41. *cis*-1,2-DCE Isoconcentration Map

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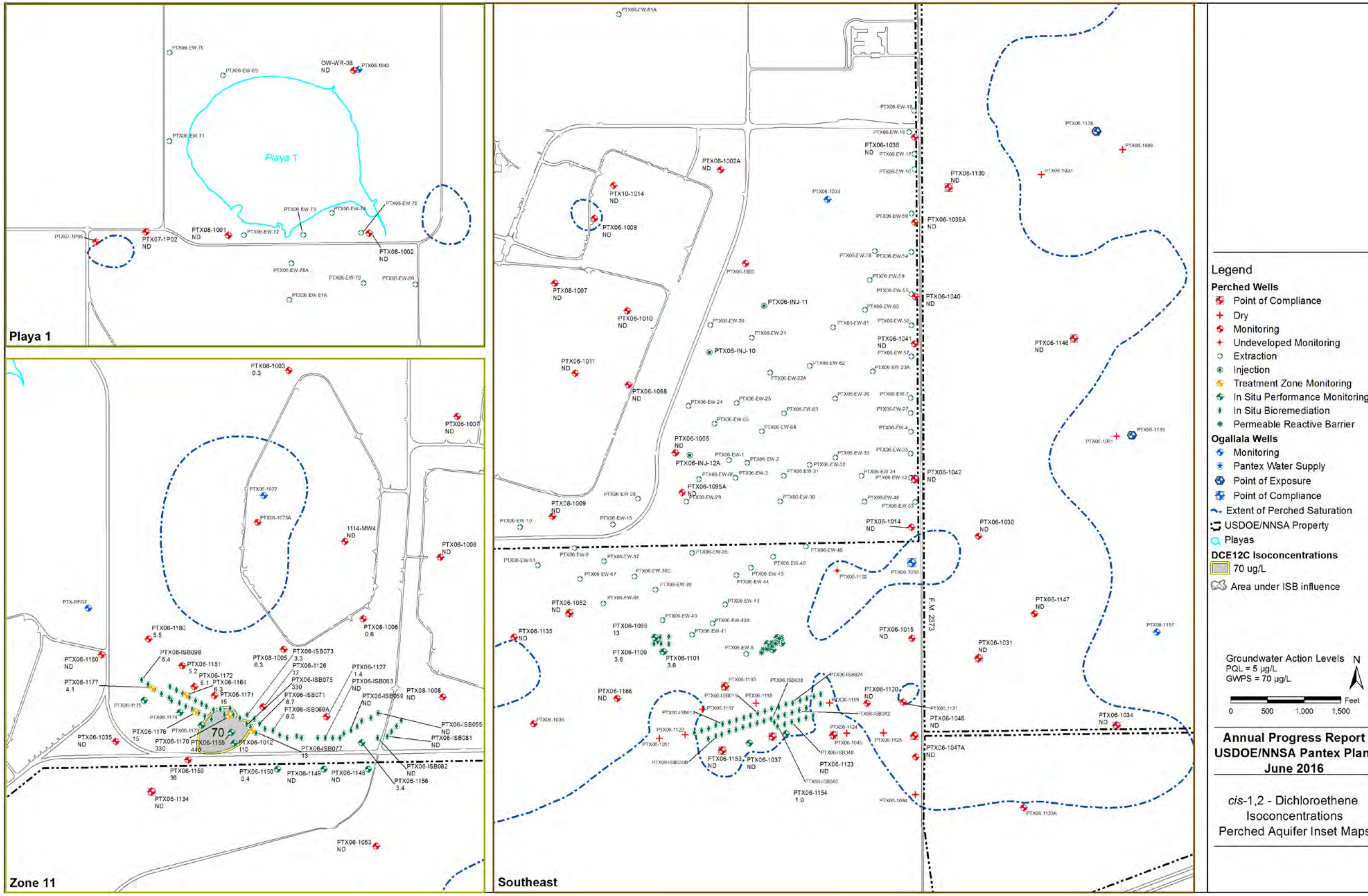

Figure 3-42. ***cis*-1,2-DCE Isoconcentration Inset Map**

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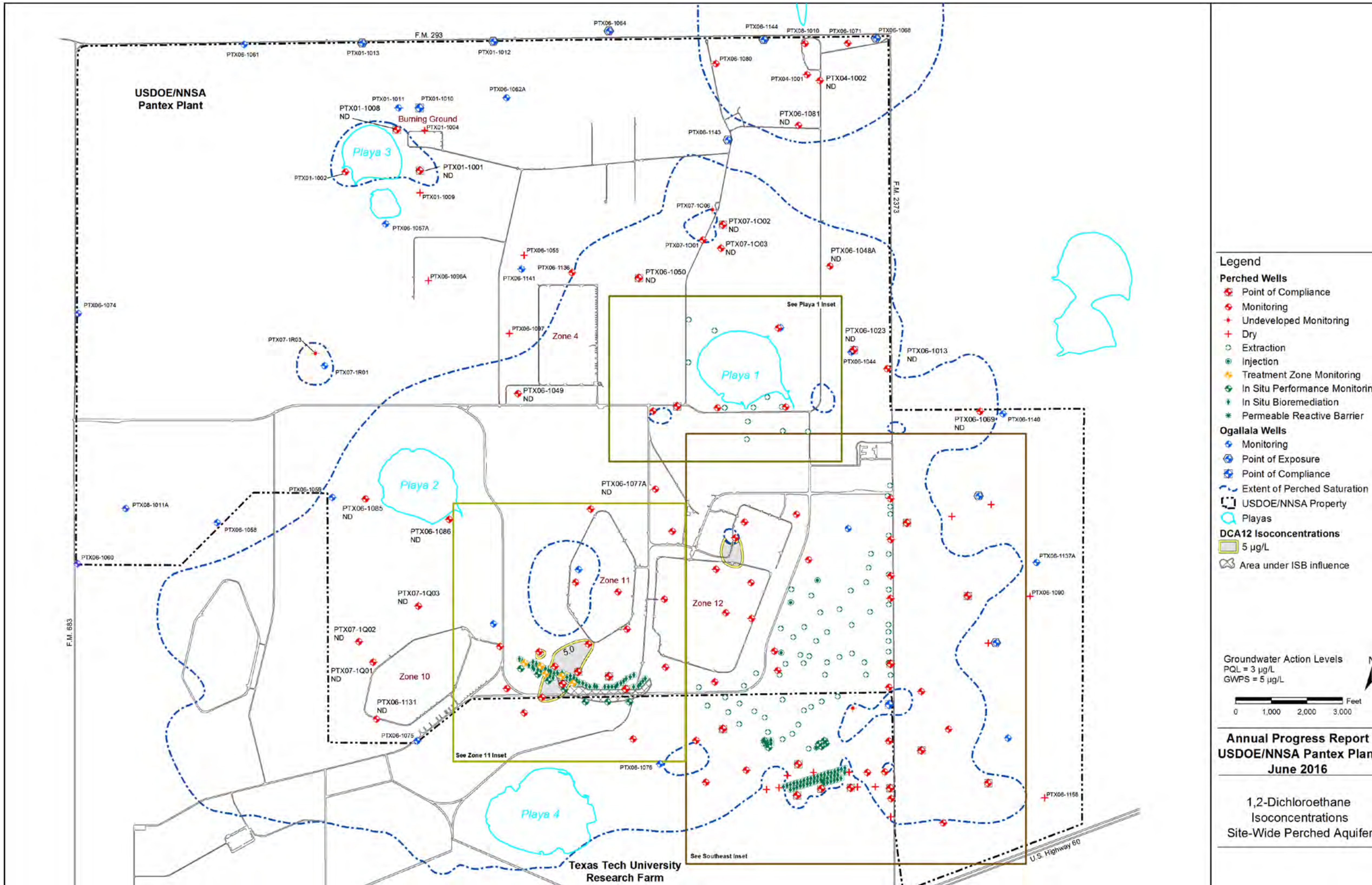

Figure 3-43. 1,2 - DCA Isoconcentration Map

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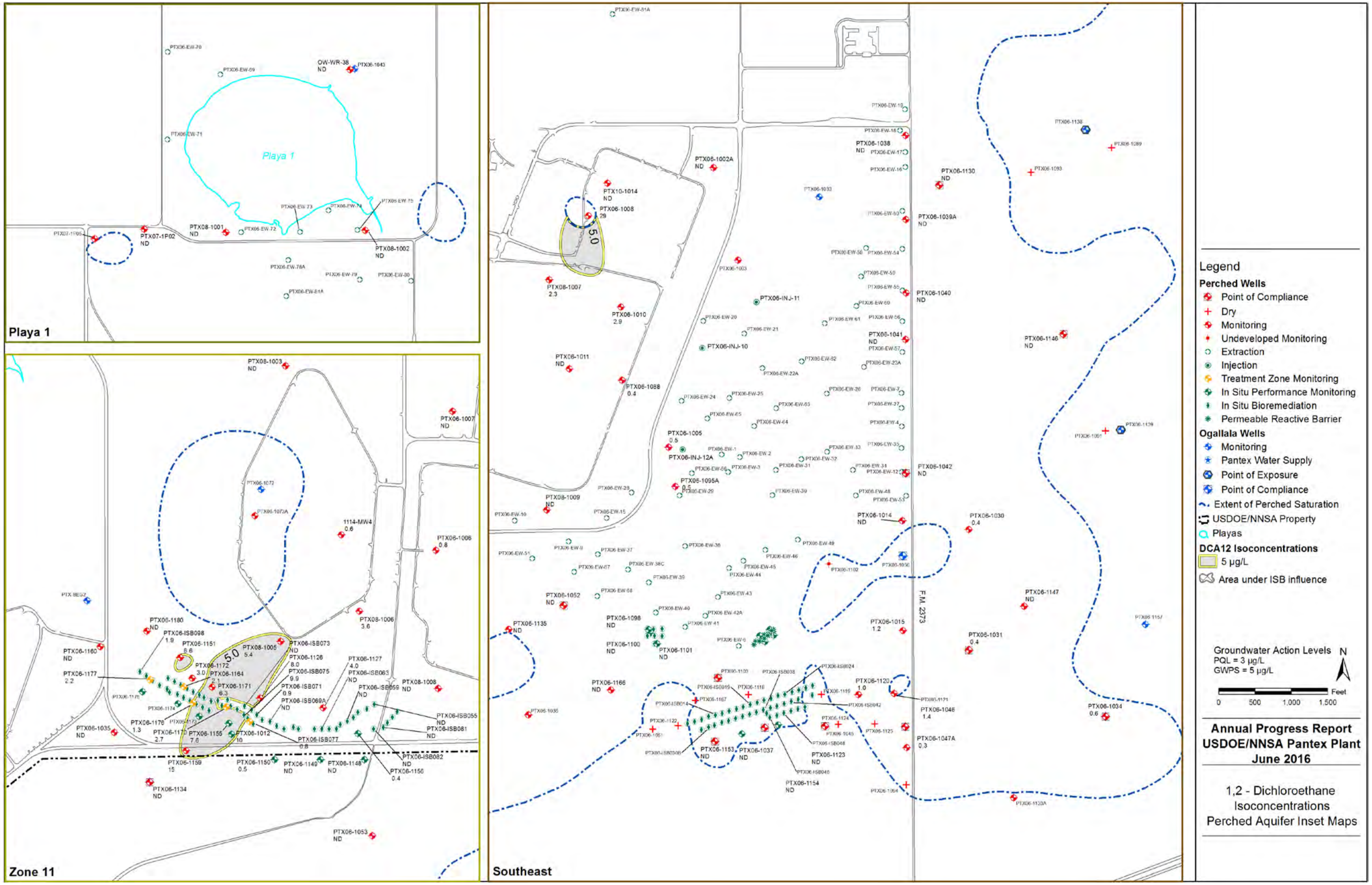

Figure 3-44. 1,2 - DCA Isoconcentration Inset Map

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3.1.7 Estimate of Plume Movement

The unique characteristics of the perched aquifer, including the limited areal extent of the aquifer, cause difficulty for estimating the rate of migration of groundwater contaminants. Unlike a typical contaminant plume in a regional aquifer, the HE plume associated with Pantex (Figure 3-11) extends to the edge of aquifer saturation, because this part of the aquifer was largely created by the infiltration of industrial wastewater discharges from legacy activities at Pantex. Furthermore, movement of contaminants within the plume is difficult to assess because of the impacts of the groundwater treatment systems. COC concentration trends for individual wells are located in Appendix E.

The approved LTM network has been in place since 2009, making it possible to compare the size and shape of plumes from specific time periods. Previous attempts to quantify plume movement by calculating plume centroids were unsuccessful, possibly due to asymmetrical plume shapes and remedial action effects. Therefore, only a qualitative discussion of plume movement from 2009–2015 is included in the following sections. 2015 plume boundaries and/or select contours were compared with the 2009 isocontour maps available. As additional data are collected, quantification of plume movement may be attempted again.

Groundwater contamination in the perched aquifer occurs as several overlapping plumes associated with historical release areas. Each of the principal plumes is discussed below.

3.1.7.1 High Explosive Plumes

Several HE plumes are present in the perched aquifer as shown in Figure 3-11 through Figure 3-26. These plumes are primarily composed of RDX and TNT, including breakdown products of those compounds, and other HE constituents. The largest plume having the highest concentrations, referred to as the Southeast Plume, is located east and southeast of Zone 12 and Playa 1 and extends offsite to the south and east to the extent of perched saturation. A second HE plume occurs beneath the southeast portion of Zone 11. Other HE plumes are present in the areas surrounding Playa 1.

The Southeast Plume was formed as a result of the discharge of HE-contaminated process waters into unlined ditches in Zone 12. The contaminated wastewater flowed through the ditches to Playa 1, but significant volumes of the water infiltrated through the ditches. The HE plume maps presented show that the highest concentrations of HEs in groundwater occur away from the ditches indicating that contaminated perched groundwater has moved to the southeast away from the source areas and that concentrations of contaminated recharge water have declined over time. Trending of historic analytical data for this plume indicates source areas along the ditches continue to leach HEs into perched groundwater, but at much lower concentrations than occurred historically. This plume is being actively remediated by the SEPTS that limits further migration of contaminants to the east. In addition, the P1PTS is actively treating the HE plume in the vicinity of Playa 1, as well as reducing the head driving the southeast plume movement. The Southeast ISB system is also actively treating the HE plume before reaching the area beneath TTU property where the FGZ becomes less resistant to vertical migration.

The Zone 11 plume was formed as a result of the discharge of HE-contaminated process waters into unlined ditches and ponds in Zone 11. Groundwater contaminant concentrations in wells located along the southeast perimeter of Zone 11 are increasing, while concentrations at the south end of Zone 11 are decreasing. These increasing concentrations indicate movement of the plume away from upgradient source areas rather than increasing concentrations related to a source near the well.

HE plumes surrounding Playa 1 may be associated with water infiltrating from the playa. Wells installed near Landfills 1 and 2 and PTX06-1050 are exhibiting some increasing trends in HEs. However, these trends are believed to be due to the reduction of saturated thickness and shifting gradients in the northern perched groundwater due to P1PTS operations rather than sourcing from the landfills. Trends will continue to be monitored at these locations.

When compared to the 2009 HE plume estimates, the shapes are generally similar, with some small differences that are primarily due to slight variations in the data and low values defining the boundaries. Breakdown product plumes are variable and will likely continue to be variable as natural attenuation and remedial actions continue in the perched aquifer.

In order to attempt to evaluate HE plume movement from 2009–2015, the RDX plume was chosen due to its size and distribution near the remedial actions. Considering the size and complexity of the RDX plume and the fact the plume is defined by the perched aquifer extent in many areas, the 1000 ug/L contours were included in the evaluation. These two contours represent the “hearts” of the two original plume sources (Playa 1 and Zone 12 ditches) that have since commingled in the southeast portion of the perched aquifer and are under the effects of the remedial actions. As depicted in Figure 3-45, the 1,000 ug/L plume outlines have slightly shifted in the SEPTS well field and shifted to the southern and eastern edge of the perched aquifer extent. This is likely due to a combination of SEPTS operations and general plume movement in areas that are not under the SEPTS influence.

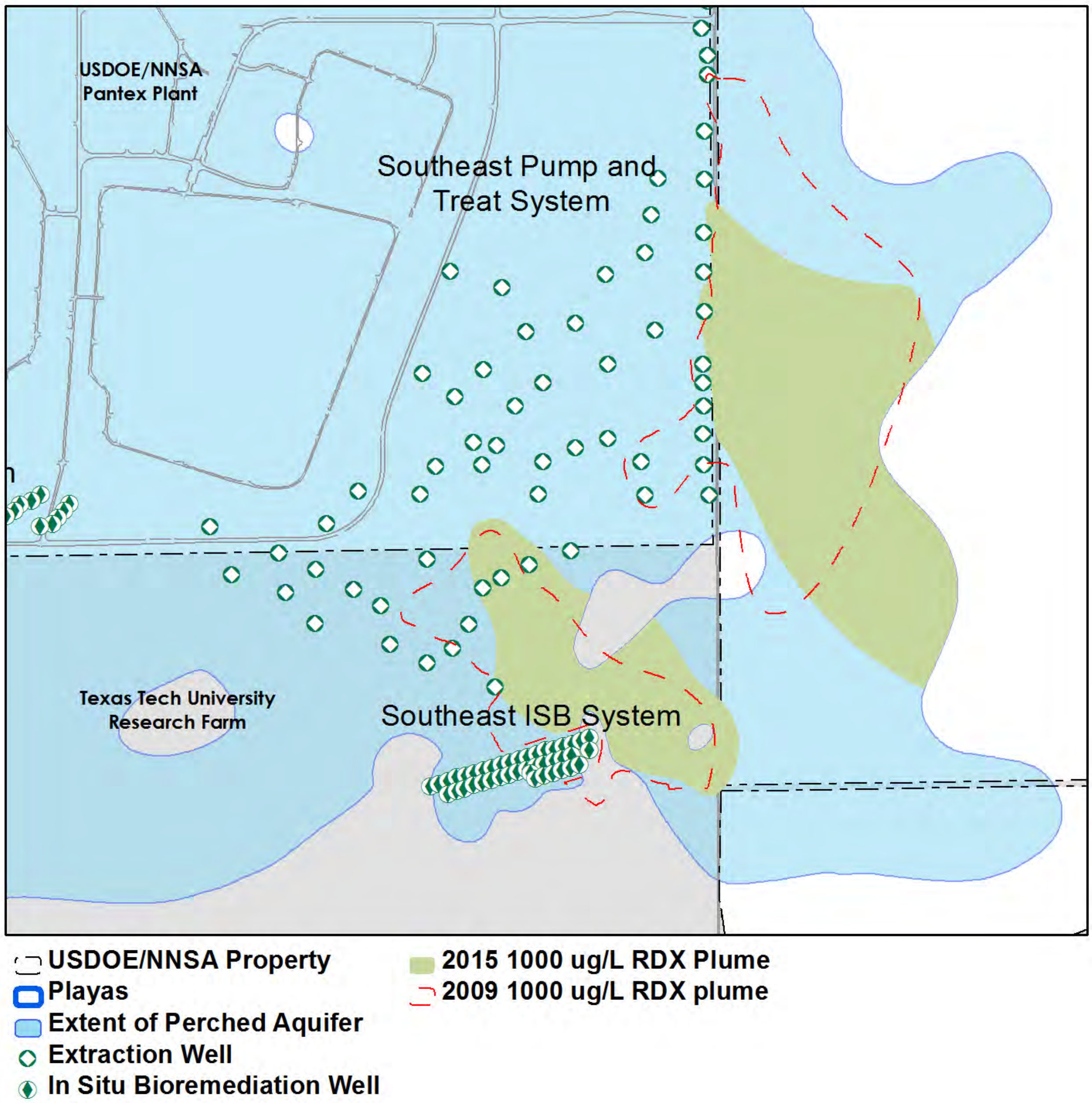

Figure 3-45. RDX Plume Movement, 2009-2015

3.1.7.2 Hexavalent Chromium Plumes

Hexavalent chromium is present in the perched aquifer in two commingled plumes originating in Zone 12 as shown in Figure 3-31 and Figure 3-32. Both of these plumes are being actively remediated by the SEPTS. The highest concentrations are associated with a source in WMG 5 outside the southwestern corner of Zone 12. Concentrations near the source area are decreasing indicating the source is declining. However, concentrations within the plume and in the far downgradient wells are variable, and the plume continues to move offsite to the southeast and extends to the limit of perched aquifer saturation on TTU property and Southeast ISB system.

A smaller plume of hexavalent chromium emanates from the area of the Former Cooling Tower on the east side of Zone 12. Concentrations in this plume have decreased, but it is likely the source area continues to leach contamination to the perched groundwater.

When compared with the 2009 hexavalent chromium maps (Figure 3-46), the shapes are similar, with the following exceptions:

- The northern lobe of the plume has apparently shifted to the east, likely due to a combination of SEPTS extraction well pumping and reduction of injection in the area.
- The southern portion of the plume has apparently shifted west due to data collected at monitoring well PTX06-1166, which has better defined the plume boundary in this area, and decreased concentrations in extraction wells north of the ISB system.

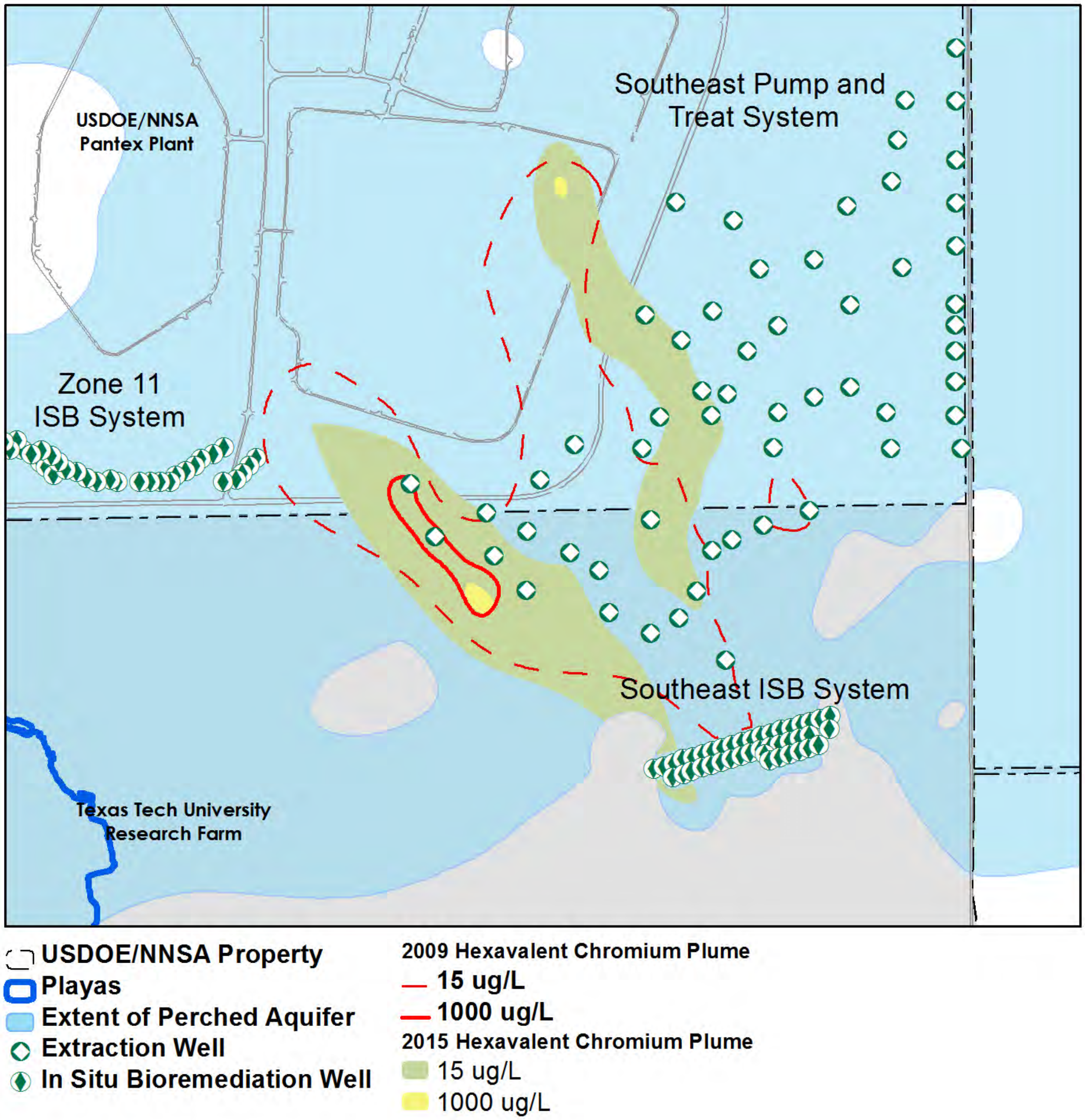

Figure 3-46. Hexavalent Chromium Plume Movement, 2009–2015

3.1.7.3 Trichloroethene Plumes

Several TCE plumes are present in the perched aquifer as shown in Figure 3-35 and Figure 3-36. The largest plume originates in the north (WMG 10) and east (SWMU 122b) sides of Zone 12 and extends to the southeast. Another TCE plume originates beneath Zone 11 and extends to the south off-site. TCE in the perched aquifer occurs from partitioning of TCE in soil gas into perched groundwater and leaching of TCE-contaminated process water associated with legacy discharges to unlined former pits and ponds.

Groundwater concentrations of TCE in the wells on the east side of Zone 12 indicate a continuing source of TCE to the groundwater. This plume is being actively remediated by the SEPTS. PTX10-1014, which is near WMG 10 in the northern part of Zone 12, is exhibiting a decreasing trend in TCE.

The TCE plume underlying Zone 11 is associated with legacy HE operations which resulted in industrial wastewater that infiltrated into the subsurface and TCE in soil gas originating from several areas within the zone. Concentrations in this plume are stable or slightly increasing beneath Zone 11 indicating continuing migration of TCE into perched groundwater. This plume is migrating southward, and observed concentrations at the TTU property boundary are increasing. This plume is being actively remediated by the Zone 11 ISB System as discussed in Section 3.2.3.1.

As depicted in Figure 3-47, the 2009 and 2015 TCE plume shapes are similar, with the following notable exceptions.

- The plume originating from Zone 12 has contracted near the Zone 12 source areas. However, the southern edge of the plume has shifted to the west due to data collected at monitoring well PTX06-1166 and decreasing TCE concentrations in Southeast ISB ISPM wells.
- The plume originating from Zone 11 has shifted to the southwest due to general gradient in the area and a newly installed well to the west.

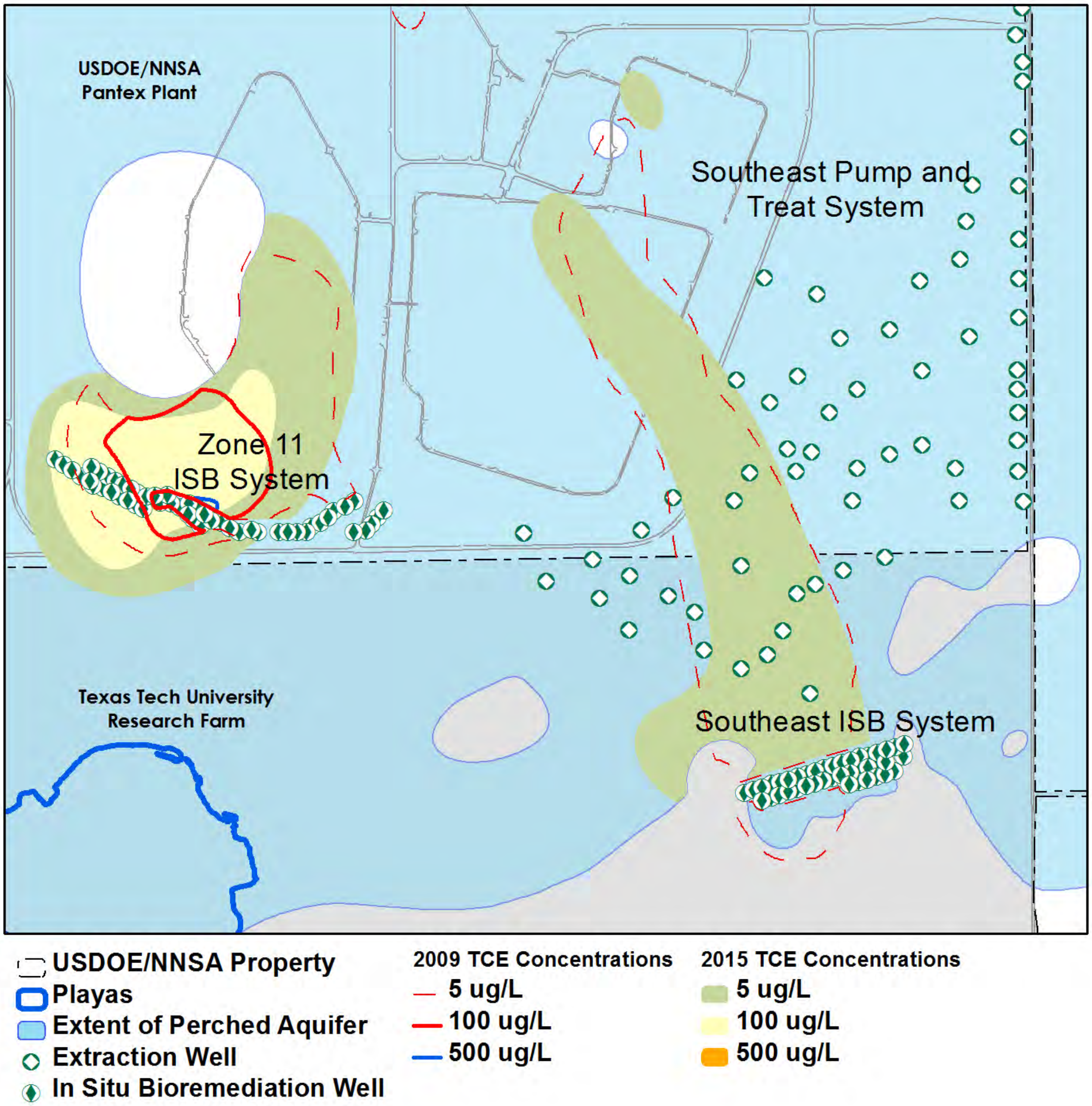

Figure 3-47. TCE Plume Movement, 2009-2015

3.1.7.4 Perchlorate Plume

A single plume of perchlorate occurs in the perched aquifer underlying Zone 11 and the western portion of Zone 12. This plume extends northeast toward Playa 1 and southwest beneath TTU property as shown in Figure 3-29 and Figure 3-30. This plume is associated with the historical release of perchlorate from processes in Zone 11 to unlined ditches that carried the untreated water to the playa.

Concentrations of perchlorate in areas underlying the potential source areas in Zone 11 are decreasing, but remain steady or are increasing near the ditch to Playa 1. Perchlorate concentrations near the southern boundary of Pantex Plant continue to generally increase. This plume is being actively remediated by the Zone 11 ISB System.

As depicted in Figure 3-48, the perchlorate plume shape is similar to the 2009 plume map, with the following notable exceptions.

- The northern lobe of the plume has contracted due to the decreasing concentrations in wells that define the boundaries in the area. However, these concentrations and resulting plume shapes have been quite variable since remedial actions began in 2009.
- The southern lobe of the plume has shifted to the south and west, likely due to advection and dispersion, as well as data collected from newly installed monitor wells.

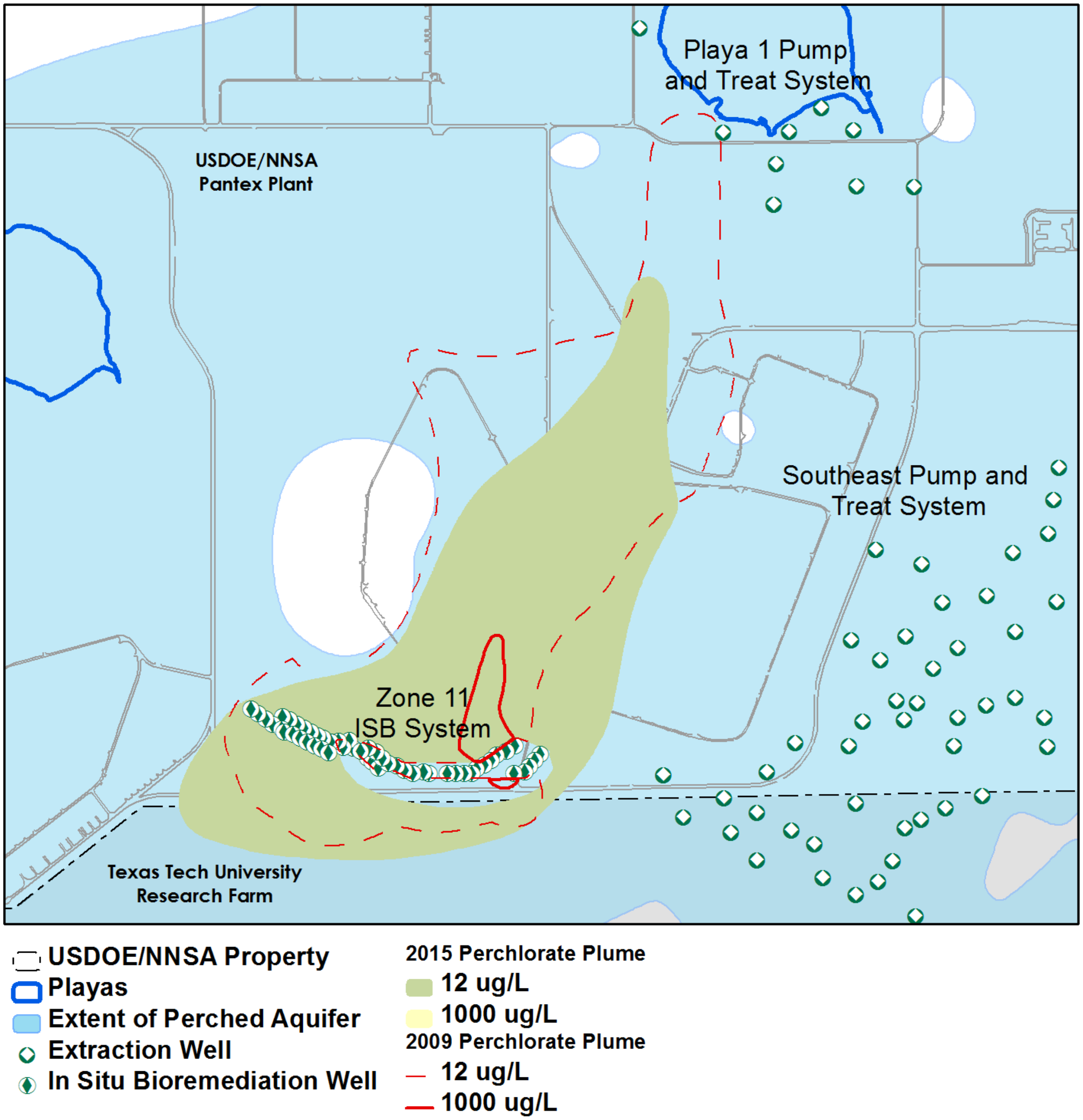

Figure 3-48. Perchlorate Plume Movement, 2009-2015

3.2 Remedial Action Effectiveness

3.2.1 Southeast Pump and Treat System

The objective of the SEPTS (Figure 3-49) is to remove contaminated perched groundwater and treat it for industrial and/or irrigation use. While the capability is being maintained for injection of treated water back into the perched zone, the intent is to permanently remove perched groundwater to gradually reduce the saturated thickness in this zone in order to achieve two important goals:

- A gradual reduction of the volume of perched groundwater (and contamination) moving downgradient toward the extent of saturation, and
- A reduction in the head (driving force) for vertical migration of perched groundwater into the FGZ and toward the drinking water aquifer.

The SEPTS has altered the groundwater flow direction and gradient at localized areas near the extraction wells in the perched aquifer. The P1PTS appears to be influencing local water levels and hydraulic gradient in the area near Playa 1. Figure 3-50 illustrates the influence of these two systems. Water levels measured at extraction wells were not used in the interpretation of water table contours so that cones of depression would not be overestimated. Localized cones of depression are present surrounding several extraction wells, but formation of an extensive cone of depression throughout the system is limited by the thin saturated thickness of the aquifer.

The water table map indicates groundwater is still flowing southward across the USDOE/NNSA property boundary onto TTU property. However, extraction wells located on TTU property limit the further migration of perched groundwater contaminants to the south.

Water table contours along FM 2373 indicate groundwater is flowing to the south and southeast along the USDOE/NNSA property boundary, thus limiting the transport of perched aquifer contaminants eastward.

The hydraulic gradient varies greatly in this area because of the influence of the SEPTS. Very steep gradients occur locally near many of the extraction wells, and the southerly flow direction is reversed in some areas.

3.2.1.1 System Operations in 2015

The SEPTS treated over 80 million gallons of extracted water during 2015. This system released about 93% of the treated water to the WWTF for use in the irrigation system, injected about 4% into the perched zone, and the remainder was beneficially used for injection of amendment in the ISB systems. Pantex used injection for a limited time in June and July when the WWTF/irrigation system was unable to accept water and water was needed for the ISB injection.

The system removed about 74 lbs of hexavalent chromium, 265 lbs of RDX, and 151 lbs of all other HEs during 2015. The average removal rate of hexavalent chromium was 0.9 lbs/Mgal of water, and the average removal rate for HEs was 5.4 lbs/Mgal of water. This system has treated approximately 10,858 lbs of HEs and 1,397 lbs of hexavalent chromium since beginning operation. Evaluation of effluent data indicates the system continues to treat the recovered groundwater to concentrations below the PQL and the GWPS.

3.2.1.2 Hydrodynamic Control

Hydrodynamic control limits the horizontal migration of contaminants by using extraction wells to alter the hydraulic gradient. Because of the limited saturated thickness of the perched aquifer, complete hydraulic containment of the contaminant plume is not possible. However, the SEPTS has been effective at altering the hydraulic gradient to limit the movement of contaminants. Analysis of groundwater flow directions as indicated by water table contours shows that the SEPTS has reduced the eastward movement of perched groundwater across FM 2373 and limited expansion of the plume south of the extraction wells on TTU property. The approximate radius of influence of the groundwater treatment systems and the directions of perched groundwater flow gradients outside the radius of influence are shown on Figure 3-50. Capture zones, shown in Figure 3-50 for the extraction wells, were calculated using a single-layer groundwater flow model of the perched aquifer. Average 2015 extraction flow rates for each well were used in the calculations.

3.2.1.3 System Effectiveness

Considering the primary goal of both pump and treat systems is to affect plume movement and reduce saturated thickness in the perched aquifer, the plume stability discussion included in Section 3.1 can be used to determine the effectiveness of these systems. To this end, the pump and treat systems have been very effective in 2015. When comparing the 2015 conditions to LTM Design expected conditions, the majority of monitor wells are meeting expected conditions in the fifth year of the remedial action. The only LTM wells not meeting expected conditions for water levels are PTX06-1014 and PTX06-1089. While the water level in PTX06-1014 has been relatively stable for the past two years, this well has less than four feet of saturated thickness remaining. PTX06-1089 is outside the estimated perched aquifer extent and not under the influence of a pump and treat system.

As a part of the SEPTS secondary goal of mass removal, the system continued to remove both HEs and hexavalent chromium and treated over 80 million gallons of extracted water to concentrations below the PQL and the GWPS. While the SEPTS did not consistently meet all throughput goals during 2015 due to system upgrades, reduced flow to the WWTF and irrigation system, and maintenance activities, Pantex continues to optimize the system operation.

Figure 3-49. SEPTS Extraction Wells and Conveyance Lines

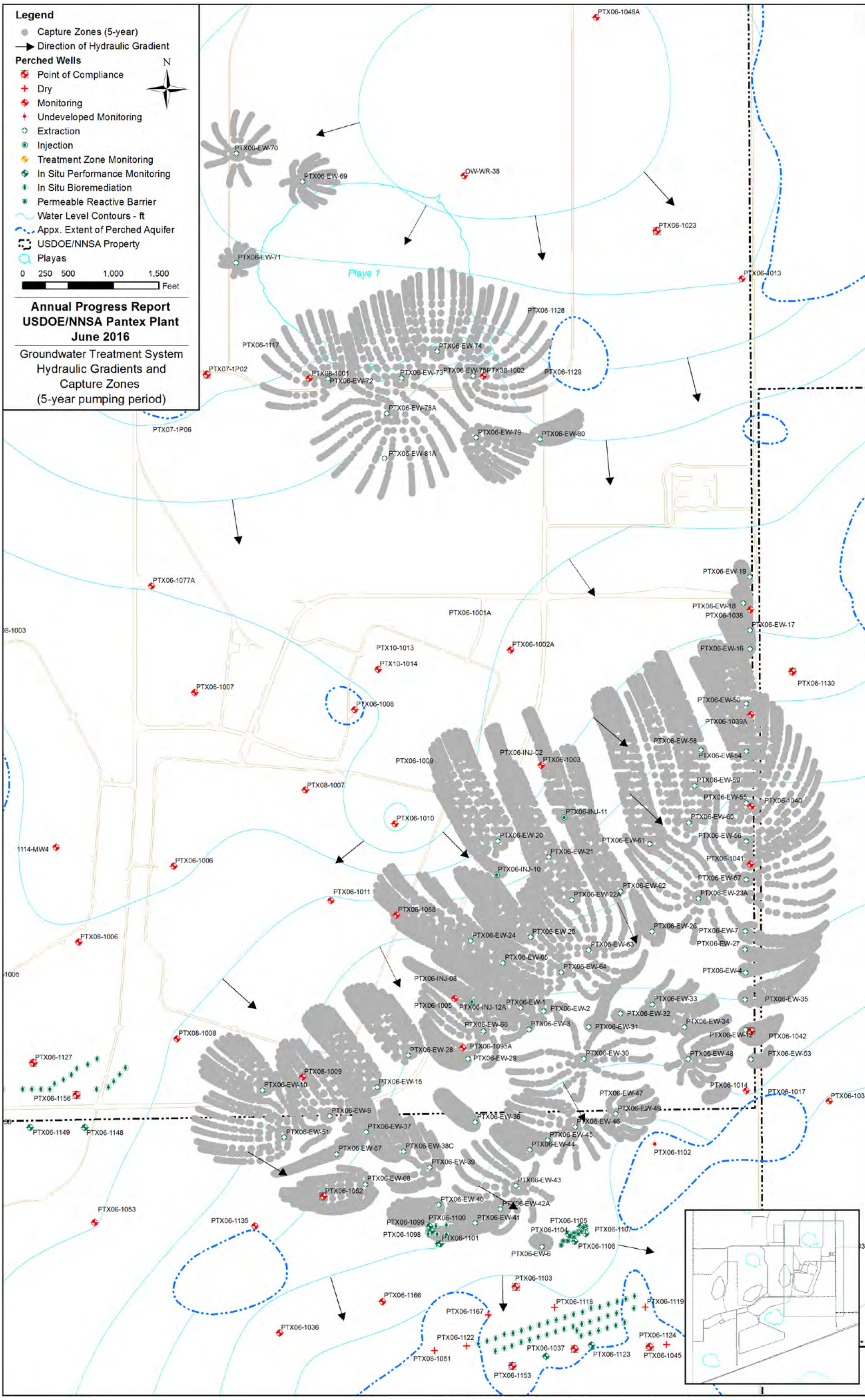

Figure 3-50. Pump and Treat System Capture Zones

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3.2.2 Playa 1 Pump and Treat System

The P1PTS was completed during 2008 with operations starting in September 2008. This system extracts water from 10 wells near Playa 1 (see Figure 3-51) and treats the water through a series of GAC beds and ion exchange process units to reduce HEs and metals below the GWPS established in HW-50284 and the ROD. The objective of this system is to reduce the mound of perched groundwater associated with Playa 1, affecting the movement of the southeast plume by reducing the hydraulic head, as well as achieving mass removal.

P1PTS appears to be influencing local water levels and hydraulic gradient in the Playa 1 area. Figure 3-50 illustrates the influence of both groundwater pump and treat systems. Water levels measured at extraction wells were not used in the interpretation of water table contours so that cones of depression would not be overestimated. Due to the thicker saturated interval near Playa 1 and more consistent pump operation, cones of depression are established around the extraction wells.

The water table map indicates the mound of groundwater beneath Playa 1 has been reduced as the groundwater high in the perched aquifer is now to the northeast. Groundwater is still generally flowing away from the Playa 1 region, then to the south/southeast across the USDOE/NNSA property boundary onto TTU property. As the perched aquifer saturated thickness continues to be reduced in this region, this flow should decrease and the driving head will be reduced. In addition, SEPTS extraction wells limit the further migration of perched groundwater contaminants to the south.

The hydraulic gradient has begun to be affected by pumping at the P1PTS well field and is difficult to estimate. Very steep gradients occur locally near most of the extraction wells, and the general flow patterns are reversed in some areas.

3.2.2.1 System Operations in 2015

The system treated approximately 102 million gallons during 2015. Operational performance was below goals for portions of the year because flow was restricted to the WWTF/irrigation system. As recommended in the first *Five-Year Review Report* (Pantex, 2013d), Pantex has installed one additional P1PTS extraction well (PTX06-EW81A) to ensure operational goals can be consistently met regardless of individual well repair issues. That well was connected to the system in May 2016. However, it should be recogized the majority of the system downtime in 2015 was due to WWTF or irrigation system issues, which cannot be addressed by P1PTS optimization or improvements.

3.2.2.2 System Effectiveness

Considering the primary goal of both pump and treat systems is to affect plume movement and reduce saturated thickness in the perched aquifer, the plume stability discussion included in Section 3.1 can be used to determine the effectiveness of these systems. To this end, the pump and treat systems have been very effective in 2015. When comparing the 2015 conditions to LTM Design expected conditions, all wells with the exception of one anomalous data point outside the estimated perched groundwater extent are meeting expected conditions.

During 2015, the system removed a total of 46 lbs of RDX and 17 lbs of all other HEs. The average removal rate of HEs was 0.6 lbs/Mgal of treated water. Evaluation of effluent data indicates the system treated the recovered groundwater to concentrations below the PQL and the GWPS.

Figure 3-51. P1PTS Extraction Wells and Conveyance Lines

3.2.3 ISB Systems

Pantex has installed and operates two ISB systems. One system is southeast of Pantex Plant on TTU property and one is south of Zone 11. The ISB systems consist of 94 active treatment zone wells and 12 active ISPM wells.

The objective of the ISB systems is to establish an anaerobic biodegradation treatment zone capable of reducing COCs to the GWPS by injecting the necessary amendments and nutrients to stimulate resident bacteria. The microbial growth first consumes oxygen and then in turn consumes other electron acceptors, creating reducing geochemical conditions. Under reducing conditions, biotic and abiotic treatment mechanisms occur. The following sections provide an understanding of the expected conditions at the ISB systems and downgradient concentrations of COCs. This information is used to determine whether further injections are required for continued treatment of COCs and to ensure that COC concentrations are being reduced downgradient of the treatment zone.

To monitor the effectiveness of the treatment zones, indicators of geochemical conditions and amendment longevity are used to determine if conditions are within an acceptable range for oxidation-reduction (redox) potential, electron acceptor concentrations (i.e., dissolved oxygen [DO], nitrate, and sulfate), and nutrient supply (total organic carbon and prevalent volatile fatty acids [VFAs]). These parameters are important because reducing conditions and adequate nutrients must be present to treat the COCs.

The bioremediation amendment, or carbon source, selected for the ISB systems is an emulsion of sodium lactate and soybean oil called Newman Zone™. The formulation provides both a rapidly-utilized electron donor (sodium lactate) and a slow-release long-term electron donor (soybean oil). As illustrated in Figure 3-52, the complex carbon source slowly ferments releasing lighter weight organic compounds, such as VFAs, which are further used for microbial energy and growth. Many steps of the fermentation process produce hydrogen, which is utilized by some microbes to directly metabolize COCs. As long as optimal subsurface reducing conditions and VFAs are available, a diverse microbial community can be sustained which leads to in situ treatment of COCs. Total VFAs are evaluated at the ISBs and serve as a good indicator that fermentation is occurring. TOC was selected as an indicator that an adequate carbon source remains available for continued ISB treatment. Pantex monitors for a wide range of VFAs and those results are included in Appendix E.

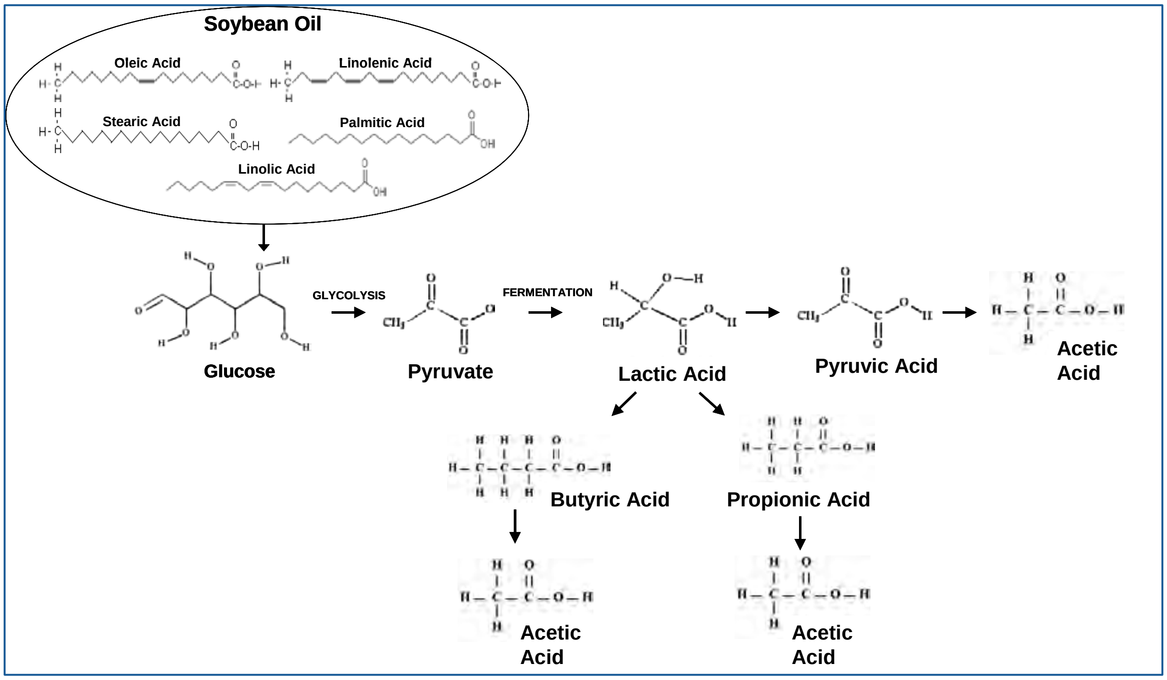


Figure 3-52. Soybean Oil Fermentation Pathways

In addition, geochemical conditions can be evaluated to determine if adequate reducing conditions exist to achieve reduction. Figure 3-53 presents the redox ranges for reduction of various COCs. TCE and perchlorate are the primary COCs in the Zone 11 area, while HEs (primarily RDX) and hexavalent chromium are the primary COCs in the southeast area. Perchlorate degradation does not require as strongly reduced conditions as RDX or TCE. To document the effectiveness of COC removal, downgradient wells are monitored for specific target indicators chosen for each ISB system. Target indicators include COCs that are the most widespread and that have the potential to affect human health if the water were to be used for residential purposes, even though perched groundwater use is controlled to prevent any potential for exposure. In addition, breakdown products are monitored to determine if complete degradation is occurring. Specific indicators are discussed separately for each system below.

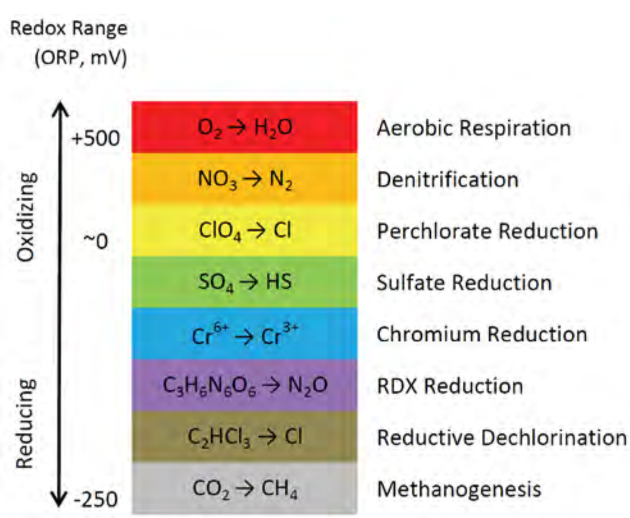


Figure 3-53. Typical Geochemical Redox Ranges

In addition to specific indicators to help determine if additional injections are required, Pantex monitors for a wide range of VFAs, metals, and general chemistry parameters. The VFAs help determine if fermentation is occurring and also help determine the fermentation pathways. Specific metals are monitored in downstream performance monitoring wells to ensure that metals are returning to background conditions after leaving the treatment zone. Specific metals are expected to increase in the treatment zone because of reducing conditions that release the naturally occurring metals in the formation soils. However, as the water moves away from the reducing conditions, the metals are expected to precipitate out into the soil matrix. The general chemistry parameters are also monitored to determine if the water is returning to baseline conditions.

3.2.3.1 Zone 11 ISB

The Zone 11 ISB system is on Pantex Property, south of Zone 11 (see Figure 3-54). The system, as operated in 2015, consists of 52 injection wells and 6 downgradient performance monitoring wells installed in a zone of saturated thickness of approximately 15-20 ft. The Zone 11 ISB was installed by early 2009 with injection completed in the original 23 wells by June 2009. As summarized in Table 3-2, a seventh injection event, described in Section 2.2.1, was completed in 2015. The seventh injection event included bioaugmentation of the western side of the Zone 11 ISB where reducing conditions are established.

Table 3-2. Zone 11 ISB Injection Dates

Injection Event	Completion Date
1	June 2009 (original 23 wells) November 2009 (9 new wells)
2	September 2010
3	October 2011
4	September 2012
5	July 2013
6	July 2014
7	November 2015

During 2015, Pantex monitored four treatment zone monitoring wells, seven injection wells, and six downgradient performance monitoring wells to evaluate the Zone 11 ISB (see Figure 3-54). Pantex also monitors three treatment zone wells in the second row to better evaluate conditions in higher concentration and/or flow areas. The injection wells were drilled in a line perpendicular to the hydraulic gradient so water flowing through this zone will be treated before it reaches the area beneath TTU property near Playa 4. Based on the current rate of perched groundwater flow, estimated amendment longevity, and data collected in the treatment zone, injections will be necessary about every 12 months.

COCs targeted for treatment by this system are perchlorate and TCE. Indicator constituents evaluated for trends at downgradient performance monitoring wells include TCE and its degradation products (*cis*-1,2-DCE and vinyl chloride) and perchlorate. Expected conditions are that the indicator constituent concentrations will begin to decline at downgradient monitoring wells at their estimated travel times from the treatment zones, which are discussed later in this section.

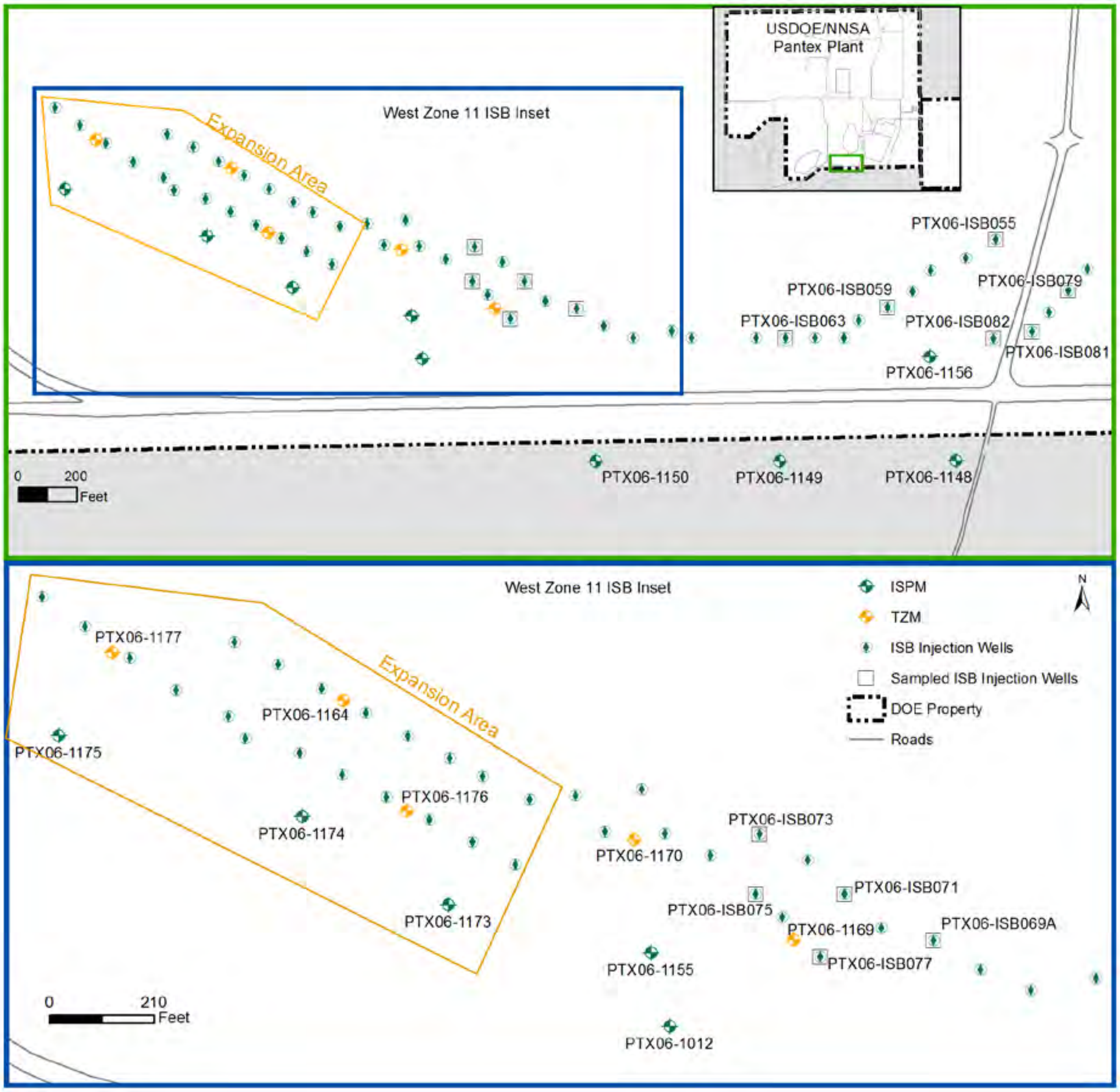


Figure 3-54. Zone 11 ISB System Wells and Sampling Locations

Dissolved oxygen, redox potential, nitrate, sulfate, total organic carbon, and total VFAs are evaluated in the ISB treatment zone performance wells to determine if the treatment zone is rebounding to baseline conditions, thus requiring amendment injection. The expected conditions for the treatment zone wells are that redox potential and electron acceptor (DO, nitrate, and sulfate) concentrations will decline after injection. As shown in Figure 3-53, strongly reducing conditions must be achieved for reductive dechlorination of TCE to occur. The redox potential should decline from baseline and be below -50 mV for the reduction of

TCE and near 0 mV for the reduction of perchlorate. Concentrations of total organic carbon and acetic acid should increase after injection, but decline over time as the amendment is consumed.

Prior to the 3rd quarter 2015 injection, the TOC remained high in the majority of the injection wells, but VFAs had decreased in all of the monitored injection wells. After injection, the TOC and VFA concentrations responded variably across the treatment zone wells, with most indicating stable TOC and increased VFAs. The TOC data indicates that a fair to good food source is available at the wells to allow continued biological activity and remediation of the COCs.

Data indicate good reducing conditions for reduction of COCs at the Zone 11 ISB. Food source is adequate for continued reducing conditions. The Zone 11 ISB has been effective at treating perchlorate and partially treating TCE. Perchlorate was detected only in wells sampled in the expansion zone. *Cis*-1,2- dichloroethene (DCE) exceeded the GWPS in one injection well and one non-injected monitor well in the treatment zone. TCE exceeded the GWPS in two injection wells and two non-injected monitor wells in the treatment zone. Vinyl chloride was detected in one injection well. Results do not currently indicate a strong influence from the *Dehalococcoides* (DHC) bioaugmentation event. Pantex plans to conduct DHC and compound specific isotope analysis (CSIA) sampling in early 2016 to determine the impact of the bioaugmentation.

Table 3-3 summarizes the current and maximum COC concentrations in each ISB, TZM, and ISPM well. PTX06-1012 and PTX06-1155 are on the western side of the ISB where TCE is the primary COC, although baseline concentrations of perchlorate also exceeded the GWPS in that area. PTX06-1156 is on the eastern side of the Zone 11 ISB where perchlorate is the primary COC. PTX06-1148, 1149, and 1150, which are located further downgradient from the ISB treatment zone, were converted to ISPM wells in 2014. Monitoring data from these three wells to date suggest that affected water has reached PTX06-1149 but not PTX06-1148 or PTX06-1150. However, due to their distance from the treatment zone, effects are not expected for another few years. The four TZM wells are located on the western side of the ISB. Three of these wells are located within the expansion zone; only PTX06-1170 is located within the established treatment zone.

Table 3-3. Summary of 2015 Zone 11 ISB Monitoring Well Data for TCE and Perchlorate

	Perchlorate					Trichloroethene				
Well ID	Max[a]	1Q	2Q	3Q	4Q	Max[a]	1Q	2Q	3Q	4Q
In Situ Bioremediation Wells										
PTX06-ISB055	3000	<12	<12	--	<24	16	<3	<3	--	<3
PTX06-ISB059	970	<12	<12	--	<24	<3	<3	<3	--	<3
PTX06-ISB063	39	<12	<12	--	<24	0.75J	0.47	<3	--	<3
PTX06-ISB069A	880	<12	10	--	<24	62	0.44	<3	--	<3
PTX06-ISB071	400	<12	<12	--	<24	1500	--	<3	--	9
PTX06-ISB073	380	<12	<12	--	<24	560	0.5	<3	--	<3
PTX06-ISB075[b]	97	<12	<12	--	<12	440	15	4.8	--	0.76
PTX06-ISB077	840	<12	<12	--	<24	310	<3	<3	--	12
PTX06-ISB081	153	<12	<12	--	<12	1.9J	<3	<3	--	<3
PTX06-ISB082[a]	3090	<24	<12	<24	<24	9.6	<3	<3	<3	<3
PTX06-ISB098	300	300	300	--	--	210	210	190	--	--
In Situ Treatment Zone Monitoring Wells										
PTX06-1164	130	160	--	--	160	140	140	--	--	71
PTX06-1170	<12	<12	<12	<12	<12	500	200	370	500	440
PTX06-1176	230	230	--	--	--	140	140	--	--	--
PTX06-1177	210	210	--	--	--	130	130	--	--	--
In Situ Performance Monitoring Wells										
PTX06-1012	341	<12	<12	<12	<12	580	15	21	42	59
PTX06-1155	487	<12	<12	<12	<12	660	7.1	14	96	150
PTX06-1156	2140	<12	<12	<12	<12	7.4	<3	<3	<3	<3
PTX06-1148	1290	620	410	340	250	3.63	2.6	1.9	2.1	1.5
PTX06-1149	684	<12	<12	<12	<12	0.39J	<3	<3	<3	<3
PTX06-1150	235	100	140	96	82	3.8	3.8	2.8	2.4	2.8

Concentrations provided in ug/L.
PERC – IRPIM code for perchlorate.
Highlighted cells indicate concentrations less than the GWPS.
The "--" symbol indicates no samples were collected.
When COC was not detected, a "less than" with the detection limit is provided.
[a]The maximum value reported in each well is used as a baseline for comparison, regardless of the date in which it was collected.
[b]Due to well damage, PTX06-ISB075 was replaced in September 2012 and the replacement well was first sampled during 2013.
J – Analyte was detected below the PQL, but above the MDL.

Perchlorate concentrations were non-detect in four of the six downgradient ISPM wells during 2015. Perchlorate is exhibiting decreasing trends in the other two downgradient ISPM wells. TCE concentrations were non-detect or below GWPS four of the six downgradient ISPM wells during 2015. TCE concentrations in PTX06-1012 and PTX06-1155 had been decreasing, but are now increasing in both wells.

TCE breakdown product *cis*-1,2-DCE and vinyl chloride continue to be detected in downgradient wells. *Cis*-1,2-dichloroethane is exhibiting a stable trend at or above the GWPS of 70 ug/L in PTX06-1012 and a decreasing trend above the GWPS in PTX06-1155 in 2015. *Cis*-1,2-DCE concentrations have been relatively stable below GWPS in PTX06-1156. Vinyl chloride was consistently measured in PTX06-1155 below the sample detection limit and was detected in two of four quarterly samples in PTX06-1012 in 2015. This condition of high concentrations of *cis*-1,2-DCE with little or no vinyl chloride continues to indicate that TCE is only partially breaking down. Pantex previously recognized in the 2013 Annual Progress Report that complete TCE treatment may be constrained by a lack of DHC that are necessary for complete dechlorination of TCE, and began working on a Bioaugmentation Plan in 2014. The seventh injection event, completed in 2015, included bioaugmentation of the western side of the Zone 11 ISB where reducing conditions are established and where the heart of the TCE plume is treated. Pantex is monitoring the impact of the bioaugmentation through the use of qPCR and compound specific isotope analysis (CSIA) sampling which began in February 2016. The results of that sampling will be reported in the Quarterly Progress Reports throughout 2016. Bioaugmentation in the expanded treatment zone described in Section 2.2.1 will not occur until the weight of evidence suggests the proper geochemical conditions exist for DHC survival and growth.

Metals concentrations are increasing in all downgradient performance monitoring wells since the start of remedial actions and some are exceeding GWPS. For example, arsenic concentrations in PTX06-1149, PTX06-1155, and PTX06-1156 and barium concentrations in PTX06-1156 exceeded GWPS in 2015. However, these concentrations are expected to decrease as the treated water moves downgradient, the water returns to more oxidized conditions, and the metals precipitate onto the soil matrix as discussed in Section 3.2.3. This can be seen in recent metals trends in the downgradient wells as arsenic and manganese were previously increasing but are now decreasing in PTX06-1012 and exhibit no trend in PTX06-1149.

3.2.3.2 Southeast ISB

The Southeast ISB System is on TTU property south of Pantex. The system was installed in 2007 as an early action and consists of 42 injection wells within the treatment zone and six performance monitoring wells (see Figure 3-55). The injection wells were drilled in a line perpendicular to the hydraulic gradient so the water flowing through the treatment zone will be treated before reaching the area beneath TTU property where the FGZ becomes less resistant to vertical migration. Based on the current rate of perched groundwater flow and estimated amendment longevity, injections will be necessary about every 18 months.

Table 3-4 summarizes the five injection events completed to date at the Southeast ISB system.

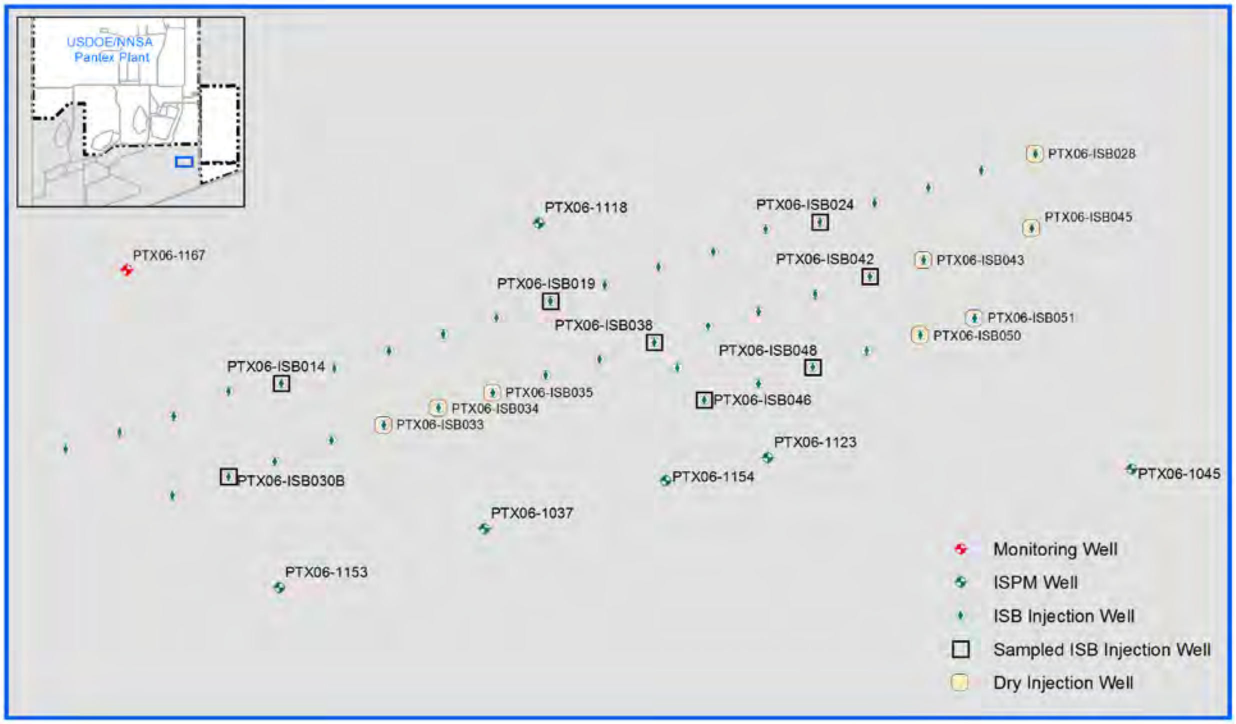


Figure 3-55. Southeast ISB System Wells and Sampling Locations

Table 3-4. Southeast ISB Injection Dates

Injection Event	Completion Date
1	March 2008
2	April 2010
3	May 2012
4	September 2013
5	April 2015

Constituents targeted for treatment by this system are RDX, other HE constituents of concern (DNTs and 1,3,5-TNB), and hexavalent chromium Indicator constituents evaluated for trends at downgradient performance monitoring wells include RDX and its degradation products (DNX, MNX, and TNX) and total and hexavalent chromium. Expected conditions at downgradient performance monitoring wells are that concentrations of indicator constituents will decline over time and that all degradation products of RDX will not be detected or will be present in low concentrations indicating complete breakdown is occurring. Dissolved oxygen, redox potential, nitrate, sulfate, total organic carbon, and volatile fatty acids are also evaluated at the ISB treatment zone performance wells.

The expected conditions for the treatment zone wells are that redox potential and electron acceptor (dissolved oxygen, nitrate, and sulfate) concentrations will decline after injection. Redox potential should be less than 0 mV for reduction of RDX and hexavalent chromium. Dissolved oxygen may continue to be observed because oxygen is replenished from the atmosphere when equipment is introduced into the well during sampling, injection, or well rehabilitation or development and the saturated thickness in the treatment zone is very thin. Concentrations of total organic carbon and total VFAs should increase after injection but decline over time as the amendment is consumed.

Graphs of the amendment indicators and COCs for the eight ISB injection wells sampled, as well as concentrations for target indicators at the six performance monitoring wells for this system are included in Appendix E. Five of the performance monitoring wells are downgradient of the system; one (PTX06-1118) is upgradient of the system. The conditions in the treatment zone and performance monitoring wells are discussed below.

Evaluation of data in treatment zone wells indicates adequate reducing conditions for the treatment of RDX and hexavalent chromium. Evaluation of COC data indicates that only RDX was detected above GWPS in one treatment zone well, PTX06-ISB014. This is a first row well and can be impacted by water entering the treatment zone.

Table 3-5 summarizes the current and maximum COC concentrations in each ISB and ISPM well. Three of the closest downgradient monitoring wells for the Southeast ISB demonstrate that reduction of RDX, HE degradation products, and hexavalent chromium has occurred resulting in concentrations below the GWPS, with most not detected. PTX06-1153 continues to exhibit RDX concentrations above 200 ug/L and variable hexavalent chromium concentrations near the GWPS. Pantex continues to monitor this well and other new wells installed nearby to determine if treated water is slow to reach it, or if this well may not be hydraulically connected to the Southeast ISB.

Table 3-5. Summary of 2015 Southeast ISB Monitoring Well Data for RDX and Hexavalent Chromium

Well ID	Hexavalent Chromium					RDX				
	Max[a]	1Q	2Q	3Q	4Q	Max[a]	1Q	2Q	3Q	4Q
In Situ Bioremediation Wells										
PTX06-ISB014	NE	NE	NE	NE	NE	217	<4	25	--	<4
PTX06-ISB019[b]	NE	NE	NE	NE	NE	143	--	--	--	--
PTX06-ISB024	NE	NE	NE	NE	NE	3860	<4	--	<4	<4
PTX06-ISB030B[b]	NE	NE	NE	NE	NE	2.7	<4	--	<4	--
PTX06-ISB038	NE	NE	NE	NE	NE	421	<2	--	<4	<1
PTX06-ISB042	NE	NE	NE	NE	NE	2920	<2	--	--	--
PTX06-ISB046	NE	NE	NE	NE	NE	4350	<2	--	<2	<4
PTX06-ISB048	NE	NE	NE	NE	NE	--	<4	--	--	<4
In Situ Performance Monitoring Wells										
PTX06-1037	108.5	<10	6.79	<10	<10	2800	<0.2	<0.2	<0.2	<0.2
PTX06-1123	10	--	<10	<10	--	4300	--	0.1	<0.2	<0.2
PTX06-1153	159	96.2	140	82.6	89.6	320	290	340	260	280
PTX06-1154	13	<10	5.67	3.39	<10	630	<0.2	<0.2	<0.2	<0.2

Concentrations provided in ug/L.

[*] NE – Hexavalent chromium was not evaluated in the ISB treatment zone due to interference from the amendment.

Highlighted cells indicate non-detect or concentrations less than the GWPS.

The "--" symbol indicates that no data are available.

[a]The maximum value reported in each well is used as a baseline for comparison, regardless of the date in which it was collected.

[b] PTX06-ISB019 and PTX06-ISB30B were either dry or had limited water and could not be sampled for all or part of 2015.

Data from ISPM Wells PTX06-1045 and PTX06-1118 were not included in this table. PTX06-1045 is the furthest downgradient ISPM well that may have little to no hydraulic connection to the Southeast ISB treatment zone. In addition, this well went dry in the second half of 2011. PTX06-1118 is upgradient to the ISB system and is used to monitor the influent COC concentrations and was dry throughout 2015. This well may not demonstrate decreasing concentrations unless it is affected by the treatment zone inadvertently.

Some of the injection and performance monitoring wells are indicating variable water conditions at the Southeast ISB. Two Southeast ISB performance monitoring wells (one upgradient, one farther downgradient) remain dry and cannot be sampled. PTX06-1123 could not be sampled in the fourth quarter of 2015. 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.

The ISB system has been effective in treating HEs and hexavalent chromium at three of the closest downgradient ISPM wells (PTX06-1037, 1123, and 1154) for the SE ISB. RDX and hexavalent chromium concentrations in all three of these wells are either non-detect or below the GWPS. These wells indicate that the reducing zone has extended beyond the treatment zone because ORP is negative, nitrate and sulfate concentrations are reduced, and TOC is present in all three wells.

RDX concentrations in PTX06-1153 are much lower than initial concentrations in the upgradient treatment zone, but still remain around 250–350 ug/L. Concentrations have ranged from approximately 100 – 400 ug/L since the well was installed in 2009 and are currently exhibiting an increasing trend. The concentrations of the degradation products (MNX, DNX, and TNX, in sequence) are either near or below the cleanup value of 2 ug/L or significantly lower than pre-injection RDX concentrations. Hexavalent chromium concentrations in this well have been variable, with most concentrations just below GWPS (100 ug/L) in 2015.

Pantex is continuing to investigate the cause of the unexpected results in PTX06-1153. As discussed in the 2013 Annual Progress Report, the conditions could be due to any number of hydrologic issues and it may be difficult to prove (or disprove) if any of these are occurring. Several confounding issues complicate the investigation efforts in the area, including significant heterogeneity in the fine-grained zone, potential changes in formation properties due to biologic growth or other injection effects, and potential reduction of saturated thickness upgradient due to pump and treat operations.

Metals concentrations have increased in all downgradient performance monitoring wells and some are exceeding GWPS. Arsenic and barium concentrations exceeded the GWPS in PTX06-1037, PTX06-1154, and PTX06-1123 during 2015. Total organic carbon data suggest the treatment zone has expanded into these wells and the reduced conditions continue to mobilize the naturally occurring metals. However, these concentrations are expected to decrease as the treated water moves out of the treatment zone and returns to more oxidized conditions.

Pantex also monitors for degradation products of RDX to evaluate whether complete breakdown is occurring. Monitoring results for the system indicate that RDX and breakdown products (MNX, DNX, and TNX) are present in downgradient performance monitoring wells. TNX, the final degradation product, is the best indicator of degradation because the other intermediate products (MNX, DNX) degrade rapidly and do not accumulate in the environment. Both RDX and TNX have been reduced to concentrations below the GWPS at PTX06-1037 and PTX06-1123 through the end of 2015 indicating complete breakdown of RDX. At PTX06-1154, RDX was non-detect throughout 2015, while TNX was below the GWPS in the first quarter sample, non-detect in the second and third quarters, but slightly above the GWPS in the fourth quarter sample. These results indicate variable treatment at this location with complete treatment occurring during portions of the year. High RDX concentrations and low TNX concentrations at PTX06-1153 continue to indicate little to no treatment at this location.

3.3 Natural Attenuation

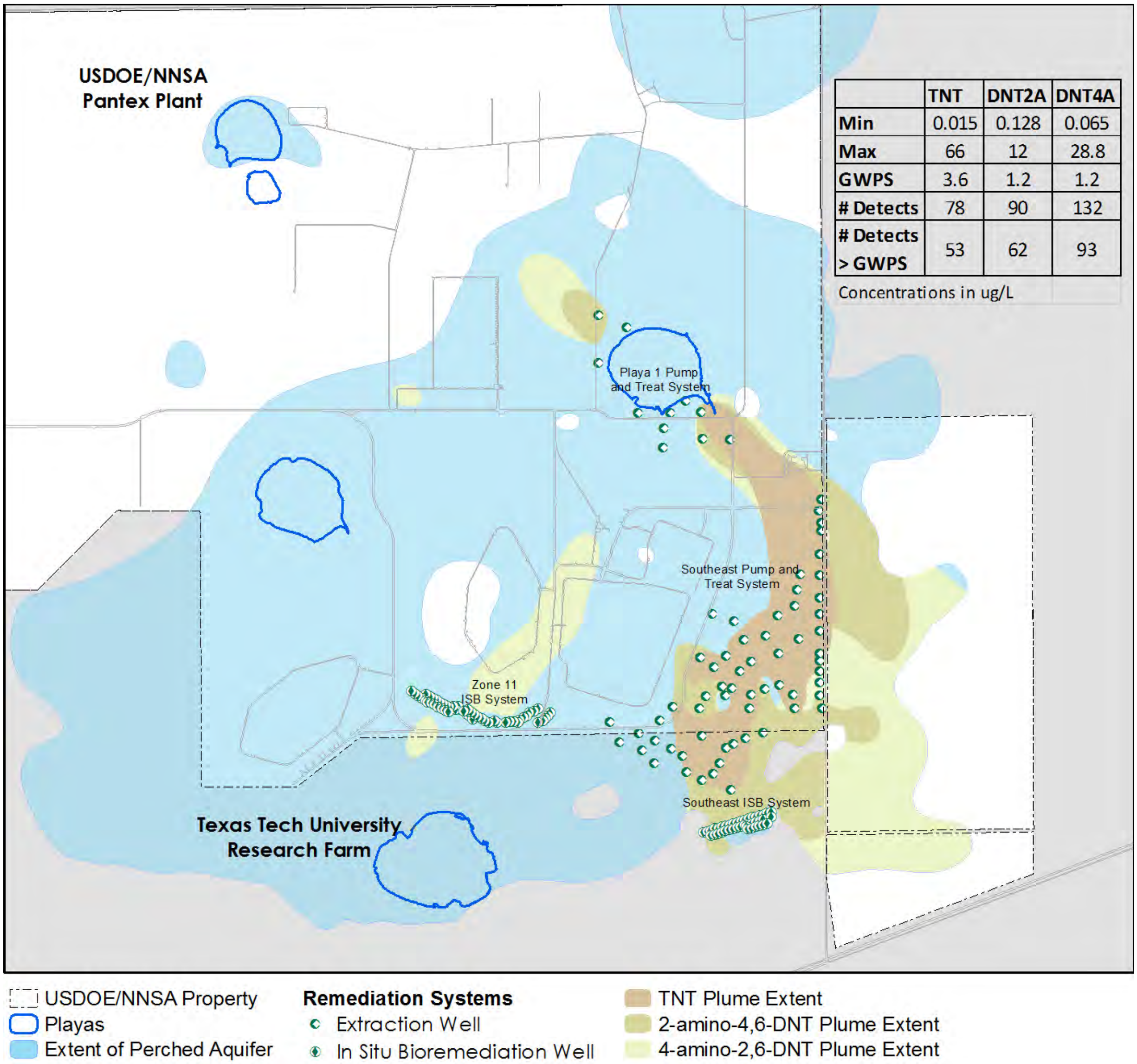
> **Natural Attenuation Processes**
>
> - Biodegradation – soil microbes can cause the contaminants to break down to less harmful products
> - Sorption – the contaminants are bound to soil particles so that movement through groundwater is stopped or is slower allowing time for other processes to work
> - Dispersion – the contaminants are dispersed through the groundwater as they move away from the source so that concentrations are diluted

Natural attenuation is the result of processes that naturally lower concentrations of contaminants over time. This process is monitored at Pantex to help determine where natural attenuation is occurring, under what conditions it is occurring, and to possibly determine a rate of attenuation. This is an important process for RDX, the primary risk driver in perched groundwater, because it is widespread and extends beyond the reach of the groundwater remediation systems in some areas. Because the right microbes for biodegradation are present in the perched sediments, Pantex is interested in monitoring for breakdown products of RDX. Pantex started monitoring for degradation products of RDX in all monitoring wells by July 2009, after testing analytical methods to ensure they can reliably detect and quantify those products. Since analytical methods are readily available, Pantex has monitored for degradation products of TNT and TCE in the past and continues to monitor for those in key areas.

Other groundwater conditions that may impact attenuation, such as dissolved oxygen and redox potential, are also monitored in each well. The concentration data, as well as dissolved oxygen and redox potential are detailed in electronic form in Appendix D.

RDX can degrade under aerobic and anaerobic conditions, but achieves best reduction under anaerobic conditions. As more data are collected, trending and statistical analysis can be used to evaluate the degradation of RDX. Trending of concentrations is also performed at each well to determine if concentrations are declining as expected.

Based on monitoring results for TNT and its breakdown products (2-amino-4,6-DNT and 4-amino-2,6-DNT), TNT has naturally attenuated over time (see Figure 3-56). TNT has been manufactured at Pantex since the 1950s, yet is only present in the central portion of the overall southeastern plume - within the SEPTS well field and near Playa 1. Its first breakdown product, 2-amino-4,6-DNT, occurs near the TNT plume and extends slightly beyond. The final monitored breakdown product, 4-amino-2,6-DNT, extends out to the edges of the perched aquifer saturation at low concentrations. Only TNT breakdown products are present in perched groundwater beneath Zone 11 and north of Playa 1. Concentrations of the breakdown products are still above GWPS, but most wells with detections are recently showing a decreasing or stable trend. A table of natural concentration ranges for wells outside the influence of the ISB systems is included in Figure 3-56.



	TNT	DNT2A	DNT4A
Min	0.015	0.128	0.065
Max	66	12	28.8
GWPS	3.6	1.2	1.2
# Detects	78	90	132
# Detects > GWPS	53	62	93

Figure 3-56. TNT and Degradation Product Plumes

Perched aquifer sampling results for RDX and breakdown products (MNX, DNX, and TNX) indicate that the breakdown products are present throughout most of the RDX plume, with TNX being the most widespread. TNX, the final degradation product, is a better indicator of degradation because the other intermediate products (MNX, DNX) degrade rapidly and do not accumulate in the environment (SERDP, 2004). If complete biodegradation of RDX is occurring, RDX and all breakdown products would be expected to decrease over time. Figure 3-57 depicts the overall RDX and TNX plume. A table of concentrations ranges for wells outside the influence of the ISB systems is included in the figure. More data will be required over time to determine trends and rates of attenuation.

A recent SERDP study (2014) provided evidence that aerobic degradation is occurring in the Pantex RDX plume. Strong evidence of aerobic degradation was found in two monitoring wells, one near the SEPTS extraction wells, and one near the southeast edge of the plume. One other well near the source (Playa 1), indicated that degradation is occurring, but no aerobic breakdown products were found. Prior to this study, Pantex had been unable to determine what type of degradation is occurring (biotic/abiotic and anaerobic/aerobic) across the plume. Because different types of degradation may be occurring near the source areas and changing to aerobic degradation as the plume moves away, the rate of attenuation is difficult to quantify because it will vary across the plume. This study provided new methods for evaluating RDX degradation including carbon and nitrogen fractionation (CSIA) approaches. These approaches, along with the ability to quantify NDAB, an aerobic degradation product, allows Pantex to better evaluate the degradation of RDX. Pantex is currently in the process of contracting for further study at the Pantex Plant to apply the CSIA and other new analytical techniques to determine where and what type of degradation is occurring across the RDX plume. If data support quantification of attenuation rates in the future, rates will be calculated.

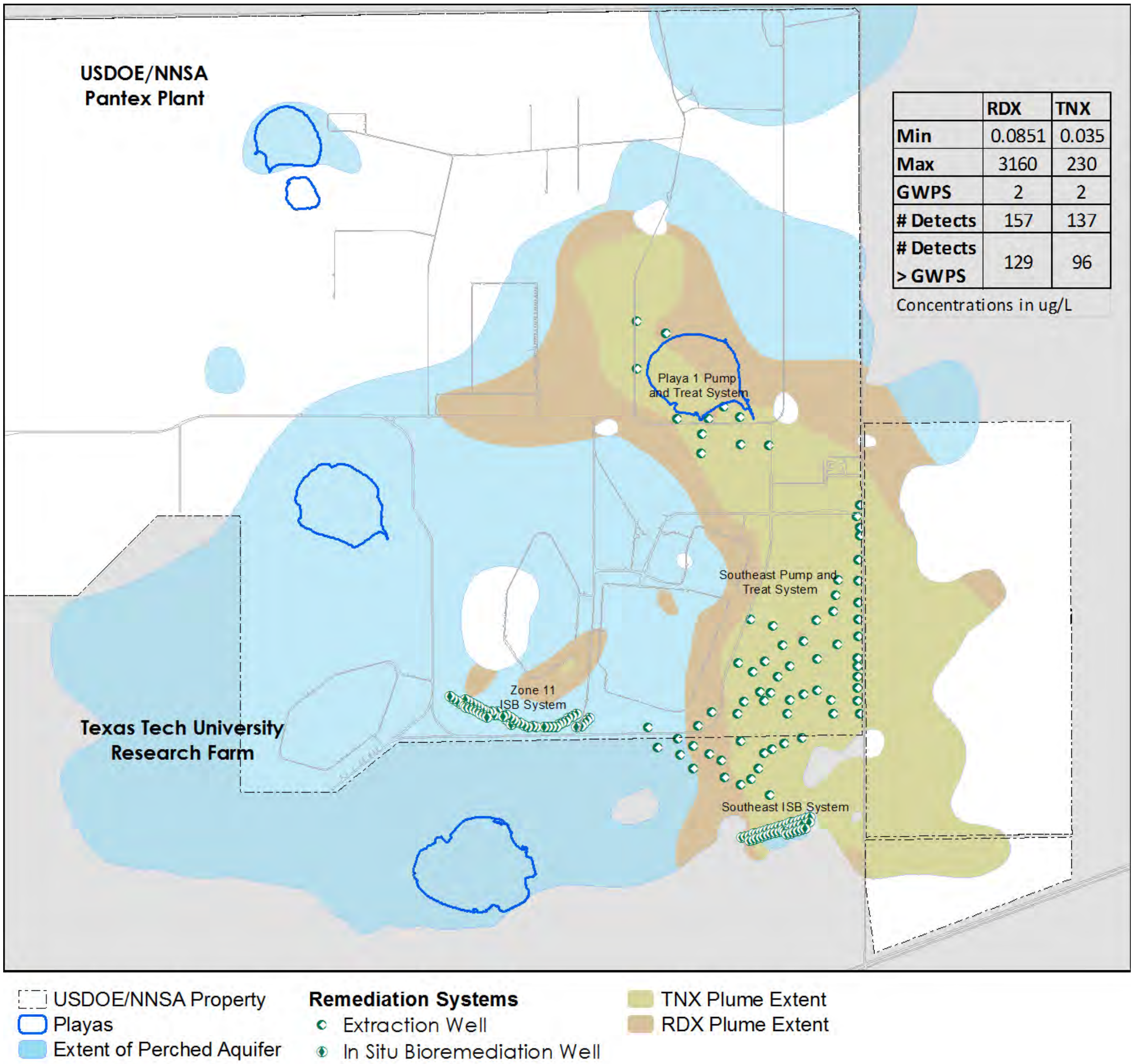


Figure 3-57. RDX and Degradation Product Plumes

Pantex has monitored for breakdown products of TCE for many years and a strong indication of natural attenuation of TCE has not been observed in the perched aquifer. Recent qPCR data collected upgradient and within the Zone 11 ISB system does not indicate that indigenous microbes are able to completely degrade TCE. However, the TCE plumes at Pantex are being actively treated by the SEPTS and the ISB treatment zones.

3.4 Uncertainty Management/Early Detection

The purpose of uncertainty management wells in perched and Ogallala groundwater is to confirm expected conditions identified in the RCRA Facility Investigations and ensure there are not any deviations, fill potential data gaps, and fulfill long-term monitoring requirements for soil units evaluated in a baseline risk assessment. The purpose of early detection wells is to monitor for breakthrough of constituents to the Ogallala Aquifer from the overlying perched aquifer, if present, or from potential source areas in the unsaturated zone before potential points of exposure have been impacted. These wells were proposed in the LTM design for purposes of evaluating the effectiveness of the soil and groundwater remedial actions. Additionally, the perched aquifer data were evaluated with respect to field observations. In 2015, no evidence of NAPL was observed in sampled perched aquifer wells.

This report focuses on subsets of the uncertainty management/early detection wells as depicted in Figure 3-58. The wells are evaluated with respect to:

Group 1 47 locations (designated by boxes on Figure 3-58) where contamination has not been detected or confirmed, or in previous plume locations where concentrations have fallen below GWPS, background, or PQL (e.g., Burning Ground and Old Sewage Treatment Plant areas). These are typically Ogallala Aquifer wells, although some perched aquifer wells are located in areas where there are no active groundwater remedial actions. These wells were evaluated in the quarterly reports.

Group 2 30 uncertainty management wells (all other wells in Figure 3-58) near groundwater contamination source areas. This is to confirm that source strength and mass flux are decreasing over time. Every five years these wells are also evaluated for new COCs from source areas.

Because of differing frequency of sampling, all available data for the UM/ED wells are used in this evaluation.

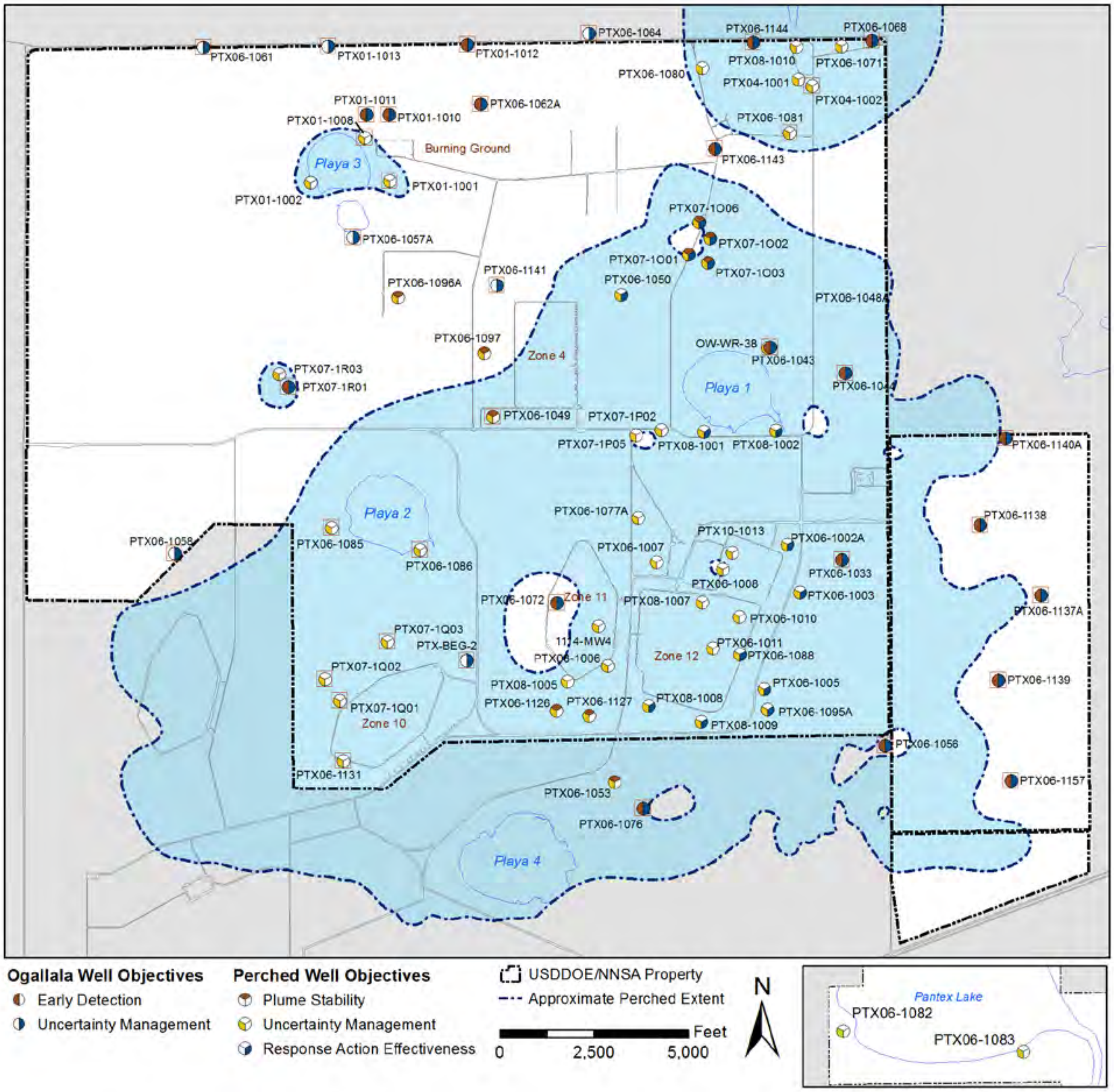


Figure 3-58. Uncertainty Management and Early Detection Wells

3.4.1 Group 1 Wells

Table 3-6 provides a summary of all 2015 Group 1 perched aquifer well indicator COC detections and comparisons of the detections to naturally occurring background concentrations, the laboratory PQL, and the GWPS provided in the approved SAP (Pantex, 2014b). Explanations are also provided in the table. The wells with unexpected conditions are discussed below.

3.4.1.1 Perched Aquifer Wells

As depicted in Table 3-6, no Group 1 perched aquifer wells had unexpected conditions in 2015.

3.4.1.2 Ogallala Aquifer Wells

As depicted in Table 3-7, five Ogallala wells had detected results (above background for those metals with site-specific background concentrations). This table does not include boron detections as these data are summarized in Table 3-8.

Manganese was detected above the background value in six wells in 2015 (PTX01-1011, PTX06-1033, PTX06-1062A, PTX06-1072, PTX06-1138, and PTX06-1141). No GWPS has been established for manganese. While manganese has been identified as an indicator for stainless steel corrosion, the remaining corrosion indicators did not demonstrate increasing concentrations in any of these wells except for PTX06-1033 as discussed below. Pantex will continue to monitor these wells for manganese to determine if concentrations increase or persist. Low-level detections of total chromium and nickel exceeding site-specific background occurred in PTX06-1033 accompanied by low-level detections of hexavalent chromium. This well has had confirmed screen corrosion as documented by increasing concentrations of metals. This well was rehabilitated in March 2013 and metals concentrations subsequently decreased to a values below their respective site-specific backgrounds. However, nickel increased to a level above background the next sampling event and continued to increase during 2015. The increasing trend in nickel concentration is likely due to continued slight well screen corrosion. This well was assigned a maintenance frequency of two years in the Well Maintenance Plan and was rehabilitated in 2015.

Hexavalent chromium was detected in eight wells (PTX06-1033, PTX06-1043, PTX06-1044, PTX06-1056, PTX06-1068, PTX06-1076, PTX06-1144, and PTX06-1157) in 2015 below the GWPS of 100 ug/L. The detections in all but two of the wells were below the laboratory PQL of 10 ug/L. As discussed in the 2013 Annual Progress Report, these detections are likely a result of one or more of the following:

- Low-level background of hexavalent chromium in the Ogallala aquifer as suggested in a study by Texas Tech University completed in 2014. Pantex worked with the Texas Tech University Water Resources Center to investigate the occurrence, distribution, and speciation of chromium in the Ogallala Aquifer system in the Texas Panhandle. In this study, 19 wells distributed across the Texas Panhandle were sampled and analyzed for total chromium and hexavalent chromium using an ultra-high resolution method (PQL = 0.015 ug/L). Low-level hexavalent chromium (approximately 0.5 – 5 ug/L) was detected in all 19 wells sampled. Furthermore, when both total and hexavalent chromium were detected in the same sample (total chromium was analyzed using a standard resolution method with a PQL of 10 ug/L), the ratio of hexavalent to total chromium ranged from approximately 0.5 to 1, with an average of 0.74. These results suggest that the oxidized conditions in the Ogallala Aquifer are converting the naturally occurring chromium to the hexavalent oxidation state, creating a possible low-level hexavalent chromium background in the aquifer.

- Lower detection limits for Method SW-7196 based on improvements to the method. MDLs dropped from 5 ug/L to 3.3 ug/L and the PQL dropped from 15 ug/L to 10 ug/L in June 2013. The revised detection limits allow low-level background concentrations to be estimated above the new MDL and below the PQL.
- Corrosion of stainless steel screen/casing. Specific wells at Pantex have documented evidence of corrosion and conversion of total chromium to hexavalent chromium is possible due to oxidized conditions in the Ogallala Aquifer.
- False positive detections near the MDL due to the colorimetric analytical method. Typically, these detections are not confirmed by total chromium results.

It is likely that most of these sporadic detections are related to the lower detection limits and the ability to quantify low-level background detections. For example, hexavalent chromium was not detected in five of the eight wells in 2014, while four wells that had detections in 2014 did not have detections in 2015. One of the wells, PTX06-1033, has long-term documented evidence of well corrosion.

PTX06-1056 continues to demonstrate detections of 4-amino-2,6-DNT, a breakdown product of the high explosive 2,4-trinitrotoluene (TNT), first detected in April 2014. The VOC 1,2-dichloroethane was also detected for the first time in PTX06-1056 in August 2015 below the PQL and GWPS. Subsequent sampling confirmed the original detection with this result also below the PQL and GWPS.

The concentrations in PTX06-1056 may be a result of a nearby perched well that was drilled deeply into the fine-grained zone possibly causing cross-contamination to the Ogallala Aquifer. Pantex has plugged the perched well, but expects continued detections until the water that has moved past the well has depleted. In August 2014, Pantex conducted a high volume purge test of PTX06-1056 to help determine whether the detections were caused by a nearby source or part of a larger widespread plume. The results of the purge test indicated that the HE plume did not appear to be widespread in the vicinity of PTX06-1056 and could be due to a nearby source.

Pantex has fully implemented the conditions specified in the *Pantex Plant Ogallala Aquifer and Perched Groundwater Contingency Plan* (Pantex, 2009d) and will continue quarterly sampling for HEs and VOCs at this well. In addition, Pantex will obtain a cement bond log of PTX06-1056 to evaluate the integrity of the casing where it penetrates the fine-grained zone. Pantex has also engaged a third-party hydrogeological consulting firm to conduct an independent assessment of the detections.

As presented in Table 3-8, boron was detected at concentrations slightly above the background value of 194 ug/L in six Ogallala wells in 2015, including PTX01-1012, PTX06-1056, PTX06-1137A, PTX06-1139 (above background in duplicate sample only), and

PTX06-1140, and PTX06-1157. Because the boron concentrations at these wells are very close to background and observed boron concentrations tend to be considerably variable, it appears that these concentrations also represent background. Evaluation of historic boron data in these wells results in variable trends. Only one (PTX06-1139) of the six wells had a boron detection above background in 2014, while three other wells that had detections in 2014 did not have detections in 2015. Additionally, all six wells were sampled two times in 2015, and the boron concentration in the other sample for each well was below the background in five of those wells. At PTX06-1139, boron was detected above background in the duplicate sample only and was below background in the subsequent normal sample. The measured concentrations are well below the GWPS of 7,300 ug/L. Pantex will continue to monitor these wells according to the *SAP*.

Tetrachloroethylene (PCE) was detected in samples from three wells collected in August 2015. However, these results were qualified as non-detect because of trip blank contamination and poor precision of matrix spike and matrix spike duplicate quality control samples.

Table 3-6. Detected Results in Group 1 Perched Aquifer Uncertainty Management/Early Detection Wells

Well ID	Sample ID	Sample Date	Sample Type	Analyte	Measured Value (ug/L)	Detection Limit (ug/L)	Lab Qualifier	PTX Qualifier	Background (ug/L)	>Background?	PQL (ug/L)	>PQL?	GWPS (ug/L)	>GWPS ?	Expected Condition?	Explanation
PTX01-1001	20150528M00110	5/28/2015	N	Trichloroethene	0.44	1	J			NA	1	N	5	N	Y	This well was previously affected by TCE. However, the concentrations have declined below the GWPS and PQL.
PTX01-1001	20151110M00303	11/10/2015	N	Trichloroethene	0.47	1	J			NA	1	N	5	N	Y	This well was previously affected by TCE. However, the concentrations have declined below the GWPS and PQL.
PTX04-1002	20150730M00184	7/30/2015	N	HMX	0.584	0.263	Q	J		NA	0.263	Y	360	N	Y	This well has historic low-level intermittent HE and TCE detections. This well will continue to be monitored and trended for HE and TCE.
PTX04-1002	20150730M00184	7/30/2015	N	RDX	0.199	0.263	JQ	J+		NA	0.263	N	2	N	Y	This well has historic low-level intermittent HE and TCE detections. This well will continue to be monitored and trended for HE and TCE.
PTX04-1002	20150730M00184	7/30/2015	N	Trichloroethene	0.41	1	J			NA	1	N	5	N	Y	This well has historic low-level intermittent HE and TCE detections. This well will continue to be monitored and trended for HE and TCE.
PTX06-1049	20150619M00141	6/19/2015	N	4-Amino-2,6-Dinitrotoluene	2.13	0.27				NA	0.27	Y	1.2	Y	Y	DNT4A was detected in this well at levels > GWPS in 2011. This may indicate that the contamination is slowly moving into this well from Playa 1 or the contributing ditches. This well will continue to be monitored and trended over time.
PTX06-1049	20150619M00141	6/19/2015	N	RDX	2.46	0.27				NA	0.27	Y	2	Y	Y	RDX was first detected in this well in 2011. This may indicate that the contamination is slowly moving into this well from Playa 1 or the contributing ditches. This well will continue to be monitored and trended over time.
PTX06-1049	20150619M00141	6/19/2015	N	Trichloroethene	1.28	1				NA	1	Y	5	N	Y	TCE has been detected in this well since 2009. This may indicate that the contamination is slowly moving into this well from Playa 1 or the contributing ditches. This well will continue to be monitored and trended over time.
PTX06-1049	20151102M00280	11/2/2015	N	4-Amino-2,6-Dinitrotoluene	1.94	0.267				NA	0.267	Y	1.2	Y	Y	DNT4A was detected in this well at levels > GWPS in 2011. This may indicate that the contamination is slowly moving into this well from Playa 1 or the contributing ditches. This well will continue to be monitored and trended over time.
PTX06-1049	20151102M00280	11/2/2015	N	HMX	0.0909	0.267	J			NA	0.267	Y	2	N	Y	This was a first-time detection at this well. However, RDX and DNT4a have been detected in this wells at levels > GWPS since 2011. This may indicate that the contamination is slowly moving into this well from Playa 1 or the contributing ditches. This well will continue to be monitored and trended over time.

Well ID	Sample ID	Sample Date	Sample Type	Analyte	Measured Value (ug/L)	Detection Limit (ug/L)	Lab Qualifier	PTX Qualifier	Background (ug/L)	>Background?	PQL (ug/L)	>PQL?	GWPS (ug/L)	>GWPS ?	Expected Condition?	Explanation
PTX06-1049	20151102M00280	11/2/2015	N	RDX	3.04	0.267				NA	0.267	Y	5	Y	Y	RDX was first detected in this well in 2011. This may indicate that the contamination is slowly moving into this well from Playa 1 or the contributing ditches. This well will continue to be monitored and trended over time.
PTX06-1049	20151102M00280	11/2/2015	N	TNX	0.111	0.267	J			NA	0.267	Y	1.2	N	Y	This was a first-time detection at this well. However, RDX and DNT4a have been detected in this wells at levels > GWPS since 2011. Because of the presence of RDX, detection of a breakdown product at low levels is not unexpected. This well will continue to be monitored and trended over time.
PTX06-1049	20151102M00280	11/2/2015	N	Trichloroethene	1.55	1				NA	1	Y	5	N	Y	TCE has been detected in this well since 2009. This may indicate that the contamination is slowly moving into this well from Playa 1 or the contributing ditches. This well will continue to be monitored and trended over time.
PTX06-1081	20150730M00185	7/30/2015	N	Trichloroethene	0.44	1	J			NA	1	N	5	N	Y	This well has continuously exhibited low-level concentrations of TCE below the GWPS. Trending indicates a stable trend (linear regression) or decreasing trend (Mann-Kendall). Because concentrations are low, this well will continue to be monitored and trended over time.

Table 3-7. Detected Results in Group 1 Ogallala Aquifer Uncertainty Management/Early Detection Wells

Well ID	Sample ID	Sample Date	Sample Type	Analyte	Measured Value (ug/L)	Detection Limit (ug/L)	Lab Qualifier	PTX Qualifier	Background (ug/L)	>Background?	PQL (ug/L)	>PQL?	GWPS (ug/L)	>GWPS?	Expected Condition?	Explanation
PTX01-1011	20150209M00023	2/9/2015	N	Manganese	45.4	5			16	Y	5	NA	1715.5	N	Y	Possible corrosion.
PTX01-1011	20150728M00177	7/28/2015	N	Manganese	40.9	5			16	Y	5	NA	1715.5	N	Y	Possible corrosion.
PTX06-1033	20150622M00148	6/22/2015	N	Chromium, Hexavalent	12.8	10				NA	10	Y	100	N	Y	Possible corrosion.
PTX06-1033	20150622M00148	6/22/2015	N	Nickel	51.6	2			15	Y	2	NA	730	N	Y	Possible corrosion.
PTX06-1033	20151019M00256	10/19/2015	N	Chromium, Total	39.6	10			31.8	Y	10	NA	100	N	Y	Possible corrosion.
PTX06-1033	20151019M00256	10/19/2015	N	Nickel	74.5	2			15	Y	2	NA	730	N	Y	Possible corrosion.
PTX06-1043	20150818M00208	8/18/2015	N	Chromium, Hexavalent	4.06	10	J			NA	10	N	100	N	Y	Possible low-level background.
PTX06-1044	20150608M00127	6/8/2015	N	Chromium, Hexavalent	6.55	10	J	J		NA	10	N	100	N	Y	Possible low-level background.
PTX06-1044	20150608M00128	6/8/2015	D	Chromium, Hexavalent	9.84	10	J	J		NA	10	N	100	N	Y	Possible low-level background.
PTX06-1044	20151020M00260	10/20/2015	N	Chromium, Hexavalent	3.74	10	J			NA	10	N	100	N	Y	Possible low-level background.
PTX06-1056	20150129M00011	1/29/2015	N	4-Amino-2,6-Dinitrotoluene	0.177	0.262	J			NA	0.262	N	1.2	N	N	Unexpected condition.
PTX06-1056	20150129M00011	1/29/2015	N	Chromium, Hexavalent	3.02	10	J			NA	10	N	100	N	Y	Possible low-level background.
PTX06-1056	20150415M00077	4/15/2015	N	4-Amino-2,6-Dinitrotoluene	0.218	0.27	J			NA	0.27	N	1.2	N	N	Unexpected condition.
PTX06-1056	20150818M00209	8/18/2015	N	4-Amino-2,6-Dinitrotoluene	0.329	0.255				NA	0.255	Y	1.2	N	N	Unexpected condition.
PTX06-1056	20150818M00209	8/18/2015	N	1,2-Dichloroethane	0.34	1	J			NA	1	N	5	N	N	Unexpected condition.
PTX06-1056	20151019M00252	10/19/2015	N	1,2-Dichloroethane	0.33	1	J			NA	1	N	5	N	N	Unexpected condition.
PTX06-1056	20151019M00253	10/19/2015	N	4-Amino-2,6-Dinitrotoluene	0.243	0.254	J			NA	0.254	N	1.2	N	N	Unexpected condition.
PTX06-1056	20151118M00312	11/18/2015	N	4-Amino-2,6-Dinitrotoluene	0.273	0.263				NA	0.263	Y	1.2	N	N	Unexpected condition.
PTX06-1056	20151208M00315	12/8/2015	N	4-Amino-2,6-Dinitrotoluene	0.195	0.266	J	J-		NA	0.266	N	1.2	N	N	Unexpected condition.
PTX06-1062A	20150729M00182	7/29/2015	N	Manganese	20.2	5			16	Y	5	NA	1715.5	N	Y	Possible corrosion.
PTX06-1068	20150504M00095	5/4/2015	N	Chromium, Hexavalent	3.46	10	J	J		NA	10	N	100	N	Y	Possible low-level background.
PTX06-1068	20151020M00261	10/20/2015	N	Chromium, Hexavalent	3.74	10	J			NA	10	N	100	N	Y	Possible low-level background.
PTX06-1072	20150210M00027	2/10/2015	N	Manganese	87.4	5			16	Y	5	NA	1715.5	N	Y	Possible corrosion.
PTX06-1076	20151019M00255	10/19/2015	N	Chromium, Hexavalent	3.74	10	J			NA	10	N	100	N	Y	Possible low-level background.
PTX06-1138	20150601M00113	6/1/2015	N	Manganese	17.7	5			16	Y	5	NA	1715.5	N	Y	Possible corrosion.
PTX06-1141	20150202M00015	2/2/2015	N	Manganese	19	5			16	Y	5	NA	1715.5	N	Y	Possible corrosion.
PTX06-1141	20150818M00210	8/18/2015	N	Manganese	47.7	5			16	Y	5	NA	1715.5	N	Y	Possible corrosion.
PTX06-1144	20150608M00126	6/8/2015	N	Chromium, Hexavalent	16.4	10		J		NA	10	Y	100	N	Y	Possible low-level background. Sample was J-qualified and higher than corresponding total chromium result.

Well ID	Sample ID	Sample Date	Sample Type	Analyte	Measured Value (ug/L)	Detection Limit (ug/L)	Lab Qualifier	PTX Qualifier	Background (ug/L)	>Background?	PQL (ug/L)	>PQL?	GWPS (ug/L)	>GWPS?	Expected Condition?	Explanation
PTX06-1144	20151019M00257	10/19/2015	N	Chromium, Hexavalent	3.74	10	J			NA	10	N	100	N	Y	Possible low-level background.
PTX06-1157	20150810M00192	8/10/2015	N	Chromium, Hexavalent	4.27	10	J			NA	10	N	100	N	Y	Possible low-level background.

Table 3-8. Detected Boron Results in Group 1 Ogallala Aquifer Wells

Well ID	Sample ID	Sample Date	Sample Type	Measured Value (ug/L)	Detection Limit (ug/L)	Lab Qualifier	PTX Qualifier	>Background? (193.9 ug/L)	PQL (ug/L)	>PQL?	GWPS (ug/L)	>GWPS?	Expected Condition?	Mann-Kendall Trends		Explanation
														LT	ST	
PTX01-1012	20150120M00003	1/20/2015	N	208	30			Y	30	NA	7300	N	Y	Decreasing	No Trend	This concentration likely represents natural variability in background.
PTX06-1056	20150129M00011	1/29/2015	N	208	75			Y	75	NA	7300	N	Y	Decreasing	No Trend	This concentration likely represents natural variability in background.
PTX06-1056	20150818M00209	8/18/2015	N	200	15			Y	15	NA	7300	N	Y	Decreasing	No Trend	This concentration likely represents natural variability in background.
PTX06-1137A	20151104M00289	11/4/2015	N	211	30			Y	30	NA	7300	N	Y	Increasing	No Trend	This concentration likely represents natural variability in background.
PTX06-1139	20150212M00033	2/12/2015	D	197	15		J	Y	15	NA	7300	N	Y	Decreasing	Decreasing	This concentration likely represents natural variability in background.
PTX06-1140	20151109M00295	11/9/2015	N	201	75			Y	75	NA	7300	N	Y	No Trend	No Trend	This concentration likely represents natural variability in background.
PTX06-1157	20150121M00006	1/21/2015	N	200	30			Y	30	NA	7300	N	Y	No Trend	Stable	This concentration likely represents natural variability in background.

LT – Long-Term Trend (all data)
ST – Short-Term Trend (last 4 samples)

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In addition to comparison of measured concentrations to GWPS, all Ogallala Aquifer wells were evaluated to determine if specific constituents that are detected are trending upward (see Appendix E). For the trending analysis, a small list of HEs (RDX and the DNTs), boron, chromium, and hexavalent chromium were evaluated. The HEs have been sporadically detected in the past at a few wells, and the metals are naturally occurring.

The Mann-Kendall trending results, summarized in Table 3-9, indicate that across all data, eight wells are indicating increasing or probably increasing trends.

Five wells indicate an increasing or probably increasing trend in chromium. However, in all five of these wells the detections were below background. These chromium trends may also be related to the stainless steel casings and the confirmed presence of bacterial growth that has been found in many wells (perched and Ogallala aquifers) at Pantex. Typically, chromium levels drop in these wells after brushing and bailing of the well.

PTX06-1068 exhibited an increasing trend in hexavalent chromium. As discussed in the 2012 Annual Progress Report, the increasing trend is likely due to several 2012 detections associated with the corrosion of the stainless steel sampling pump. All other detections have been below the PQL, and detections in 2015 likely represent naturally occurring background concentrations.

Mann-Kendall trending across all data also indicates that boron is increasing or probably increasing in three Ogallala Aquifer wells. However, all boron detections are well below the GWPS of 7,300 ug/L and likely represent background variability.

Table 3-9. Increasing Trends in Group 1 Ogallala Aquifer Wells

Well	COC	Concentration Trend
PTX06-1043	CR	Probably Increasing
PTX06-1058	CR	Probably Increasing
PTX06-1062A	CR	Increasing
PTX06-1068	CR	Increasing
PTX06-1068	CR-6	Increasing
PTX06-1076	CR	Increasing
PTX06-1137A	B	Increasing
PTX06-1138	B	Increasing
PTX07-1R01	B	Probably Increasing

3.4.2 Group 2 Wells

These wells are near source areas and generally have contamination at levels above the GWPS. The purpose of this evaluation is to determine if source strength is declining. It is an expected condition that the ditches and playas would continue to contribute contamination to the perched aquifer for a long period of time (20 years or more), but at much lower concentrations than in the past (Pantex, 2006). For many of these wells, it is expected that concentrations will stabilize with an eventual long-term decreasing trend below the GWPS. Table 3-10 presents the evaluation of Group 2 wells COC trends (since the start of remedial actions) against expected conditions that were developed in the LTM Design Report. A full reporting of all trends versus expected conditions is included in Appendix E.

The following indicator parameters were not included in Table 3-10:

- HE breakdown products (MNX; TNX; DNX; 1,3-DNB; 2-amino-4,6-DNT; and 4-amino-2,6-DNT) were not included since increasing trends are not an indicator of continued sourcing.
- TCE breakdown products (*cis*-1,2-DCE; trans-1,2-DCE; and vinyl chloride) were not included since increasing trends are not an indicator of continued sourcing.
- Total Chromium was not included in lieu of hexavalent chromium.

Many wells that have detections of COCs already meet expected conditions at the well. Several wells have increasing or probably increasing historical COC trends. PTX06-1095A, PTX06-1005, and PTX08-1002 are exhibiting increasing trends in multiple COCs, but these three wells are under the influence of remedial actions and these trends more likely reflect the influences of the remedial actions rather than increased mass flux from the source areas. PTX06-1126, PTX06-1127, PTX07-1O02, and PTX07-1O03, while classified as Group 2 wells, are far away from the identified source areas, so these trends are not representative of the current mass flux near the source areas.

The remaining 12 wells that are exhibiting increasing trends when the expected condition is a decreasing or stable trend are discussed below.

- 1114-MW4, located in central Zone 11, is exhibiting increasing trends in perchlorate and 1,4-dioxane, possibly due to increased mass flux and plume movement downgradient away from the source (Hypalon pond and nearby ditches).
- PTX06-1002A is exhibiting an apparent increasing trend in TCE; however, all samples in 2015 were non-detect and the trend is due to the use of one-half the sample detection limit as a surrogate for trend identification.
- PTX06-1007 is exhibiting an increasing trend in perchlorate while the expected condition is a long-term decreasing trend. As discussed in Section 3.1.1.3, this trend could be caused by changes in mass flux from the perchlorate source area or possible effects of injection.
- PTX06-1010 is exhibiting increasing trends in TCE and chloroform while the expected condition is a long-term decreasing trend. These trends may be due to increased mass

flux at the source area (WMG 10) or possible down gradient plume movement from the source.

- PTX06-1077A is exhibiting an apparent increasing trend in perchlorate; however, all samples in 2015 were non-detect and the trend is due to the use of one-half the sampe detection limit as a surrogate for trend identification.

- PTX06-1088 is exhibiting increasing trends in TCE and PCE since the start of remedial actions. However, short-term data for PCE indicate a decreasing trend. TCE concentrations in PTX06-1088 are only slightly increasing and reflect general movement of the plume in this area.

- PTX07-1P02 is exhibiting increasing trends in RDX and 1,4-dioxane since the start of remedial actions while the expected condition is a stable or decreasing trend below GWPS. Both long-term trends are decreasing, and 1,4-dioxane remains below the GWPS while RDX concentrations are variable at about the GWPS.

- PTX08-1005 is exhibiting an increasing trend in PCE while the expected condition is a long-term decreasing trend. This well is located on the south end of Zone 11, further away from the Zone 11 VOC source areas. Therefore, these trends may be due to general plume movement downgradient rather than a current increase in mass flux at the source.

- PTX08-1006 is exhibiting an increasing trend in TCE, while the expected condition is a long-term decreasing trend. This well is located in southeast Zone 11 and the trends are likely due to plume movement away from upgradient sources.

- PTX08-1007 is exhibiting a slight increasing trend in 1,4-dioxane below the GWPS since the start of remedial actions while the expected condition is a long-term decreasing trend. Although the trend was identified as increasing, little actual change in concentration has been observed over the past four years.

- PTX08-1008 is exhibiting increasing trends in perchlorate and chloroform while the expected condition is a long-term stabilization of concentrations. As discussed in Section 3.1.1.3, the increasing trend in perchlorate may be due to general plume movement to the southeast, which may also be influenced by SEPTS operations. The long-term trend for chloroform is decreasing, and recent detections have been below the sample detection limit and below the GWPS.

- PTX08-1009 is exhibiting a slight increasing trend in hexavalent chromium below the GWPS since the start of remedial actions while the expected condition is a long-term stabilization of concentrations. Although the trend was identified as increasing, little actual change in concentration has been observed over the past two years, the trend analysis was affected by the use of one-half the sample detection limit as a surrogate for non-detects, and the long-term trend is decreasing.

Many other wells show stabilization of concentrations or no trend, rather than a decreasing trend. However, the expected condition is that most of these wells will have a long-term decreasing trend. These wells should start indicating a decreasing trend over the next few years.

Table 3-11 summarizes all detections of analytes above the laboratory PQL and site-specific background, if calculated, that are not considered to be indicator parameters. All of the detections above background were nickel or manganese, which are components of stainless steel and are likely due to corrosion of stainless steel screens. Specific exceedances are discussed below:

- A single detection of manganese exceeding the site-specific background occurred in PTX06-1002A in 2015. This detections was below the GWPS and is likely due to stainless steel screen corrosion.
- PTX06-1095A had manganese and nickel detections exceeding site-specific background in both samples collected in 2015. These detections are likely due to stainless steel screen corrosion. All detections were well below their respective GWPS.
- PTX10-1014 had a nickel detection exceeding site-specific background in 2015. This detection is likely due to stainless steel screen corrosion as indicated by increasing trends in several components of stainless steel.

Table 3-10. COC Trends vs. Expected Conditions, Group 2 Wells

			Historic Mann-Kendall Trends										
Well ID	COC Expected Condition - LTM Design	COC >GWPS	RDX	TNT	DNT24	DNT26	TNB135	PERC	TCE	PCE	CR(VI)	1,4-Dioxane	TCLME
1114-MW4	Long-term decreasing trend	PERC, TCE	N/A	ND	ND	ND	ND	Increasing	Decreasing	Decreasing	NT	Increasing	Decreasing
OW-WR-38	Long-term stabilization of concentrations	RDX	Decreasing	ND	ND	ND	ND	NT	No Trend	ND	NT	NT	ND
PTX06-1002A	Long-term stabilization of concentrations	RDX, TNX	Decreasing	ND	ND	ND	N/A	NT	Increasing	N/A	N/A	NT	ND
PTX06-1003[1]	Long-term stabilization of concentrations		NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PTX06-1005	Long-term stabilization of concentrations	DNT2A, DNT4A, RDX, TNB135, TNX, TCE, CR, CR(VI)	Decreasing	Probably Increasing	Decreasing	Increasing	Decreasing	NT	Probably Increasing	Increasing	No Trend	NT	Increasing
PTX06-1007	Long-term decreasing trend	PERC, DNT4A	Decreasing	ND	ND	Decreasing	ND	Increasing	No Trend	ND	NT	No Trend	ND
PTX06-1008	Long-term decreasing trend	DCA12	ND	ND	ND	ND	ND	N/A	Decreasing	ND	N/A	ND	No Trend
PTX06-1010	Long-term decreasing trend	CR, CR(VI), RDX	Decreasing	ND	ND	ND	ND	NT	Increasing	Decreasing	No Trend	NT	Probably Increasing
PTX06-1011	Stable or decreasing trend below GWPS	TCE	N/A	ND	N/A	ND	N/A	N/A	No Trend	No Trend	No Trend	Decreasing	N/A
PTX06-1050	Long-term stabilization of concentrations	RDX, TNX, DNT4A	Decreasing	ND	ND	ND	ND	NT	ND	ND	NT	NT	ND
PTX06-1053	Stable or decreasing trend below GWPS	NONE	Decreasing	ND	ND	ND	ND	ND	ND	ND	N/A	ND	ND
PTX06-1077A	Stable or decreasing trend below GWPS	TCE	Decreasing	ND	ND	ND	ND	Probably Increasing	Decreasing	N/A	NT	N/A	ND
PTX06-1088	Long-term stabilization of concentrations	TCE, RDX, DNT24, DNT4A, PCE	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing	NT	Increasing	Increasing	Decreasing	NT	Decreasing
PTX06-1095A	Long-term stabilization of concentrations	RDX, TNX, DNT4A, DNT2A, TCE, CR, CR(VI)	Increasing	Increasing	ND	Decreasing	No Trend	NT	No Trend	Increasing	Increasing	NT	Increasing
PTX06-1126	Long-term decreasing trend	TCE, PERC, DIOXANE14, DNT4A, DCA12	Probably Increasing	ND	ND	N/A	ND	Decreasing	Decreasing	Increasing	N/A	No Trend	Increasing
PTX06-1127	Long-term decreasing trend	TCE, PERC, DIOXANE14, DNT4A, DCA12	Increasing	ND	ND	ND	ND	Decreasing	Decreasing	Increasing	N/A	Decreasing	Increasing
PTX07-1O01	Long-term decreasing trend	RDX	Decreasing	ND	ND	ND	ND	NT	N/A	ND	NT	NT	ND
PTX07-1O02	Long-term decreasing trend	NONE	Decreasing	ND	ND	ND	ND	NT	Increasing	ND	NT	NT	N/A
PTX07-1O03	Long-term decreasing trend	RDX, TNX	Increasing	ND	ND	ND	ND	NT	N/A	ND	NT	NT	ND
PTX07-1O06[1]	Stable or decreasing trend below GWPS		NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PTX07-1P02	Stable or decreasing trend below GWPS	NONE	Increasing	ND	ND	ND	ND	N/A	ND	ND	NT	Increasing	ND
PTX07-1P05[1]	Stable or decreasing trend below GWPS		Decreasing	ND	ND	ND	ND	N/A	ND	No Trend	NT	Decreasing	ND

			Historic Mann-Kendall Trends											
Well ID	COC Expected Condition - LTM Design	COC >GWPS	RDX	TNT	DNT24	DNT26	TNB135	PERC	TCE	PCE	CR(VI)	1,4-Dioxane	TCLME
PTX08-1001	Long-term stabilization of concentrations	RDX, TNX	No Trend	ND	ND	ND	ND	Decreasing	ND	ND	NT	N/A	ND
PTX08-1002	Long-term stabilization of concentrations	RDX, MNX, TNX, DNT2A, DNT4A	Decreasing	Increasing	Increasing	N/A	Increasing	NT	ND	ND	ND	NT	ND
PTX08-1005	Long-term decreasing trend	TCE, DNT4A	Decreasing	ND	ND	ND	ND	Decreasing	Decreasing	Probably Increasing	Decreasing	Decreasing	Decreasing
PTX08-1006	Long-term decreasing trend	RDX, TNX, PERC, DNT4A, TCE, PCE, DIOXANE14, DCA12	Decreasing	ND	ND	Decreasing	N/A	Decreasing	Increasing	Decreasing	NT	Decreasing	Decreasing
PTX08-1007	Long-term decreasing trend	TCE, RDX	No Trend	ND	ND	ND	ND	N/A	Decreasing	Decreasing	N/A	Increasing	No Trend
PTX08-1008	Long-term stabilization of concentrations	CR, CR(VI)	ND	ND	ND	ND	ND	Increasing	N/A	ND	Decreasing	ND	Increasing
PTX08-1009	Long-term stabilization of concentrations	NONE	Decreasing	ND	ND	ND	ND	NT	N/A	ND	Increasing	NT	Decreasing
PTX10-1014	Long-term decreasing trend	TCE	Decreasing	ND	ND	ND	ND	N/A	Decreasing	Decreasing	N/A	N/A	Decreasing

CR = Chromium, total; CR+6 = Chromium, hexavalent; DCA12 = 1,2-dichloroethane; DNT2A = 2-amino-4,6-dinitrotoluene; DNT4A = 4-amino-2,6-dinitrotoluene
DNT24 = 2,4-dinitroluene; DIOXANE14 = 1,4-dioxane; PCE = tetrachloroethene; PERC = perchlorate; TCE = trichloroethene
TCLME = chloroform; TNB135 = 1,3,5-trinitrobenzene; N/A = not enough detections; ND = non-detect; NT = not tested

[1] – PTX06-1003, PTX07-1O06, and PTX07-1P05 were not able to be sampled in 2015 due to either dry conditions or insufficient water to sample.

Table 3-11. Group 2 Well Detections of non-Indicator Parameters

Well ID	Sample ID	Sample Date	Sample Type	Analyte	Measured Value (ug/L)	Detection Limit (ug/L)	Lab Qualifier	PTX Qualifier	Background (ug/L)	>Background?	PQL (ug/L)	>PQL?	GWPS (mg/L)	>GWPS ?	Expected Condition?	Explanation
PTX06-1002A	20150820M00212	8/20/2015	N	Manganese	20.8	5			16	Y	5	NA	1715.5	N	Y	Likely Screen Corrosion
PTX06-1095A	20150218M00043	2/18/2015	N	Manganese	24.7	5			16	Y	5	NA	1715.5	N	Y	Likely Screen Corrosion
PTX06-1095A	20150218M00044	2/18/2015	F	Manganese	20.5	5			16	Y	5	NA	1715.5	N	Y	Likely Screen Corrosion
PTX06-1095A	20150218M00043	2/18/2015	N	Nickel	147	10			15	Y	15	NA	730	N	Y	Likely Screen Corrosion
PTX06-1095A	20150218M00044	2/18/2015	F	Nickel	99.8	2			15	Y	15	NA	730	N	Y	Likely Screen Corrosion
PTX06-1095A	20150820M00213	8/20/2015	N	Manganese	19.9	5			16	Y	5	NA	1715.5	N	Y	Likely Screen Corrosion
PTX06-1095A	20150820M00214	8/20/2015	F	Manganese	19.2	5			16	Y	5	NA	1715.5	N	Y	Likely Screen Corrosion
PTX06-1095A	20150820M00213	8/20/2015	N	Nickel	137	10			15	Y	15	NA	730	N	Y	Likely Screen Corrosion
PTX06-1095A	20150820M00214	8/20/2015	F	Nickel	97.5	2			15	Y	15	NA	730	N	Y	Likely Screen Corrosion
PTX10-1014	20150422M00088	4/22/2015	N	Nickel	41.5	2			15	Y	15	NA	730	N	Y	Likely Screen Corrosion

N – Normal sample D-Duplicate sample F – Filtered Sample

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3.5 POC/POE Well Evaluation

POC/POE Wells

- 21 perched aquifer POC wells, with 15 exceeding GWPS
- 2 Ogallala Aquifer POC wells, with no GWPS exceedances.
- 8 Ogallala Aquifer POE wells, with no GWPS exceedances.

As part of the approved changes to HW-50284, Pantex has designated POC and POE wells. As defined by HW-50284, the purpose of these wells is:

1. POC wells demonstrate compliance with the GWPS.
2. POE wells demonstrate compliance with the GWPS and are used to evaluate the effectiveness of the remediation program.

The remediation program must continue until the POC and POE wells are compliant with the GWPS. The POC/POE wells approved in HW-50284 are depicted in Figure 3-59. All but two POC wells are in the perched aquifer. All POE wells are in the Ogallala Aquifer and are not expected to exhibit detections of organic COCs or detections above background values for inorganic COCs.

All POC/POE wells were evaluated against the established GWPS. Evaluation of the data indicates that only four perched aquifer POC wells had concentrations below GWPS. This is an expected condition at these wells as the full remedial actions were started in 2009. The COC concentrations above the GWPS are provided in Table 3-12. The Ogallala Aquifer wells were evaluated in the uncertainty management/early detection section to determine if any COCs were detected above background or PQL. All well data, along with comparison to the laboratory PQL, background, and GWPS are provided in Appendix D.

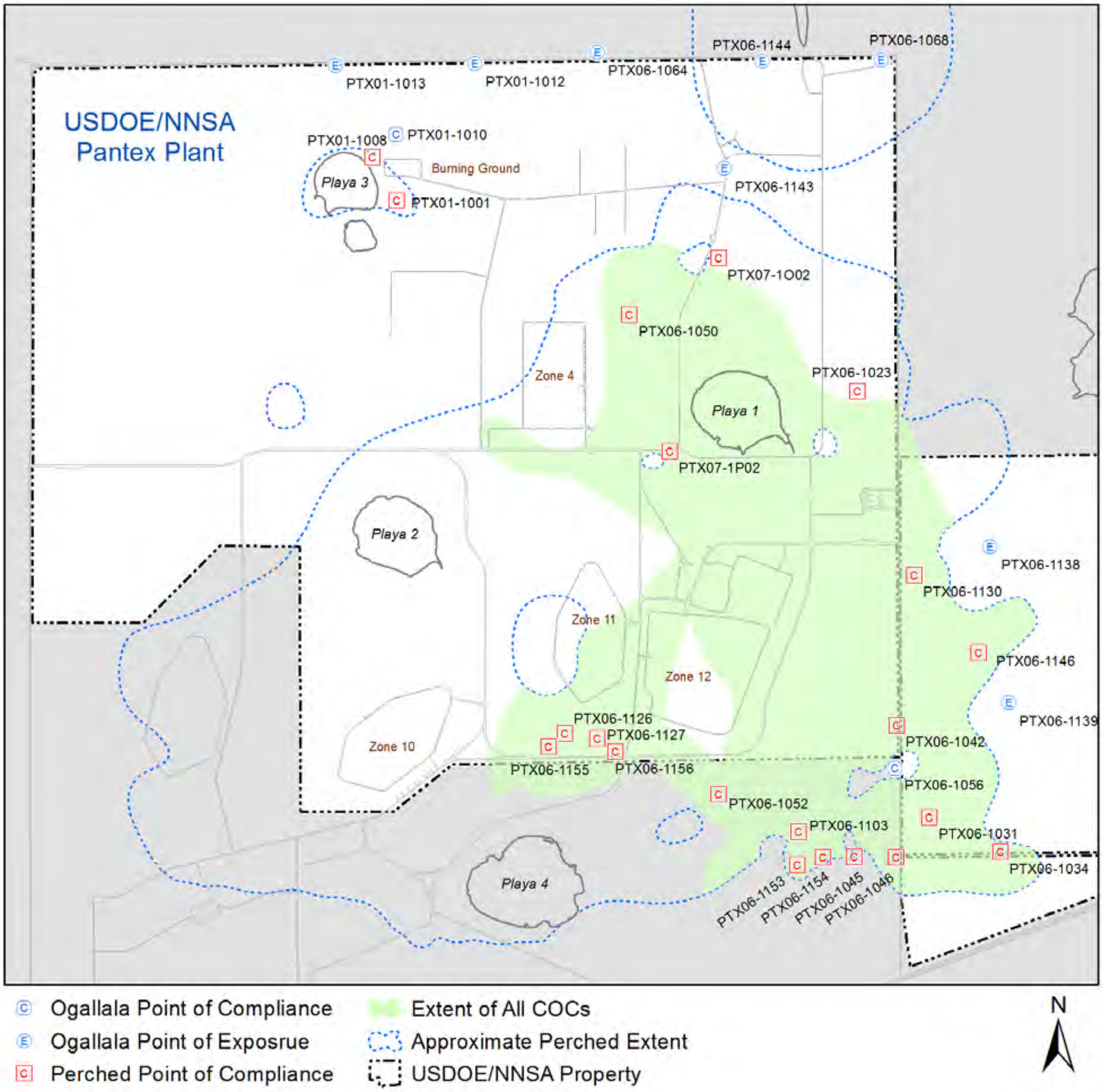

Figure 3-59. POC and POE Wells

Table 3-12. POC Well Detections Above GWPS

Well ID	Sample ID	Analyte	2015 Average Value (ug/L)	Measured Value (ug/L)	Detection Limit (ug/L)	Lab Qualifier	PTX Qualifier	GWPS (ug/L)
PTX06-1031	20150602M00117	4-Amino-2,6-Dinitrotoluene	2.51	2.3	0.267			1.2
PTX06-1031	20150602M00117	RDX	516	549	66.8		J	2
PTX06-1031	20150602M00117	TNX	7.74	6.39	0.267	Q	J	2
PTX06-1031	20151027M00270	4-Amino-2,6-Dinitrotoluene	2.51	2.72	0.26			1.2
PTX06-1031	20151027M00270	RDX	516	483	13		J	2
PTX06-1031	20151027M00270	TNX	7.74	9.09	0.26			2
PTX06-1034	20150216M00036	4-Amino-2,6-Dinitrotoluene	8.89	9.14	0.266		J+	1.2
PTX06-1034	20150216M00036	RDX	780	774	66.5		J	2
PTX06-1034	20150216M00036	TNX	51.5	46.5	6.65		J	2
PTX06-1034	20150824M00218	4-Amino-2,6-Dinitrotoluene	8.89	8.63	6.44			1.2
PTX06-1034	20150824M00218	RDX	780	786	64.4		J	2
PTX06-1034	20150824M00218	TNX	51.5	56.5	6.44		J	2
PTX06-1042	20150205M00021	4-Amino-2,6-Dinitrotoluene	14.5	16.6	1.36	H	J	1.2
PTX06-1042	20150205M00021	MNX	4.47	4.36	0.272	H	J	2
PTX06-1042	20150205M00021	RDX	742	770	27.2	H	J	2
PTX06-1042	20150205M00021	TNX	9.08	8.85	0.272	H	J-	2
PTX06-1042	20150715M00170	4-Amino-2,6-Dinitrotoluene	14.5	12.3	6.91		J	1.2
PTX06-1042	20150715M00170	MNX	4.47	4.57	0.276		J	2
PTX06-1042	20150715M00170	RDX	742	714	69.1		J	2
PTX06-1042	20150715M00170	TNX	9.08	9.3	0.276		J	2
PTX06-1046	20150204M00018	2-Amino-4,6-Dinitrotoluene	2.32	2.81	0.258	H	J	1.2
PTX06-1046	20150204M00018	4-Amino-2,6-Dinitrotoluene	8.88	9.82	0.644	H	J	1.2
PTX06-1046	20150204M00018	RDX	2180	3160	129	H	J	2
PTX06-1046	20150204M00018	TNX	163	230	12.9	H	J	2
PTX06-1046	20150827M00231	2-Amino-4,6-Dinitrotoluene	2.32	1.78	0.273	Q	J	1.2
PTX06-1046	20150827M00231	4-Amino-2,6-Dinitrotoluene	8.88	7.68	0.273	Q	J	1.2
PTX06-1046	20150827M00231	RDX	2180	1390	68.3			2
PTX06-1046	20150827M00231	TNX	163	101	6.83		J-	2
PTX06-1050	20150610M00134	4-Amino-2,6-Dinitrotoluene	8.05	8.21	0.255			1.2
PTX06-1050	20150610M00134	RDX	125	138	12.8			2
PTX06-1050	20150610M00134	TNX	6.33	6.73	0.255			2
PTX06-1050	20151123M00314	4-Amino-2,6-Dinitrotoluene	8.05	7.89	0.258			1.2
PTX06-1050	20151123M00314	RDX	125	111	12.9		J	2
PTX06-1050	20151123M00314	TNX	6.33	5.93	0.258			2
PTX06-1052	20150309M00046	Chromium, Total	1140	1320	50		J	100

Well ID	Sample ID	Analyte	2015 Average Value (ug/L)	Measured Value (ug/L)	Detection Limit (ug/L)	Lab Qualifier	PTX Qualifier	GWPS (ug/L)
PTX06-1052	20150309M00046	Chromium, Hexavalent	988	1440	150			100
PTX06-1052	20150826M00227	Chromium, Total	1140	955	100		J	100
PTX06-1052	20150826M00227	Chromium, Hexavalent	988	536	250			100
PTX06-1126	20150421M00085	4-Amino-2,6-Dinitrotoluene	16.3	14.8	0.661		J+	1.2
PTX06-1126	20150421M00085	Perchlorate	56.2	51	12			26
PTX06-1126	20150421M00085	1,2-Dichloroethane	6.64	5.3	5			5
PTX06-1126	20150421M00085	1,4-Dioxane	27.2	27.8	5		J+	7.7
PTX06-1126	20150421M00085	Trichloroethene	274	263	5			5
PTX06-1126	20151026M00265	4-Amino-2,6-Dinitrotoluene	16.3	17.7	0.683			1.2
PTX06-1126	20151026M00265	Perchlorate	56.2	61.3	12			26
PTX06-1126	20151026M00265	1,2-Dichloroethane	6.64	7.97	1			5
PTX06-1126	20151026M00265	1,4-Dioxane	27.2	26.5	4		J	7.7
PTX06-1126	20151026M00265	Trichloroethene	274	285	5			5
PTX06-1127	20150421M00084	4-Amino-2,6-Dinitrotoluene	14.8	14.8	0.665		J+	1.2
PTX06-1127	20150421M00084	Perchlorate	370	417	120			26
PTX06-1127	20150421M00084	1,4-Dioxane	26.9	26.7	5		J+	7.7
PTX06-1127	20150421M00084	Trichloroethene	12.1	8.77	1			5
PTX06-1127	20151026M00264	4-Amino-2,6-Dinitrotoluene	14.8	14.7	0.676			1.2
PTX06-1127	20151026M00264	Perchlorate	370	323	120			26
PTX06-1127	20151026M00264	1,4-Dioxane	26.9	27	4		J	7.7
PTX06-1127	20151026M00264	Trichloroethene	12.1	15.4	1			5
PTX06-1130	20150311M00054	2-Amino-4,6-Dinitrotoluene	5.83	5.83	0.255	H	J-	1.2
PTX06-1130	20150311M00054	4-Amino-2,6-Dinitrotoluene	5.55	5.55	0.255	H	J-	1.2
PTX06-1130	20150311M00054	RDX	99.7	99.7	3.19	H	J-	2
PTX06-1130	20150311M00054	TNX	6.56	6.56	0.255	H	J-	2
PTX06-1146	20150216M00037	4-Amino-2,6-Dinitrotoluene	25	21.1	1.35		J+	1.2
PTX06-1146	20150216M00037	RDX	1010	981	67.6		J	2
PTX06-1146	20150216M00037	TNX	17.8	16.9	1.35		J	2
PTX06-1146	20150824M00219	2-Amino-4,6-Dinitrotoluene	1.1	1.34	0.256			1.2
PTX06-1146	20150824M00219	4-Amino-2,6-Dinitrotoluene	25	28.8	1.28			1.2
PTX06-1146	20150824M00219	RDX	1010	1040	64.1		J	2
PTX06-1146	20150824M00219	TNX	17.8	18.6	1.28		J	2
PTX06-1146	20150824M00219	Chromium, Total	63.4	107	20			100
PTX06-1153	20150211ISB009	2-Amino-4,6-Dinitrotoluene	2.7	2.8	0.2		J+	1.2

Well ID	Sample ID	Analyte	2015 Average Value (ug/L)	Measured Value (ug/L)	Detection Limit (ug/L)	Lab Qualifier	PTX Qualifier	GWPS (ug/L)
PTX06-1153	20150211ISB009	4-Amino-2,6-Dinitrotoluene	2.67	2.8	0.2		J+	1.2
PTX06-1153	20150211ISB009	MNX	2.37	2.6	0.5			2
PTX06-1153	20150211ISB009	RDX	293	290	40			2
PTX06-1153	20150211ISB009	TNX	2.4	2.2	0.5			2
PTX06-1153	20150211ISB009	Chromium, Total	175	180	10			100
PTX06-1153	20150422ISB025	2-Amino-4,6-Dinitrotoluene	2.7	2.8	0.2			1.2
PTX06-1153	20150422ISB025	4-Amino-2,6-Dinitrotoluene	2.67	2.7	0.2			1.2
PTX06-1153	20150422ISB025	MNX	2.37	2.6	0.5			2
PTX06-1153	20150422ISB025	RDX	293	340	20		J	2
PTX06-1153	20150422ISB025	TNX	2.4	2.6	0.5			2
PTX06-1153	20150422ISB025	Chromium, Total	175	170	10			100
PTX06-1153	20150422ISB025	Chromium, Hexavalent	102	140	50			100
PTX06-1153	20150729ISB041	2-Amino-4,6-Dinitrotoluene	2.7	2.5	0.2		J	1.2
PTX06-1153	20150729ISB041	4-Amino-2,6-Dinitrotoluene	2.67	2.5	0.2			1.2
PTX06-1153	20150729ISB041	RDX	293	260	40		J	2
PTX06-1153	20150729ISB041	TNX	2.4	2.4	0.5			2
PTX06-1153	20150729ISB041	Chromium, Total	175	190	50			100
PTX06-1153	20151111ISB061	RDX	293	280	40		J	2
PTX06-1153	20151111ISB061	Chromium, Total	175	160	25			100
PTX06-1154	20150209ISB002	Arsenic	90	71	5			12
PTX06-1154	20150209ISB002	Barium	17300	13000	5	B ^	J	2000
PTX06-1154	20150421ISB022	TNX	1.22	2.2	0.5			2
PTX06-1154	20150421ISB022	Arsenic	90	59	5	B		12
PTX06-1154	20150421ISB022	Barium	17300	15000	10			2000
PTX06-1154	20150805ISB044	Arsenic	90	110	50			12
PTX06-1154	20150805ISB044	Barium	17300	20000	20		J+	2000
PTX06-1154	20151112ISB064	Arsenic	90	120	25			12
PTX06-1154	20151112ISB064	Barium	17300	21000	10			2000
PTX06-1155	20150119ZSB004	Arsenic	36.8	36	5			12
PTX06-1155	20150119ZSB004	1,2-Dichloroethane	6.98	7.6	3			5
PTX06-1155	20150119ZSB004	*cis*-1,2-Dichloroethene	353	440	25			70
PTX06-1155	20150119ZSB004	1,4-Dioxane	24.5	22	5			7.7
PTX06-1155	20150119ZSB004	Trichloroethene	66.8	7.1	3			5
PTX06-1155	20150413ZSB047	Arsenic	36.8	42	5			12
PTX06-1155	20150413ZSB047	1,2-Dichloroethane	6.98	7.2	3			5
PTX06-1155	20150413ZSB047	*cis*-1,2-Dichloroethene	353	350	10			70
PTX06-1155	20150413ZSB047	1,4-Dioxane	24.5	20	5			7.7
PTX06-1155	20150413ZSB047	Trichloroethene	66.8	14	3	F1	J-	5

Well ID	Sample ID	Analyte	2015 Average Value (ug/L)	Measured Value (ug/L)	Detection Limit (ug/L)	Lab Qualifier	PTX Qualifier	GWPS (ug/L)
PTX06-1155	20150713ZSB094	Arsenic	36.8	32	5			12
PTX06-1155	20150713ZSB094	1,2-Dichloroethane	6.98	6.7	3			5
PTX06-1155	20150713ZSB094	*cis*-1,2-Dichloroethene	353	290	10			70
PTX06-1155	20150713ZSB094	1,4-Dioxane	24.5	26	5			7.7
PTX06-1155	20150713ZSB094	Trichloroethene	66.8	96	3			5
PTX06-1155	20151109ZSB150	Arsenic	36.8	37	5			12
PTX06-1155	20151109ZSB150	1,2-Dichloroethane	6.98	6.4	3			5
PTX06-1155	20151109ZSB150	*cis*-1,2-Dichloroethene	353	330	13		J	70
PTX06-1155	20151109ZSB150	1,4-Dioxane	24.5	30	5			7.7
PTX06-1155	20151109ZSB150	Trichloroethene	66.8	150	3	F1	J-	5
PTX06-1156	20150119ZSB005	Arsenic	48.8	37	5			12
PTX06-1156	20150414ZSB051	Arsenic	48.8	32	5			12
PTX06-1156	20150727ZSB108	Arsenic	48.8	55	25			12
PTX06-1156	20150727ZSB108	Barium	2530	2600	10	F1	J+	2000
PTX06-1156	20151109ZSB151	Arsenic	48.8	71	13			12
PTX06-1156	20151109ZSB151	Barium	2530	4100	5			2000
PTX07-1P02	20150512M00100	RDX	2.13	2.17	0.267			2
PTX07-1P02	20151102M00281	RDX	2.13	2.34	0.266			2

Note: A description of all qualifiers can be found in Appendix D ("Information" tab in the 2015 electronic data file).

4.0 Soil Remedial Action Effectiveness

Three soil remedial actions were implemented to prevent cross-contamination of soils to groundwater. Those actions include soil covers on landfills, a ditch liner in Zone 12, and the Burning Ground SVE. This evaluation focuses on the following two aspects of effectiveness:

1. Remedial action effectiveness of the SVE
2. Uncertainty Management

4.1 SVE Remedial Action Effectiveness

The small-scale Burning Ground SVE system operated intermittently during 2015. The small catalytic oxidizer (CatOx)/wet scrubber system installed in 2012 continues to focus on treating residual soil contamination and soil gas at a single soil gas well (SVE-S-20), where soil gas concentrations continue to remain high. The system was down for power outages, freezing weather, and maintenance or repairs. The system removed approximately 398 lbs of VOCs during 2015.

Influent and effluent PID readings are taken at the SVE system (prior to the oxidizer and at the scrubber stack) at least weekly to ensure compliance with the permit by rule. Pantex also collects quarterly influent samples that are sent to a laboratory for analysis. The analytical samples are used to estimate the mass removal for the SVE system. For 2015, three samples were collected for laboratory analysis.

Table 4-1 presents a summary of detected 2015 data and the average concentrations from 2007-2008. The 2015 data represent the current SVE system. Samples were collected in March, September, and December.

The 2015 measured values are typically lower than the 2007-2008 data collected at the system, and generally lower than 2014 values. Maximum and average values are lower than the baseline concentrations, with the majority of the COC maximum concentrations still within the same order of magnitude. This change in concentration will continue to be tracked to determine if a long-term trend emerges. Methylene chloride was detected in all three samples in 2015 (it was detected twice in 2014) although it was not detected in baseline data. This COC has been detected prior to 2007 at low concentrations at the large-scale system or in individual soil gas wells. Other COCs may be detected at low levels in the future because detection limits are expected to become smaller as the major COC concentrations decrease and dilutions by the laboratory lessen.

Table 4-1. Burning Ground SVE Data Summary

Analyte	2015 Measured Value			2007-2008 Measured Value		
	Avg	Max	Min	Avg	Max	Min
Acetone	20,333	27,000	15,000	82,666	140,000	38,000
Toluene	226,667	260,000	170,000	477,307	990,000	45,000
Methylene chloride	1,767	2,200	1,600	ND	ND	ND
PCA	3,200	5,200	1,700	3,356	6,300	760
TCE	10,233	12,000	8,700	26,714	41,000	13,000
Tetrahydrofuran (THF)	6,133	9,100	2,900	20,107	26,000	9,500

Measured concentrations in parts per billion by volume (ppbv).
Indicates values greater than the baseline 2007-2008 concentration.

To verify whether concentrations of VOCs are decreasing, a Mann-Kendall test was performed on all available SVE analytical data collected since the small-scale CatOx system was installed in early 2012. Trends were calculated based on all data and recent data (last 4 measurements). Since the analytical results can be affected by multiple factors including extraction equipment, sample port location, or other system conditions, no effort was made to trend the new results with analytical data associated with the old system. Generally, the concentrations appear to be lower than those collected in the GAC system, but it is unknown whether these lower concentrations reflect a true source reduction or are caused by one of the factors listed above.

Table 4-2 provides a summary of the statistical trending. The results indicate that, of the four main COCs (acetone, toluene, TCE, and tetrahydrofuran [THF]), TCE and acetone exhibited decreasing trends considering all data, while the others exhibited no trend. Considering only the last four measurements, trends for the four main COCs are either decreasing or stable. Other low-level detections of COCs indicate decreasing, stable, or no trend for all data and the last four measurements.

Table 4-2. Mann-Kendall Results for Soil Gas COCs

COC	Trend-All Data	Recent Trend
Toluene	Decreasing	Stable
TCE	No Trend	Decreasing
Tetrahydrofuran (THF)	No Trend	Stable
Acetone	Decreasing	Decreasing
1,1,2,2-Tetrachloroethane	No Trend	Stable

The average monthly PID measurements collected at the system influent, summarized in Figure 4-1, are showing some variability but linear regression results for the dataset, represented by the trend line on the graph, indicate an increasing trend. This increase is likely due to a shutdown period in mid-2015 with concentrations spiking at start up and decreasing over time. Continued decreases in PID readings are expected as operations continue.

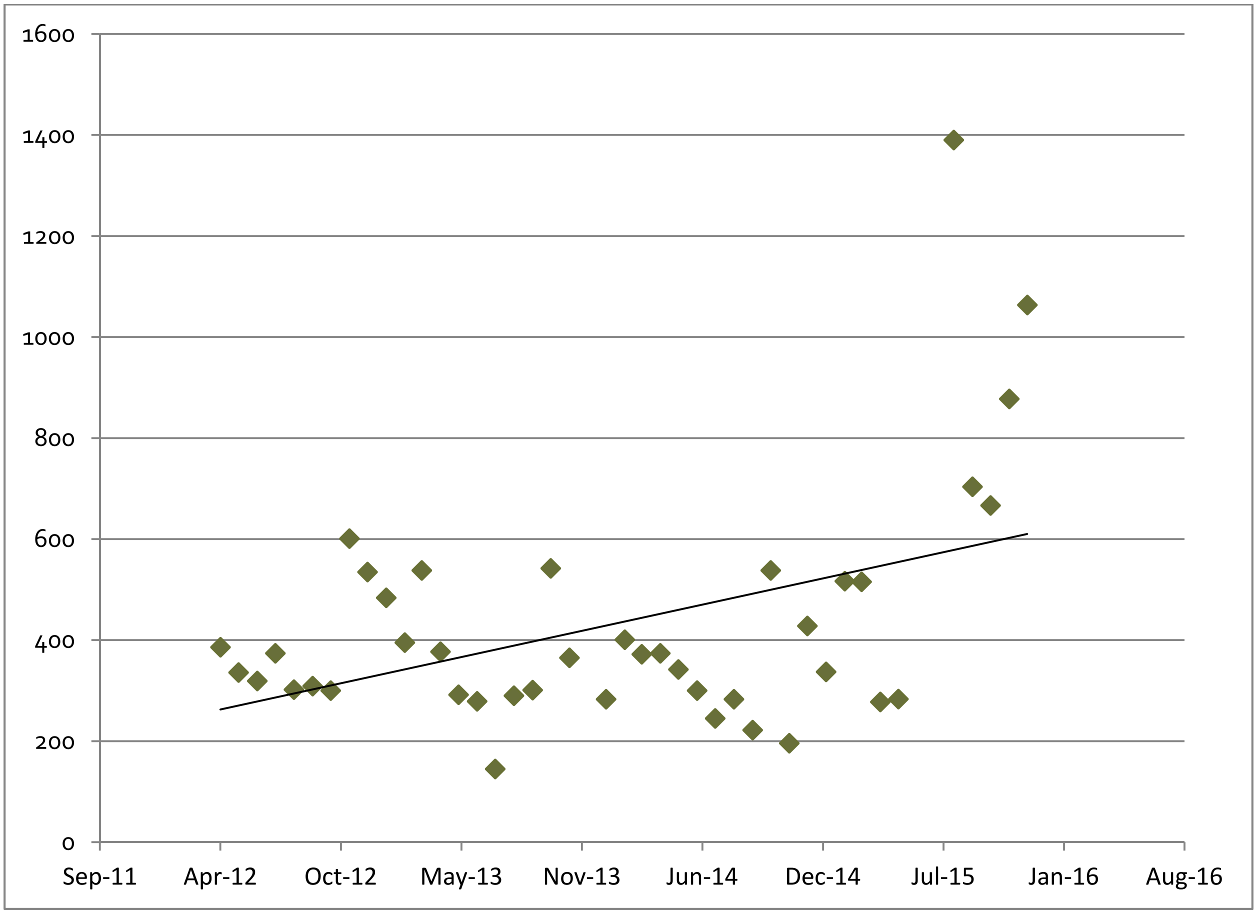

Figure 4-1. Influent Average PID VOC Concentrations vs. Time

In the *Five-Year Review Report* (Pantex, 2013d), Pantex recognized the conflicting data and uncertainty concerning the reduction of soil gas VOCs and mass of NAPL remaining in the soil near SVE-S-20. However, no expected conditions or path toward closure were defined for the SVE system, other than "significant reduction in soil gas VOCs." Therefore, Pantex recommended the development of a Burning Ground SVE Performance Monitoring Plan, which will define expected conditions of the system performance as well as a clear path towards an end point of active SVE operations and potential transition to a passive system. In anticipation of this plan, three rebound tests were attempted in 2014 with the expectation of establishing baseline conditions to which future rebound tests could be compared.

Because of inconsistent data collected during rebound testing in 2014, the SVE Performance Monitoring Plan was not completed by the proposed date of December 2014. One additional rebound test was performed in 2015. As discussed in the 2015 Progress Report, lessons learned from the 2014 rebound tests were applied to the planning of the 2015 rebound test. Several tasks were completed in early 2015 in order to prepare for rebound testing, including:

- The purchase of a PID instrument with a higher range, as well as the capability of using a 3-point calibration (0, 100 ppm, and 1000 ppm, consistent with observed VOC concentrations in the analytical data).
- Additional moisture removal (knockout tank from the previous system) was installed upstream of the system influent sampling location to reduce the potential for moisture carryover in the sample line.
- Frequent instrument challenging/calibration were also included in the testing strategy.

The water main feeding the scrubber was shut down on June 1 due to a leak and remained down through June and early July, presenting a sufficient rebound period for testing. However, the system was intentionally left offline in preparation for the testing. The system was restarted on July 26 and observed PID measurements began to increase as observed in the July and October 2014 events. However, it appears the PID starts to drift and significant shifts in the PID data occur after calibration.

The system shut down on the afternoon of July 28 due to a low air flow alarm caused by the blower overload switch tripping off in the control panel. It appears the switch was affected by the high ambient temperatures, combined with a broken cooling fan inside the control panel.

Based on the system operational data and data collected during four attempts at rebound testing over two years it does not appear the SVE Performance-based approach will be technically practicable in attaining closure at the SEP/CBP.

4.2 Uncertainty Management

One of purposes of the uncertainty management wells is to confirm expected conditions from the soil units. The expected conditions are:

1. Declining source contributions from soil units that have historically contributed to groundwater.
2. No new source contributions to the current impacted groundwater.
3. Areas that have no historical contamination in the uppermost groundwater will not exhibit signs of sourcing to groundwater.

Pantex analyzes for indicator constituents at all wells according to the SAP. This list of constituents helps determine possible impact at areas that were previously unaffected or to ensure that source area strength is declining in impacted areas. This evaluation is presented in Section 3.4.

No Group 1 perched aquifer wells had unexpected conditions in 2015. As discussed in Section 3.4.2, twelve Group 2 perched aquifer wells exhibited increasing long-term trends in COC concentration while the expected condition was decreasing or stable trends below the GWPS. However, only two of these wells, 1114-MW4 and PTX06-1007, exhibit trends that might indicate a new release related to a soil source. Apparent increasing trends for perchlorate were identified for both wells. Historical perchlorate concentrations at 1114-MW4 were much higher than recent levels, and the long-term trend for this well is decreasing. Therefore, the observed perchlorate in this well does not indicate a new release to perched groundwater. Perchlorate concentrations at PTX06-1007 increased from 2010 through 2015, but decreased substantially in the 2015 sample. However, this well is not located near the historical source area in Zone 11, so the observed trend is associated with plume movement and does not indicate a new release. These wells will continue to be monitored and evaluated over time to determine if the concentrations decline as expected.

An apparent increasing trend for 1,4-dioxane was also identified for 1114-MW4; however, all samples in 2015 were below PQL and the trend is due to the use of one-half the sample detection limit as a surrogate for trend identification. Therefore, this trend does not indicate a new release of 1,4-dioxane to perched groundwater.

Five Ogallala aquifer uncertainty management wells had unexpected conditions in 2015. Most of these unexpected conditions were estimated hexavalent chromium detections. As discussed in Section 3.4.1.2, these detections are likely the result of lower detection limits, low-level background, stainless steel screen corrosion, or a combination of these factors. Detections of 4-amino-2,6-DNT and 1,2-dichloroethane occurred in samples collected from PTX06-1056 in 2015. In response to these detections, Pantex has fully implemented the conditions specified in the *Pantex Plant Ogallala Aquifer and Perched Groundwater Contingency Plan* (Pantex, 2009d) and will continue quarterly sampling for HEs and VOCs at this well. As discussed in Section 3.4.1.2, Pantex will obtain a cement bond log of PTX06-1056 to evaluate the integrity of the casing where it penetrates the fine-grained zone and has also engaged a third-party hydrogeological consulting firm to conduct an independent assessment of the detections. These detections are not likely related to a release from a soil source area.

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5.0 Conclusions and Recommendations

5.1 Conclusions from the 2015 Annual Report

Overall, the groundwater remedial actions have been effective in 2015. In particular, the groundwater pump and treat systems are affecting groundwater levels and COC concentrations in nearby wells. The influence of both pump and treat systems will continue to expand as the saturated thickness is reduced in the perched aquifer.

One Ogallala aquifer well had continued COC detections slightly above and below the laboratory PQL, indicating possible migration of perched groundwater to the Ogallala Aquifer. Detections of 4-amino-2,6-DNT and 1,2-dichloroethane below the GWPS occurred in samples collected from PTX06-1056 in 2015. In response to these detections, Pantex has fully implemented the conditions specified in the *Pantex Plant Ogallala Aquifer and Perched Groundwater Contingency Plan* (Pantex, 2009d). Pantex has addressed one potential source by plugging a nearby perched aquifer well that was drilled deeply into the fine-grained zone. Pantex will continue quarterly sampling for HEs and VOCs at PTX06-1056 to determine if a trend emerges. As discussed in Section 3.4.1.2, Pantex will obtain a cement bond log of PTX06-1056 to evaluate the integrity of the casing where it penetrates the fine-grained zone and has also engaged a third-party hydrogeological consulting firm to conduct an independent assessment of the detections.

Several Ogallala Aquifer wells had low-level detections of hexavalent chromium, but these detections are attributed to a combination of lower detection limits and either screen corrosion or background levels rather than breakthrough of perched groundwater.

The pump and treat systems throughput performance consistently achieved close to 90% throughout the year when unaffected by maintenance, power loss, reduced flow to the WWTF, and system upgrades. P1PTS continues to be affected when more than one high-producing well is down for more than a few days. Pantex will have a new extraction well operating in 2016 to address this. The two highest prioritized goals (90% operation and no injection at SEPTS) were not consistently met. P1PTS operation was primarily affected by power losses and SEPTS operation was primarily affected by system upgrades into May and scheduled maintenance in November. SEPTS beneficially used 97% of the treated water. Minimal injection was required at the SEPTS during two months when the WWTF reduced flow and the ISB required water for amendment injection.

Downgradient Zone 11 ISPM wells are exhibiting effects from the treatment zone. TOC and total VFAs have been detected, nitrate and sulfate concentrations have declined, and ORP is negative in all three original downgradient wells suggesting the arrival of affected water. Treatment is also evident in those three wells, with perchlorate not detected and TCE is greatly reduced. Cis-1,2-dichloroethene continues to be detected at concentrations above the GWPS with little or no detections of vinyl chloride, indicating that TCE is not completely treated. Three additional wells located further away from the treatment zone were converted to ISB performance monitoring wells in 2014 and one of the three is exhibiting treatment zone effects, with perchlorate not detected. Perchlorate is declining in the other two wells.

To address the absence of complete treatment of TCE, bioaugmentation for the current treatment zone was completed during the 2015 injection event. However, bioaugmentation for the expanded treatment zone cannot occur until required reducing conditions are established for DHC. Pantex will begin evaluating the effectiveness of the bioaugmentation in 2016 and will report that data in the appropriate quarterly and annual reports.

The Southeast ISB system has been effective in treating HEs and hexavalent chromium at three downgradient ISPM wells (PTX06-1037, 1123, and 1154). RDX concentrations in all three of these wells are below the GWPS of 2 ug/L. Hexavalent chromium is either non-detect or detected at levels below the GWPS in these wells. Data collected from the westernmost ISPM well PTX06-1153 continue to indicate HE and Cr concentrations exceeding GWPS. Pantex continues efforts to determine flow patterns on the west end of the ISB. In 2015 an old dry well (PTX06-1051) was replaced to confirm the dry conditions in that area. The new well confirmed the dry conditions west of the ISB. Pantex will install passive flux meters in a select group of wells in 2016 to determine the amount of water and contaminant flux into the system and in downgradient ISPM wells. Pantex will continue to evaluate data collected and develop a path forward for this area as needed.

Soil remedies have been effective at Pantex as workers and the public are protected from exposure to contaminated soils and data do not indicate that new contamination is migrating to the underlying groundwater from soil source areas. The landfill covers are operating as designed and the 2015 rainfall significantly improved the vegetative cover on the landfills. Further work is required in a few areas to fully revegetate the covers and will be conducted through a long-term maintenance contract. Pantex will also address, through contracting, erosion at Landfill 3 caused by heavy rainfall. The ditch liner is maintained and prevents the infiltration of water that would cause migration of HEs in soils to the perched aquifer. Due to the age of the liner and noted degradation in a few areas, Pantex will replace the liner in early 2017. The SVE system is actively removing soil gas and residual NAPL in soils at the Burning Ground thereby mitigating vertical movement of VOCs to the Ogallala Aquifer.

The institutional controls are in place for soils and groundwater providing short-term protection of human health and the environment while active remedies continue to operate. Pantex will continue to evaluate areas that are not under the influence of the active remedies to determine if the remedies will actively affect the areas to provide permanent long-term protection.

In order to address the identified issue of HE plumes expanding east of FM 2373 and in the southeast lobe of the perched aquifer, Pantex completed a hydrologic evaluation of these areas in 2012. This evaluation is to be updated annually as part of the annual progress reporting process. The 2015 update included the addition of groundwater data collected during 2015, as well as the results from the aquifer testing conducted by Pantex in the summer of 2015. Key findings from the new dataset include:

- Groundwater elevations are suggesting continuing effects of pump and treat operations, resulting in reduced mass flux to the southeast.
- Data suggest continued plume movement from the eastern edge of the perched aquifer extent moving southward. However, preliminary aquifer testing data suggest this area is conducive to groundwater extraction, which would reduce the flux of COCs to the south. Additional aquifer testing at two new wells was conducted in 2015. While flow rates were low, the test indicates that pump and treat is viable.

Based on the information from the aquifer testing and the understanding that water extraction would limit the perched contaminant migration to the southeast lobe and potential downward migration to the Ogallala, Pantex plans to extend the SEPTS operation to that area. Pantex will install four additional extraction wells and the infrastructure to extract from the new wells installed near PTX06-1147. This will be completed in an area where there is approximately 10-15 ft of saturated thickness and water is expected to move in from the northeast area of the perched aquifer. This project will begin in 2016 and is expected to be complete in 2017.

Pantex will also contract for research in 2016 to evaluate natural attenuation of RDX across the perched aquifer. This research will help determine the type of attenuation that is occurring as well as the rate of attenuation in varying areas of the perched aquifer. This purpose of this research is to possibly address the attenuation of RDX in areas where active remedies will not be effective.

5.2 Conclusions from the Five-Year Review

The first Five-Year Review Report was submitted in December 2012 and final approval was received in August 2013. While the recommended changes outlined in the 2012 Annual Report did not change, this section will remain in the Annual Progress Reports in order to track the recommendations and subsequent actions taken to address them.

The conclusions of the Five-Year Review indicate that the overall soil and groundwater remedies are performing as designed and expected. The institutional controls and soil remedies are actively preventing contact with contaminated soil and groundwater while active remedies decrease concentrations of contaminants in soil and groundwater to provide long-term protection of human health and the environment. The groundwater pump and treat systems continue to decrease perched aquifer saturated thickness to reduce the driving force (head) that may cause migration of impacted water to the Ogallala Aquifer.

Some issues were noted that require Pantex to gather additional information to assess the active remedies and the areas that are outside the influence of the remedies and to develop and implement plans to correct noted issues. Deficiencies were also noted in the active remedies so Pantex recommended further actions to optimize remedies or monitoring to ensure continued protection of human health and the environment. The majority of the identified issues and recommendations for optimization have been resolved or the work is ongoing. The status of the remaining issues and recommendation follows:

- Recommendation: If more than one extraction well is not operational for an extended period of time at P1PTS, the system cannot meet throughput goals. Pantex recommended installing 1-2 new extraction wells to increase throughput when more than one well is down.
    - To close out this recommendation, Pantex installed PTX06-EW-081A and started design and construction of the connection of the well to the P1PTS in 2015. The well will be operational in 2016.
- Recommendation: There are no criteria established for ceasing SVE system operations. Pantex recommended completion of an SVE Performance Monitoring Plan.
    - Pantex has conducted multiple rebound tests of the system for use in establishing a path to closure. The rebound tests have been unsuccessful, including one conducted in July 2015. Based on the continued issues encountered with the rebound tests, Pantex will pursue another path forward for developing a path to closure.
    - Pantex contracted for outside review of the system in 2016 to assist with determining a path to closure for the system. A plan will be developed after the review and recommendations are complete.
- Issue: Reduced vegetative cover on specific landfills that were affected by drought. The lack of cover could cause erosion of the covers. Pantex has addressed this by reseeding the landfills that were affected. However, continued drought conditions after the seeding limited growth. Rainfall increased in 2015 and the areas have greatly

improved. A few areas will require a second seeding to address the bare areas. To close out this action Pantex will complete the following:

  - Contract for long-term maintenance of the landfills. Issues will be identified during the yearly inspections and work will be planned for maintenance each year, as funding allows. Contracting will be complete by July 2016 and maintenance will occur before the end of FY 2016.

- Issue: Plumes of high explosives (primarily RDX) are expanding east of FM 2373 and in the southeast lobe of the perched aquifer.
  - Pantex evaluated three wells east of FM 2373 to determine if extending pump and treat to that area is viable. The pump tests indicate that this will be viable and will mitigate the continued southward migration of contaminated water into the southeast lobe. Pantex will begin contracting for design and construction of wells and infrastructure in 2016 to extend the SEPTS operation to the area near PTX06-1147, east of FM 2373.
  - Pantex began contracting in 2016 for research of RDX natural attenuation across the perched aquifer. The research will determine where, what type, and the rate of degradation of RDX (if data support the calculation of a rate). This will be used to address areas where active remedies will not be effective.
- Issue: Incomplete treatment of contaminants (HEs and hexavalent chromium) downgradient of the west end of the Southeast ISB (at PTX06-1153).
  - Pantex has installed two new wells to determine flow patterns in the vicinity of PTX06-1153. A well was installed upgradient of the west end of the system. The well was dry when drilled and continues to remain dry. A dry well to the west of the ISB was replaced to confirm the dry conditions in that area. The new well confirmed the dry conditions to the west of the ISB. Dry conditions are expanding in the Southeast ISB due to upgradient removal of water by the SEPTS, so flow patterns may be difficult to discern.
  - Pantex injected amendment into two dry injection wells to attempt to influence PTX06-1153. The wells have received two injections, in 2013 and 2015. The injections do not appear to have influenced PTX06-1153.
  - Pantex will install passive flux meters in select injection and downgradient ISPM wells in 2016 to assist with determining water and contaminant flux into the Southeast ISB. PTX06-1153 will be assessed to determine if water continues to flux into that area or if the water may no longer be hydraulically connected to the system. A path forward will be determined based on the results of the study.

5.3 Recommendations

Pantex plans to continue the current approved remedial actions. The groundwater remedies are considered protective for the short-term as untreated perched groundwater use is controlled to prevent human contact and Ogallala Aquifer data continues to indicate COC concentrations either non-detect or below GWPS. The systems are proving to be effective in reaching long-term established objectives for cleanup. Soil remedies have been effective at Pantex as workers and the public are protected from exposure to contaminated soils and data do not indicate that new contamination is migrating to the underlying groundwater from soil source areas. The SVE system is actively removing soil gas and residual NAPL in soils at the Burning Ground thereby mitigating vertical movement of VOCs to the Ogallala Aquifer.

Based on issues identified in the Five-Year Review and during completion of this report, several changes are recommended or have been implemented to enhance the effectiveness of the remedies in some areas and to better monitor the effectiveness of the actions. Those recommendations are provided in the following sections.

5.3.1 Recommended Changes to the Pump and Treat Systems

Pantex recommends extending SEPTS extraction east of FM 2373 to limit further migration of impacted perched water southward along the eastern margin of the perched aquifer. This action is in agreement with the selected remedy for the southeast perched groundwater. The ROD selected the SEPTS as the final remedy to stabilize migration and treat perched groundwater contaminants.

5.3.2 Recommended Changes to the ISB Systems

5.3.2.1 Southeast ISB

Since no clear reason for the unexpected conditions in PTX06-1153 has been identified, it is recommended to continue monitoring the water level and analytical data collected in and around the Southeast ISB to continue to attempt to discern groundwater flow patterns. Pantex will install passive flux meters in select wells in 2016 and will provide results and recommendations in the 2016 Annual Report.

5.3.2.2 Zone 11 ISB

As discussed in Section 2.2.2.3, Pantex will pause injection at two wells on the perchlorate (eastern) side of the ISB. The pause will evaluate whether the life of the wells can be extended while continuing to treat perchlorate, because only mild reducing conditions are required for treatment of perchlorate. The Design Basis Document and the RD/RA Work Plan recognize that the period between injections may be lengthened once the system is fully developed. Pantex will collect field data including DO, ORP, and pH to evaluate changes in those wells until they are injected in the 2017 injection event. The wells will be rehabilitated at each injection event (2016 and 2017) to help increase the potential for future injections. These wells will be used as a test case for rehabilitation of wells experiencing problems with extensive biofouling and decreased injection rates.

5.3.3 Recommended Changes to the Monitoring Network

Pantex will replace PTX06-1071 during 2016 due to a failed screen. Pantex will also install a well south of the southeast lobe, between PTX06-1133A and PTX06-1158, to verify dry conditions in that area. A well will also be drilled downgradient of the hexavalent chromium plume that originates from the southwest corner of Zone 12. This new well will address a gap downgradient of well PTX06-1052.

5.3.4 Recommended Changes to Soil Remedies

Vegetative loss on landfill covers was identified as an issue in the first Five-Year Review Report, primarily due to the drought conditions in the Texas panhandle. Therefore, Pantex proposed to develop and implement a phased plan to revegetate the landfill covers as outlined in Section 2.3.2. Pantex completed reseeding in 2013 and is now evaluating its effectiveness. Based on the 2015 evaluations, most areas have recovered due to heavy rainfall that occurred in 2015. A few small bare areas remain and will be planned for reseeding under the new long-term landfill maintenance contract.

Pantex has contracted for a design to improve the side slopes of Landfill 3. Heavy rainfall in 2015 increased runoff to the nearby ditches and caused erosion. A more aggressive plan to stabilize the slopes is being developed. Construction of the landfill design is expected to begin in 2016 and complete in 2017.

The small-scale SVE system continues to remove VOCs from SVE-S-20 and the VOC source area may be slowly decreasing. As discussed in the Five-Year Review and 2012 Annual Progress Report, no expected conditions or path toward closure were defined for the SVE system, other than “significant reduction in soil gas VOCs”. Therefore, Pantex recommended the development of a Burning Ground SVE Performance Monitoring Plan, which will define expected conditions of the system performance as well as a clear path towards an end point of active SVE operations and potential transition to a passive system. To this end, three rebound tests were conducted in 2014, resulting in conflicting or unusable data. Using lessons learned from the 2014 testing, another rebound test was conducted in 2015, but was also unsuccessful. Pantex has contracted outside review of the SVE and will provide a plan for a path to closure after review and recommendations are complete.

Pantex will replace the ditch liner at SWMUs 5-05 and 2 in Zone 12 due to observed degradation of the liner. Considering the age and life cycle of the liner, it was determined that it would be best to replace the liner rather than complete repairs. The liner will be replaced in early 2017.

Pantex has received additional funding to upgrade a select amount of landfill covers with Closure Turf® that was previously installed at Landfill 1. Pantex will evaluate the landfills to identify the most appropriate landfills to be lined and will complete that project in 2017. The liner is expected to reduce long-term maintenance costs and provides superior erosion and infiltration control for the landfills.

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