Pantex Plant

2024 Annual Progress Report

Remedial Action Progress

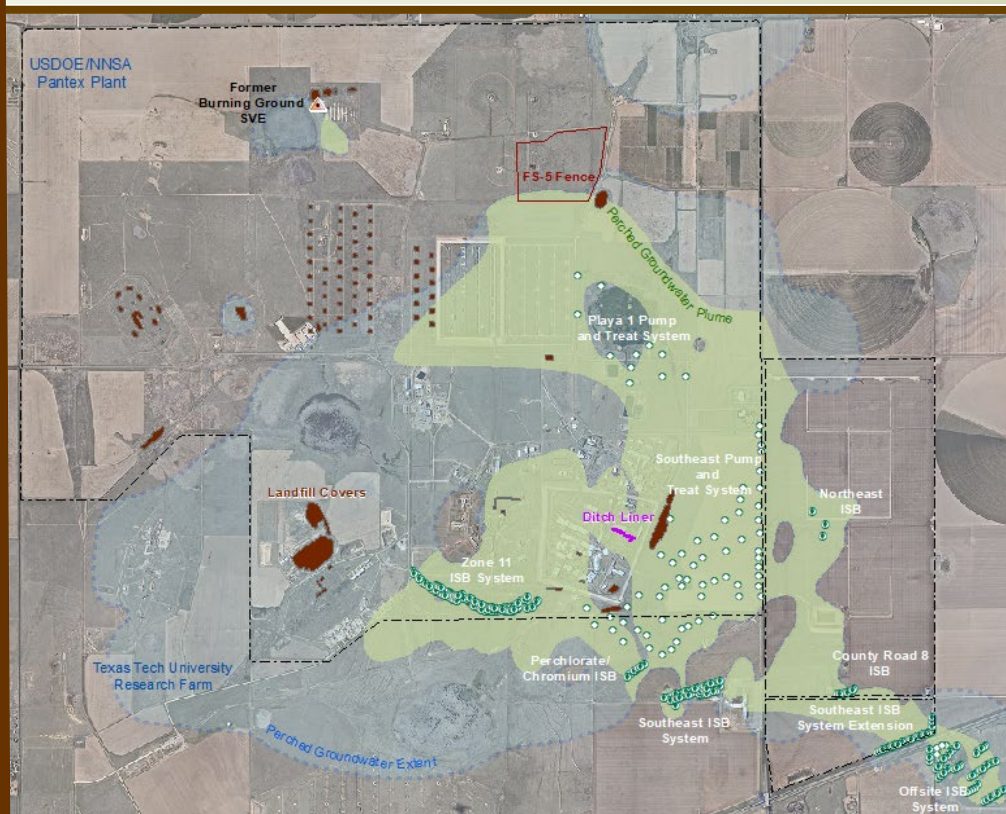
In Support of Hazardous Waste Permit 50284 and Pantex Plant Interagency Agreement

June 2025

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

Managed and Operated by
PANTEXAS DETERRENCE

Pantex Plant Remedial Action Systems



CERTIFICATION STATEMENT

2024 Annual Progress Report
Remedial Action Progress
Pantex Plant, June 2025

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.

Martin R. Amos 6/26/2025

Martin R. Amos — Date
Senior Manager, Environmental Projects
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PanTeXas Deterrence, LLC

2024 Annual Progress Report
Remedial Action Progress
in Support of Hazardous Waste Permit #50284
and Pantex Plant Interagency Agreement
for the Pantex Plant, Amarillo, Texas
June 2025

Prepared by:
PanTeXas Deterrence, LLC
Management and Operating Contractor for the
Pantex Plant
under Contract No. 89233224CNA000004
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.

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E.0 Executive Summary

> ***Annual Progress Report Outline***
>
> - ❖ Background Information
> - ❖ O&M of Remedial Actions
> - ❖ Groundwater Remedial Action Effectiveness
> - ❖ Soil Remedial Action Effectiveness
> - ❖ Conclusions and Recommendations

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 four areas. A soil vapor extraction (SVE) system was used to remediate volatile organic compounds (VOCs) in soils at the Burning Ground area. The SVE system is closed, but groundwater monitoring will continue in the area to evaluate the long-term effectiveness of the SVE. Other soil remedies (i.e., fencing, soil covers, and ditch liners) 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 No. 50284 (HW-50284) to provide information on performance of the remedial action systems and components. The focus of this report is the data and information collected for the soil and groundwater remedies during 2024. Data are evaluated according to criteria outlined in the *Update to the Long-Term Monitoring System Design Report* (Pantex, 2019a); HW-50284; the Interagency Agreement effective February 22, 2008; *Land and Groundwater Use Control Implementation Plan* (Pantex and Sapere, 2010); and various operation and maintenance (O&M) plans for the remediation systems.

E.1 Remedial Actions

Pantex has implemented soil and groundwater remedial actions, which are highlighted here:

Groundwater Remedial Actions

Two pump and treat systems:

- Reduce saturated thickness
- Reduce contaminant mass
- Stabilize Plumes

Six ISB systems:

- Reduce contaminant concentrations as groundwater migrates through the treatment zone

Institutional controls:

- Control perched groundwater use and drilling in contaminated areas

Soil Remedial Actions

Ditch liner and soil covers on landfills:

- Protect future groundwater

Institutional controls:

- Protect workers
- Restrict areas to industrial use

Former SVE system:

- Closure has been approved at this system, but monitoring continues to evaluate effectiveness of this action.

Fencing:

- Prevent traffic and control access

E.2 Operation and Maintenance of Remedial Actions

E.2.1 Pump and Treat Systems

Operational goals have been developed to promote mass removal and the continued removal of perched groundwater to reduce the perched aquifer saturated thickness. The first goal of 90% system operation was not achievable at all times during 2024 due to maintenance shutdowns of the systems and restricted storage capacity of the wastewater treatment facility (WWTF) lagoon. Continued repairs of lagoons at the WWTF and the inability to utilize the subsurface irrigation system impacted operation of the Playa 1 Pump and Treat System (P1PTS). Additionally, the Playa 2 Injection wellfield was shut down towards the end of 2024 due to radio communication failures, further limiting water outlet availability. Pantex operated the pump and treat systems in accordance with the new 2023 goals so that P1PTS operations were reduced or discontinued when water outlets were limited so that the South East Pump and Treat System (SEPTS) could effectively control the contaminant plumes in the southeast.

The average operational rate across 2024 was 45% at the P1PTS and 95% at the SEPTS. Performance of the pump and treat systems for 2024 is depicted in Fig. E-1.

The 90% goal was applicable for the SEPTS during most of 2024, after treatment goals were revised. In accordance with the new goals, P1PTS could not be operated at times due to limited outlets for treated water. SEPTS is fully operated at all times unless there are severely limited treated water outlets. SEPTS provides the primary capture and control of the plumes that are moving to the southeast; therefore, the goals have been redefined to ensure that this system consistently operates. Although water was still limited to the WWTF through 2024, SEPTS was able to operate fully through most of the year due to the shutdown of P1PTS, and P1PTS was able to operate for portions of 2024 by sending treated water to the new pivot system through the warmer months of the year.

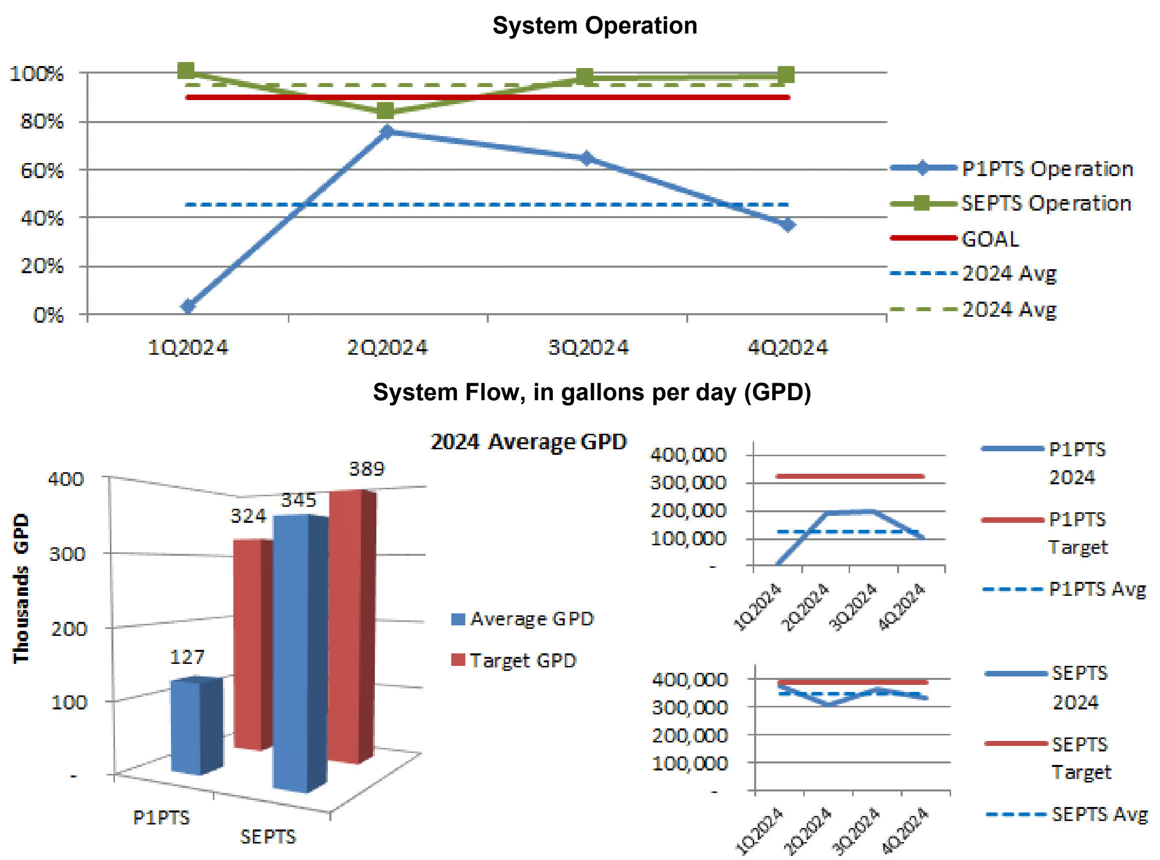

Fig. E-1. Pump and Treat System performance.

P1PTS operation was affected in the early months of 2024 when the pivot irrigation system was shut down due to a break in piping near the wet well that occurred in December 2023. Because WWTF treated water is now routed to Playa 1 due to limited storage capacity resulting from ongoing lagoon repairs, and release to Playa 1 is limited by permit, the P1PTS was shut down through mid-March 2024. P1PTS was able to operate once the break was repaired and temperatures were warm enough to operate the pivot system.

To better manage treated water, Pantex constructed a new pivot irrigation system east of FM 2373 and began operating this system in late August 2023. Additionally, a project was initiated in 2018 to install new injection capabilities near Playa 2, away from the large plumes of contamination in the perched groundwater. That project was completed in February 2022; however, the system was impacted by radio issues that required upgrade and repair. The radio issues were addressed in April 2023, allowing flow to increase at the SEPTS, but the wellfield again experienced radio issues in late 2024. Radio repairs are anticipated to occur by September 2025. Despite these radio issues, the injection wellfield was able to receive about one-third of the treated water from SEPTS in 2024 proving to be an effective water outlet that allows improved throughput at the SEPTS when other outlet options are limited.

In 2024, the systems treated about 173.9 million gallons of impacted perched groundwater. Overall, the systems have operated to treat contamination and reduce saturated thickness. As depicted in Fig. E-2, Pantex has treated about 3.5 billion gallons since the startup of the systems, with about 1.9 billion gallons removed and beneficially used. Pantex goals were realigned to ensure continuous operation of SEPTS to capture and control plume migration and reduce saturated thickness. The goals also prioritize beneficial use of water rather than reinjection into the perched groundwater or sending the water to Playa 1. During 2024, 32.6% of the treated water was beneficially used, 33.9% was injected back into the perched aquifer, and the rest was sent to Playa 1. Beneficial use of the treated water was optimized during the warm months when the pivot irrigation system could be operated.

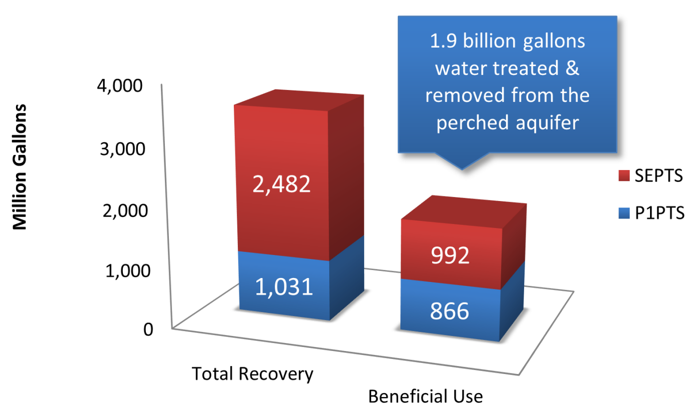

Fig. E-2 System Recovery and Use

In addition to removing impacted water from the perched aquifer, the pump and treat systems remove contaminant mass from groundwater. The P1PTS primarily removes the high explosive (HE) hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), and the SEPTS primarily removes RDX, perchlorate, and hexavalent chromium, shown as CR(VI) in Fig. E-3 and Fig. E-4. The figures below provide the mass removal for HEs and hexavalent chromium for 2024 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 2024, the SEPTS removed approximately 455 pounds (lbs) of contaminants, and the P1PTS removed approximately 11.1 lbs of contaminants. The systems are also removing per- and poly-fluoroalkyl substances (PFAS). But due to the low concentrations of these contaminants of concern (COCs), only about 1 lb is estimated to be removed per system annually and is not tracked for this reason.

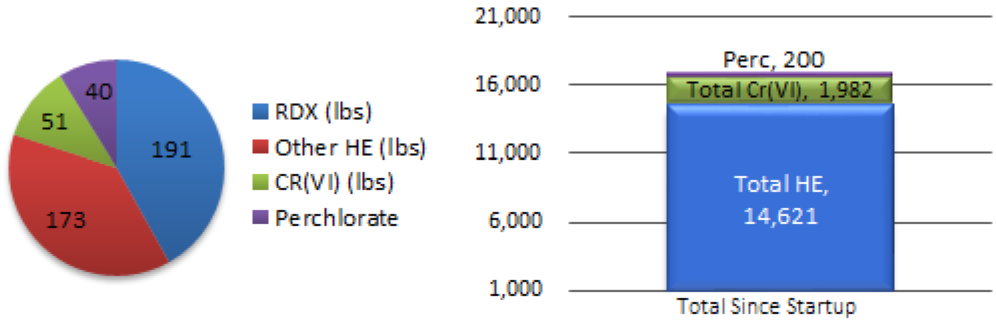

Fig. E-3. SEPTS mass removal.

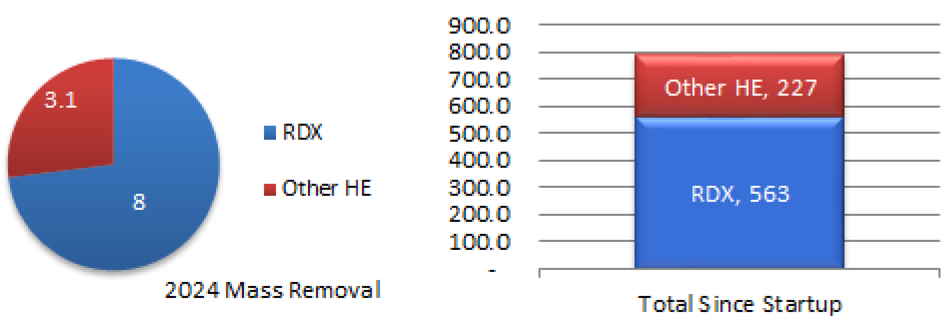

Fig. E-4. P1PTS mass removal.

E.2.2 In Situ Bioremediation Systems

Pantex has six ISB systems installed: Zone 11 ISB, Southeast ISB, Southeast ISB Extension, Offsite ISB, the Perchlorate/Chromium (PCR) ISB, and the County Road 8 (CR8) ISB. All but the Southeast ISB and the CR8 ISB were maintained and injected during 2024. The CR8 ISB is pending installation of infrastructure as funding becomes available and is expected to be injected and maintained in 2026.

Injection occurred in 55 Zone 11 ISB system wells in 2024, including the two newly installed wells on the east side of the system. Pantex continued the use of molasses injection in all wells during the 2024 injection event. The longer-lasting Newman Zone® will not require another injection until 2026.

Results from the treatment zone indicate that conditions between the wells have improved with the use of molasses. The use of molasses has decreased concentrations of trichloroethene (TCE) and perchlorate at the downgradient wells. All but three downgradient wells (PTX06-1148, PTX06-1149, and PTX06-1150) are below the groundwater protection standard (GWPS). Those wells are downgradient of the new 2nd row of wells, so the downgradient concentrations are expected to decrease with time.

Pantex experienced issues with injection at a portion of the Zone 11 ISB wells; therefore, conditions between those wells was not improving, and response at the downgradient wells was hampered. In 2021, Pantex infilled wells in areas where injection was no longer possible. Injection has occurred in those wells and those areas will continue to be evaluated for improvement. Pantex has also temporarily paused injection in some first row wells to allow recovery of the wells and formation so that the wells can be injected again. This strategy was effective for the PTX06-ISB079 through PTX06-ISB082, as the wells were successfully injected in 2023 and again in 2024.

Due to limited water conditions at the Southeast ISB, the system was not injected in 2024. Wells in the treatment zone indicate that HEs and chromium are treated. All but one downgradient monitoring well indicates treatment to the GWPS. PTX06-1153 has not fully responded to changes in injections, indicating only partial treatment of the HEs. Pantex has requested removal of this well from HW-50284, so it may be injected during the next event.

Pantex injected 27 wells with molasses amendment at the Southeast ISB Extension during 2024. Wells in the treatment zone indicate that HEs are treated, but downgradient performance monitoring wells have not yet had time to fully demonstrate treatment. Newly installed extraction wells at the offsite area demonstrate that treated water has arrived in the faster flow paths. The two downgradient performance monitoring wells at this system demonstrated detections below GWPS in 2024. This system is planned for injection again in 2025.

Pantex injected the Offsite ISB twice during 2024. Forty-seven wells were injected in the spring and 41 wells were injected in the fall. This system is planned for two injections annually through 2036, based on an optimized plan for the offsite remediation. Evaluation of treatment zone well data indicates that a treatment zone is being established in areas where multiple injection have occurred and treatment in the heart of the RDX plume has been observed. All HE concentrations are below the GWPS at the downgradient performance monitoring well, indicating the system is preventing further plume growth. The treatment is expected to expand as injections continue at the Offsite ISB.

E.2.3 Soil Remedial Actions

The Former SVE system was installed and had been operating at the Burning Ground since February 2002. After a large-scale system remediated a significant area at the Burning Ground, a small-scale activated carbon system was installed in late 2006 when the large-scale system became inefficient at continued removal of non-aqueous phase liquids (NAPL). The most recent system, consisting of a small-scale catalytic oxidizer and wet scrubber, was installed in early 2012 to replace the activated carbon system. Pantex modified the system in 2017 to increase air flow through the soils to improve remediation and evaluate the system for closure. This system focused on treating residual soil gas and NAPL at a single well (SVE-S-20) where soil gas concentrations continued to remain high. Pantex began actively pulsing the system in 2020 to gain information relating to closure. Data collected in 2021 and 2022 indicated the NAPL source was nearly depleted and shutdown was recommended in 2023.

By this time, the SVE system had effectively removed 21,378 lbs of VOCs. Pantex requested closure of the system in the Draft Final Burning Ground Soil Vapor Extraction System Closure Report (Pantex, 2023a). The Texas Commission on Environmental Quality (TCEQ) and Environmental Protection Agency (EPA) approved the closure report for the SVE system in December and October 2024, respectively. Pantex has requested the removal of the SVE system in the renewal application for HW-50284. As of 2024, Pantex no longer operates this system, although groundwater monitoring will continue for a period of time to evaluate the long-term effectiveness of the removal.

Pantex maintains institutional controls in accordance with deed restrictions 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 prevent the spread of contaminated soils. Soil covers at the landfills are maintained as issues are identified. Engineered and institutional controls maintenance in 2024 consisted of the following:

- SWMU interference permitting was approved for five new projects that required work in a SWMU.
- Pantex completed the control of burrowing animals in specific landfills. Extra soil material was placed in areas where the prairie dogs heavily impacted the cover.
- Approximately 570 cubic yards of soil was placed over Landfill 3 to cover exposed geocells. Seed was spread to encourage vegetation growth, and the landfill slopes were covered with coconut husk erosion control blanket.
- Pantex continues to regularly inspect and maintain all soil covers, fences, signs, postings, and ditch liners annually.

Pantex will continue to evaluate the landfills and ditch liner annually and report findings and plans that are developed to address issues. Any problems will be addressed annually through a combination of onsite resources and contracts, based on available funding.

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 and 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* (LTM Design Report; Pantex, 2019a) was conducted as part of the evaluation process. Trends were evaluated both for recent data (the past two years or four semiannual monitoring events) and data collected since the start of remedial actions in 2009.

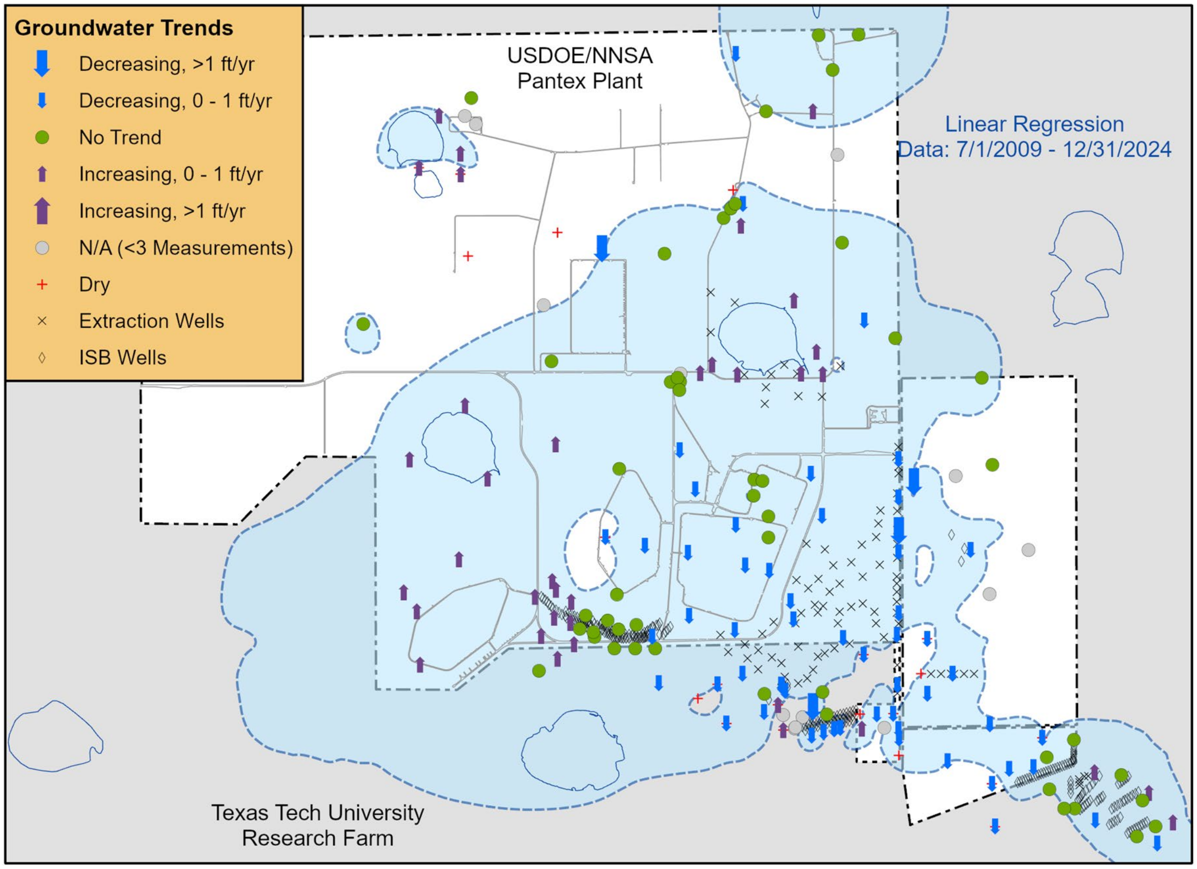

Fig. E-5. Perched Aquifer water level trends.

Overall, calculated concentration and groundwater level trends were consistent with expected conditions defined in the LTM Design Report. Fig. E-5 depicts water level trends in the perched aquifer long-term monitoring (LTM) wells.

A total of 43 monitoring wells were expected to have decreasing water level trends, limited water, or dry conditions, as specified in the 2019 LTM System Update Report. Of these 43 wells, eight exhibited conditions inconsistent with expected conditions or trends, including six wells with increasing trends and two wells with "no trend" conditions considering data since the start of remedial actions. High amounts of rainfall contributed to the increasing trend in all six wells. Additionally, five of these wells are located near Playa 1 and have been affected by permitted wastewater releases to the playa as well as significant P1PTS downtime, resulting in less water being extracted from this region of the perched aquifer. The other well is located in the Burning Ground near a water line that had a persistant leak throughout 2024. The leak contributed to the increased water level at this well, though it has since been repaired.

Expected COC concentration conditions are defined for 116 perched monitoring wells in the 2019 LTM Design Report; four more wells have been installed and expectations defined since that time. These conditions are either for concentrations to stabilize, to show a decreasing trend, and/or to decline below or remain below the GWPS. Of the perched long-term monitoring wells, 26 currently show either increasing or probably increasing trends since the start of remedial actions in 2009 for at least one of the four major COCs (RDX, hexavalent chromium, TCE, or perchlorate). These trends are anticipated to change to meet the expected conditions as corrective actions and natural attenuation continue to operate in the perched aquifer.

Fig. E-6 depicts RDX trends since the start of full remedial actions in the perched aquifer LTM wells. Fifteen wells have increasing trends for RDX. Trends are generally associated with downgradient movement of the plume and are expected to be treated by a downgradient system. RDX is declining or below GWPS at source areas in Zone 12.

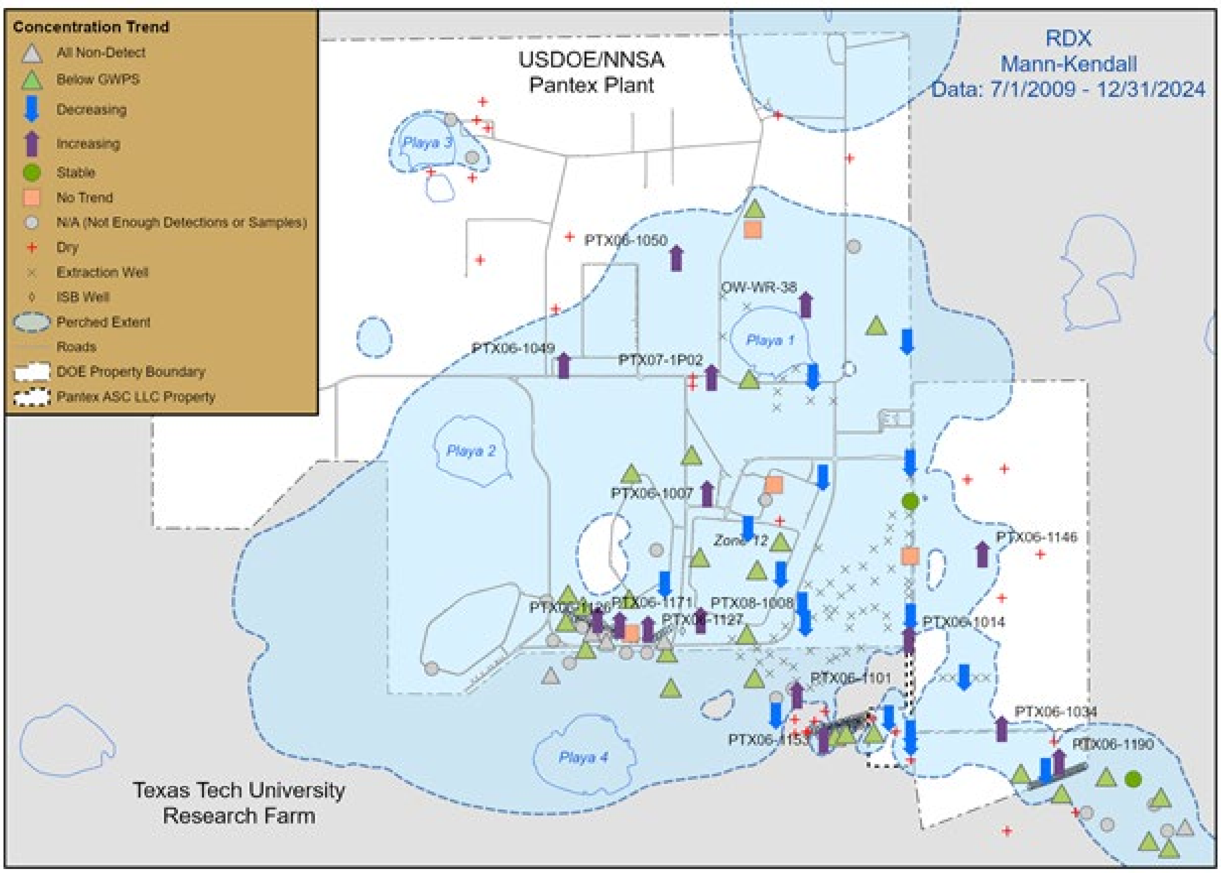

Fig. E-6. RDX trends in the Perched Aquifer.

Generally, 2024's mapped plume shapes are similar to 2009's COC plume shapes. The greatest differences between the shapes are due to changes in the extent of perched saturation in the extreme southeast lobe of the perched groundwater and HE plumes in that area because of new information collected from recently drilled wells. Perchlorate has also shifted further to the southeast based on collection of data at more wells and influence of the SEPTS on hydraulic gradients at Zone 11. A shift in the hydraulic gradient eastward in the area between the southern parts of Zones 11 and 12 has allowed perchlorate and TCE to migrate east and southeast toward the SEPTS well field; portions of the perchlorate plume are being actively remediated by the SEPTS at this time. Perchlorate that is outside the influence of the SEPTS will be treated through the new Perchlorate/Chromium ISB. Other changes in plume size and shape were caused by 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.

Major COC plumes of interest are depicted in Fig. E-7.

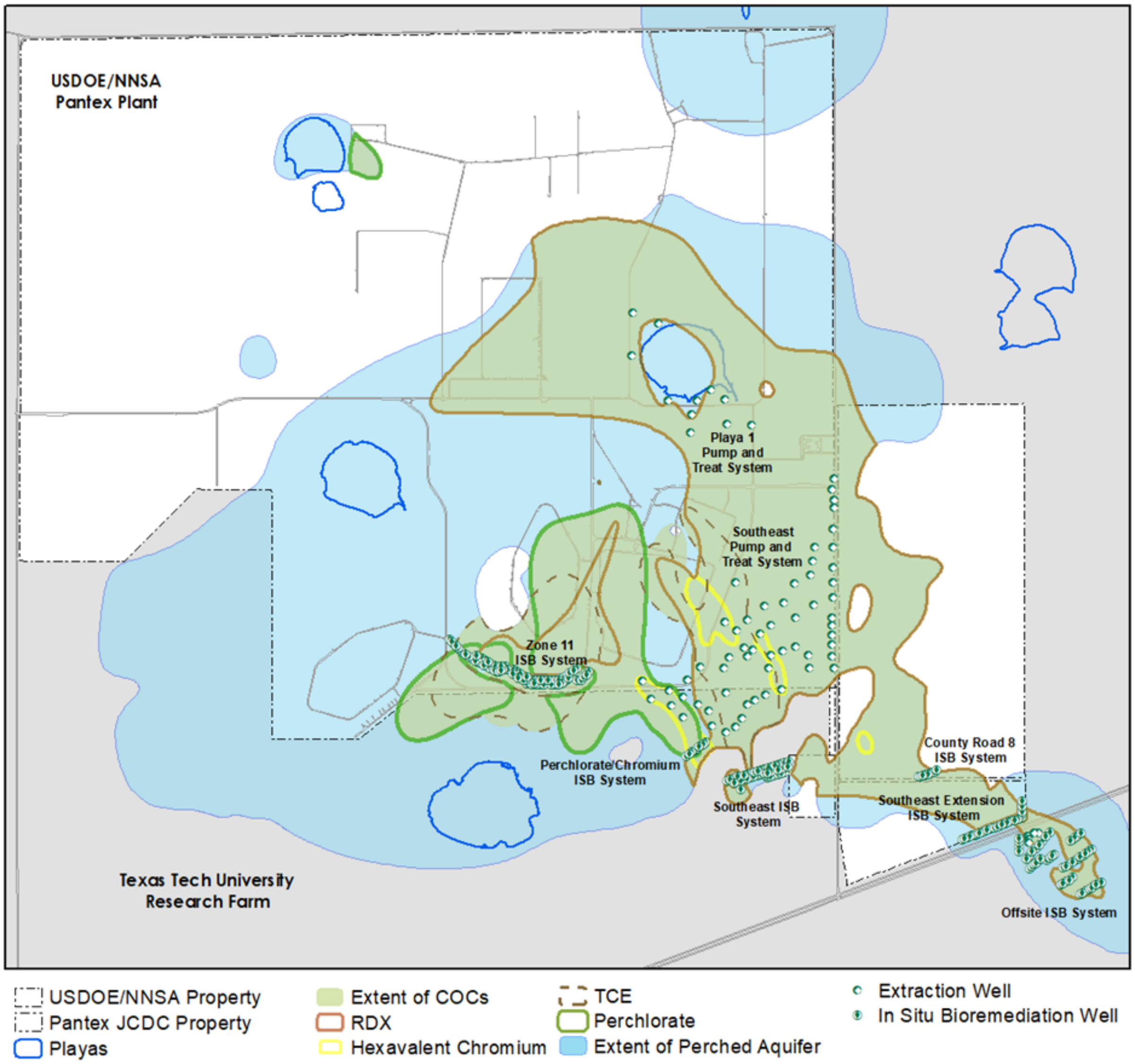

Fig. E-7. Major COC plumes in the Perched Aquifer.

E.3.2 Remedial Action Effectiveness

One goal of the pump and treat systems is to affect plume movement; therefore, a plume stability evaluation can be used to determine the effectiveness of these systems.

The pump and treat systems have continued to be effective in 2024, although their operation was affected by repairs at the WWTF lagoon that limited storage capacity, the continued repairs at the subsurface irrigation system, and ongoing repair of the radio communication system at the Playa 2 injection wellfield. Prioritized operation of the SEPTS has allowed water and mass to be controlled in critical areas. The SEPTS has altered the groundwater flow direction and gradient at localized areas near the extraction wells in the perched aquifer. When operating, the P1PTS appears to be influencing local water levels and hydraulic gradient in the area near Playa 1. When comparing the 2024 conditions to the LTM Design Report, the majority of expected conditions are being met, as noted above. Many wells not yet meeting expected conditions are in locations that have not yet been affected by the remediation systems. Others have been affected by the release of treated water to Playa 1 and P1PTS downtime.

The Southeast ISB system data collected in 2024 indicates that it is effectively meeting treatment objectives set in the *Remedial Design/Remedial Action 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. Two of the closest downgradient monitoring wells for the Southeast ISB (PTX06-1037 and PTX06-1154) demonstrate reductions in RDX, HE degradation products, and hexavalent chromium, resulting in concentrations below the GWPS, with most not detected.

PTX06-1153 demonstrated signs of partial treatment in 2024 as the breakdown products of RDX are present. The concentration of RDX in this well is currently lower than the peak concentration in 2019, but recent measured concentrations (from 2023 and 2024) are variable and average around 179 µg/L. Molasses was injected in the treatment zone in 2019 to better distribute amendment, but treatment of RDX appears to have stalled at this location. Pantex has requested removal of PTX06-1153 from permit HW-50284 so the monitoring well can be used for injection.

The Zone 11 ISB system 2024 data indicate that the system has been effective in treating perchlorate and TCE at most downgradient areas. The system has a well-established treatment zone in the original portion of the system where injection has occurred since 2009. Deeper reducing conditions have been established at injection wells within the expansion area, due to increased injection volumes, use of molasses, and repeated injections. The molasses injection has improved conditions between the injection wells across the western side of the Zone 11 ISB; however, some wells have limited ability to accept injection, and those areas will likely continue to demonstrate milder reducing conditions until the wells can be replaced or infilled. Wells with limited injection capacity are being paused. Other wells will continue to be injected in the system and evaluation of infilling additional wells may be necessary in areas where poor performance is observed.

Evaluation of data in the treatment zone wells indicates mild to strong reducing conditions across the Zone 11 ISB. All in situ performance-monitoring (ISPM) wells downgradient of the system have indicated arrival of treated water. Perchlorate was detected above the GWPS in one ISPM well in each semiannual sampling event in 2024—PTX06-1148 in the first event, PTX06-1149 in the second. TCE concentrations are below the GWPS in six of nine ISPM wells. Pantex has added a second row of wells on the southern side of the ISB to improve treatment of TCE and perchlorate. Improvement of downgradient results are expected with time due to injection of the new wells.

The Southeast ISB Extension was first injected in 2019. Treatment zone data, including two treatment zone monitoring (TZM) wells, indicate strong to mild reducing conditions are present for the treatment of HEs. Downgradient wells demonstrated treatment in 2024 supported by increase in total organic carbon (TOC), reduction of RDX concentrations to below GWPS in the two ISPM wells for this system, and increase in metals. In response to recommendations in the recent Five-Year Review, Pantex evaluated the duration between injection events at the Southeast ISB Extension. Treatment zone results indicate that reducing conditions have been adequate to treat the high explosives and that an injection timeframe of 12 months is suitable for this system.

The Offsite ISB was installed in 2020. Phases 1 and 2 of infrastructure to support an injection event were completed in 2021, with first injection of molasses occurring in 2021. The final infrastructure phase and two injection events were completed in 2023. Two more injection events were carried out in 2024. ISB extraction wells at the leading edge of the plume that were sampled in 2024 have indicated arrival of the carbon source and have demonstrated concentrations of HE remains low in wells at the leading edge of the plume. Treatment zone data for the TZM wells indicate that the treatment zone is being established, although portions of the plume will take time to establish treatment due to the spacing of the rows of injection and extraction wells and the timing of when injections started. The downgradient monitoring well for this system demonstrates concentrations below the GWPS, indicating the plume is not expanding.

E.3.3 UNCERTAINTY MANAGEMENT AND EARLY DETECTION

The uncertainty management wells in the High Plains Aquifer (commonly and hereafter referred to as the Ogallala Aquifer) and perched aquifer have the following purposes:

- Confirm expected conditions identified in the Resource Conservation and Recovery Act (RCRA) Facility Investigations and ensure there are no deviations
- Fill potential data gaps in the investigations
- Fulfill LTM 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 from potential source areas in the unsaturated zone before potential points of exposure are impacted. These wells were proposed in the LTM Design Report to evaluate 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 the GWPS, background, or practical quantitation limit (PQL). These wells were evaluated in 2024 and one Group 1 perched aquifer well had an unexpected condition. Perchlorate was detected at 68 µg/L, above the GWPS (15 µg/L), and TCE was detected at 1.11 µg/L, above the PQL (1 µg/L), but below the GWPS (5 µg/L) at PTX01-1001 at the Burning Ground. Previous detections in PTX01-1001 have been associated with releases from the wash rack at the southwest corner of the loop road inside the Burning Ground area. A documented leak from a water line on the south side of the loop road has occurred for a long period of time, as evidenced by the cattails growing in that area and increasing water level trends in PTX01-1001 while other locations at the Burning Ground do not demonstrate a similar trend. Pantex has taken actions to minimize the leak; however, the leak cannot be fully stopped until the maintenance crew receives needed parts for the repair. It is expected that with the removal of water from the area, concentrations and water levels will decline with time, as observed in past data.

In 2024, detection of indicator constituents above background occurred in five Ogallala wells. Data for these detections are provided in Table D-3, Appendix D. Hexavalent chromium was detected slightly above background in three wells in 2024. These detections were below the GWPS of 100 µg/L and represent natural variability in background. At PTX06-1012, perchlorate was detected at a measured value of 1.04 µg/L, slightly above the background value of 0.96 µg/L; this detection also represents background variability. TCE was detected at PTX01-1010, located just north of the Burning Ground, in the third quarter at 0.67 µg/L, below the GWPS (5 µg/L) and the PQL (1 µg/L). Although resampling is not required when the detection is less than the PQL, Pantex initiated a resampling event during fourth quarter to validate this detection as a precaution. The verification sample was split and sent to two separate labs; both TCE verification samples support the initial detection results. In accordance with the Contingency Plan and requirements established in the approved *Draft Final Burning Ground SVE System Closure Report* (Pantex, 2023a), Pantex will continue to monitor this well and evaluate the data.

Boron was detected slightly above background in 11 Ogallala wells (data in Table D-4). Boron concentrations at these wells were close to background and significantly below the GWPS.

Additionally, HEs and VOCs were detected in five Ogallala wells beneath the southeast area in 2024. These wells were installed to investigate detections in PTX06-1229 and PTX06-1056. Please refer to section 3.4.6 for a detailed description of these detections. Pantex plans to continue investigation of the Ogallala Aquifer to define the nature and extent of these 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 sourcing contaminants to the perched aquifer for 20 years or more but at much lower concentrations than in the past (Pantex, 2006). For many of these wells, concentrations are expected to stabilize, with an eventual long-term decreasing trend below the GWPS.

Twelve of the Group 2 wells that have detections of COCs already meet expected conditions. Two show stable or no trend when long-term decreasing trends are expected. Ten wells are showing increasing trends since remedial actions began in 2009. Several of these wells are experiencing more recent no trend conditions or decreasing trends. Some of those wells' increasing trends are due to changing gradients and/or plume movement away from the source. Pantex will continue to evaluate these trends over time. For many of these wells, concentrations are anticipated to stabilize, with an eventual long-term decreasing trend below the GWPS.

Several other Group 2 wells had metals detections above their site-specific backgrounds but below the GWPS. These detections are likely due to either well-screen corrosion or variation in background.

E.3.3.1 Other Unexpected Conditions

Pantex routinely evaluates laboratory data to determine if data are off-trend, are at an all-time high, or represent a new detection that may require further sampling or evaluation. Through the well-maintenance program, Pantex also inspects wells at least every five years to ensure they are not silting in and to evaluate whether the well remains in contact with the formation. One unexpected condition was noted in 2024.

POE well, PTX06-1064, was damaged by agricultural equipment in 2024. Pantex requested approval from the TCEQ to plug and abandon this well by letter on November 20, 2024. TCEQ approved this request by letter on December 4, 2024. This well was plugged and abandoned on January 28, 2025 and PTX06-1062A was designated as the replacement POE well. A class 2 modification application will be submitted for this change once the updated permit is issued.

E.3.3.2 Natural Attenuation

Natural attenuation is the result of processes that naturally lower concentrations of contaminants over time. Data are collected at Pantex to evaluate natural attenuation in the perched aquifer. This is an important process for RDX, the primary risk driver in perched groundwater, because RDX is widespread and extends beyond the reach of the groundwater remediation systems in some areas. Pantex has historically monitored for RDX; 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 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 its breakdown products indicate that the breakdown products are present throughout most of the RDX plume, with hexahydro-1,3,5-trinitroso-1,3,5-triazine (TNX) being the most widespread. If complete biodegradation of RDX were occurring, RDX and all breakdown products would be expected to decrease over time.

A Strategic Environmental Research and Development Program (SERDP) study (2014) provided evidence that aerobic degradation is occurring in the Pantex RDX plume but was unable to quantify the rates of attenuation. This study provided new methods for evaluating RDX degradation, including carbon and nitrogen fractionation approaches (compound specific isotope analysis). These approaches, along with the ability to quantify 4-nitro-2,4-diazabutanal (NDAB), an aerobic degradation product, allows Pantex to better evaluate the degradation of RDX.

Pantex subsequently contracted with the leading researcher of the SERDP study, Dr. Mark Fuller with APTIM Corporation, for a project to evaluate lines of evidence for natural attenuation of RDX at the plant. The study included both aerobic and anaerobic degradation, with evidence of both occurring. The predominant attenuation process is aerobic biodegradation by bacterial strains. Biodegradation rates of 0.016 to 0.168 per year were calculated, translating to RDX half-lives of approximately 5 to 50 years.

The project found that the rates of RDX biodegradation are likely limited by the available labile organic carbon in the groundwater. The study found several lines of evidence for natural attenuation of RDX as well as the potential to enhance aerobic biodegradation of RDX by introducing low levels of labile organic carbon. Recommendations were presented for additional treatability studies, bioaugmentation, and additional proteomics analyses of degrading bacterial strains. Results of this study were used in the recent optimization of the Offsite ISB and pump and treat systems.

E.4 Soil Remedial Action Effectiveness

The small-scale SVE system at the Burning Ground was the only active soil remediation system at Pantex prior to 2024. The most current CatOx/wet scrubber system has effectively removed the soil NAPL source in the Burning Ground and system closure was approved in December 2023 This system was not operated in 2024, although monitoring of surrounding groundwater wells will continue to ensure system effectiveness.

E.5 Recommendations and Conclusions

Pantex plans to continue currently approved remedial actions. The groundwater remedies are considered protective for the short term since untreated perched groundwater use is controlled to prevent human contact and Ogallala Aquifer data continues to indicate COC concentrations are either non-detect or below the GWPS in areas near onsite and offsite water resources. The systems are also proving to be effective in reaching long-term objectives for cleanup in areas that are under the influence of a remedial action. Pantex has some recommended changes provided below to address areas outside of the influence of the remedial action.

Soil remedies have also been effective at Pantex; 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 Former SVE system effectively removed soil gas and residual NAPL in soils at the Burning Ground, thereby mitigating the vertical movement of VOCs to the Ogallala Aquifer.

Based on issues identified in the third five year review (FYR) and this report, changes are recommended or have already been implemented to enhance the effectiveness of the remedies in some areas and improve monitoring of the overall effectiveness of the actions. Those recommendations are provided in the following sections.

E.5.1 Recommended Changes to the Selected Remedies

Pantex continues to work toward installation and operation of new systems that were proposed in the 2022 ESD. Wells have been installed for two additional ISB systems and one has begun operation; the other is scheduled to have infrastructure installed and will be injected in 2026 given adequate funding. Nine wells east of FM 2373, six of which have been used for extraction and three of which were drilled and found to have too little water to justify extraction infrastructure, are planned for conversion to injection, given adequate funding. These injection wells will address two critical remaining regions of perched groundwater contamination.

No new recommendations are necessary at this time.

E.5.2 Recommended Changes to the Pump and Treat Systems

Pantex has implemented the new operational goals that prioritize operation of the SEPTS to more effectively capture perched groundwater and contaminant plumes moving to the southeast. Pantex planned to further evaluate priority of pumping at the SEPTS to ensure that plumes and water are efficiently removed, including in the third FYR. However, water levels have declined so much across the SEPTS well network that further prioritization of pumping by individual wells is infeasible. All operational wells will be pumped to maintain SEPTS throughput. SEPTS will continue to be prioritized over P1PTS whenever water outlets are limited, which is anticipated to be less and less the case, as noted above (Section E.2).

E.5.3 Recommended Changes to the ISB Systems

Pantex continues to evaluate the ISBs and make changes, as appropriate, to address incomplete treatment in certain areas. The third FYR recommended changes to ISB operations in some areas and Pantex is working toward implementing those changes.

E.5.3.1 Southeast ISB

Although Pantex has injected a more soluble carbon (i.e., molasses) to improve the distribution of amendment at the ISB and injected in dry upgradient wells, RDX has declined, but continues to persist above GWPS at PTX06-1153. Pantex has requested the removal of PTX06-1153 as a point of compliance monitoring well from HW-50284 and plans to inject the well after the new permit is issued and as recommended in the third FYR.

E.5.3.2 Southeast ISB Extension

Pantex has evaluated moving to yearly injections at the Southeast ISB Extension, and did so during fiscal year (FY) 24.

No further changes to the ISB are recommended at this time.

E.5.3.3 Zone 11 ISB

Pantex has installed additional infrastructure to address the hydraulic changes in the system and has infilled wells where old injection wells will no longer accept amendment injections. Amendment volumes were reviewed for the wells surrounding PTX06-1164 and PTX06-1169 to determine if extra volume was required during injections. Volumes were increased in 2024, as needed. Pantex continues to monitor the effect of these changes.

Pantex was able to install two wells that were planned as part of the second row of wells on the southeastern side of this ISB in FY 24. These wells were injected in FY 24, and the treatment coverage around these wells will be monitored.

No other changes to the ISB are recommended at this time.

E.5.3.4 Offsite ISB

Injections began in 2021 with injections occurring the year following installation of each phase. All phases of installation were complete by the end of 2023 and was fully operated in 2024.

No changes to the ISB are recommended at this time.

E.5.3.5 Perchlorate/Chromium ISB

This system was installed and fully injected in 2024 and a second injection event is planned for 2025. No changes to this ISB system are recommended at this time.

E.5.4 Recommended Changes to the Monitoring Network

Pantex is currently implementing select recommendations from the MAROS monitoring optimization completed for the third FYR. These changes have been included in the updated *Long-Term Monitoring System Design* and *Sampling and Analysis Plan* (Nov 2024).

Due to detections of three high explosives above GWPS at Ogallala well PTX06-1229, Pantex drilled four additional wells to evaluate nature and extent of a plume in the Ogallala Aquifer. As recommended in the third FYR, Pantex will develop a work plan to evaluate nature and extent and plans to drill four or more additional Ogallala monitor wells in FY2025.

Regulatory comments have indicated the need for further wells to the south of Zone 11 to delineate the southern extent of perched groundwater contamination; these wells will be installed as funding and time permit, starting with at least one well in 2025.

E.5.5 Recommended Changes to Soil Remedies

No changes to the landfill or ditch remedies are recommended.

Pantex prepared a closure plan for the Burning Ground SVE. The system closure was approved by regulatory agencies in 2023. Pantex plans to continue groundwater monitoring at the point of compliance and exposure wells at the Burning Ground to evaluate the long-term effectiveness of this remedial action. Pantex also included requirements for response to detections in those wells in an updated *Pantex Plant Ogallala Aquifer and Perched Groundwater Contingency Plan* (March 2025).

E.5.6 Recommended Changes Based on Regulatory Comments

Pantex received comments from the TCEQ on the supporting documents for the recommended changes to the Pantex Remedial Action (TCEQ, 2022). Pantex has agreed to complete some additional work and track the actions to completion in the annual progress reports, per letter dated February 15, 2023 (USDOE/NNSA, 2023). The following table provides the two items and their current status: both have been completed.

In letters dated December 4, 2024, February 28 and March 13, 2025 (TCEQ 2024, 2025a, b), the TCEQ requested additional information and work to be completed. Items from this list that were requested in the next Progress Report or that relate to ongoing work are also referenced in the following table. Responses to other requests have been or will be sent under separate cover.

Table E-1. Status of Actions from Regulatory Correspondence

Recommended Actions to Complete	Milestone Date	Completion Date	Status
Review/update the well information data table to include updated bottom of the fine-grained zone (FGZ) picks from Ogallala wells.	Dec 2026	Dec 2024	The table update is complete; new information from newly installed wells has been incorporated based on data collected during drilling.
Put in two additional wells at the southeast and southwest perimeter of Zone 11 to better evaluate the Zone 11 plumes.	Dec 2026	Nov 2024	Pantex contracted to have those wells installed in 2024. Pantex was able to install one of the wells on the southeast perimeter of Zone 11, but encountered issues with a high in the fine-grained zone at the chosen location for the second well on the southwest perimeter of Zone 11. That boring was plugged and another location was drilled, but another high in the fine-grained zone was encountered at that location as well. A third location was not drilled because other wells were already present in the area. Therefore, Pantex has installed one well in accordance with this request, but a second location will not be feasible on the southwestern perimeter of Zone 11. No further well installations are planned for this request.
Provide HE data collected to date from wells PTX06-1056, 1223, 1224, and 1229.	June 2025 (next Progress Report)	June 2025	This data is provided in Appendix D, Tables D-7 and D-8.
Provide laboratory analytical results from PTX01-1010.	June 2025 (next Progress Report)	June 2025	This data is provided in Appendix D, Table D-10.
Install two wells southwest and southeast of PTX06-1207 to delineate the southern extent of COCs in the perched aquifer.			The need to install these wells has been added to Pantex planning documents. For 2025 a well (PTX06-1238) will be installed west of PTX06-1207 to delineate contamination migrating southwest from Zone 11 (Section 5.3.4).

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List of Acronyms

amsl	above mean sea level
AFFF	aqueous film-forming foam
AOC	area of concern
APAR	Affected Property Assessment Report
ASC	Administrative Site Complex
bgs	below ground surface
CatOx	catalytic oxidation
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cis-1,2-DCE	cis-1,2-dichloroethene
CFR	Code of Federal Regulations
CMI	Corrective Measures Implementation
COC	contaminant of concern
CP-50284	Compliance Plan 50284
CR8	County Road 8
CR(VI)	hexavalent chromium
DCA	dichloroethane
DNT	dinitrotoluene
DNT4A	4-amino-2,6-dinitrotoluene
DNX	hexahydro-1,3-dinitroso-5-nitro-1,3,5-triazine
EPA	Environmental Protection Agency
ESD	Explanation of Significant Difference
EVO	emulsified vegetable oil
FGZ	fine-grained zone
FM	Farm-to-Market Road
FS	Firing Site
ft	feet
ft/ft	feet per foot
FGZ	fine-grained zone
FS-5	Firing Site 5
FY	fiscal year
FYR	five-year review
GAC	granular activated carbon
gpm	gallons per minute
gpd	gallons per day
GPS	Global Positioning System
GWPS	groundwater protection standard
HE	high explosive

HMX	octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
HW-50284	Hazardous Waste Permit No. 50284
IAG	Interagency Agreement
ICM	Interim Corrective Measure
IRAR	Interim Remedial Action Report
ISB	in-situ bioremediation
ISM	interim stabilization measure
ISPM	in situ performance monitoring
lbs	pounds
LOTO	lockout/tagout
LTM	long-term monitoring
LTM Design Report	Long-Term Monitoring System Design Report
Mgal	million gallons
MAROS	Monitoring and Remediation Optimization System
MCL	maximum contaminant level
MDL	method detection 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
NDAB	4-nitro-2,4-diazabutanal
O&M	operation and maintenance
OMPTS	Offsite Mobile Pump and Treat System
ORP	oxidation reduction potential
OSTP	Old Sewage Treatment Plant
P&A	plugging and abandonment
P1PTS	Playa 1 Pump and Treat System
PCE	tetrachloroethylene
PCL	protective concentration level
PCR	Perchlorate/Chromium
PFAS	per- and poly-fluoroalkyl substances
PFHXS	Perfluorohexane Sulfonic Acid
PFPEA	Perfluoropentanoic Acid
PFOA	Perfluorooctanoic Acid
PFOS	Perfluorooctane Sulfonic Acid
Pantex	Pantex Plant
PMZ	Plume Management Zone
POC	point of compliance
POE	point of exposure

ppm	parts per million
ppmv	parts per million by volume
PTS	pump and treat system
PQL	practical quantitation limit
PVC	polyvinyl chloride
RA	Remedial Action
RAP	Response Action Plan
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
SCADA	supervisory control and data acquisition
scfm	standard cubic feet per minute
SEP/CBP	Solvent Evaporation Pit/Chemical Burn Pit
SEPTS	Southeast Pump and Treat System
SERDP	Strategic Environmental Research and Development Program
SIN	SWMU Interference Notification
SVE	soil vapor extraction
SVS	supplemental verification site
SWMU	Solid Waste Management Unit
TCE	trichloroethene
TCEQ	Texas Commission on Environmental Quality
TLAP	Texas Land Application Permit
TNX	hexahydro-1,3,5-trinitroso-1,3,5-triazine
TNT	2,4,6-trinitrotoluene
TOC	total organic carbon
TOP	Total Oxidizable Precursor
TRRP	Texas Risk Reduction Program
TTU	Texas Tech University
TZM	treatment zone monitoring
ug/L	micrograms per liter
USDOE/NNSA	United States Department of Energy/National Nuclear Security Administration
VOC	volatile organic compound
WMG	waste management group
WWTF	Wastewater Treatment Facility
6:2FTS	1h,1h,2h,2h-perfluorooctane sulfonic acid

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1.0 INTRODUCTION

The Pantex Plant (Pantex), located in the Texas Panhandle approximately 17 miles northeast of Amarillo (see Fig. 1-1), was established in 1942 to build conventional munitions in support of World War II. Pantex 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).

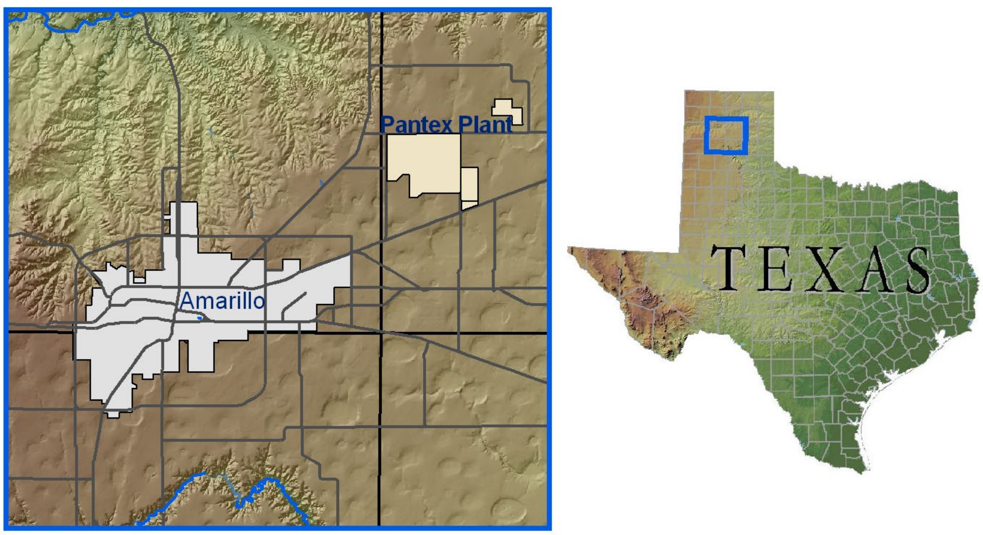

Fig. 1-1. Location of Pantex Plant.

The main 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. The remaining USDOE/NNSA-owned land serves safety and security purposes. In 2008, approximately 1,526 acres east of Farm-to-Market Road (FM) 2373 was purchased to provide better access and control of perched groundwater areas included in the Pantex Remedial Action (RA). USDOE/NNSA also owns a detached piece of property called Pantex Lake, approximately 2.5 miles northeast of the main plant. This property, encompassing 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, TTU property to the south, property east of FM 2373 and offsite property to the southeast. The extent of perched groundwater and major contaminant plumes are depicted in Fig. 1-2.

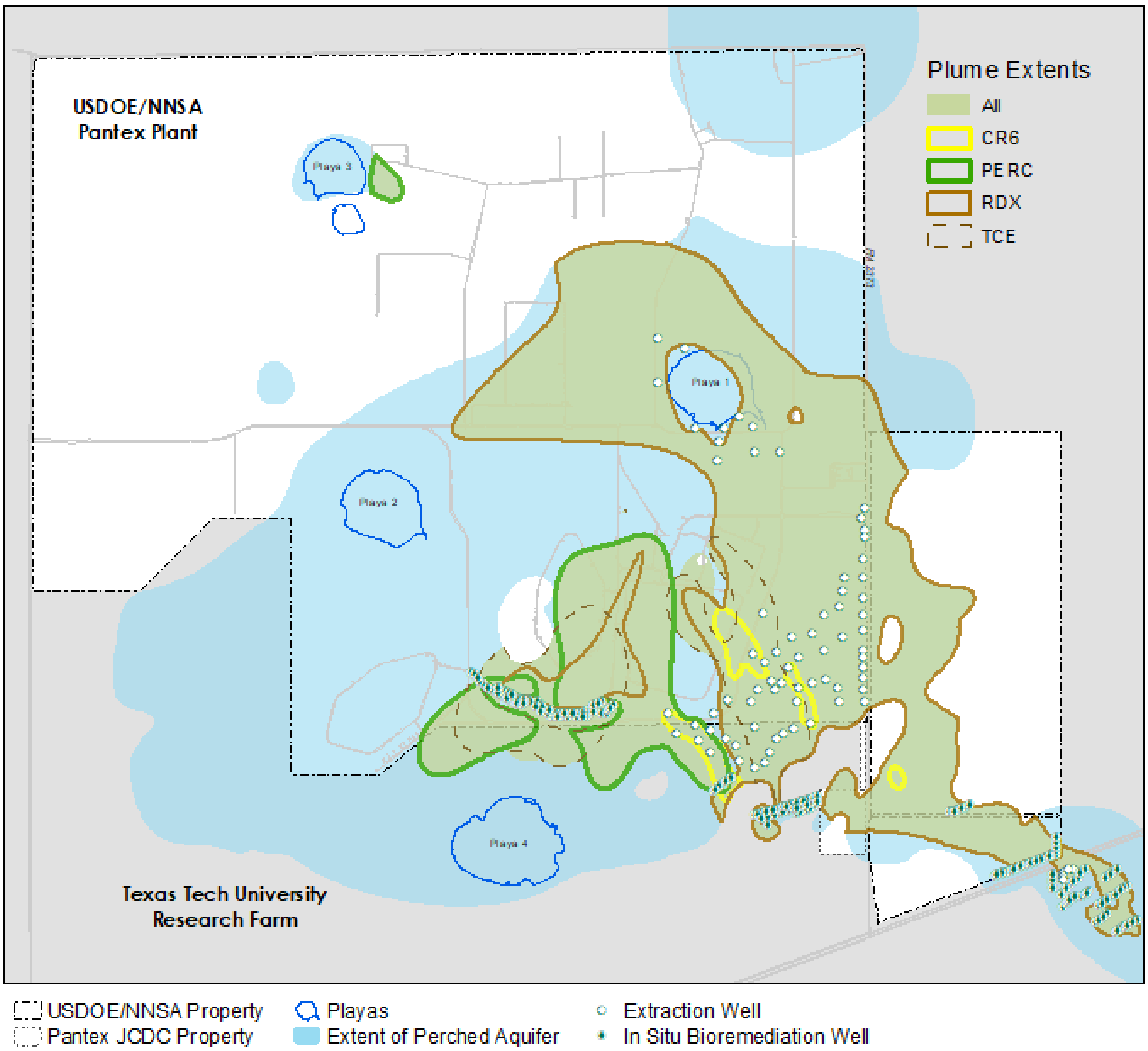

Fig. 1-2. Extent of perched groundwater and contaminant plumes exceeding the Groundwater Protection Standard.

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 vicinity of Pantex.

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 soil covers and ditch liners to be maintained to prevent the infiltration of water and downward migration of contaminants to groundwater. Fencing and signs are also maintained to control worker use and traffic within the soil units.

Pantex has implemented RAs to mitigate perched groundwater contamination and prevent contamination of the deeper drinking water aquifer.

1.1 Regulatory Background

Pantex implemented its RAs in accordance with the *Compliance Plan for Industrial Solid Waste Management Sites* (Compliance Plan [CP-50284]), originally issued on October 21, 2003, and subsequently updated with final RAs on September 16, 2010, under the provisions of Chapter 361 of the Texas Health and Safety Code and Chapter 26 of the Texas Water Code. CP-50284 is a Texas Commission on Environmental Quality (TCEQ) permit that stipulates the requirements for conduct of corrective actions and groundwater monitoring programs according to the Resource Conservation and Recovery Act (RCRA). Pantex's hazardous waste permit (HW-50284) was renewed in 2014, and CP-50284 requirements were incorporated into the permit.

Pantex was listed on the National Priorities List in 1994, requiring investigation and cleanup according to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), in addition to RCRA. Pantex meets the requirements of CERCLA through the Pantex Interagency Agreement (IAG), effective February 22, 2008. Table 1-1 lists the Compliance Plan (shown as CP), hazardous waste permit (shown as HW), and IAG with the 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 to stabilize groundwater plumes and monitor that action.
Interagency Agreement for the Pantex Superfund Site	2/22/2008	Established an agreement between the Environmental Protection Agency, Texas Commission on Environmental Quality, and the United States Department of Energy for final RAs, the framework for responding to and implementing Comprehensive Environmental Response, Compensation, and Liability Act requirements, and the framework for participation and exchange of information between parties.
Record of Decision	9/25/2008	The Pantex Record of Decision (ROD) presents the "Selected Remedy" for Pantex in accordance with Comprehensive Environmental Response, Compensation, and Liability Act and is synchronized with the Texas Commission on Environmental Quality Compliance Plan provisions.
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. Changes include corrective action observation well changes and minor edits. Compliance Plan requirements are included as Provision XI of HW-50284.
Explanation of Significant Difference for the Record of Decision	12/21/2022	Provides an explanation of differences between the following: 1. Several components of the "Selected Remedy" for Pantex and the actual systems constructed, operated, and maintained to achieve RA objectives. 2. The action level in the ROD and protective levels and health advisories established for perchlorate since issuance of the ROD and establishment of the new perchlorate protective level for cleanup of groundwater.

CP-50284, issued in 2003, stipulated the requirements for conducting corrective actions and groundwater monitoring associated with 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 *Record of Decision for Groundwater, Soil and Associated Media* (ROD) (Pantex and Sapere Consulting, 2008), and the final remedy was incorporated into CP-50284, effective September 16, 2010. Pantex provided an *Explanation of Significant Difference for Zone 11 ISB, Southeast ISB Extension, Offsite ISB, Southeast Pump & Treat System, and the Action Level for Perchlorate in Perched Groundwater* (ESD) for the ROD, in 2022 (Pantex, 2022a). The changes described in the

ESD were included in the hazardous waste permit renewal application that was provided to the TCEQ in December 2023. The *Long-Term Monitoring System Design Report* (LTM Design Report) (Pantex, 2009a) and the *Sampling and Analysis Plan* (SAP) (Pantex, 2009b) were approved through the Compliance Plan as the basis for monitoring and reporting of the remedies. The 2009 documents were updated in January 2014 and again in 2019 (Pantex, 2019a and 2019b). The 2019 update was approved for use starting January 2020. HW-50284 was renewed in May 2014 and included the Compliance Plan requirements from the September 2010 CP-50284 as Provision XI, with minor changes. HW-50284 was updated in 2024; however, it will not be implemented until 2025.

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

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

1. Ensure that the environmental impacts associated with past and present activities at Pantex have been analyzed, tested, and thoroughly evaluated, and appropriate RA 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 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 sections of the annual or quarterly report in which the requirements are fulfilled. The requirements are from CP Tables VII and VIII of HW-50284. The specific Articles in the IAG that contain reporting requirements are also listed in the table. Other requirements in the ROD and final documents supporting the design of the RAs were also considered when developing 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 the 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 the annual report. "Recommendations and Conclusions" section 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.

Item	Program	Reporting Frequency	Requirements	Location of Information in Progress Reports
8.	Corrective Action	Annual June 30	Water table maps shall be prepared from the groundwater data collected pursuant to Provision G and shall be evaluated by the Permittee with regard to the following parameters: 8.1. Development and maintenance of a cone of depression during operation of the system; 8.2. Direction and gradient of groundwater flow; 8.3. Effectiveness of hydrodynamic control of the contaminated zone during operation; and, 8.4. Estimation of the rate and direction of groundwater contamination migration.	Sections 3.1.5, 3.1.7, and 3.2.
9.	Corrective Action	Annual June 30	The Permittee shall submit a report to each recipient listed in Provision XI.J.3, 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 XI.B 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, contaminant of concern (COC) trending, and hydrographs.

Item	Program	Reporting Frequency	Requirements	Location of Information in Progress Reports
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
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 1.6.
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 groundwater protection standard (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 point of compliance/point of exposure 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.

Item	Program	Reporting Frequency	Requirements	Location of Information in Progress Reports
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.
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.

Item	Program	Reporting Frequency	Requirements	Location of Information in Progress Reports
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: a. See Section 2.1 and "List of Appendices" for detailed extraction well flow information. b. See Section 2.3.1 for soil vapor extraction of residual non-aqueous phase liquids (NAPL)s in soils at the Burning Ground. Quarterly Report: a. "Pump and Treat Systems" section and Appendix B.
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: a. Section 2.1. Quarterly Report: a. "Pump and Treat Systems" and "SVE System" sections.
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. See Section 2.1 and "List of Appendices" for detailed extraction well flow information. 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. "Pump and Treat Systems" section and Appendix B. b. "Pump and Treat Systems" and "SVE System" sections. c. See Appendix C. d. "Uncertainty Management and Early Detection" section.
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 Interim Corrective Measures (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 to the ICM requirements in Provision VIII.

Item	Program	Reporting Frequency	Requirements	Location of Information in Progress Reports
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 third five-year review was started in 2022. The final approved report was completed in September 2023.
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 1.6.4 of the annual report contains a 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 the "Schedule Update" section.

Item	Program	Reporting Frequency	Requirements	Location of Information in Progress Reports
IAG Progress Report Requirements:				
16.4.	Remedial Action	Quarterly Annual	All results of sampling or other monitoring results obtained during the previous quarter.	The "Uncertainty Management and Early Detection" section of the quarterly report summarizes the quarterly data. Annual Report: a. These data are summarized in Section 3.4 and 3.5. b. 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 1.6.4 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 1.6.4.

1.2 Remedial Action Background

Pantex has implemented soil and groundwater RAs to mitigate contamination that resulted from historical waste management practices. The remedial actions are described in detail in the ROD, which can be found here: https://pantex.energy.gov/mission/environment/environmental-cleanup-documents. Soil and groundwater RAs are detailed in the following sections.

1.3 Soil Remedial Actions

In accordance with RCRA and CERCLA, Pantex and regulatory agencies identified 254 units at Pantex for further investigation and cleanup. Investigations that identified the nature and extent of contamination at solid waste management units (SWMUs) 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 RAs; therefore, 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 RAs to protect human health and the environment. Fig. 1-3 depicts the location and status of the 254 units.

The 15 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 as well as when funding is identified for investigation and cleanup of the site. One active facility has been changed to inactive, and Pantex has requested funding to address the site. A detailed summary of actions for the 254 units can be found in the ROD (Pantex and Sapere Consulting, 2008).

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

In late 2023, Pantex identified a new SWMU and reported it to the TCEQ, in accordance with the HW-50284. Building 11-35 AOC has now been included in the application to renew HW-50284 and is included in the SWMU status table in Appendix A. Pantex has submitted a Response Action Plan (RAP) and a work plan that describe the path for investigation and closure under the TRRP. Investigation of this site commenced in 2024, and the Affected Property Assessment Report (APAR) will be complete in 2025.

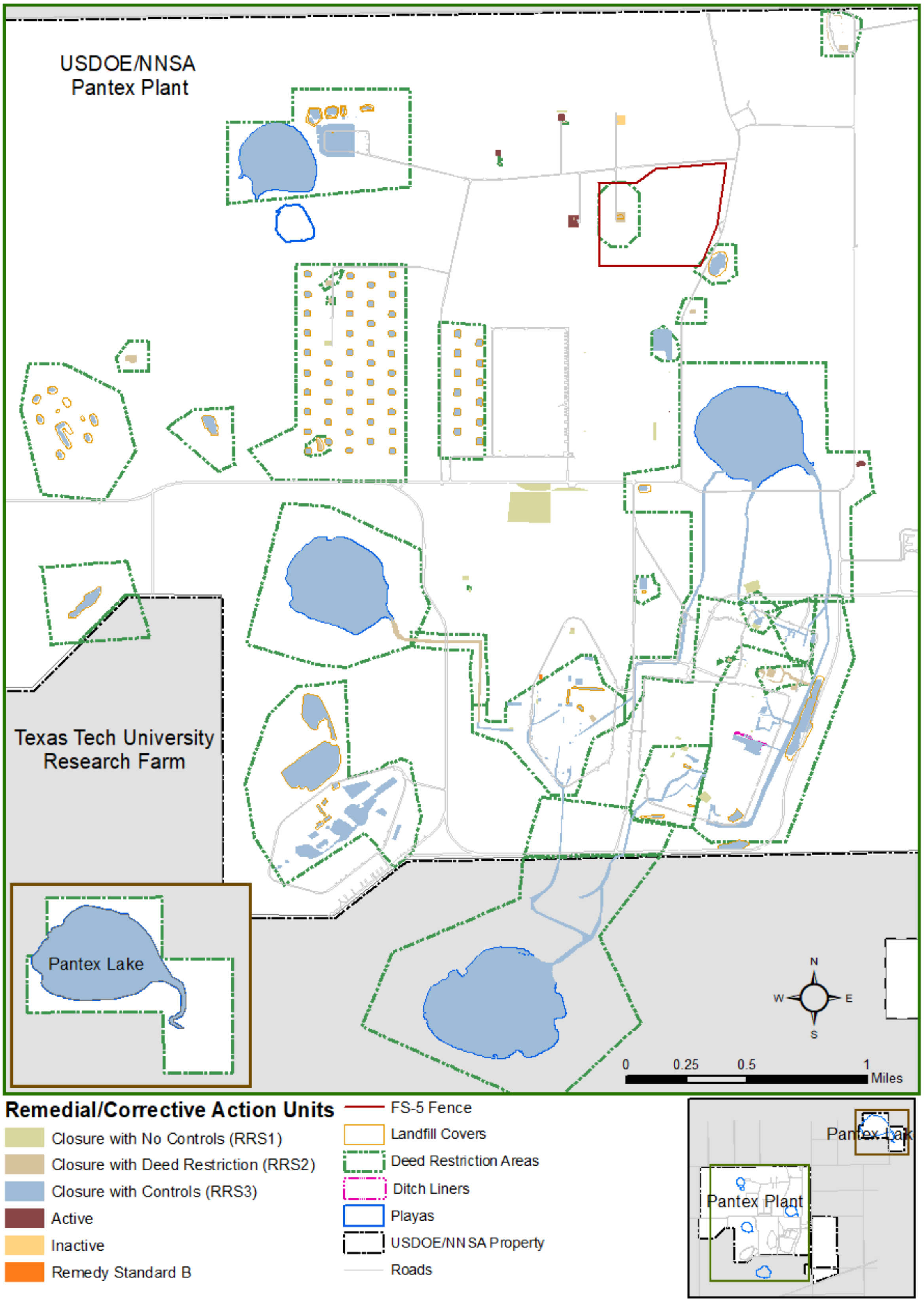

Fig. 1-3. Status of Corrective/Remedial Action units.

Soil RAs focus on the following:

- Cleanup of soil gas and non-aqueous phase liquids (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)
- Maintenance of soil remedies (i.e., ditch liners and soil covers) for future protection of groundwater resources

Soil Remedial Actions

- Ditch Liner
- Soil Covers on Landfills
- Institutional Controls
- Former Soil Vapor Extraction System
- Fencing

In addition to the RAs, 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.

1.3.1 Former Burning Ground Soil Vapor Extraction System

The Former Burning Ground soil vapor extraction (SVE) system was installed in February 2002 as an interim RA and became the final RA with the issuance of the ROD and HW-50284. The SVE system was installed to remediate volatile organic compounds (VOCs) present in the shallow- and intermediate-depth vadose zone at the Burning Ground, specifically SWMUs 38 and 47.

The system was designed to remediate soil gas in areas beneath the solvent evaporation pit/chemical burn pit (SEP/CBP) and the landfills north of the SEP/CBP. The RCRA Facility Investigations noted that original volatile organic compound (VOC) concentrations at the Burning Ground were as high as 962 parts per million by volume (ppmv) in the shallow zone [i.e., 20 to 90 feet (ft) below ground surface (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 (i.e., 95 to 275 ft bgs) were as high as 1845 ppmv (Stoller, 2002).

The remedial goal was to significantly reduce the mass of VOC contaminants in soil gas, thus mitigating impacts to the underlying groundwater. That goal was 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 (CatOx) 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 SVE-S-20, where soil gas concentrations in the shallow zone continued to remain above 100 parts per million (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 install a small-scale CatOx system that focused on remediating SVE-S-20.

The new system was more cost efficient and effectively treated all detected contaminants of concern (COCs) at the Burning Ground. System construction and installation began in February 2012. System startup and testing began on April 5, 2012, with normal operations commencing on April 19, 2012.

The system was modified in May 2017 to increase air flow through the area surrounding SVE-S-20 and promote increased volatilization and bioremediation of the remaining soil NAPL. Six wells surrounding SVE-S-20 were modified to include aboveground piping that allowed airflow through the wells while the system was operating and pulling air from SVE-S-20 (see Fig. 1-4). Pantex increased influent flow to the SVE by 40% from 32 standard cubic ft per minute (scfm) to approximately 45 scfm, close to the maximum design flow of 50 scfm. To gain baseline information, Pantex also increased monitoring and evaluation of influent air to the SVE system and of the individual wells that were modified. The evaluations provided a path to closure of the Burning Ground SVE. Pantex requested closure of the system in the *Draft Final Burning Ground Soil Vapor Extraction System Closure Report* (Pantex, 2023a). The TCEQ and EPA approved the closure report in December and October 2024, respectively. Pantex has requested the removal of the SVE system in the renewal application for HW-50284. As of 2024, Pantex no longer operates this system, although groundwater monitoring will continue for a period of time to evaluate the long-term effectiveness of the removal.

Fig. 1-4. Former Burning Ground SVE System wells and modifications.

1.3.2 Protective Covers

The RA for landfills included installing and maintaining protective covers for the Former Burning Ground Ash Disposal Trench (SWMUs 14 through 27), the former operational area of FS-5, and 27 landfill units depicted in Fig. 1-3. These protective covers were either placed after landfilling operations ceased or were installed as interim corrective measures (ICMs) under State RCRA Authority to prevent worker contact and the infiltration of water through landfill materials that could lead to migration of contaminants to the underlying aquifer without mitigation.

Construction of all protective covers was completed and approved in 2009. All but two covers are constructed of soil, with the two landfills, Landfill 1 and 2, having Closure Turf installed over the soil cover. Closure Turf was installed at Landfill 1 in 2013 and at Landfill 2 during 2017. Refer to the respective annual reports for the Closure Turf installation information.

1.3.3 Ditch Liners

A total of five ditch sections representing SWMUs 2 and 5-05, with a total length of approximately 832 ft, were lined as an ICM in 2004 to prevent migration of vadose zone soil contamination to the perched groundwater. The ditch liner location is depicted in Fig. 1-3.

The synthetic liner was installed in sections, constructed by welding together smaller sections in the factory using a single-track hot wedge fusion machine. The edges of the liner were anchored into the shoulders of the ditches at least 1-ft deep to control erosion and guard the liner edges against uplift from strong winds. River rock was placed in the bottom of the lined ditches to provide ballast for the liner and protect against uplift. The river rock ballast was replaced by Platipus® anchors in 2011.

Between December 2016 and March 2017, a new 45-millimeter Hypalon® liner was installed over the existing SWMUs 2 and 5-05 ditch liner. Before installing the new liner, sediment, debris, and water were removed from the ditch areas. An anchor trench was excavated around nearly all sides of the liner emplacement and used to secure the new liner around the outer edge of the ditch. A total of 163 Platipus® anchors were installed at approximately 5-ft intervals, typically located at the bottom of the ditch, to further secure the liner in place.

The Platipus® device consists of a flat metal anchor attached to a wire driven two ft vertically into the ground with a pivot set horizontally and a plastic plate tightened to the surface of the liner. At the anchor location, the surface of the liner is then patched to create a water-tight seal. Ten anchors were not installed as planned due to potential interferences with utilities. The Hypalon liner was installed in sections and physically attached and sealed to existing penetrations (e.g., culverts, pipes). The liner was attached to concrete structures including the headwalls and the 12-83 building foundation. Seams were welded and sealed in the field.

1.4 Groundwater Remedial Actions

In accordance with the IAG and HW-50284, Pantex has implemented actions to remediate the contaminated perched groundwater. Two types of active remediation systems (see Fig. 1-5) 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 RAs focus on the following tasks:

- Clean up perched aquifer to the groundwater protection standard (GWPS).
- Reduce perched water levels to protect the underlying drinking water aquifer (i.e., Ogallala Aquifer) and prevent growth of plumes.
- Implement institutional controls to restrict perched groundwater use without treatment and 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

ISB Systems

- Zone 11 ISB
- Southeast ISB
- Southeast ISB Extension
- Offsite ISB
- Perchlorate/Chromium ISB
- County Road 8 ISB

Institutional Controls

Groundwater deed restrictions have been recorded in the county record for Pantex, TTU property, and three neighboring offsite properties. Two of the offsite restrictions were recently completed in 2021 and 2022 to prevent use of the perched groundwater and restrict drilling into or through the perched groundwater. The original restrictions were provided to TCEQ and EPA in the *Final Pantex Interim Remedial Action Report* (IRAR) (Pantex, 2010a). The two recent deed restrictions were provided to TCEQ and EPA in a comment response letter for the ESD (Pantex, 2022b and 2022c). The two newest restrictions will be removed once remediation is complete at the offsite properties. Fig. 1-5 provides the location of deed restrictions at Pantex, TTU, and offsite properties and also depicts the groundwater remediation systems installed at Pantex.

Two pump and treat systems were installed to address contamination in areas with generally greater than 15 ft of saturation in the perched aquifer. These systems are designed to remove and treat perched groundwater to reduce contaminant mass and the perched aquifer's saturated thickness. Reduction in saturated thickness should significantly reduce the migration of contaminants both vertically and horizontally so that natural breakdown processes can occur over time. Two mobile pump and treat systems were recommended for the future to control plume movement and reduce concentrations offsite and at an area that will continue to contribute high concentrations of hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) to the offsite area in the future. The Offsite Mobile Pump and Treat System has been installed and was operated in 2024. The Northeast Mobile Pump and Treat System wells have been installed. After evaluation of pumping rates in those wells, it has been determined that the new wells will not pump enough to conduct pump and treat operations. Pantex is planning to inject those wells to lower concentrations of RDX that will move to the southeast. The system will be renamed as the Northeast ISB and operations are expected to begin when funding is available for construction of infrastructure (pad and water line for supply water to mix with molasses) and injection operations.

Pantex has installed ISBs to reduce the concentration of contaminants as they migrate through the remediation zone in targeted areas of the groundwater plumes. Currently, Pantex has six ISB systems, two of which were newly installed in 2024 to reduce risk to the offsite area to the southeast and to the Ogallala Aquifer that lies beneath the northeast TTU property.

Each of the current remediation systems is detailed in the following sections. Newly planned or installed systems will be included in future reports when they begin operating.

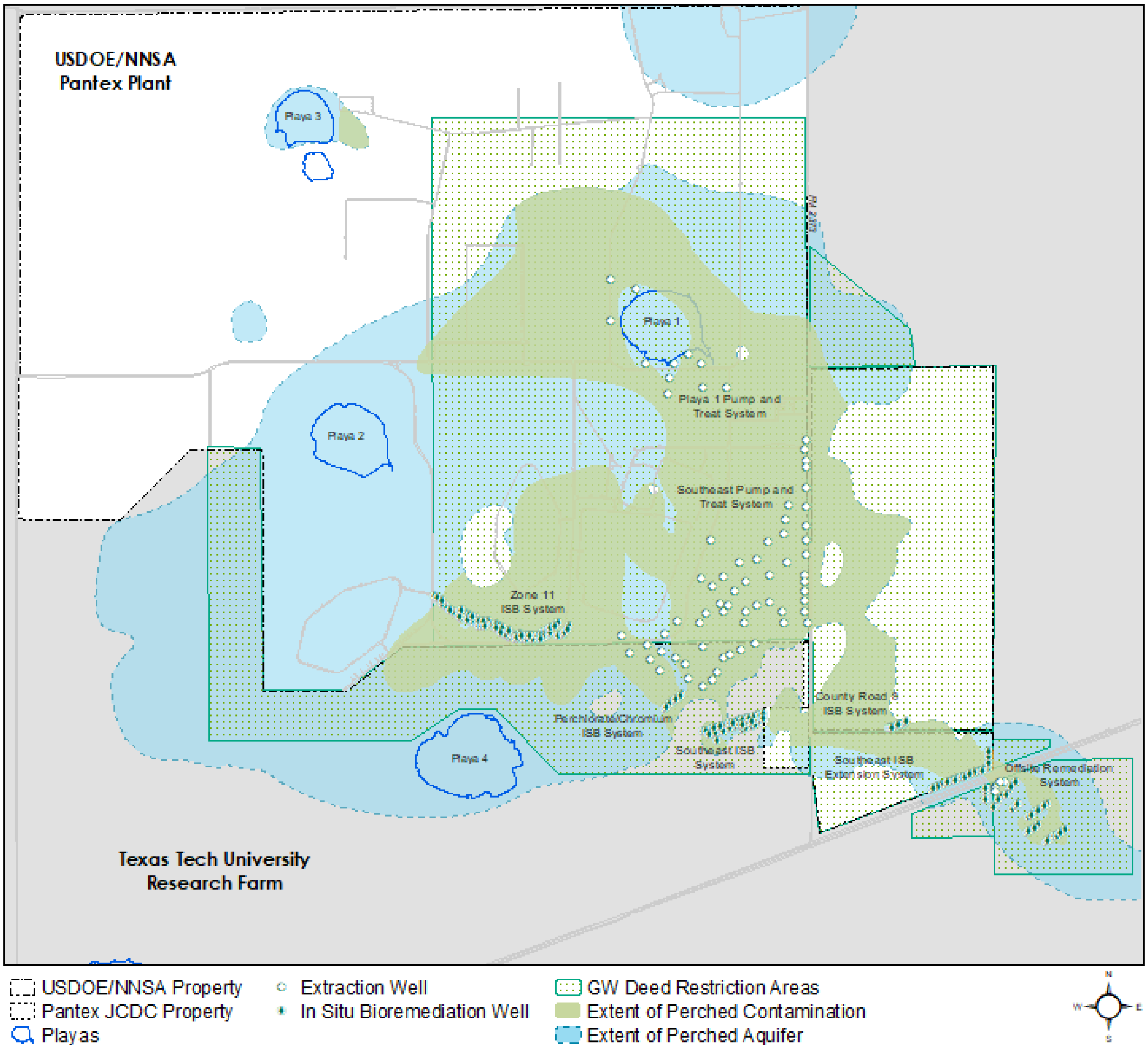

Fig. 1-5. Groundwater Remedial Actions.

1.4.1 Pump and Treat Systems

As part of the RA, Pantex installed two pump and treat systems, the Southeast Pump and Treat System (SEPTS) and the Playa 1 Pump and Treat System (P1PTS), with four injection wells and 76 extraction wells that currently treat up to a total of 550 gallons per minute (gpm) of contaminated perched groundwater. The systems address contamination in areas that generally had greater than 15 ft of saturation in the perched aquifer at the time of system installation. These systems were designed to remove and treat groundwater to achieve contaminant mass reduction as well as 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. Operational goals for the two systems, as operated in 2024, are provided in the highlight box. Based on results of the pump and treat optimization (Hydrogeologic HydroGeoLogic [HGL], 2021a), Pantex realigned the pump and treat system (PTS) operational goals in early 2023 to ensure that SEPTS will be prioritized for operation to continue to capture the RDX, perchlorate, and hexavalent chromium plumes.

> ***PTS Operational Goals***
>
> 1. Achieve 90% operation time and 90% design capacity flow at both systems when the irrigation systems can receive treated water. Treated water is also managed through injection to the Playa 2 area and ISBs.
> 2. If well field capacity cannot provide 90% design capacity flow, operate systems at highest flow possible using a combination of irrigation, ISB injection and Playa 2 injection for treated water release. Maintain a minimum of 150 gpm flow at each system.
> 3. When the irrigation systems limit flow, operation of SEPTS is priority. Maintain 90% operation time and flow at SEPTS or highest flow possible. Operate P1PTS if minimum flow of 150 gpm can be achieved and there are available outlets for water release. All water outlets, including irrigation, ISB injection, Playa 2 injection and injection well near SEPTS will be used. Release to Playa 1 in accordance with permit limits may be used if needed. Operate P1PTS for a few days monthly or quarterly to maintain operability, if the system must be shut down to operate SEPTS at the highest rate possible.

To achieve mass reduction and reduction in saturated thickness, PTSs treat extracted water and remove contaminants before the effluent is sent for beneficial use to the wastewater treatment facility (WWTF) lagoons and the center pivot irrigation system, or to the subsurface irrigation system once communication failures are repaired. 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 installed a bulk water station at the SEPTS that began operating in 2016 to allow beneficial use in accordance with the Texas Land Application Permit (TLAP). While the primary use option is irrigation and ISB injection, the SEPTS retains the capability to inject back into the perched zone as necessary. Currently four wells are used for injection back into the perched aquifer. The wells occur in two areas: Pantex has installed an injection system near Playa 2, consisting of three injection wells and conveyance to that area, and one well near the SEPTS system. The new system goals prioritize irrigation, ISB injection, and injection into the Playa 2 injection wells to maintain full operation of both pump and treat systems. If irrigation release is limited, injection into the well near the SEPTS is also used. Pantex can use release to Playa 1, in accordance with TCEQ permit requirements. Release to Playa 1 is used only as a last option to ensure continued operation of SEPTS. Playa 1 has been used for release by the WWTF while repairs continued at the subsurface irrigation system and to the WWTF lagoons. Pantex started operating the pivot irrigation system in late 2023, and release to Playa 1 is expected to be discontinued or reduced once the lagoon repairs are complete. Pantex will continue to periodically rely on release to Playa 1 until the subsurface irrigation system communication components are repaired so that release of treated water to irrigation during freezing periods can occur.

The P1PTS began start-up operations 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 since been expanded with additional extraction wells and the capacity to treat boron, perchlorate and hexavalent chromium to become part of the final RA for the southeastern portion of the groundwater plumes. A list of the extraction and injection wells and their status is included in Section 1.6.

A new mobile pump and treat system was installed at the Offsite ISB, and is referred to as the Offsite Mobile Pump and Treat System (OMPTS). This system occurs in the northwest corner of the offsite leased property, where five extraction wells have been installed. The purpose of the system is to help pull water from the neighboring property to the west, where there is no active remediation. This will help remediate the adjacent western property in a shorter time frame.

1.4.1.1 Playa 1 Pump and Treat System

The P1PTS extracts water from 11 wells near Playa 1 and treats it through a series of granular activated carbon (GAC) beds to reduce high explosives (HEs) below the GWPS established in the ROD and HW-50284. This system focuses on reducing the mound of perched groundwater associated with Playa 1, thereby affecting the movement of the southeast plume by reducing the hydraulic head and achieving mass removal. This system is designed to treat up to 250 gpm.

This system consists of a treatment building and 11 extraction wells that treat small amounts of HEs and volatile organics such as trichloroethene (TCE). Boron is treated using an ion exchange vessel to concentrations below 500 micrograms per liter (ug/L) when the water will be used for irrigation purposes. In 2023, Pantex evaluated perched groundwater at P1PTS for the presence of per- and poly-fluoroalkyl substances (PFAS). PFAS were discovered at low concentrations. Thirteen PFAS were identified in the influent to the system. The current P1PTS GAC treatment is removing PFAS, along with the high explosives below regulatory standards. Since the primary focus of this system is to remove water, only small amounts of COCs are removed during the treatment process as high explosive concentrations have greatly declined in groundwater beneath Playa 1. Fig. 1-6 depicts the P1PTS wells and conveyance.

P1PTS beneficially uses all treated water by sending it through the WWTF to the subsurface irrigation system or to the new pivot irrigation system. Because this system cannot 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. In 2017, a break occurred at the subsurface irrigation system, so irrigation usage was discontinued until the center pivot irrigation system started operation in late 2023.

Operating under a permit issued by the State of Texas, Pantex can release treated wastewater to Playa 1. Pantex continued to release WWTF and pump and treat effluent to Playa 1 through 2024 while repairs were completed at the onsite subsurface irrigation system and WWTF lagoons. Repairs were completed at the subsurface irrigation system, but it is now experiencing communication failures that are being investigated. Additionally, storage at the WWTF lagoons continues to be limited as repairs continue at that facility. While communication failure repairs and repairs at the lagoons are ongoing, the WWTF continues to release water to Playa 1, in accordance with the TCEQ permit. Pantex anticipates that release to Playa 1 will end once the WWTF lagoon repairs and repairs at the subsurface irrigation system are complete. The repairs at the WWTF heavily impacted the ability to fully operate P1PTS throughout 2024, however Pantex completed installation of a second irrigation system east of FM 2373 to allow beneficial use of water from both pump and treat systems. The new center pivot system construction was complete in August 2023, and it was successfully used as a beneficial use outlet throughout 2024 and alleviated water release to the WWTF and Playa 1.

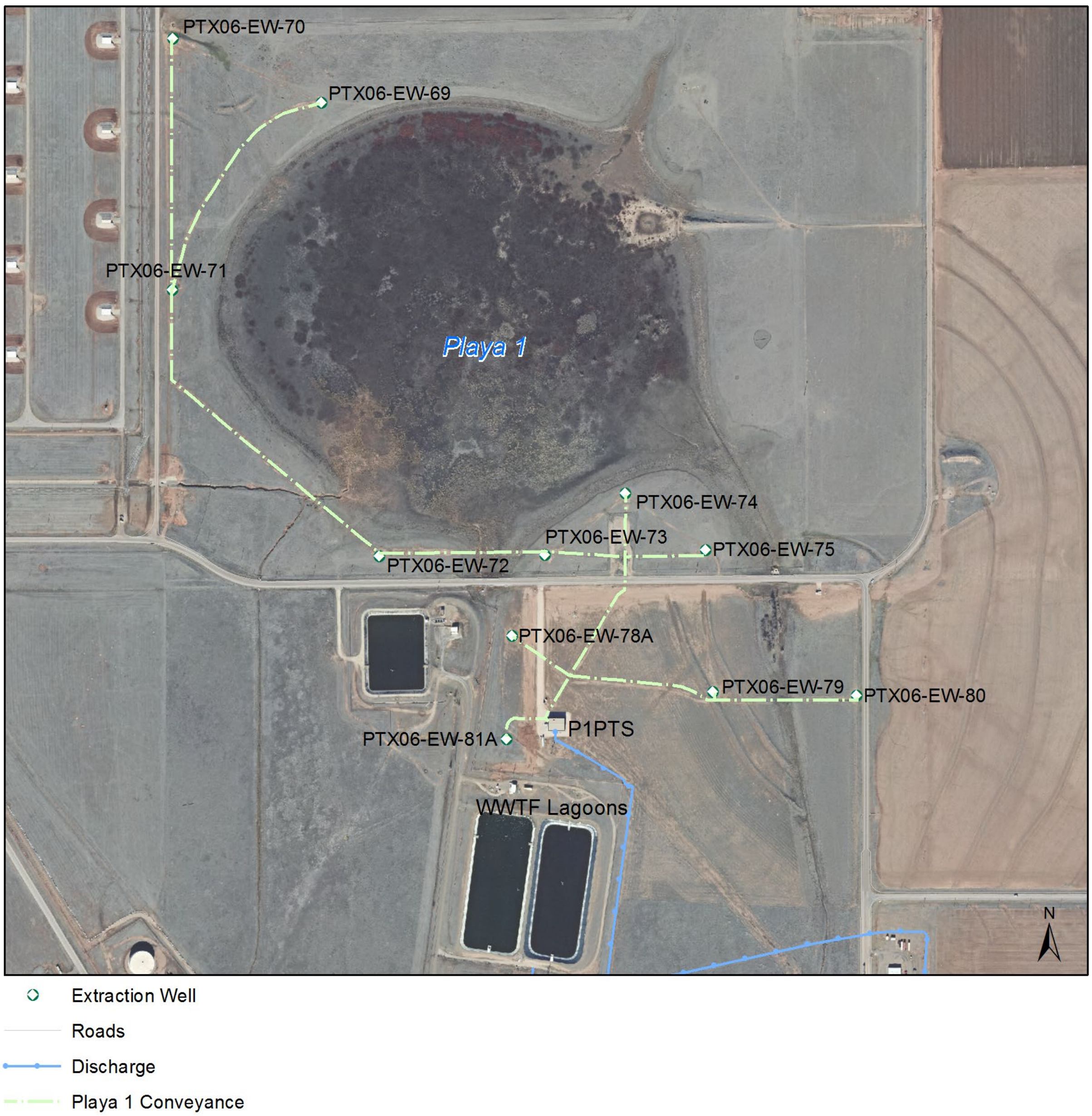

Fig. 1-6. P1PTS wells and conveyance lines.

1.4.1.2 Southeast Pump and Treat System

The SEPTS was originally installed at Pantex in 1995 as part of a treatability study. Since then, the PTS 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, 65 extraction wells and four injection wells (see Fig. 1-7). Of the 65 extration wells included in Appendix B, Pantex operated 57 due to a decrease in saturated thickness at some locations that limits the amount certain wells can be pumped. Six extraction wells were drilled east of FM 2373 to provide additional control of plume movement to the southeast. The wells were tied in to the SEPTS and started operating by May 2019. Due to declining water levels in that area, Pantex was able to consistently operate only two of the six new extraction wells through August 2024. After August, these wells were not operated through the remainder of the year. To optimize control and cleanup of that plume, Pantex plans to convert those wells into ISB injection wells in 2025. These wells will not be operated as extraction wells after 2024.

The SEPTS is designed to treat up to 300 gpm. Treatment of the recovered perched groundwater is completed through a series of GAC vessels and ion exchange resin beds to reduce concentrations below the GWPS established in the ROD and HW-50284. Primary contaminants treated by this system include HEs, hexavalent chromium, and perchlorate. There are other minor plumes in the area, including TCE, that are treated by the SEPTS. Boron is treated to below 500 ug/L when the water will be used for irrigation purposes. Pantex designed and installed a new resin pre-treatment system for perchlorate in 2022.

Pantex started evaluating SEPTS for the possible presence of PFAS in 2023. PFAS was found in the influent to SEPTS and at individual extraction wells. Eleven PFAS compounds continue to be found in the influent to SEPTS. Perfluorooctanoic acid (PFOA) detections were the highest concentrations found. The GAC treatment that was designed to treat high explosives is also removing PFAS from the perched groundwater to levels below regulatory standards.

The objective of the SEPTS is to remove and treat contaminated perched groundwater for industrial and/or irrigation use. While this system can inject 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 effort will achieve the following two important objectives:

- Gradual reduction of the volume of perched groundwater and contamination moving downgradient toward the extent of the perched aquifer.
- A reduction in the head (i.e., 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 were established for this system, as presented in the highlight box in Section 1.4.1. Goals are prioritized for system operation and will be met as conditions allow. Based on observed extensions of the RDX plume and optimization modeling conducted for the PTSs, Pantex revised the operational goals in early 2023. Based on optimization modeling and observations of plume movement, it is clear that operation of the SEPTS is necessary to control the RDX plume and reduce future risk due to movement of the plume to the southeast; therefore, the goals emphasize the operation of SEPTS when water outlets are limited for the pump and treat systems. Pantex started operating the two pump and treat systems under the new goals, once approved by the TCEQ in a letter dated April 13, 2023.

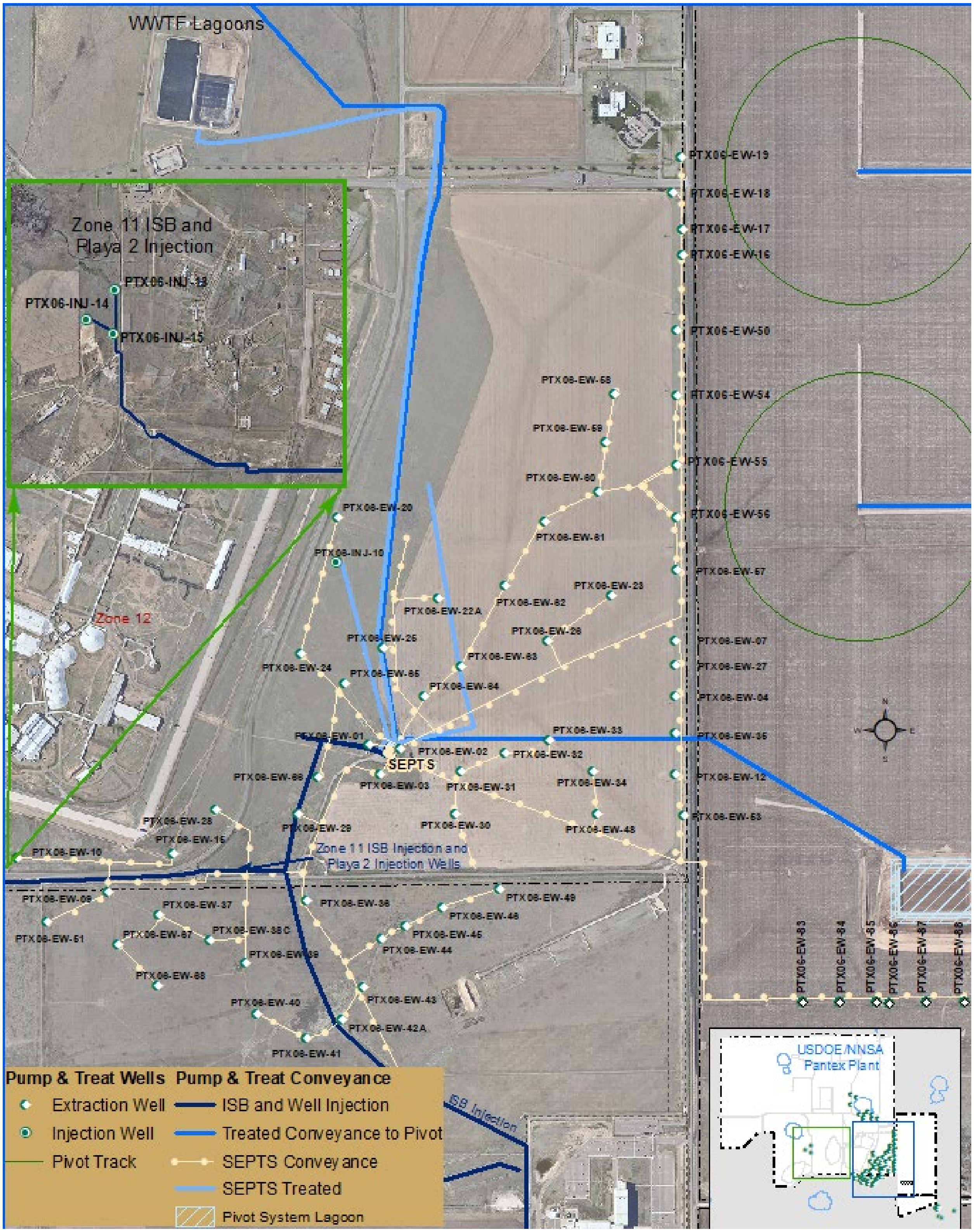

Fig. 1-7. SEPTS wells and conveyance lines.

1.4.1.3 Offsite Mobile Pump and Treat System

The OMPTS was installed in 2023 to help remediate the western area adjacent to the offsite leased property. This system consists of five extraction wells and three injection wells and has the capability to route effluent water to the offsite ISB system to be used beneficially for injections. Since the OMPTS operation is tied to the requirements developed from the design of the offsite ISB System, its goals differ from the SEPTS and P1PTS. The goal of the OMPTS is to pull water from the neighboring property, where no active remediation occurs, and assist in the treatment of RDX and its breakdown products. The OMPTS began operations in 2024 and was utilized throughout the warm months before it was winterized in late October. All treated effluent water from the OMPTS has been reused for offsite ISB injections.

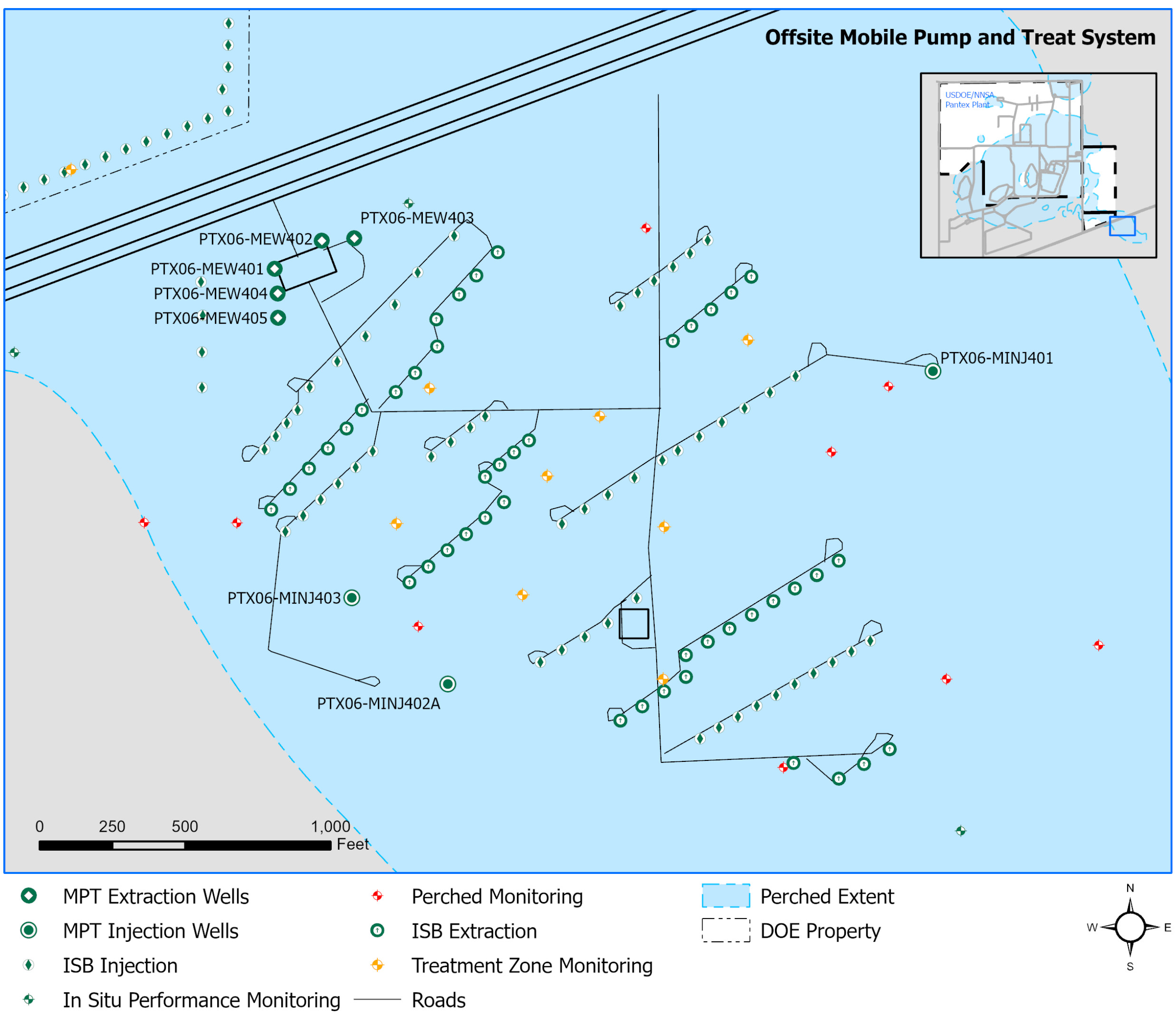

Fig. 1-8. Offsite Mobile Pump and Treat.

1.4.2 In Situ Bioremediation Systems

Pantex has installed and operated five ISB systems as part of the final RA for groundwater. Two operating systems are on the southeast side of the Plant on TTU property, another along the southeast property boundary east of FM 2373, one is offsite to the southeast, and the final one is south of Zone 11.

ISB Injection wells for a sixth ISB system, the County Road 8 ISB (CR8 ISB), were also installed to evaluate the plume in that area. Infrastructure for the CR8 ISB is planned for installation in 2025, pending availability of funding. The CR8 ISB will be detailed in future reports, once the system is fully installed.

In 2024, the operating ISB systems consisted of 230 ISB injection wells, 44 ISB extraction wells (REC-named wells in figures), 20 treatment zone monitoring (TZM) wells, and 18 in-situ performance-monitoring (ISPM) wells.

Pantex is in the process of converting three previously installed wells that were originally installed to be used for a mobile pump and treat system. The wells could only pump approximately 2 gpm each; rendering them unusable for the pump and treat system. The wells are intended to be converted to ISB injection since water is difficult to extract; therefore, Pantex is converting the wells to injection and will begin injecting once funding is identified to build infrastructure for injection. Pantex plans to install a pad and water conveyance line from the pivot irrigation inlet to the pad so that injections can be performed. Once the system is completely installed, the new Northeast ISB will be detailed in future reports.

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.

1.4.2.1 Zone 11 ISB

The Zone 11 ISB System is on Pantex property, south of Zone 11 (see Fig. 1-9). The system, as operated in 2024, consists of 91 active injection wells, 8 TZM wells, and 9 downgradient ISPM wells installed in a zone of saturated thickness of approximately 15 to 20 ft.

The system, originally consisting of 23 wells and 3 downgradient performance monitoring 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.

Pantex expanded the system in late 2014 to include an additional 20 injection wells (i.e., 18 new injection wells and 2 previously installed pump test wells), 3 new downgradient ISPM wells, and 3 TZM wells that will not receive injection. One TZM well was previously installed as a pump test well, and two additional TZM wells were also installed in the original system on the TCE (i.e., western) side. The TZM wells have replaced monitoring of a portion of the injection wells in the areas they are installed.

To evaluate the movement of treated water to the south of the system, Pantex also designated three established downgradient monitoring wells as ISPM wells to evaluate the movement of treated water to the south of the system. In late 2019, Pantex extended the system again with six new injection wells to the northwest. The expansion wells were installed to fully encompass the TCE and perchlorate plume that extended northwest of the original system.

In 2021, a second row of wells, consisting of 26 ISB injection wells, was added across the southern side of the ISB to address the higher concentrations of TCE that are now moving to the southeast. Those wells were spaced at approximately 50 ft to allow for use of emulsified soybean oil, which does not distribute as widely as a more soluble carbon. Five wells were infilled on the western side of the ISB due to the loss of injection capacity at nearby wells. Additionally, two TZM wells were added to the southern expanded area. One upgradient monitoring well was added to evaluate the incoming TCE plume. To avoid confusion, the well installed as a replacement for PTX06-ISB075 was renamed as PTX06-1230 and will serve as a TZM well until the original PTX06-ISB075 fails.

In 2024, Pantex installed two new ISB injection wells on the east side of the Zone 11 ISB, PTX06-ISB164 and PTX06-ISB165. The purpose of these wells is to extend the treatment zone further northeast to control the movement of the TCE plume in that area. These wells were injected in 2024, and it is expected that treatment will establish in this area in 2026.

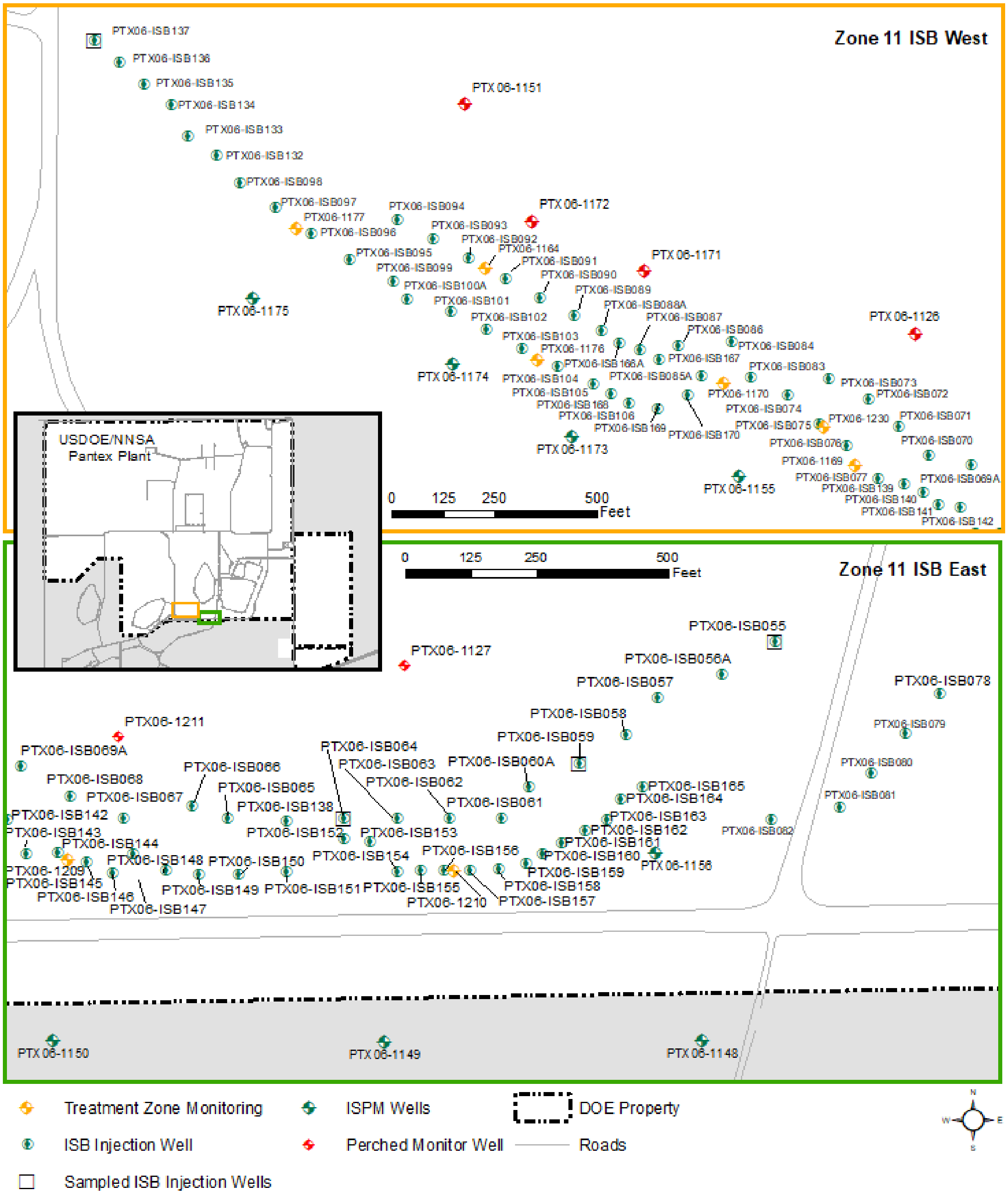

Fig. 1-9. Zone 11 ISB treatment zone and performance monitoring wells.

Installed 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. This system treats primarily TCE and perchlorate, although minor plumes of HEs are also present. Based on the rate of perched groundwater flow and estimated amendment longevity of the Newman Zone® soybean oil, injections were estimated to be necessary approximately every 12 to 36 months. Pantex has been scheduling rehabilitation and injection activities every 36 months at wells that receive the soybean oil based on data collected in the original treatment zone.

To improve amendment distribution at more widely spaced wells, Pantex recently moved to use of a more soluble amendment, molasses, for injection. However, molasses will require more frequent injections and thus has been scheduled for reinjection about every 12 months following the 2019 injection.

Sixteen injection events have been completed for this system. Table 1-3 provides the list of injection events and dates of completion.

Table 1-3. Zone 11 ISB Injection Events

Injection Event	Completion Date
1	June 2009
2	November 2009
3	September 2010
4	October 2011
5	September 2012
6	July 2013
7	July 2014
8	November 2015
9	August 2016
10	October 2018
11	January 2020
12	January 2021
13	November 2021
14	September 2022
15	December 2023
16	December 2024

The *In Situ Bioremediation Corrective Measures Construction Zone 11 South Implementation Report* (Aquifer Solutions, 2009a) documents the implementation of the Zone 11 ISB

System. That report was included with the 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) 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). Well installations are documented in the *Well Drilling Implementation Report* (Trihydro, 2014), which is also included in the *2014 Annual Progress Report*. The *Bioaugmentation Implementation Plan* (Trihydro, 2015) provides the detailed plan for injection of *Dehalococcoides sp*.

The 2019 well installations follow the design of the original well installation. The 2021 expansion was developed based on the original design, although spacing was varied depending on the type of injection expected at the wells. An additional two injection wells were added in 2024 to expand the treatment of TCE in that area. Well construction details for newly installed wells were provided in the annual report for the year that the wells were drilled.

1.4.2.2 Southeast ISB

Installed in 2007 as an early action, the Southeast ISB System is on TTU property south of Pantex and consists of 42 injection wells within the treatment zone and 5 ISPM wells (see Fig. 1-10). 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. The system is designed to treat HEs and hexavalent chromium.

Based on the rate of perched groundwater flow and estimated longevity of the Newman Zone® soybean oil, injections were originally estimated to be necessary about every 12 to 24 months. However, recent injections at this ISB are now informed by data and the presence of water in the system.

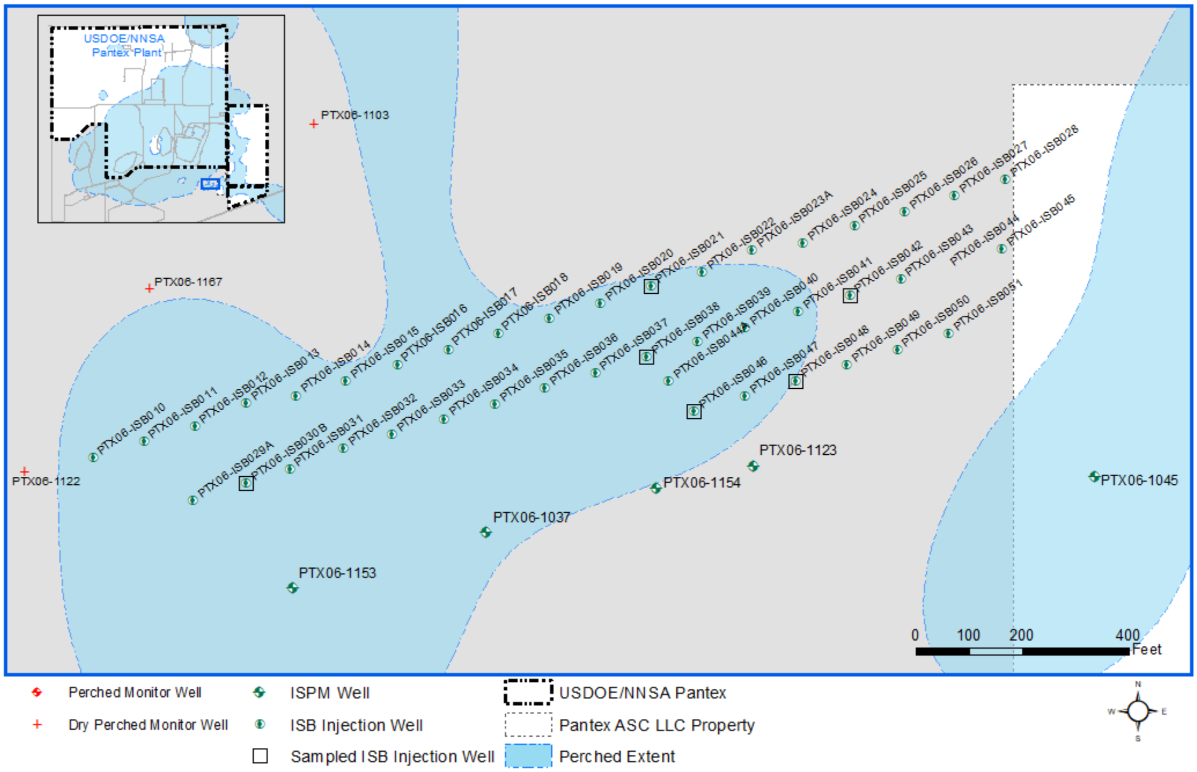

Fig. 1-10. Southeast ISB treatment zone and performance monitoring wells.

In 2019, Pantex moved to injection of molasses in this system to achieve wider distribution of amendment. With the change in substrate, another injection was completed in 2022. However, due to continued water level decline, injections are expected to cease in upcoming years. Current injections are limited to approximately 50% of the system due to increased dry areas within the system. Eight injection events have been completed for the Southeast ISB, as shown in Table 1-4.

Table 1-4. Southeast ISB Injection Events

Injection Event	Completion Date
1	March 2008
2	April 2010
3	May 2012
4	September 2013
5	April 2015
6	October 2016
7	January 2020
8	May 2022

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 IRAR (Pantex, 2010a).

1.4.2.3 Southeast ISB Extension

Pantex installed a new system in 2017 to address another area of contamination in the southeast perched groundwater. The new system is an extension of the original ISB remedy for the southeast perched groundwater plume, as provided in the ROD.

The system consists of 31 ISB injection wells, 2 TZM wells, and 2 ISPM wells. The system was originally installed in 2017 with 24 new injection wells and one monitoring well that was converted for use as an injection well. The system was expanded northward with four new ISB injection wells in 2020 and further expanded in 2021 with two new ISB injection wells and two new TZM wells. Further expansion to the north is anticipated in the future, due to observed and modeled expansion of the plume to the east.

The system was positioned to treat HE contaminants, particularly RDX, that are moving to offsite landowner property. Due to upgradient removal of water from nearby extraction wells, water levels are anticipated to decline in this system over time, and future injections will be unnecessary or limited. Fig. 1-11 depicts the Southeast ISB Extension.

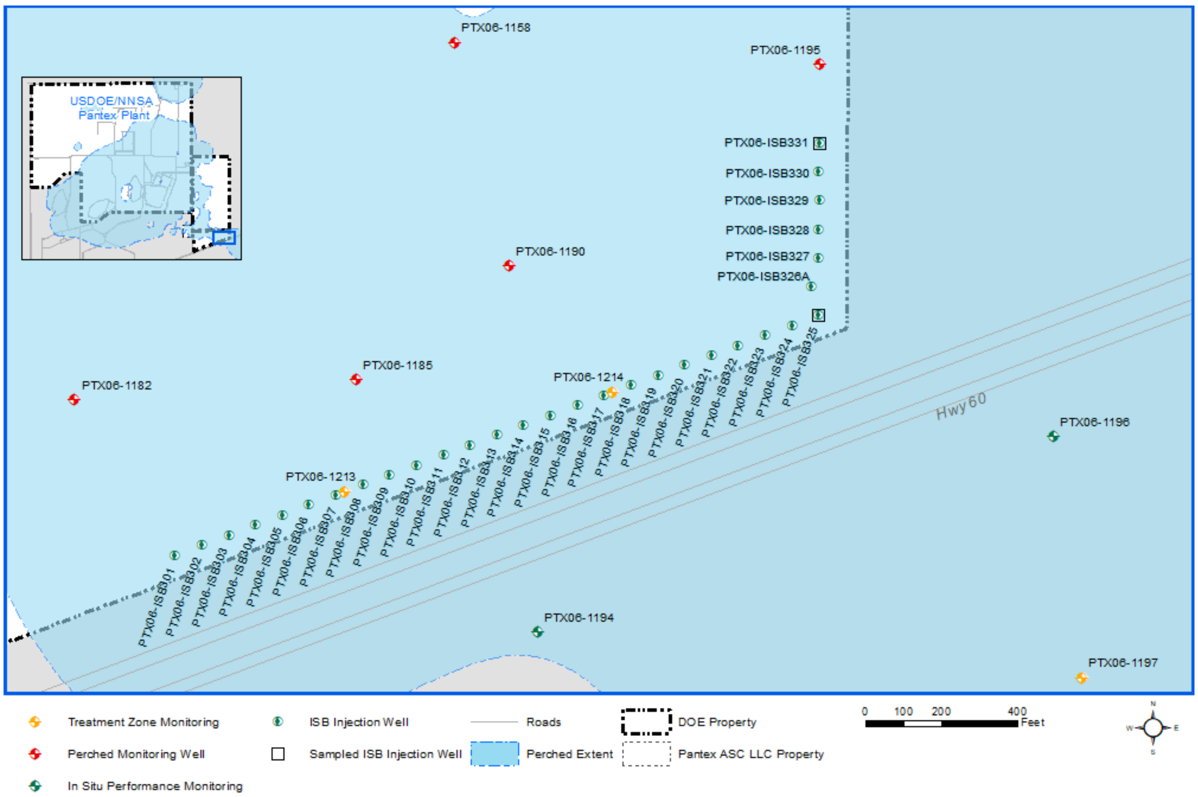

Fig. 1-11. Southeast ISB Extension treatment zone and performance monitoring wells.

Based on the rate of perched groundwater flow and estimated amendment longevity of molasses, injections are estimated to be necessary about every 12 months. As depicted in Table 1-5, eight injection events have been completed at this system.

This system was installed using a similar design to the Southeast ISB. Wells were more closely spaced at 75 ft to ensure better distribution of amendment. The implementation of this system was documented in the 2018 Annual Progress Report (Pantex, 2019d) as part of the implementation report for drilling. Wells drilled in the future will be added to the Well Certifications and Completion Diagrams appendix in each year's annual progress report.

Table 1-5. Southeast ISB Extension Injection Events

Injection Event	Completion Date
1	February 2019
2	September 2019
3	August 2020
4	May 2021
5	December 2021
6	September 2022
7	October 2023
8	September 2024

1.4.2.4 Offsite ISB

To address HE contamination that moved beneath a neighboring property, Pantex began installing an offsite ISB system in 2020 with installation complete in 2023. Pantex has reserved a few wells that would not currently be within the plume of HE contamination. Those wells will only be installed if needed to mitigate HEs due to plume growth. This ISB is located to the southeast of Pantex-owned property, south of Highway 60, and currently consists of 56 ISB injection wells and 44 active ISB extraction wells (REC-named wells), 8 TZM wells, and 1 ISPM well as depicted in Fig. 1-12. PTX06-1191, a former ISPM well at the Southeast ISB Extension, was converted to an injection well late in 2022 to treat a neighboring property where a small portion of the plume occurs. This well is now a part of the Offsite ISB.

The first phase of system installation in 2020 focused on beginning treatment at the leading edge and in the heart of the plume near the property's northern boundary. Three new ISB injection wells were installed on the neighboring property in 2021 and were injected in 2022, in addition to the converted ISPM well PTX06-1191. The system was expanded in 2022 with 19 ISB wells, 17 ISB extraction wells and 3 TZM wells. The final planned phased system installation was completed in 2023 and included ISB injection, ISB extraction, pump and treat injection, and TZM wells.

All water used in the injection process must be withdrawn from beneath the offsite property, so downgradient ISB extraction wells were installed. Downgradient removal also assists in pulling the amendment towards the removal wells, providing an expanded zone for COC treatment.

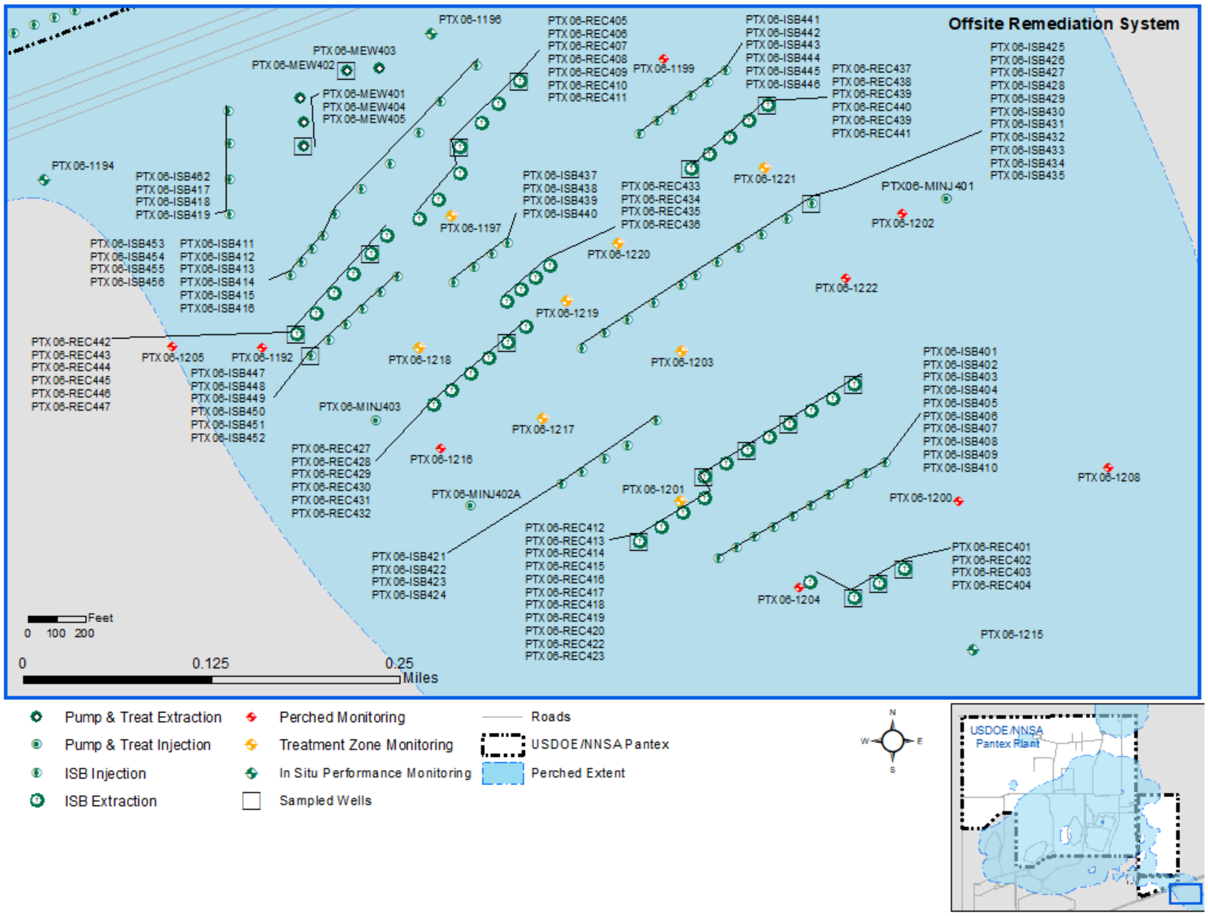

Fig. 1-12. Offsite ISB treatment zone and performance monitoring wells.

Based on the use of molasses, injections are planned every six months at differing parts of the system. Injection plans will follow the schedule that was designed using fate and transport and optimization modeling. No injections occurred in 2020 and early 2021 due to required planning, setting up of new contracts, and development of necessary infrastructure for injection. However, injection began in June 2021 and seven injection events have been completed at the system. Injection events for this system are provided in Table 1-6.

Table 1-6. Offsite ISB Injection Events

Injection Event	Completion Date
1	October 2021
2	August 2022
3	November 2022
4	August 2023
5	December 2023
6	June 2024
7	December 2024

Designed to complete cleanup within 25 years at the offsite property, the system was developed using the updated perched groundwater fate and transport model (HGL, 2021b). The final placement of wells was driven by the data collected from new system wells installed in 2020, with modeling used to determine optimum placement and timing of injections to achieve cleanup. That modeling effort has guided the plans for final placement of system wells in 2022 and 2023 as well as the future injection timing for the system wells. Based on the optimization modeling, all or portions of the injection wells are injected twice per year.

1.4.2.5 Perchlorate/Chromium ISB

The Perchlorate/Chromium ISB (PCR ISB) is located northwest of the Southeast ISB on TTU property. Newly installed in 2024, the system consists of ten ISB injection wells and two TZM wells as observed in Fig. 1-13. The purpose of the system is to treat the perchlorate and hexavalent chromium (Cr(VI)) plumes that are outside the influence of the SEPTS system as they move towards the southeast. The PCR ISB was injected for the first time in 2024, using molasses.

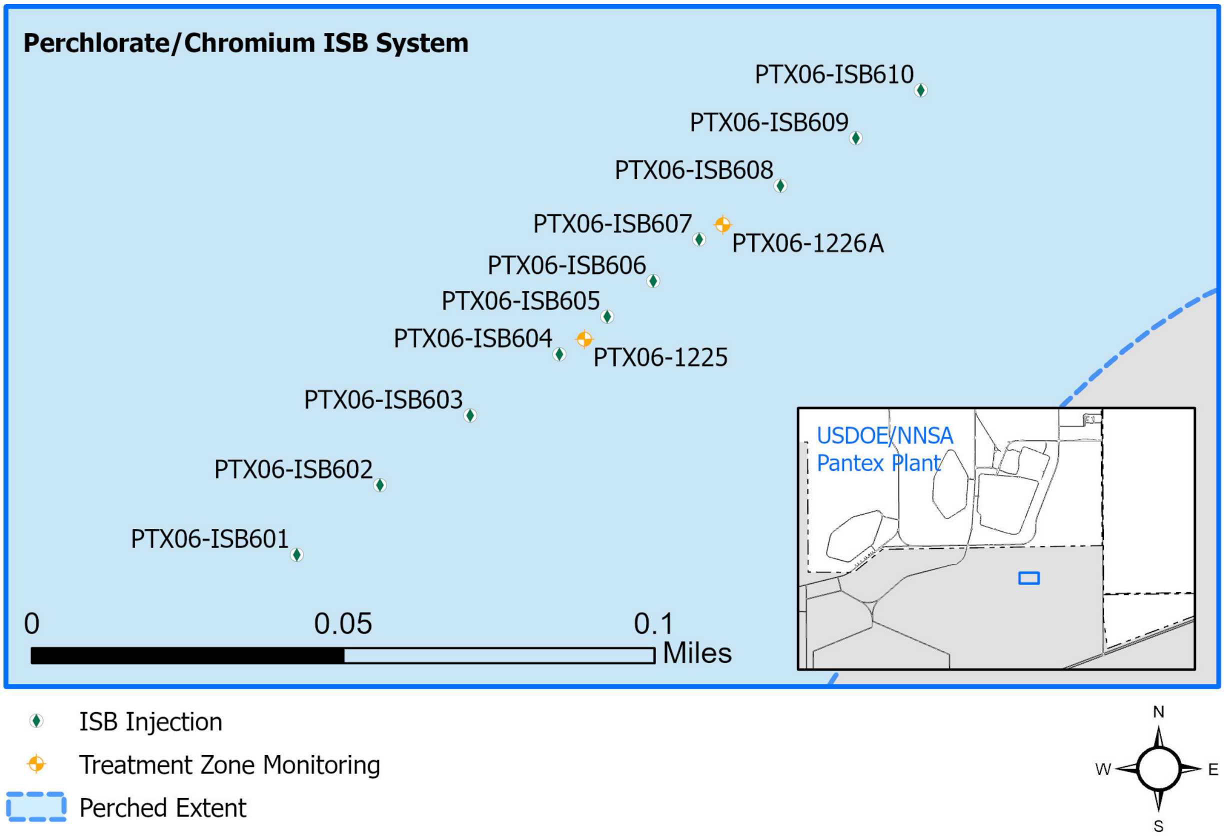

Fig. 1-13. Perchlorate/Chromium ISB System Map.

1.5 Report 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 of this report is on the data and information collected for the soil and groundwater remedies during the previous year, and the objective is to provide a more detailed account of the remedies than the quarterly reports.

Currently, Pantex does not have any active soil remedies. The Burning Ground SVE system was approved for closure, however wells in that area will continue to be closely monitored and reported on. This report also provides information on the inspection and maintenance of the ditch liner, soil covers, and fencing that are part of the RA. 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 also provides information on the O&M of groundwater remediation systems and components. Data are evaluated according to criteria outlined in the *Update to the Long-Term Monitoring System Design Report* (Pantex, 2019a). Those criteria are included in the highlight box on the left 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 in the appendices to provide an understanding of the conclusions. The appendices include detailed information such as statistical trending of concentrations and water levels at each well, electronic analytical and field-collected data, pump and treat flow data, well maintenance activities, SWMU status, contractor operational reports for the ISB, certification and well construction diagrams for new wells, implementation reports, and well-drilling reports, as applicable.

1.6 Long-Term Monitoring of Remedial Actions

Pantex has developed a long-term monitoring (LTM) network to evaluate the effectiveness of the RAs, ensure that objectives from the ROD are achieved, and confirm expected future conditions within the perched and Ogallala aquifers. The LTM design and evaluation criteria are provided in the *Update to the Long-Term Monitoring System Design Report* (Pantex, 2019a). The final system design was incorporated into the Compliance Plan portion of the hazardous waste permit when it was issued. The design was further detailed in the Compliance Plan portion of the hazardous waste permit to designate specific wells as point of exposure (POE) and point of compliance (POC) wells where the GWPS is required to be met.

Pantex also monitors extraction wells in the PTS to supplement data used to map plumes and to evaluate plume changes in the systems. ISB and TZM wells are used to monitor the health of the ISB treatment zones, and downgradient ISPM wells are used to monitor the effectiveness of the ISB RAs. Most ISPM wells also serve as POC wells in HW-50284.

All of the LTM and remedial system wells are detailed in the following sections, along with the dates of drilling or inclusion in the hazardous waste permit, as applicable.

1.6.1 Perched Aquifer LTM Network

The final perched aquifer LTM network is divided into four areas defined by indicator COC monitoring lists for wells in each area. At the end of 2024, the network consisted of the 131 perched wells. The well assets were sampled or managed according to the following criteria:

- Twenty-eight wells are monitored for continued dry or limited water conditions.
- Eighty-four wells are sampled for indicator COCs and other applicable analytes including natural attenuation products, corrosion indicators, and general water quality indicators.
- Nineteen wells are monitored as ISPM wells for the ISB systems and previous pilot study system. The ISPM wells are monitored for COCs, degradation products, and ISB treatment zone parameters.
- All 131 perched LTM wells and 47 additional wells not included in the LTM network have water levels measured semi-annually.
- Forty-two wells are sampled semi-annually, 49 wells are sampled annually, and 12 wells are sampled every five years.

- Thirty-five of the sampled wells, including 24 of the annually and semi-annually sampled wells, are sampled every five years using a modified groundwater list in Title 40 of the Code of Federal Regulation (40 CFR), Part 264, *Protection of Environment*, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," Appendix IX, to satisfy uncertainty management requirements. The modified Appendix IX monitoring list is included in HW-50284 as CP Table III. The next five-year sampling is scheduled for 2026.
- Pantex has designated 20 of the perched wells as POC wells where the GWPS must be met for all COCs. The 20 wells were updated with the application to renew HW-50284. Those wells are depicted in Fig. 1-14.
- Four indicator areas were defined for the perched groundwater. COCs to be monitored are defined for each of those areas.
- Eight previous LTM wells were removed from the network in 2024, two of which were converted to ISB injection wells, three wells changed to TZM wells, and another was plugged so that building expansion could occur, and a new one was drilled to replace it in a downgradient location. The other two wells had persistent dry conditions and were not contributing any relevant information.
- PTX08-1006 was plugged and abandoned due to its proximity to a building that requires expansion. It was replaced with new well PTX06-1234.
- PTX06-1236 was installed to address a gap in sampling along the southeast side of Zone 11 and to evaluate the long-term sourcing of TCE from Zone 11.
- The former Burning Ground SVE system has been approved for closure and is no longer operated, but Pantex will continue to monitor groundwater wells in that area as part of uncertainty management and early detection.

Table 1-7 lists all wells in the perched LTM network and HW-50284, their LTM objective, indicator monitoring area, Compliance Plan objective (POC or 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 HW-50284's CP Table VII requirements. Fig. 1-14 depicts the current active LTM wells listed in Table 1-7.

Table 1-7. Perched LTM Network and 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	P&A			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	1/4/2017	P&A			3769596.99	628496.92
PTX06-1012	ISPM Zone 11	Y	Y	6/9/2003		Active	PS, RAE		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	2/11/2020	Active			3772643.95	638901.00
PTX06-1081	Miscellaneous	Y	Y	6/9/2003	2/11/2020	Active			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, RAE		3766957.63	642103.43
PTX06-1015	Southeast	Y	Y	6/9/2003		Active	RAE		3753617.00	643765.00
PTX06-1023	Southeast	Y	Y	6/9/2003		Active	RAE	POC	3764603.10	642773.84
PTX06-1030	Southeast	Y	Y	6/9/2003		Dry	RAE		3755008.03	644670.42
PTX06-1034	Southeast	Y	Y	6/9/2003		Active	RAE	POC	3752434.98	646555.62
PTX06-1036	Southeast	Y	Y	6/9/2003		Dry	PS		3752455.56	638615.43
PTX06-1038	Southeast	Y	Y	6/9/2003		Active	RAE		3760426.35	643802.04
PTX06-1040	Southeast	Y	Y	6/9/2003		Active	RAE		3758262.93	643811.23
PTX06-1042	Southeast	Y	Y	6/9/2003		Active	RAE	POC	3755779.88	643812.20
PTX06-1046	Southeast	Y	Y	6/9/2003		Active	RAE	POC	3752292.55	643802.63
PTX06-1052	Southeast	Y	Y	6/9/2003		Active	RAE	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, RAE		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	RAE		3752194.06	641549.25
PTX06-1045	ISPM Southeast	N	Y	9/16/2010		Active	RAE	POC	3752300.00	642697.65
PTX06-1118	ISPM Southeast	N	Y	9/16/2010	2/11/2020	Active			3752736.07	641644.92
PTX06-1123	ISPM Southeast	N	Y	9/16/2010		Active	RAE		3752319.94	642051.96
PTX06-1153	ISPM Southeast	N	Y	9/16/2010	Date Pending	Inactive	RAE	POC	3752089.44	641184.13
PTX06-1154	ISPM Southeast	N	Y	9/16/2010		Active	RAE	POC	3752278.90	641870.52
PTX06-1155	ISPM Zone 11	N	Y	9/16/2010		Active	RAE	POC	3755215.62	634603.74
PTX06-1156	ISPM Zone 11	N	Y	9/16/2010		Active	RAE	POC	3755076.47	636378.92
PTX04-1001	Miscellaneous	N	Y	9/16/2010	2/11/2020	Active			3772334.66	641458.10
PTX06-1049	Miscellaneous	N	Y	9/16/2010		Active	PS		3763376.96	633343.53
PTX06-1055	Miscellaneous	N	Y	9/16/2010	2/11/2020	Active			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	2/11/2020	Active			3766548.35	630823.57
PTX06-1097	Miscellaneous	N	Y	9/16/2010		Dry	PS		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	2/11/2020	Active			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, RAE		3765214.16	640649.01
PTX06-1050	North	N	Y	9/16/2010		Active	UM, RAE	POC	3766622.06	636746.04
PTX06-1136	North	N	Y	9/16/2010		Dry	PS		3766771.76	634860.83

Well ID	Indicator Area	ISM Well[1]	LTM Well[2]	CP Approval Date	CP Removal Date	Well Status	LTM Objectives	POC/ POE	Northing	Easting
PTX07-1O01	North	N	Y	9/16/2010	3/15/2025	Active	PS, UM, RAE		3767695.22	638532.53
PTX07-1O02	North	N	Y	9/16/2010		Active	PS, UM, RAE	POC	3768117.46	639106.56
PTX07-1O03	North	N	Y	9/16/2010		Active	PS, UM, RAE		3767462.56	639046.64
PTX07-1O06	North	N	Y	9/16/2010	2/11/2020	Active			3768536.81	638814.40
PTX06-1002A	Southeast	N	Y	9/16/2010		Active	UM, RAE		3759984.00	641161.56
PTX06-1003	Southeast	N	Y	9/16/2010	2/11/2020	Active			3758711.05	641498.93
PTX06-1005	Southeast	N	Y	9/16/2010		Active	UM, RAE		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	RAE		3764075.09	643710.38
PTX06-1014	Southeast	Y	Y	9/16/2010		Active	RAE		3755125.71	643758.88
PTX06-1031	Southeast	Y	Y	9/16/2010		Active	RAE		3753348.03	644674.92
PTX06-1039A	Southeast	N	Y	9/16/2010		Active	RAE		3759272.56	643807.47
PTX06-1041	Southeast	N	Y	9/16/2010		Active	RAE		3757622.78	643803.61
PTX06-1047A	Southeast	N	Y	9/16/2010		Active	RAE		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, RAE		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	2/11/2020	Active			3751494.55	643813.77
PTX06-1095A	Southeast	N	Y	9/16/2010		Active	UM, RAE		3755598.65	640634.87
PTX06-1098	Southeast	N	Y	9/16/2010	3/15/2025	Active			3753628.43	640266.14
PTX06-1100	Southeast	N	Y	9/16/2010	2/11/2020	Active			3753579.52	640285.97
PTX06-1101	Southeast	N	Y	9/16/2010		Active	RAE		3753437.09	640383.57
PTX06-1102	Southeast	N	Y	9/16/2010		Dry	RAE		3754532.94	642751.09

Well ID	Indicator Area	ISM Well[1]	LTM Well[2]	CP Approval Date	CP Removal Date	Well Status	LTM Objectives	POC/ POE	Northing	Easting
PTX06-1103	Southeast	N	Y	9/16/2010		Dry	RAE	POC	3752963.37	641222.64
PTX06-1119	Southeast	N	Y	9/16/2010	2/11/2020	Active			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		Dry	PS		3752750.09	643645.57
PTX06-1122	Southeast	N	Y	9/16/2010		Dry	PS		3752308.74	640677.35
PTX06-1124	Southeast	N	Y	9/16/2010	2/11/2020	Active			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	RAE	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		Dry	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, RAE		3763003.22	640859.00
PTX08-1009	Southeast	N	Y	9/16/2010		Active	UM, RAE		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	POC	3755562.85	635034.72
PTX06-1127	Zone 11	N	Y	9/16/2010		Active	PS	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, RAE		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, RAE		3754718.24	635233.98

Well ID	Indicator Area	ISM Well[1]	LTM Well[2]	CP Approval Date	CP Removal Date	Well Status	LTM Objectives	POC/ POE	Northing	Easting
PTX06-1151	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, RAE		3762976.26	638941.45
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	3/15/2025	Active	UM		3756761.86	636400.41
PTX06-1167	Southeast	N	Y	7/28/2013		Dry	RAE		3752653.00	640913.72
PTX06-1158	Zone 11	N	Y	5/30/2014		Dry	PS		3752025.93	648137.99
PTX06-1159	Zone 11	N	Y	5/30/2014		Active	PS, RAE		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	Zone 11	N	Y	11/17/2015		Active	RAE		3755312.40	634197.62
PTX06-1174	Zone 11	N	Y	11/17/2015		Active	RAE		3755489.15	633904.63
PTX06-1175	Zone 11	N	Y	11/17/2015		Active	RAE		3755651.06	633416.97
PTX06-1182	Southeast	N	Y	7/11/2016		Active	PS		3751088.49	647140.17
PTX06-1183	Southeast	N	Y	7/11/2016		Active	PS		3753350.43	639765.77
PTX06-1184	Southeast	N	Y	5/4/2017		Dry	PS		3750638.25	646625.06
PTX06-1185	Southeast	N	Y	5/6/2017		Active	PS		3751139.83	647878.41
PTX06-1190	Southeast	N	Y	11/20/2017		Active	PS		3751439.52	648281.31
PTX06-1191	Southeast	N	Y	1/22/2018	3/15/2025	Active			3750720.88	648996.85
PTX06-1192	Southeast	N	Y	1/19/2018		Active	PS		3749893.14	649119.32
PTX06-1193	Southeast	N	Y	1/24/2018		Dry	PS		3749346.75	646719.13
PTX06-1194	Southeast	N	Y	1/27/2018		Active	RAE		3750477.77	648355.41
PTX06-1195	Southeast	N	Y	1/30/2018		Active	PS		3751968.74	649096.79
PTX06-1196	Southeast	N	Y	7/20/2018		Active	RAE		3750989.94	649710.26
PTX06-1197	Southeast	N	Y	7/17/2018	3/15/2025	Active			3750355.29	649782.14
PTX06-1199	Southeast	N	Y	7/11/2018		Active	PS		3750905.45	650525.52

Well ID	Indicator Area	ISM Well[1]	LTM Well[2]	CP Approval Date	CP Removal Date	Well Status	LTM Objectives	POC/ POE	Northing	Easting
PX06-1200	Southeast	N	Y	01/07/19		Active	PS		3749356.32	651557.89
PX06-1201	Southeast	N	Y	01/10/19	3/15/2025	Active			3749355.48	650585.15
PX06-1202	Southeast	N	Y	01/12/19		Active	PS		3750361.84	651358.99
PX06-1203	Southeast	N	Y	01/25/19	3/15/2025	Active			3749879.41	650588.31
PX06-1204	Southeast	N	Y	01/29/19		Active	PS		3749051.98	650997.75
PX06-1205	Southeast	N	Y	01/23/19		Dry	PS		3749894.03	648801.56
PX06-1207	Zone 11	N	Y	1/21/2020		Active	PS		3754046.00	632911.00
PTX06-1171	Zone 11	N	Y	2/11/2020		Active	PS		3755715.08	634373.95
PTX06-1180	Zone 11	N	Y	2/11/2020		Active	PS		3756487.93	633474.07
PTX06-1208	Southeast	N	Y	4/26/2020		Active	PS		3749472.60	652081.58
PTX06-1211	Zone 11	N	Y	8/22/2021		Active	PS		3755297.21	635358.50
PTX06-1212	Southeast	N	Y	8/29/2021		Dry	PS		3753016.03	640166.01
PTX06-1215	Southeast	N	Y	4/24/2022		Active	PS		3748834.66	651607.49
PTX06-1216	Southeast	N	Y	6/24/2022		Active	PS		3749537.50	649743.32
PTX06-1218	Southeast	N	Y	5/4/2022		Active	PS		3749890.07	649667.96
PTX06-1221	Southeast	N	Y	4/27/2022		Active	PS		3750521.45	650875.74
PTX06-1222	Southeast	N	Y	8/22/2023		Active	RAE		3750136.29	651163.21
PTX06-1234	Zone 11	N	Y	10/8/2024		Active	UM		3756515.49	636518.53
PTX06-1236	Zone 11	N	Y	10/19/2024		Active	UM		3756437.88	635852.04

P&A – plugged and abandoned POC – point of compliance POE – point of exposure
PS – plume stability RAE – remedial action effectiveness UM – uncertainty management

Wells with no designation in the POC/POE column are considered observation wells. These wells are not listed in HW-50284, CP Table V, so the corresponding date of HW-50284 approval or removal date corresponds to either the date of inclusion in a Compliance Plan modification, approval letter date for the corresponding progress report where the recommendation was made to include or remove the well in the monitoring network, approval date of the LTM System Design Report, or the date the well was drilled. Typically, wells are included in the annual report the year they are drilled.

[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. CP-50284 is now included as Provision XI in HW-50284.

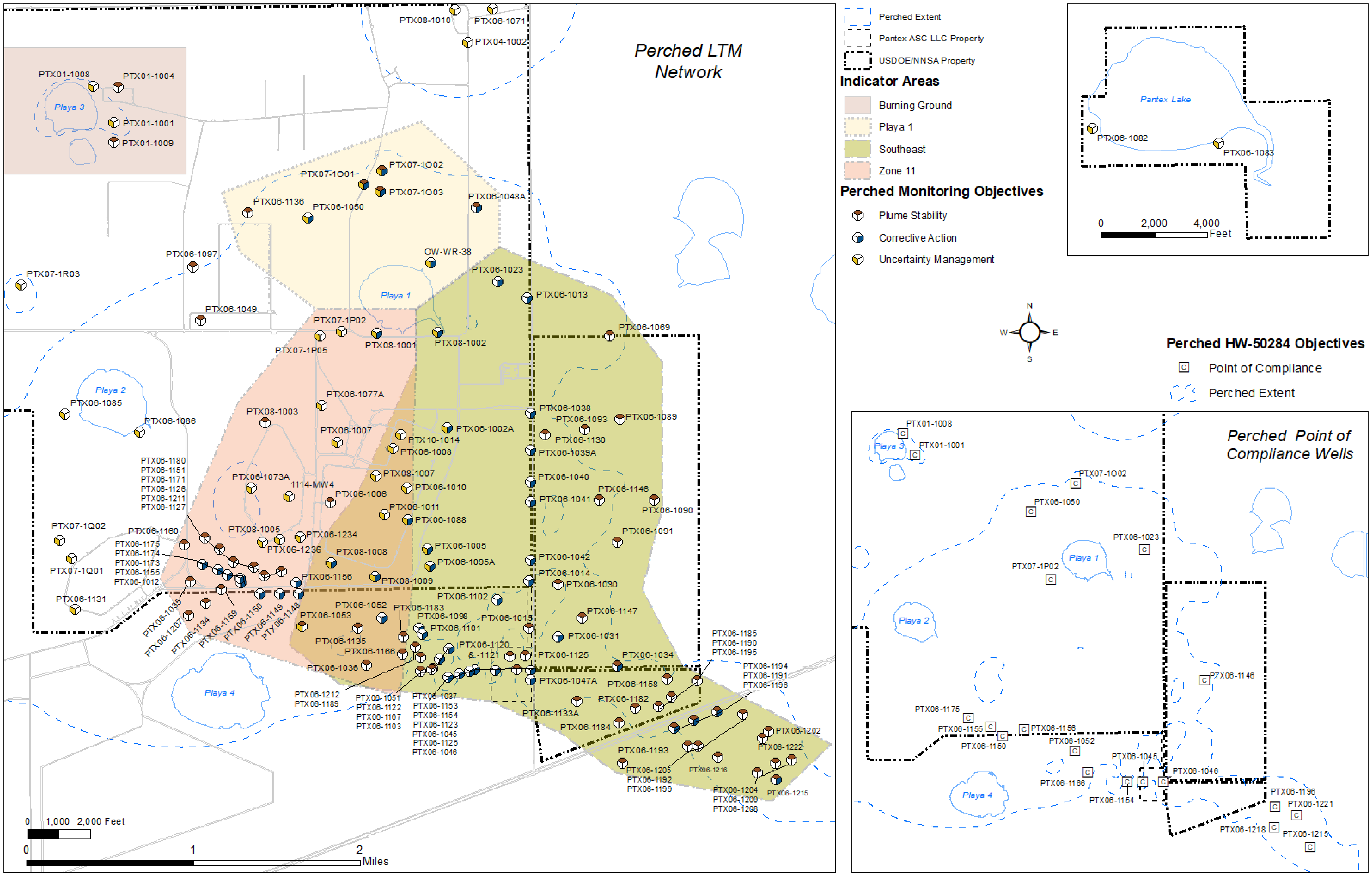

Fig. 1-14. Perched LTM network and HW-50284 CP Table V wells.

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1.6.2 Ogallala Aquifer LTM Network

The final Ogallala Aquifer LTM network consists of the 29 LTM wells and 3 additional monitoring wells along the southern boundary that are monitored annually to evaluate the quality of groundwater upgradient of the Plant. The LTM well assets are monitored and managed as follows:

- All 29 LTM wells are monitored for indicator COCs and water levels.
- Twenty-two wells are sampled semiannually and eight are sampled annually.
- Ten wells are sampled at multiple levels every five years. The baseline multi-level sampling was conducted after the wells were installed with the exception of newly installed well PTX06-1233. This well is still being developed and will be sampled at multiple depths in the coming year. All other multi-level sampling events are conducted for five-year reviews (FYRs). The next FYR sampling event is scheduled for 2026.
- Seven wells are sampled every five years using a modified groundwater analyte list from 40 CFR 246, *Protection of Environment,* "Source Separation for Materials Recovery Guidelines," Appendix IX, to satisfy uncertainty management requirements.
- Two Ogallala wells are designated as POC wells in HW-50284. The GWPS must be met at these locations, if a plume should develop in that area.
- Eight Ogallala wells are designated as POE wells in HW-50284. The GWPS must not be exceeded at these locations.
- Two indicator areas were defined for the Ogallala wells, and indicator COC monitoring lists were developed for each of those areas.
- Four new Ogallala wells were installed in 2024 to evaluate detections in the PTX06-1056 and PTX06-1229 wells.
- POE well, PTX06-1064, was damaged by agricultural equipment in 2024. Pantex requested approval from the TCEQ to plug and abandon this well by letter on November 20, 2024. TCEQ approved this request by letter on December 4, 2024. This well was plugged and abandoned on January 28, 2025 and PTX06-1062A was designated as the replacement POE well. A class 2 modification application will be submitted for this change once the updated permit is issued.

- PTX06-1076 was plugged and abandoned due to improper installation of this well that may have led to cross contamination from the perched to the Ogallala aquifer. PTX06-1076 was replaced with PTX06-1237.
- The former Burning Ground SVE system has been approved for closure and is no longer operated, but Pantex will continue to monitor groundwater wells in that area as part of uncertainty management and early detection.

Table 1-8 lists all wells in the LTM network and HW-50284, with the corresponding LTM objective, indicator monitoring area, Compliance Plan objectives (POE and POC wells), date of inclusion or removal from HW-50284, and coordinates. Fig. 1-15 depicts current active monitoring wells listed in Table 1-8 as well as the additional three wells monitored along the southern boundary. The figure also depicts the designated POC and POE wells in the Ogallala network. The wells are listed in chronological order according to their date of inclusion in HW-50284, in accordance with CP Table VII requirements.

Table 1-8. Ogallala Aquifer LTM and Compliance Plan Wells

Well ID	Indicator Area	ISM Well[1]	LTM Well[2]	CP Approval Date	CP Removal Date[3]	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	N	6/9/2003	11/15/2017	P&A	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				641522.72	3752221.24
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[4]		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	POE		633017.18	3771685.22
PTX06-1063A[5]		Y	N	6/9/2003	9/16/2010	Unknown				639265.11	3775502.62
PTX06-1064[3]	Northwest	Y	N	6/9/2003	12/4/2024	P&A	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		Y	N	6/9/2003	9/16/2010	P&A				620994.02	3765626.52
PTX06-1075[4]		Y	N	6/9/2003	9/16/2010	Active				630512.54	3753624.01
PTX06-1076	Southeast/Northwest	Y	N	6/9/2003	10/2/2024	P&A	ED, UM			637327.32	3752978.41
PTX-BEG2	Northwest	Y	N	6/9/2003	1/31/2018	P&A	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[3]	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	N		2/10/2010	P&A	ED, UM			646004.29	3752640.94
PTX06-1060[4]		N	N			Active				620969.93	3758599.72
PTX06-1223	Southeast	N	Y	5/2/2023		Active	ED, UM			642669.67	3753673.34
PTX06-1224	Southeast	N	Y	4/19/2023		Active	ED, UM		Y	644065.72	3754118.10
PTX06-1229	Southeast	N	Y	9/17/2023		Active	ED, UM		Y	642725.64	3754642.57
PTX06-1231	Southeast	N	Y	10/6/2024		Active	ED, UM		N	641635.60	3753558.70
PTX06-1232	Southeast	N	Y	11/16/2024		Active	ED, UM		N	644456.90	3757673.60
PTX06-1233	Southeast	N	Y	1/25/2025		Active	ED, UM		Y	646598.00	3759608.70
PTX06-1237	Southeast	N	Y	10/21/2024		Active	ED, UM		N	637363.50	3753017.90

P&A – plugged and abandoned POC – point of compliance POE – point of exposure

ED – early detection RAE – 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. CP-50284 is now included as Provision XI in HW-50284.

[3]The CP removal date corresponds to the date of a Compliance Plan/hazardous waste permit change or an approval letter date.

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

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

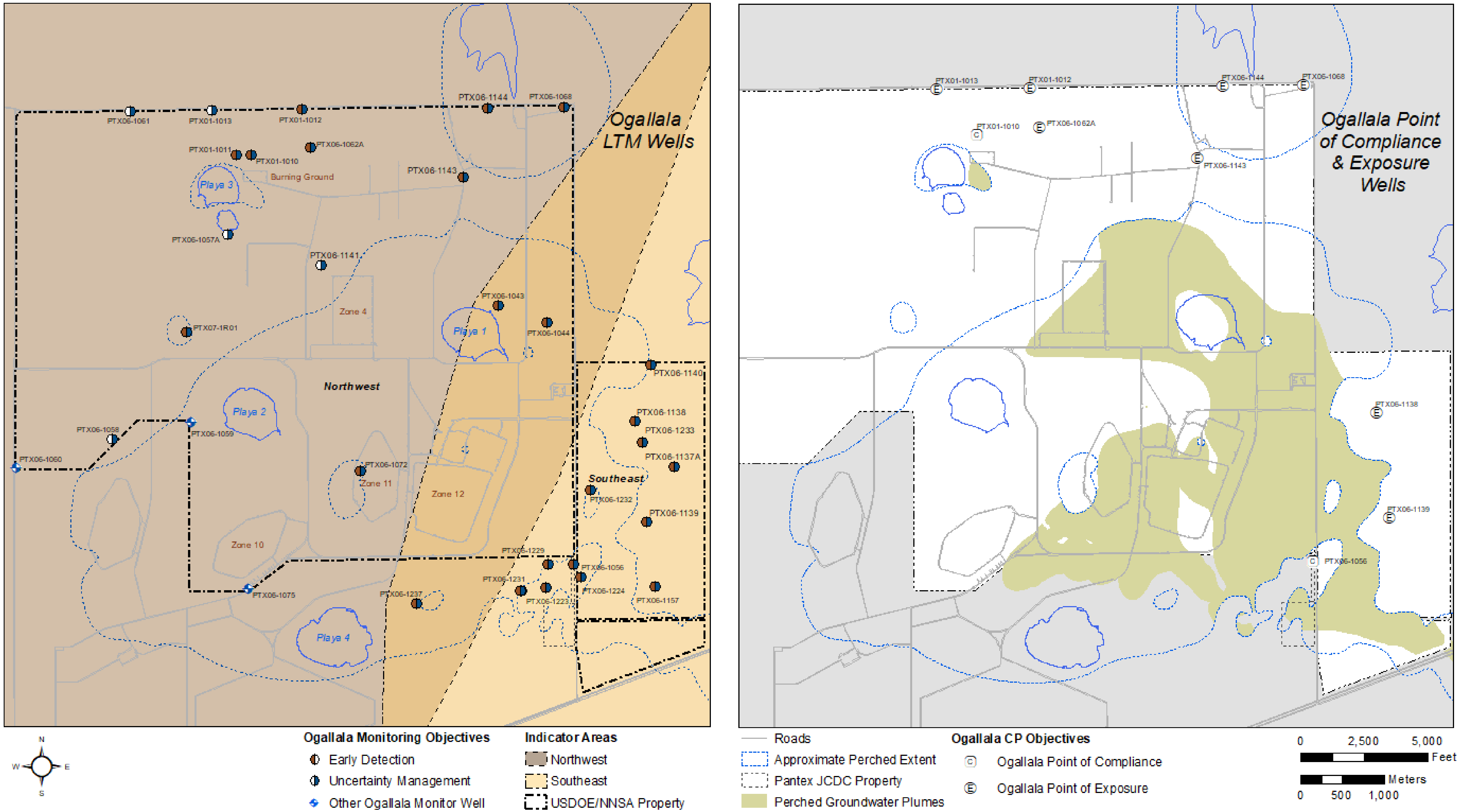

Fig. 1-15. Ogallala Aquifer LTM network and HW-50284 CP Table V wells.

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1.6.3 Remedial Action Wells

Two groundwater remedial actions (pump and treat and ISB) are being performed at Pantex. Pantex closed the SVE in 2023, however this area will continue to be closely monitored. Wells have been installed for two PTSs, a mobile PTS, six ISB systems, and the SVE system.

Table 1-9 and Table 1-10 detail all installed wells for the PTSs and for the ISB systems, respectively, as well as their current status, date of plugging and abandonment, and coordinates. Table 1-11 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 remedial action wells are used for remediation, but some wells are also monitored to provide information for the remedial action. TZM wells are installed to monitor conditions inside the treatment zone at ISB systems and are used exclusively for monitoring rather than for remediation. The RA system monitoring consists of the following:

- Fourteen active ISB wells are used to monitor treatment zone conditions in the four established ISB systems.
- Eight TZM wells are used to monitor treatment zone conditions in the Zone 11 ISB, two TZM wells at the Southeast ISB Extension, eight TZM wells at the Offsite ISB, and two TZM wells at the PCR ISB.
- Fifteen ISB extraction (named REC) wells at the Offsite ISB are monitored for carbon and reducing conditions.
- All available pump and treat extraction wells (i.e., pumping at time of sampling) are generally monitored annually during the summer. These data are used to support the plume mapping.
- Twelve wells in the SEPTS are monitored annually to evaluate the movement or change of perchlorate into those wells.

The following changes to the RA systems occurred during 2024:

- Two new ISB injection wells were added to the Zone 11 ISB.
- Ten new ISB injection wells were installed for the PCR ISB system.
- Two new TZM wells were installed at the PCR ISB.

- Ten new ISB injection wells were installed for the CR8 ISB and are awaiting infrastructure

Table 1-9. 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[1]	9/15/1996	Converted to PTX06-1206		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
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	Inactive		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

Well ID	Completion/ Replacement Date	Current Status	P&A Date	Easting	Northing
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
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-EW-82	07/26/2016	Active		644481.36	3753953.55
PTX06-EW-83	07/24/2016	Inactive		644782.02	3753953.69
PTX06-EW-84	07/21/2016	Inactive		645082.73	3753954.16
PTX06-EW-85	09/14/2015	Inactive		645382.52	3753959.20
PTX06-EW-86	09/13/2015	Active		645482.05	3753946.07
PTX06-EW-87	08/03/2016	Active		645782.09	3753953.71
PTX06-EW-88	09/12/2016	Active		646083.18	3753954.30
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	Inactive		641752.09	3758137.05
PTX06-INJ-12A	1/24/2008	P&A	5/24/2017	640737.15	3756104.67
PTX06-INJ-13	2/14/2020	Active		632833.86	3758925.67

Well ID	Completion/ Replacement Date	Current Status	P&A Date	Easting	Northing
PTX06-INJ-14	2/18/2020	Active		632209.79	3758255.51
PTX06-INJ-15	2/21/2020	Active		632812.71	3757937.70
		Playa 1 Pump and Treat System			
PTX06-EW-69	7/22/2007	Active		638869.86	3765146.41
PTX06-EW-70	8/11/2006	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	Active		639773.41	3762095.77
		Offsite Mobile Pump and Treat System			
PTX06-MEW401	8/10/2020	Active		649249.28	3750765.90
PTX06-MEW402	9/13/2020	Active		649411.98	3750861.97
PTX06-MEW403	9/17/2020	Active		649523.62	3750870.15
PTX06-MEW404	10/10/2021	Active		649260.39	3750681.12
PTX06-MEW405	10/8/2021	Active		649260.94	3750597.10
PTX06-MINJ401	9/12/2022	Active		651112.69	3749713.17
PTX06-MINJ402A	8/26/2023	Active		649844.32	3749339.38
PTX06-MINJ403	8/29/2023	Active		649514.67	3749634.99

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

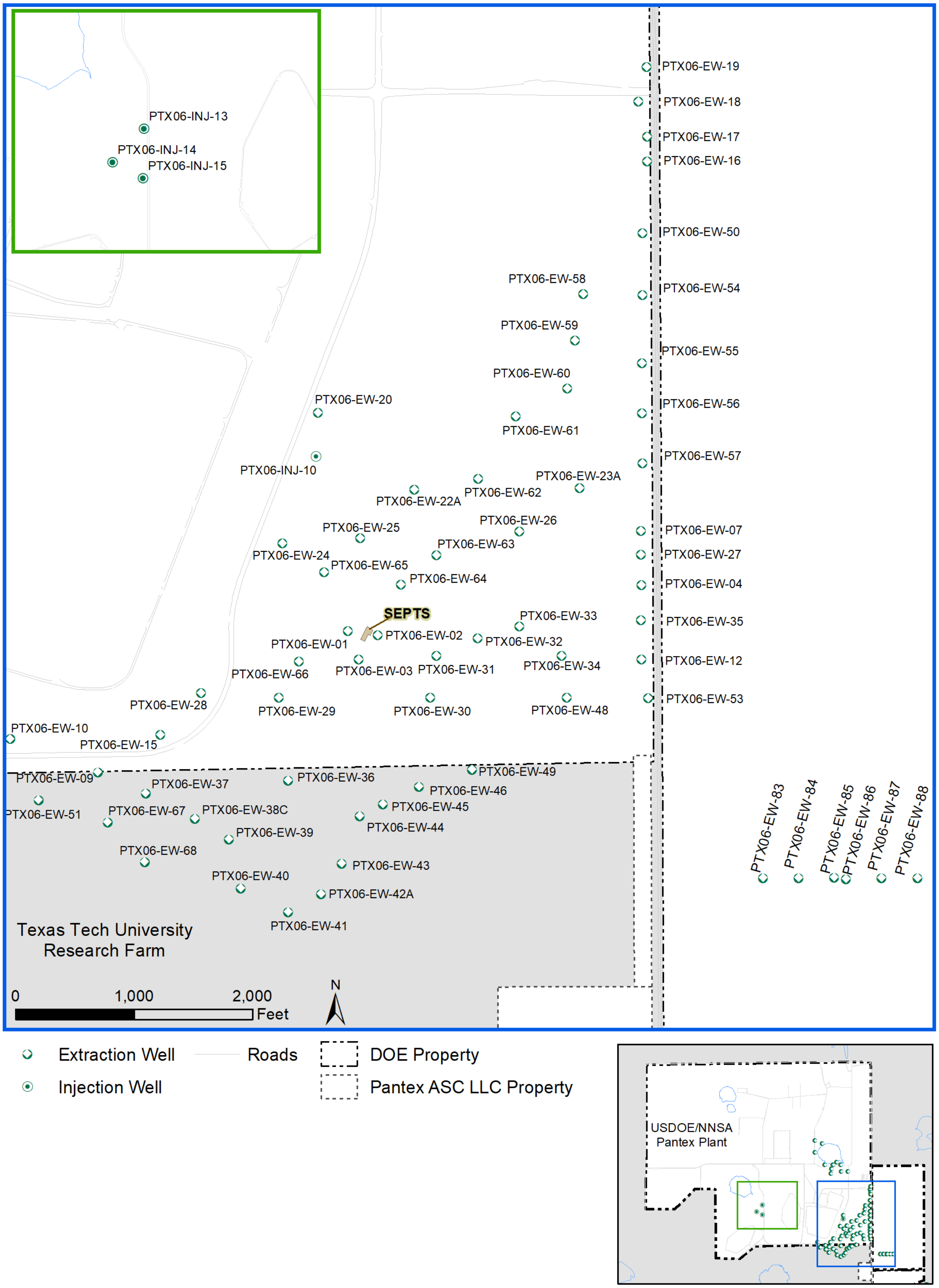

Fig. 1-16. SEPTS wells.

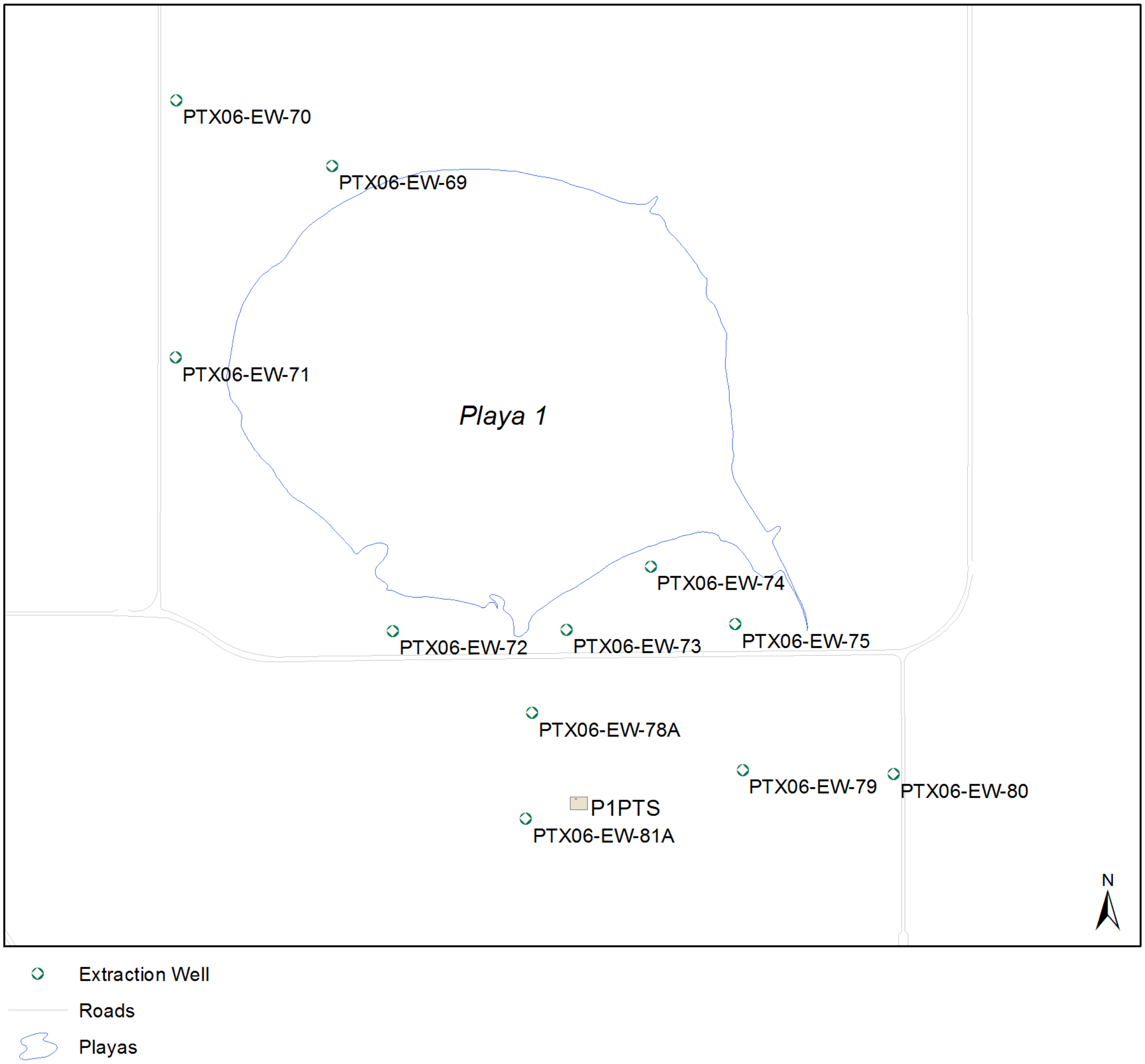

Fig. 1-17. P1PTS wells.

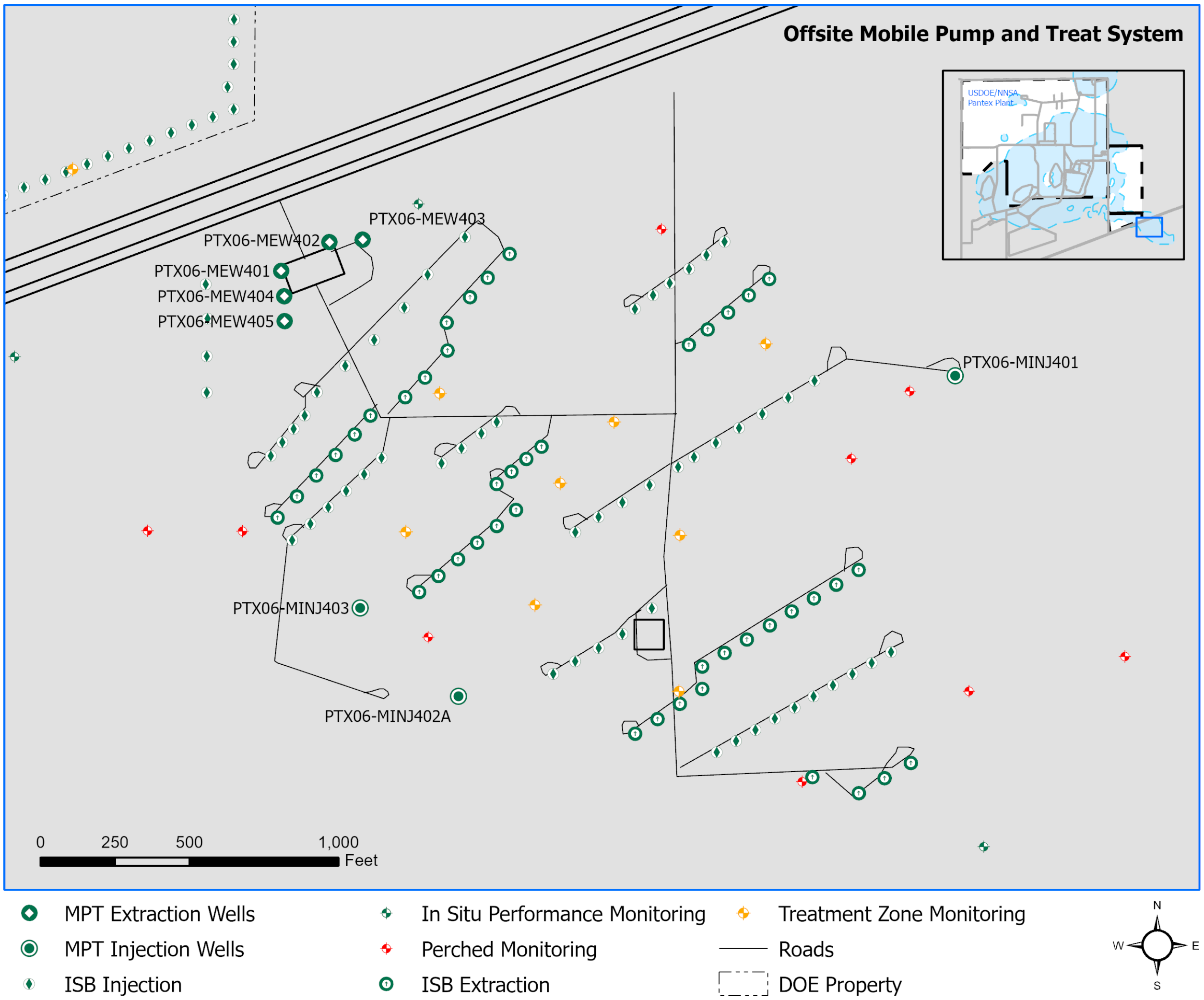

Fig. 1-18. Mobile pump and Treat Wells

Table 1-10. 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

Well ID	Completion Date	Current Status	Replacement Date	P&A Date	Easting	Northing
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
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	Inactive			636854.05	3755302.76
PTX06-ISB080	9/18/2009	Inactive			636787.42	3755227.38
PTX06-ISB081	8/26/2009	Inactive			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	07/24/2014	Active			634360.64	3755523.08
PTX06-ISB088A	09/23/2014	Active			634266.60	3755570.13
PTX06-ISB089	07/12/2014	Active			634200.34	3755606.47
PTX06-ISB090	07/10/2014	Active			634117.26	3755650.38
PTX06-ISB091	09/09/2012	Active			634032.91	3755697.13
PTX06-ISB092	09/11/2012	Active			633944.35	3755745.69
PTX06-ISB093	07/16/2014	Active			633857.23	3755794.35
PTX06-ISB094	07/07/2014	Active			633769.25	3755838.98
PTX06-ISB095	07/24/2014	Active			633652.63	3755742.68
PTX06-ISB096	06/22/2014	Active			633559.57	3755807.06
PTX06-ISB097	08/27/2014	Active			633470.54	3755870.31
PTX06-ISB098	08/19/2014	Active			633384.06	3755929.79
PTX06-ISB099	08/11/2014	Active			633757.56	3755690.13
PTX06-ISB100A	09/16/2014	Active			633791.28	3755646.03
PTX06-ISB101	08/07/2014	Active			633899.71	3755616.85
PTX06-ISB102	07/31/2014	Active			633985.55	3755572.69

Well ID	Completion Date	Current Status	Replacement Date	P&A Date	Easting	Northing
PTX06-ISB103	09/02/2014	Active			634073.50	3755527.39
PTX06-ISB104	08/19/2014	Active			634160.38	3755482.36
PTX06-ISB105	08/06/2014	Active			634245.60	3755438.20
PTX06-ISB106	07/29/2014	Active			634332.49	3755393.36
PTX06-ISB132	12/15/2019	Active			633327.01	3755997.20
PTX06-ISB133	12/18/2019	Active			633258.03	3756042.56
PTX06-ISB134	12/21/2019	Active			633217.07	3756119.70
PTX06-ISB135	1/11/2020	Active			633150.44	3756170.97
PTX06-ISB136	1/8/2020	Active			633089.99	3756225.42
PTX06-ISB137	12/14/2019	Active			633029.65	3756277.60
PTX06-ISB138	8/8/2021	Active			635675.44	3755137.30
PTX06-ISB139	4/24/2021	Active			635005.52	3755195.02
PTX06-ISB140	4/27/2021	Active			635051.38	3755174.17
PTX06-ISB141	5/6/2021	Active			635088.36	3755145.85
PTX06-ISB142	5/7/2021	Active			635143.73	3755139.11
PTX06-ISB143	5/9/2021	Active			635180.87	3755074.58
PTX06-ISB144	5/11/2021	Active			635241.47	3755075.28
PTX06-ISB145	6/4/2021	Active			635296.63	3755057.95
PTX06-ISB146	5/25/2021	Active			635344.98	3755036.21
PTX06-ISB147	6/6/2021	Active			635384.38	3755074.70
PTX06-ISB148	6/8/2021	Active			635445.64	3755043.39
PTX06-ISB149	6/10/2021	Active			635508.91	3755035.46
PTX06-ISB150	6/12/2021	Active			635585.74	3755034.55
PTX06-ISB151	6/22/2021	Active			635675.13	3755038.51
PTX06-ISB152	8/5/2021	Active			635784.45	3755102.76
PTX06-ISB153	7/28/2021	Active			635835.66	3755095.93
PTX06-ISB154	6/25/2021	Active			635885.73	3755039.76
PTX06-ISB155	6/27/2021	Active			635930.84	3755041.30
PTX06-ISB156	7/8/2021	Active			635976.40	3755042.87
PTX06-ISB157	7/11/2021	Active			636025.19	3755042.94
PTX06-ISB158	7/13/2021	Active			636078.85	3755043.82
PTX06-ISB159	7/25/2021	Active			636131.78	3755054.73
PTX06-ISB160	12/4/2021	Active			636164.03	3755072.21
PTX06-ISB161	12/2/2021	Active			636200.30	3755094.74
PTX06-ISB162	11/23/2021	Active			636243.20	3755117.70
PTX06-ISB163	11/21/2021	Active			636285.73	3755137.92
PTX06-ISB164	8/14/2024	Active			636312.50	3755178.30
PTX06-ISB165	7/29/2024	Active			636354.10	3755201.90
PTX06-ISB166A	10/28/2021	Active			634311.35	3755540.15
PTX06-ISB167	11/7/2021	Active			634408.63	3755500.04
PTX06-ISB168	11/5/2021	Active			634291.60	3755416.38
PTX06-ISB169	11/10/2021	Active			634403.01	3755377.62
PTX06-ISB170	11/18/2021	Active			634476.21	3755411.44
PTX06-1164[2]	9/10/2012	Active			633987.48	3755722.37
PTX06-1169[2]	8/11/2014	Active			634889.61	3755241.66
PTX06-1170[2]	8/9/2014	Active			634569.69	3755442.71
PTX06-1176[2]	8/27/2014	Active			634114.06	3755500.53
PTX06-1177[2]	8/23/2014	Active			633524.62	3755818.55
PTX06-1209[2]	8/20/2021	Active			635261.07	3755063.54

Well ID	Completion Date	Current Status	Replacement Date	P&A Date	Easting	Northing
PTX06-1210[2]	8/24/2021	Active			635995.51	3755042.86
PTX06-1230[2]	9/28/2012	Active			634813.17	3755333.92
Southeast ISB Extension[1]						
PTX06-ISB301	04/22/2017	Active			647400.94	3750677.17
PTX06-ISB302	12/13/2017	Active			647471.65	3750705.36
PTX06-ISB303	12/04/2017	Active			647541.96	3750731.23
PTX06-ISB304	12/02/2017	Active			647612.02	3750757.59
PTX06-ISB305	12/15/2017	Active			647682.57	3750783.88
PTX06-ISB306	12/13/2017	Active			647753.08	3750810.07
PTX06-ISB307	11/03/2017	Active			647823.09	3750836.66
PTX06-ISB308	11/07/2017	Active			647894.07	3750862.53
PTX06-ISB309	11/03/2017	Active			647964.07	3750888.51
PTX06-ISB310	11/05/2017	Active			648034.69	3750914.87
PTX06-ISB311	11/14/2017	Active			648105.30	3750940.93
PTX06-ISB312	11/15/2017	Active			648175.64	3750967.12
PTX06-ISB313	11/17/2017	Active			648245.97	3750993.50
PTX06-ISB314	11/30/2017	Active			648316.24	3751019.54
PTX06-ISB315	11/08/2017	Active			648386.52	3751045.71
PTX06-ISB316	11/06/2017	Active			648457.75	3751072.09
PTX06-ISB317	11/04/2017	Active			648527.50	3751098.16
PTX06-ISB318	12/03/2017	Active			648597.96	3751124.55
PTX06-ISB319	12/01/2017	Active			648668.62	3751150.76
PTX06-ISB320	11/17/2017	Active			648738.78	3751176.87
PTX06-ISB321	11/29/2017	Active			648809.07	3751203.15
PTX06-ISB322	10/24/2017	Active			648879.71	3751229.17
PTX06-ISB323	11/15/2017	Active			648950.08	3751255.41
PTX06-ISB324	11/14/2017	Active			649020.47	3751282.05
PTX06-ISB325	11/01/2017	Active			649090.64	3751308.18
PTX06-ISB326A	10/7/2020	Active			649069.98	3751382.33
PTX06-ISB327	10/15/2020	Active			649090.60	3751459.62
PTX06-ISB328	10/18/2020	Active			649090.73	3751534.22
PTX06-ISB329	10/20/2020	Active			649091.36	3751609.51
PTX06-ISB330	9/26/2021	Active			649090.85	3751684.95
PTX06-ISB331	9/30/2021	Active			649092.70	3751760.79
PTX06-1213[2]	9/22/2021	Active			647847.08	3750845.56
PTX06-1214[2]	9/24/2021	Active			648550.59	3751106.97
Offsite ISB						
PTX06-ISB401	6/11/2020	Active			650711.91	3749151.58
PTX06-ISB402	5/28/2020	Active			650841.82	3749226.42
PTX06-ISB403	5/18/2020	Active			650906.57	3749264.00
PTX06-ISB404	6/2/2020	Active			650972.52	3749300.97
PTX06-ISB405	5/13/2020	Active			651036.29	3749338.63
PTX06-ISB406	5/19/2020	Active			651101.78	3749376.17
PTX06-ISB407	5/14/2020	Active			651167.09	3749413.87
PTX06-ISB408	6/3/2020	Active			651231.74	3749451.28
PTX06-ISB409	5/16/2020	Active			651296.89	3749487.69
PTX06-ISB410	8/21/2020	Active			649369.83	3750358.61
PTX06-ISB411	8/23/2020	Active			649464.65	3750447.35
PTX06-ISB412	6/17/2020	Active			649562.18	3750534.62

Well ID	Completion Date	Current Status	Replacement Date	P&A Date	Easting	Northing
PTX06-ISB413	6/26/2020	Active			649662.66	3750642.84
PTX06-ISB414	8/25/2020	Active			649740.82	3750753.45
PTX06-ISB415	8/27/2020	Active			649866.95	3750879.41
PTX06-ISB416	6/11/2020	Active			650711.91	3749151.58
PTX06-ISB417	9/14/2021	Active			649002.830	3750605.840
PTX06-ISB418	9/12/2021	Active			649000.080	3750479.950
PTX06-ISB419	9/9/2021	Active			648999.920	3750358.330
PTX06-REC401A	5/2/2020	Active			651032.67	3749068.08
PTX06-REC402	6/15/2020	Active			651188.55	3749013.99
PTX06-REC403	5/31/2020	Active			651274.87	3749064.42
PTX06-REC404	6/13/2020	Active			651363.17	3749115.24
PTX06-REC405	9/10/2020	Active			649666.01	3750342.12
PTX06-REC406	8/31/2020	Active			649732.34	3750408.10
PTX06-REC407	7/25/2020	Active			649808.08	3750498.69
PTX06-REC408	7/28/2020	Active			649805.35	3750592.25
PTX06-REC409	8/6/2020	Active			649883.64	3750677.72
PTX06-REC410	8/8/2020	Active			649942.73	3750742.93
PTX06-REC411	8/10/2020	Active			650016.35	3750822.87
PTX06-ISB425	8/7/2022	Active			650237.10	3749889.05
PTX06-ISB426	8/4/2022	Active			650315.00	3749940.31
PTX06-ISB427	8/2/2022	Active			650394.60	3749988.93
PTX06-ISB428	7/7/2022	Active			650485.88	3750047.56
PTX06-ISB429	6/29/2022	Active			650582.37	3750108.23
PTX06-ISB430	6/27/2022	Active			650635.79	3750141.61
PTX06-ISB431	8/18/2022	Active			650708.72	3750189.11
PTX06-ISB432	8/8/2022	Active			650787.00	3750238.86
PTX06-ISB437	6/29/2022	Active			649787.61	3750120.41
PTX06-ISB438	7/7/2022	Active			649855.36	3750171.10
PTX06-ISB439	7/9/2022	Active			649921.41	3750221.31
PTX06-ISB440	7/12/2022	Active			649972.93	3750258.98
PTX06-ISB453	7/13/2022	Active			649215.32	3750145.23
PTX06-ISB454	7/20/2022	Active			649253.94	3750191.39
PTX06-ISB455	7/23/2022	Active			649291.57	3750235.65
PTX06-ISB456	7/24/2022	Active			649328.78	3750281.30
PTX06-ISB501	8/31/2022	Inactive			645402.44	3758144.97
PTX06-ISB502	8/25/2022	Inactive			645791.43	3757732.13
PTX06-ISB503	8/28/2022	Inactive			645698.75	3757351.47
PTX06-REC416	7/25/2022	Active			650662.78	3749438.56
PTX06-REC417	8/26/2022	Active			650738.08	3749484.59
PTX06-REC418	8/18/2022	Active			650812.65	3749529.58
PTX06-REC419	8/5/2022	Active			650889.91	3749576.75
PTX06-REC420	8/10/2022	Active			650963.40	3749623.60
PTX06-REC421	8/8/2022	Active			651037.35	3749667.44
PTX06-REC422	8/2/2022	Active			651112.69	3749713.17
PTX06-REC433	6/19/2022	Active			649972.75	3750051.20
PTX06-REC434	6/21/2022	Active			650022.61	3750092.70
PTX06-REC435	7/11/2022	Active			650072.32	3750134.99
PTX06-REC436	7/20/2022	Active			650123.62	3750176.26
PTX06-REC442	5/9/2022	Active			649237.73	3749938.28

Well ID	Completion Date	Current Status	Replacement Date	P&A Date	Easting	Northing
PTX06-REC443	5/18/2022	Active			649302.46	3750009.54
PTX06-REC444	5/22/2022	Active			649367.39	3750079.82
PTX06-REC445	6/1/2022	Active			649432.37	3750148.34
PTX06-REC446	6/5/2022	Active			649496.71	3750217.21
PTX06-REC447	6/7/2022	Active			649549.37	3750280.47
PTX06-1218[2]	5/4/2022	Active			649667.96	3749890.07
PTX06-1219[2]	6/26/2022	Active			650185.72	3750054.28
PTX06-1221[2]	4/27/2022	Active			650875.74	3750521.45
PTX06-ISB420	8/4/2023	Active			650162.60	3749414.18
PTX06-ISB421	8/6/2023	Active			650236.94	3749456.45
PTX06-ISB422	8/8/2023	Active			650315.41	3749501.38
PTX06-ISB423	8/24/2023	Active			650394.76	3749548.27
PTX06-ISB424	8/29/2023	Active			650493.88	3749634.53
PTX06-ISB433	8/19/2023	Active			650864.32	3750286.73
PTX06-ISB434	8/18/2023	Active			650951.71	3750341.34
PTX06-ISB435	8/9/2023	Active			651040.07	3750397.41
PTX06-ISB441	8/7/2023	Active			650437.34	3750638.45
PTX06-ISB442	8/4/2023	Active			650497.81	3750684.05
PTX06-ISB443	8/5/2023	Active			650553.74	3750724.76
PTX06-ISB444	8/1/2023	Active			650619.07	3750772.62
PTX06-ISB445	7/26/2023	Active			650677.26	3750818.52
PTX06-ISB446	7/24/2023	Active			650737.83	3750863.50
PTX06-ISB447	8/26/2023	Active			649286.70	3749862.88
PTX06-ISB448	8/24/2023	Active			649347.71	3749917.94
PTX06-ISB449	8/22/2023	Active			649407.57	3749973.28
PTX06-ISB450	8/20/2023	Active			649467.66	3750028.13
PTX06-ISB451	8/18/2023	Active			649528.05	3750083.49
PTX06-ISB452	8/10/2023	Active			649586.87	3750138.63
PTX06-REC412	4/6/2023	Inactive			650437.73	3749213.32
PTX06-REC413	4/12/2023	Inactive			650512.91	3749262.62
PTX06-REC414	5/21/2023	Inactive			650587.71	3749313.76
PTX06-REC415	6/23/2023	Inactive			650662.99	3749363.57
PTX06-REC423	4/5/2023	Inactive			651187.96	3749762.93
PTX06-REC427	5/18/2023	Inactive			649712.76	3749688.43
PTX06-REC428	5/31/2023	Inactive			649777.58	3749742.50
PTX06-REC429	6/13/2023	Inactive			649843.53	3749798.74
PTX06-REC430	6/25/2023	Inactive			649907.33	3749854.10
PTX06-REC431	7/20/2023	Inactive			649973.39	3749909.97
PTX06-REC432	7/10/2023	Inactive			650037.95	3749964.07
PTX06-REC437	7/11/2023	Inactive			650617.99	3750517.92
PTX06-REC438	7/19/2023	Inactive			650681.26	3750569.55
PTX06-REC439	7/9/2023	Inactive			650749.77	3750626.27
PTX06-REC440	6/28/2023	Inactive			650818.95	3750684.18
PTX06-REC441	6/20/2023	Inactive			650887.46	3750738.62
PTX06-1217[2]	8/2/2023	Inactive			650101.19	3749645.37
PTX06-1220[2]	8/20/2023	Inactive			650367.11	3750258.95
			PCR ISB			
PTX06-ISB601	7/31/2024	Active			639666.81	3753007.50
PTX06-ISB602	8/7/2024	Active			639738.59	3753066.46

Well ID	Completion Date	Current Status	Replacement Date	P&A Date	Easting	Northing
PTX06-ISB603	8/9/2024	Active			639814.01	3753125.83
PTX06-ISB604	4/1/2023	Active			639890.39	3753175.99
PTX06-ISB605	8/25/2024	Active			639930.99	3753209.49
PTX06-ISB606	9/4/2024	Active			639969.93	3753239.12
PTX06-ISB607	9/6/2024	Active			640009.33	3753274.76
PTX06-ISB608	9/8/2024	Active			640077.36	3753320.05
PTX06-ISB609	9/24/2024	Active			640140.59	3753362.38
PTX06-ISB610	10/2/2024	Active			640197.13	3753401.36
PTX06-1225[2]	9/2/2024	Active			639910.39	3753190.01
PTX06-1226A[2]	9/24/2024	Active			640029.72	3753287.86
CR8 ISB						
PTX06-ISB701	1/4/2025	Inactive			646163.50	3752450.78
PTX06-ISB702	12/11/2024	Inactive			646222.34	3752460.40
PTX06-ISB703	12/6/2024	Inactive			646280.47	3752469.83
PTX06-ISB704	12/9/2024	Inactive			646338.29	3752487.12
PTX06-ISB705	12/11/2024	Inactive			646396.42	3752503.69
PTX06-ISB706	12/9/2024	Inactive			646453.69	3752521.12
PTX06-ISB707	12/6/2024	Inactive			646510.45	3752538.55
PTX06-ISB708	12/3/2024	Inactive			646574.54	3752557.90
PTX06-ISB709	11/16/2024	Inactive			646631.66	3752582.01
PTX06-ISB710	12/3/2024	Inactive			646681.09	3752615.46

[1]Pantex renumbered the wells in this system in 2020 for ease of system identification.

[2]TZM wells used for monitoring the treatment zone.

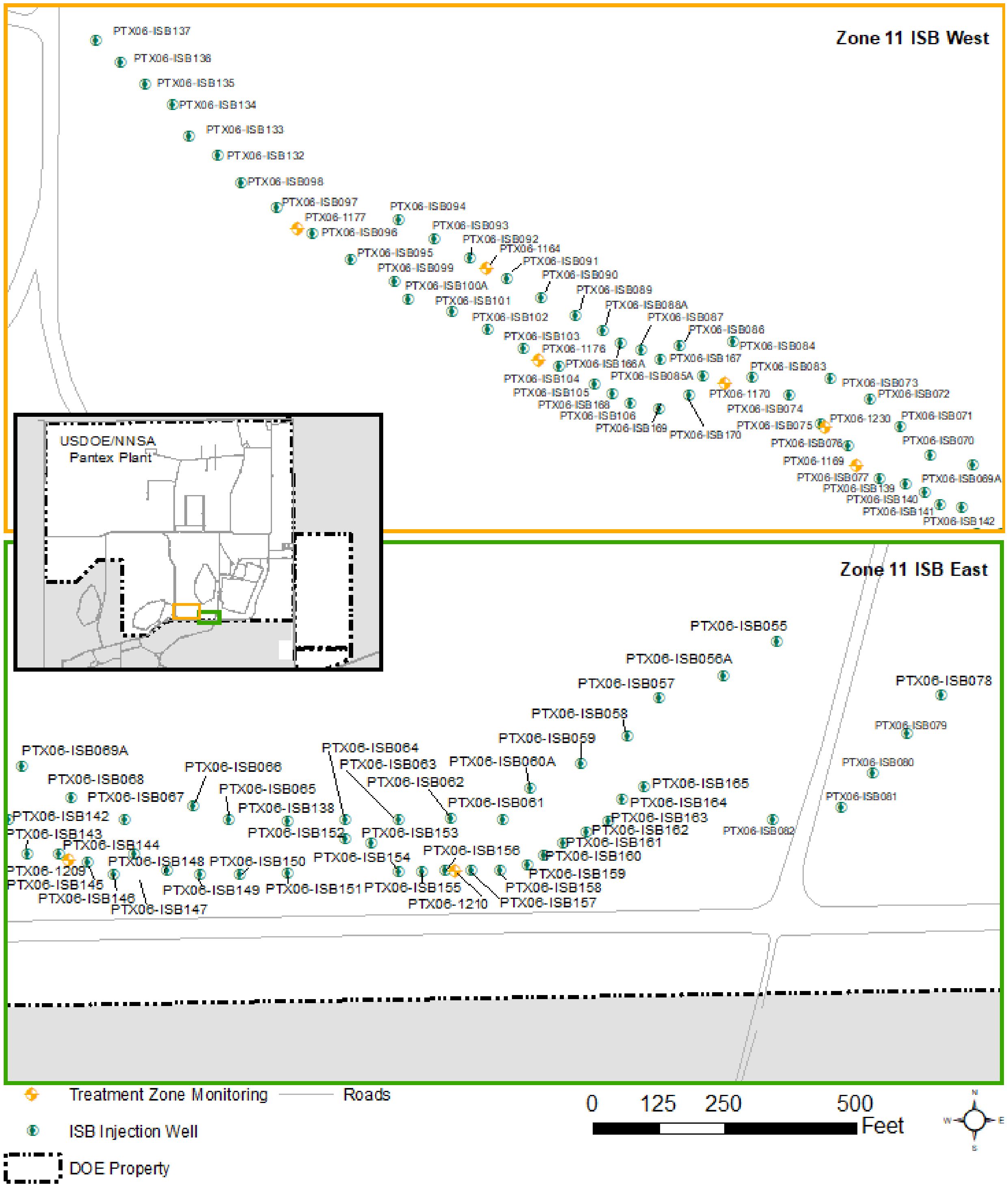

Fig. 1-19. Zone 11 ISB System wells.

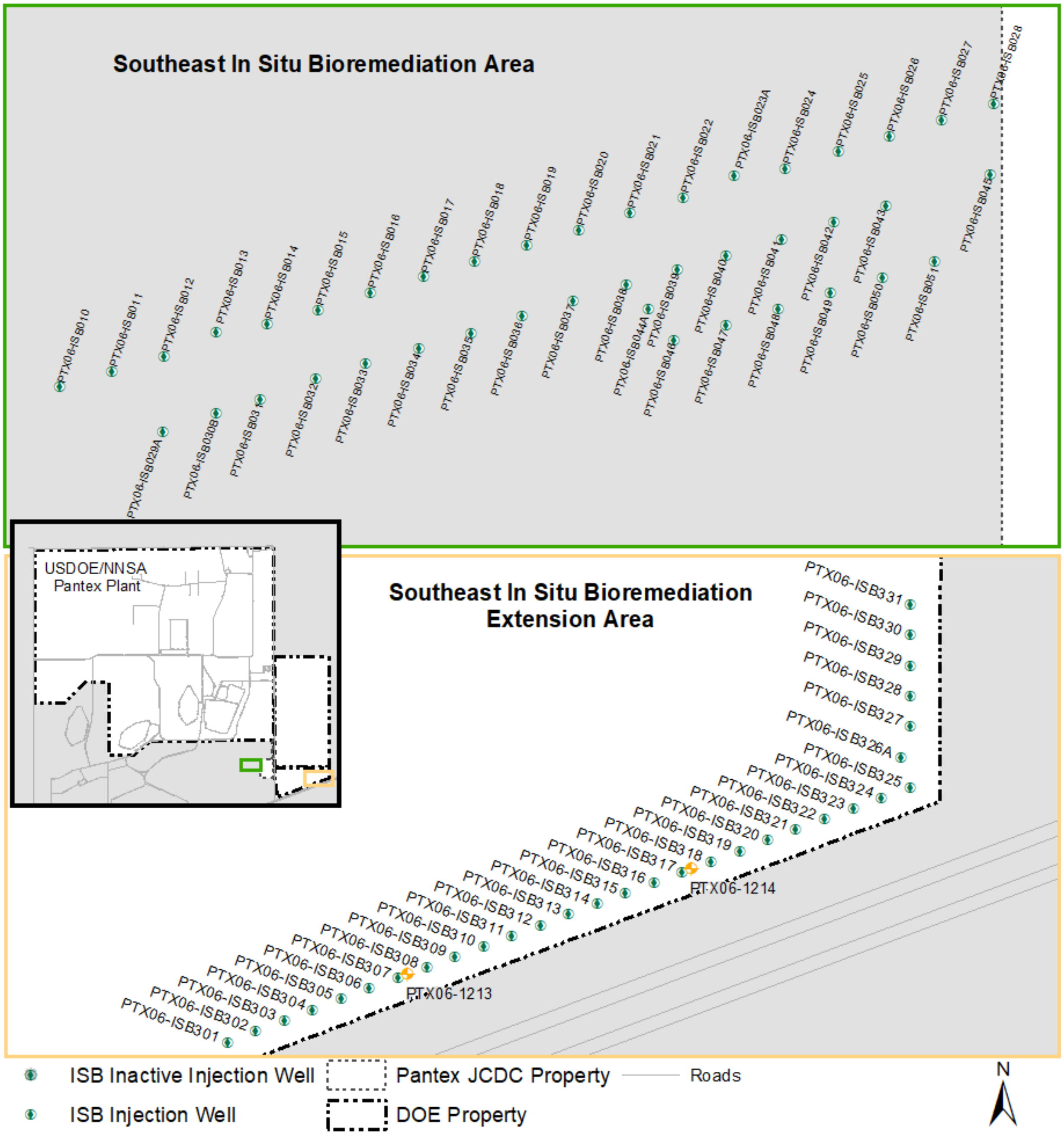

Fig. 1-20. Southeast ISB System wells.

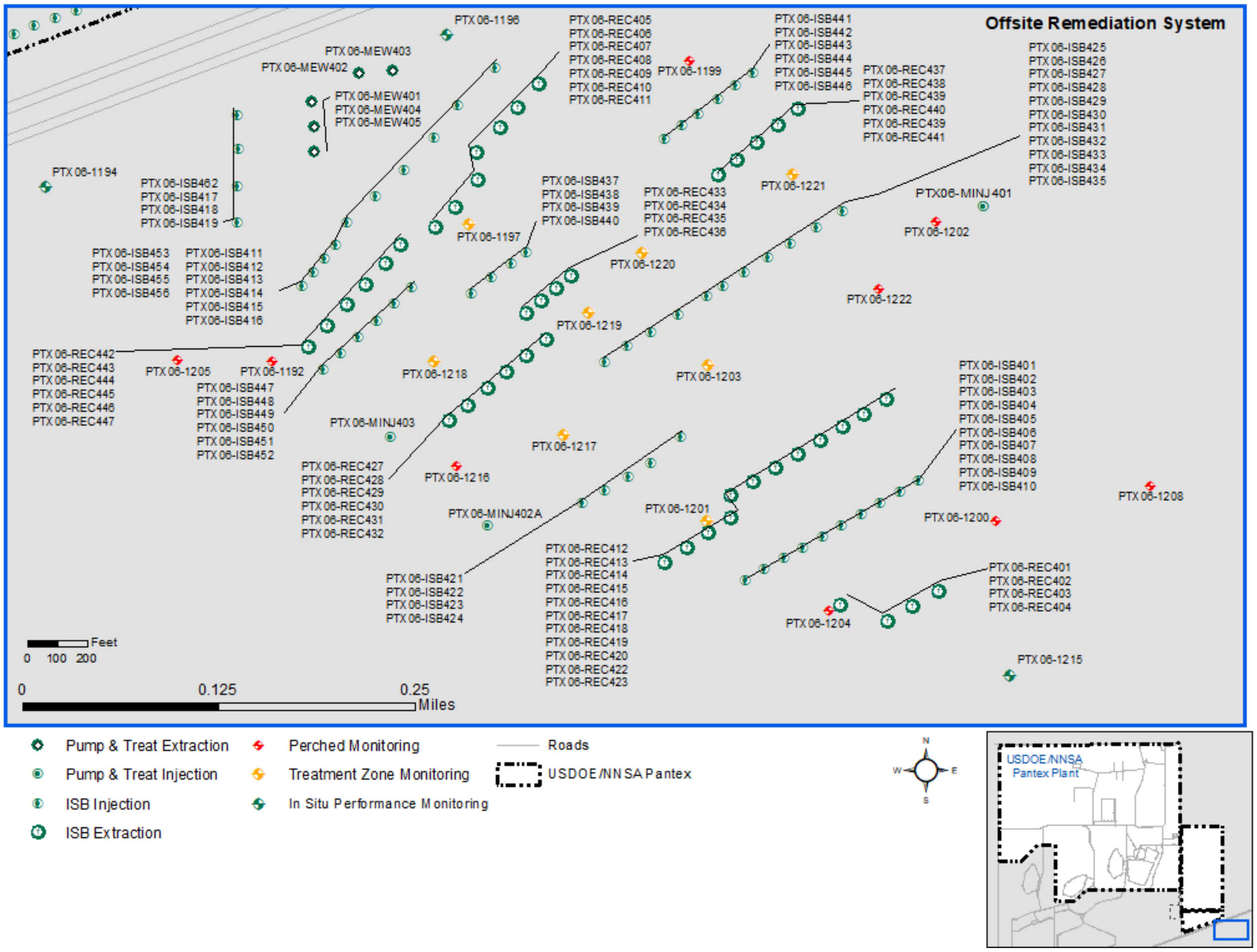

Fig. 1-21. Offsite ISB System wells.

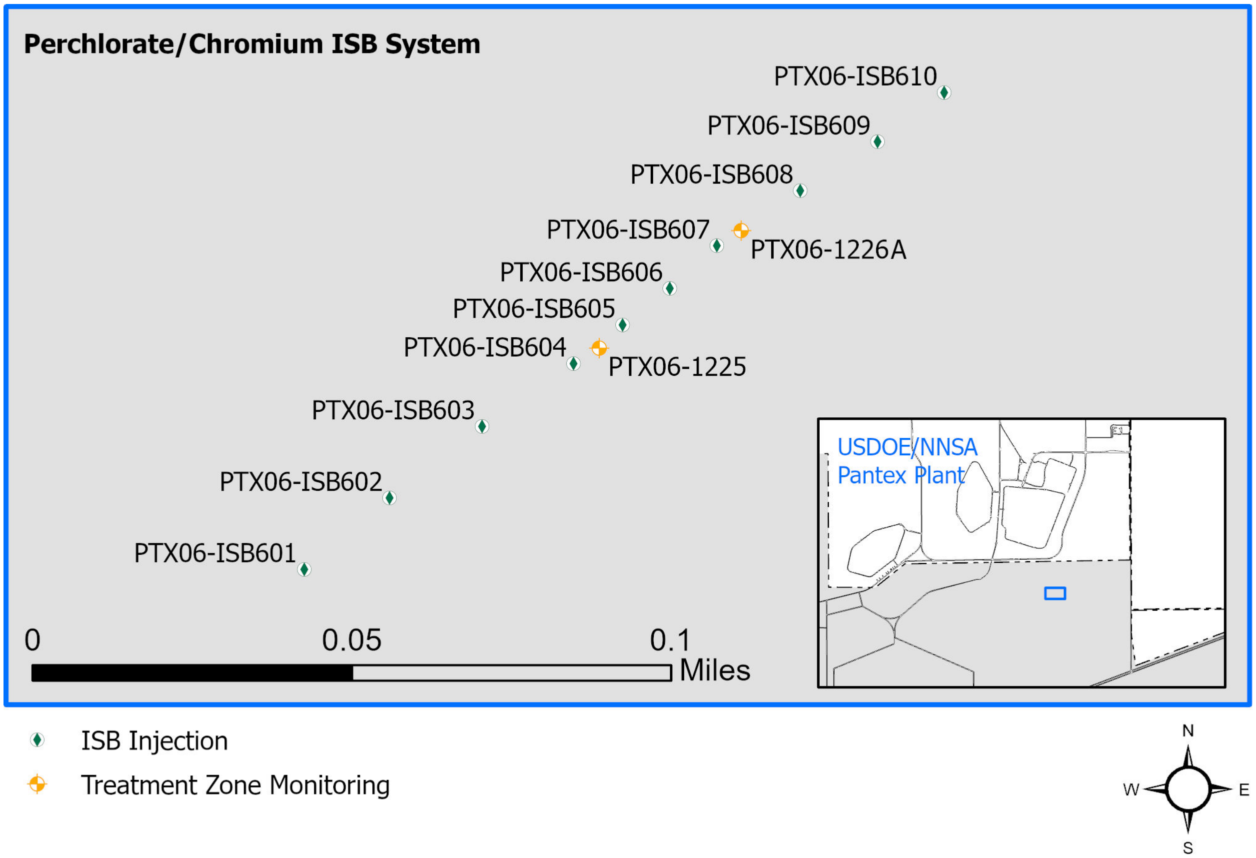

Fig. 1-22. Perchlorate/Chromium ISB System Map.

Table 1-11. Former 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	Inactive	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

P&A = plugging and abandonment
[1]The shallow depth wells are screened from 20 to 45 ft and 50 to 90 ft bgs. The intermediate depth wells are screened from 95 to 180 ft and 190 to 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.

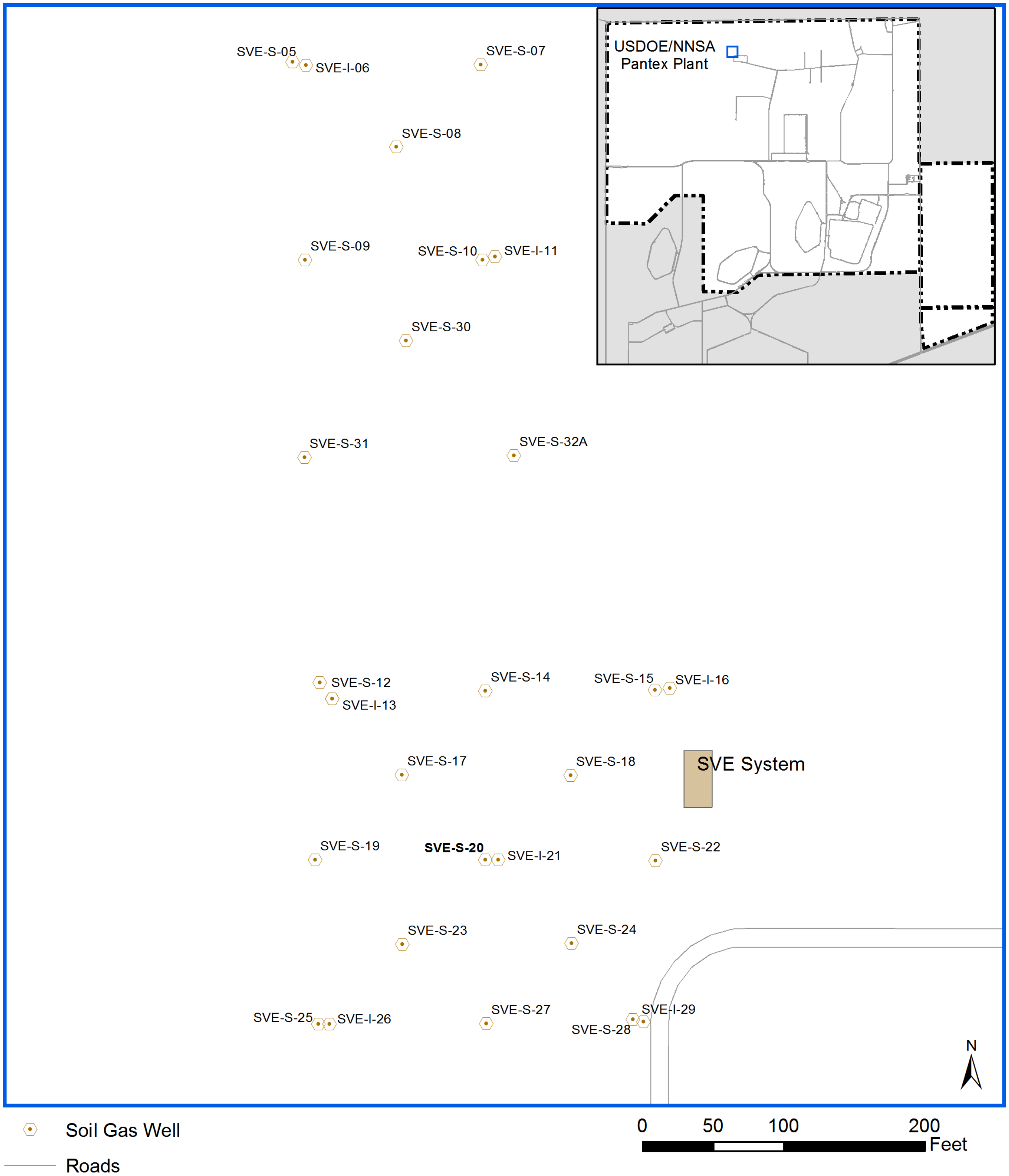

Fig. 1-23. Former Burning Ground SVE wells.

1.6.4 Schedule of Activities

As detailed in HW-50284 and the IAG, Pantex must meet requirements under CERCLA and RCRA. In accordance with the IAG, Pantex has submitted a site management plan that provides a list of required activities and planned dates of completion. This section provides a schedule of activities planned for the next year and projects required to be completed in accordance with HW-50284, CP Table VIII.

Table 1-12 summarizes activities completed in 2024 since the date of the last annual report, activities completed in 2025 prior to the publication of this report, and activities that have projected starts or completions between July 2025 and June 2026. The schedule of activities included in the 2023 Annual Progress Report was the basis for this table, which also includes revisions made to that schedule.

Pantex completed 2024 activities related to recommendations from previous reports while completing normally scheduled monitoring and operation of the RAs.

Pantex completed an FYR in 2013, 2018 and 2023. Most of the recommendations and issues to be addressed from the first FYR were completed before the second FYR. Some of the continuing evaluations, such as the expansion of plumes to the southeast, will continue to be addressed through issues and recommendations from the second FYR, from which a table of action items has been developed. New issues and recommendations were identified in the third FYR that was completed in 2023. Those actions are included in Section 5 of this report and will also be tracked to completion.

The significant actions completed in 2024 and early 2025 related to the FYRs include the following:

- Pantex incorporated 1,4-dioxane into *the Pantex Plant Ogallala Aquifer and Perched Groundwater Contingency Plan* update with steps to take if concentrations increase in March 2025.
- In response to the incomplete degradation of TCE near TZM wells PTX06-1164 and PTX06-1169 at the Zone 11 ISB, Pantex reviewed amendment injection volumes to confirm that they are sufficient to distribute amendment away from the injection wells and towards the treatment zone in December 2024.
- Pantex provided a closure report to the TCEQ and EPA in August 2023 for the shutdown of the Burning Ground SVE. The closure report provided the termination criteria for the system, as required by the second FYR. TCEQ and EPA provided approval for the closure report in 2023. The application to renew HW-50284

requested removal of the SVE system from the compliance plan was completed in 2023. The permit is expected to be issued in 2025. Pantex continued to monitor groundwater wells PTX01-1001, PTX01-1010, and PTX01-1011, point of compliance and exposure wells in the Burning Ground, to evaluate the effectiveness of the system post closure.

- Pantex updated the LTM System Design and SAP documents to capture changes and recommendations from the Third FYR in November 2024.

Pantex has received comments from the TCEQ Project Manager (Maria Sifuentes-Chavez) on multiple submittals. Where those comments have required the installation of new wells, Pantex will complete the work as budget is available. Due to the time required for requesting and implementing changes into the budget and the need to drill more Ogallala wells, Pantex will provide a status update in Section 5 of this report. When the agreed-upon activities are planned to be implemented within the timeframe for the annual report schedule of activities, they will be added to Table 1-12 below.

In-progress and upcoming activities for the next year continue to focus on the O&M and monitoring of the RAs, O&M of soil actions, reporting in accordance with the IAG and HW-50284, and progress on the second FYR's issues and recommendation. Some of the reporting and plans will require regulatory review and approval and are provided in bold in Table 1-12.

Table 1-12. Complete, In-Progress, and Upcoming Activities

Activity	Start Date	Scheduled Completion Date	Actual Completion	IAG/CP Provision or Requirement	Origin of Recommended Action
Completed Work (through Jun 2024)					
Annual Landfill Cover/Ditch Liner Maintenance – 2024	Sep 2024	Dec 2024	Dec 2024	IAG Article 8.9 HW-50284 Provision XI.E	
Annual Pantex Environmental Projects Public Meeting	Sep 2024	Nov 2024	Nov 2024	IAG Article 25	
Perchlorate/Chromium ISB installation and Injection	Oct 2024	Dec 2024	Dec 2024	IAG Article 8 HW-50284 Provision XI.E.1	2022A
Offsite ISB Rehabilitation/Injection	Feb 2024 Sep 2024	Jun 2024 Nov 2024	Jun 2024 Dec 2024	IAG Article 8 HW-50284 Provision XI.E.1	
Southeast ISB Extension Rehabilitation and Injection	Jun 2024	Aug 2024	Sep 2024	IAG Article 8 HW-50284 Provision XI.E.1	
Evaluation of the Mass at PTX06-1229, Plume Seeker fate and transport modeling for placement of new Ogallala wells	May 2024	Sep 2024	Sep 2024	HW-50284 Provision XI.H.1	
Repair of Landfill 3, SWMU 54	Jun 2024	Sep 2024	Sep 2024	IAG Article 8.9 HW-50284 Provision XI.E	
Well Drilling – Four new Ogallala monitor wells, 21 perched injection wells, and 2 perched monitor wells	Jun 2024	Nov 2024	Feb 2025	HW-50284 XI.B.1 and XI.B.2	2023A
Replace Ogallala well PTX06-1076	Jun 2024	Sept 2024	Sep 2024	HW-50284 XI.B.1 and XI.B.2	2022A
Zone 11 ISB Rehabilitation and Injection	Mar 2024	Oct 2024	Dec 2024	IAG Article 8 HW-50284 Provision XI.E.1	
Plugging and Abandonment of PTX06-1064	Jun 2024	Dec 2024	Jan 2025	HW-50284 Provision XI.B.1	
Sample PFAS at perched wells in accordance with the *Preliminary Per- and Polyfluoroalkyl Substances Sampling Plan for the Pantex Plant*	Nov 2023	Jul 2024	Jul 2024	HW-50284 Provision XI.F.	3FYR

Activity	Start Date	Scheduled Completion Date	Actual Completion	IAG/CP Provision or Requirement	Origin of Recommended Action
2nd Semi-Annual 2024 Groundwater and ISB Sampling	Jul 2024	Dec 2024	Dec 2024	HW-50284 Provision XI.F	
1st Semi-Annual 2025 Groundwater and ISB Sampling	Jan 2025	Jun 2025	Jun 2025	HW-50284 Provision XI.F	
1st Quarter 2024 Progress Report	May 2024	Jun 2024	Jul 2024	HW-50284 Provision XI.G.3 and IAG Article 16.4	
2nd Quarter 2024 Progress Report	Aug 2024	Sep 2024	Sep 2024	HW-50284 Provision XI.G.3 and IAG Article 16.4	
3rd Quarter 2024 Progress Report	Nov 2024	Dec 2024	Dec 2024	HW-50284 Provision XI.G.3 and IAG Article 16.4	
4th Quarter 2024 Progress Report	Feb 2025	Mar 2025	Mar 2025	HW-50284 Provision XI.G.3 and IAG Article 16.4	
Updated Pantex *Long-Term Monitoring System Design* and *Sampling and Analysis Plan*	Jul 2024	Nov 2024	Nov 2024	HW-50284 CP Table VIII IAG Article 8	3FYR and CP Table VIII[1]
2024 Annual Progress Report	Mar 2025	Jun 2025	Jun 2025	HW-50284 Provision XI.G.3 and IAG Article 16.4	
Updated Pantex Site Management Plan	May 2025	Jun 2025	Jun 2025	IAB Article 7.2	
Update *Pantex Plant Ogallala Aquifer and Perched Groundwater Contingency Plan*	Dec 2024	Mar 2025	Mar 2025	IAG Article 8	3FYR BG Closure Rpt
Work In Progress					
Annual Landfill Cover/Ditch Liner Maintenance – 2025	May 2025	Dec 2025		IAG Article 8.9 HW-50284 Provision XI.E	
Offsite ISB Rehabilitation/Injection	Feb 2025 Aug 2025	Jul 2025 Nov 2025		IAG Article 8 HW-50284 Provision XI.E.1	
Southeast ISB Extension Rehabilitation and Injection	June 2025	Aug 2025		IAG Article 8 HW-50284 Provision XI.E.1	
Zone 11 ISB Rehabilitation and Injection	Apr 2025	Oct 2025		IAG Article 8 HW-50284 Provision XI.E.1	

Activity	Start Date	Scheduled Completion Date	Actual Completion	IAG/CP Provision or Requirement	Origin of Recommended Action
Southeast ISB Rehabilitation and Injection	May 2025	Aug 2025		IAG Article 8 HW-50284 Provision XI.E.1	
Construction of Phase 1 and 2 of the SCADA replacement at SEPTS	Apr 2025	Apr 2026		HW 50284 XI.B.3 and XI.B.5	2020A
Development of Ogallala Investigation Work Plan	**Jun 2025**	**Mar 2026**		HW 60284 XI.H.1	3rd FYR
Development of PFAS Investigation Work Plan	**Jun 2025**	**Mar 2026**		HW 60284 XI.H.1	3rd FYR
Well Drilling- 8 new Ogallala monitor wells and 2 perched monitor wells	Jun 2025	Dec 2025		HW-50284 XI.B.1 and XI.B.2	2022A
Installation of infrastructure at the County Road 8 ISB	Jun 2025	Nov 2025		HW-50284 XI.B.1 and XI.B.2	2022A
Conversion of 6 pump and treat extraction wells to injection wells	June 2025	Dec 2025		HW 50284 XI.B.3 and XI.B.5	2024A
Upcoming Work (Jun 2025 through Jun 2026)					
PCR ISB Rehabilitation and Injection	Aug 2025	Oct 2025		IAG Article 8 HW-50284 Provision XI.E.1	
Construct new ISB pad and water conveyance to Northeast ISB	Sep 2025	March 2026		HW-50284 XI.B.3	2022A
Zone 11 ISB Rehabilitation and Injection	March 2026	Oct 2026		IAG Article 8 HW-50284 Provision XI.E.1	
Offsite ISB Rehabilitation and Injection	Mar 2026 Aug 2026	Jul 2026 Nov 2026		IAG Article 8 HW-50284 Provision XI.E.1	
Southeast ISB Extension Rehabilitation and Injection	Mar 2026	Aug 2026		IAG Article 8 HW-50284 Provision XI.E.1	
Annual Landfill Cover/Ditch Liner Maintenance – 2026	Mar 2026	Sep 2026		IAG Article 8.9 HW-50284 Provision XI.E	3FYR
Updated Pantex Site Management Plan	**May 2026**	**June 2026**		IAG Article 7.2	
2025 Semi-Annual Progress Report	**Nov 2025**	**Dec 2025**		HW-50284 Provision XI.G.3 and IAG Article 16.4	

Activity	Start Date	Scheduled Completion Date	Actual Completion	IAG/CP Provision or Requirement	Origin of Recommended Action
2025 Annual Progress Report	**Mar 2026**	**Jun 2026**		HW-50284 Provision XI.G.3 and IAG Article 16.4	

*Revised activity or date.

"Origin of Recommended Actions" refers to the report that first presented the recommendation to complete the project. Year plus "A" refers to the specific yearly annual progress report and the year plus "SA" represents the semi-annual progress report that presented the recommendation. Quarterly progress reports will include the quarter and year of the report that was used. Quarterly progress reports were discontinued at the end of 2024. The Five-Year Review Report is represented as the specific number of the review (e.g., 1, 2, 3…) and FYR.

[1] Was included in the application for renewal of HW-50284.

BG – Burning Ground
FYR - Five-Year Review
Activities in bold require regulatory interaction and/or review and 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 and HW-50284. Maintenance activities, both routine and unscheduled, ensure that the systems continue to operate optimally. This section summarizes the remedial action systems' O&M efforts to provide an understanding of the remedy's effectiveness.

2.1 Groundwater Remedial Actions

As discussed in Section 1, Pantex has implemented pump and treat and ISB for the final remedial actions for perched groundwater. Additionally, institutional controls, in the form of deed restrictions, have been placed in areas of impacted perched groundwater as part of the final remedial action. Pantex drafted all deed restrictions as part of the final remedy during 2009 and submitted them to TCEQ and EPA as part of the draft final IRAR. Those deed restrictions were filed in 2010 in conjunction with the approval of the final IRAR (Pantex, 2010a). The deed restrictions were placed on Pantex, TTU, and one neighboring property where impacted perched groundwater is present. Pantex has added two additional neighboring property deed restrictions due to the plume extending offsite to the southeast. The deed restrictions were completed in June 2022 and will remain in place until the offsite remedial action is complete.

2.1.1 Pump and Treat Systems

The pump and treat systems were described in Section 1.4. In 2024, these systems continued to reduce saturated thickness and contaminant mass in the southeast perched groundwater, although they were impacted by reduced flow and shutdowns resulting from continuing issues with the subsurface irrigation and repairs that are being conducted on the WWTF lagoons. These data demonstrate that the systems are effective in removing mass and water from the perched aquifer, and system operation continues to move toward meeting Pantex remedial action objectives.

Appendix B contains the monthly flow calculations for each active well and detailed O&M information.

Pump and Treat Systems Milestones

2024	Since Startup
173.9 million gallons treated	3.5 billion gallons treated
32.6% of treated water beneficially used	1.9 billion gallons beneficially used
466 lbs of contaminants removed	17,594 lbs of contaminants removed

2.1.1.1 Water Outlets for Treated Water

The pump and treat systems are designed to extract water and remove contaminant mass from the water before the effluent is beneficially used for irrigation, general Plant needs, and/or for amendment injections at the ISB systems. The systems were also designed to remove water from the perched aquifer to reduce saturated thickness. This reduction in saturated thickness reduces migration of contaminants both vertically and horizontally so that natural breakdown processes can occur over time. Reducing migration provides protection for the underlying High Plains Aquifer (also known as and referred to herein as the Ogallala Aquifer).

In addition to release of water to all beneficial use outlets, SEPTS has the capability to inject the treated water back into the perched aquifer when beneficial use is not possible. P1PTS can release water to the pivot irrigation system directly or to the WWTF storage lagoons, which can discharge to Playa 1 or a subsurface drip irrigation system. Operational priorities for the pump and treat systems emphasize beneficial use of water, but when those release options are not available, Pantex will utilize the Playa 2 injection wellfield or decrease the operation of the P1PTS. Injection well 10 and Playa 1 are used as final options for management of treated water. A description of each water outlet and its corresponding effectiveness in 2024 is included below.

2.1.1.1.1 Waste Water Treatment Facility Lagoons

The SEPTS and P1PTS have the ability to use the WWTF lagoons as a treated water outlet. The WWTF has three lagoons, one of which continues to undergo liner repairs during the summer of 2025. WWTF lagoon repairs were ongoing throughout the duration of 2024 which limited treated water storage and resulted in the inability to consistently achieve the throughput and operational goals at the PTS. The WWTF has the ability to send treated water to the drip irrigation system or to Playa 1 to manage water from the lagoons, however; the drip irrigation system was not operating in 2024, and there are permitted restrictions on how much water can be released to Playa 1. These two systems are detailed below.

2.1.1.1.2 Subsurface Drip Irrigation System

The subsurface drip irrigation system is connected to the WWTF so that treated water from both P1PTS and the SEPTS can be sent to the WWTF lagoons and distributed to the drip irrigation system for beneficial use. This system is operated by the Utilities Operators at the Pantex Plant. In 2017 a break occurred at this system causing a pause in operations. Since then, that break has been repaired, but the subsurface drip irrigation was not utilized in 2024 due to ongoing system communication issues. Pantex is currently considering the possibility of contracting for the installation of fiber optic cable to replace radio communications in order to create a more stable line of communication. The inability to use the subsurface drip irrigation system as a water outlet through 2024 limited options for use of treated water from P1PTS and SEPTS, and therefore contributed to reduced throughput at those systems throughout the year.

2.1.1.1.3 Playa 1

Release to Playa 1 is regulated by the TCEQ wastewater permit (WQ0002296000). This release option is used when other water outlets are not available. The permit restricts the amount of water that can be released to Playa 1, so pump and treat throughput is reduced if other outlets are not available for use. Since the drip irrigation system continued to experience problems throughout 2024, and the pivot irrigation and Playa 2 injection wellfield experienced issues (described in sections 2.1.1.1.7 and 2.1.1.1.4 respectively) release to Playa 1 was utilized within the permit restrictions.

2.1.1.1.4 Playa 2 Injection Wellfield

The Playa 2 Injection Wellfield was installed in February 2022 and became operational in April 2023. The wellfield is comprised of three injection wells; Injection Wells 13 through 15. The purpose of this wellfield is to inject treated water from SEPTS in an area that will not impact plume movement from source areas. This injection is used when excess treated water cannot be accommodated by irrigation or ISB. These injection wells were utilized throughout a majority of 2024 until they began experiencing radio communication failures in October 2024. The wells were taken offline at that point and are awaiting repair. Pantex is currently contracting for repairs of the radio communication system at the Playa 2 wellfield. The radio communication failures greatly impacted the ability to operate the PTS at full throughput capacities because it significantly limited water outlet options for the SEPTS.

2.1.1.1.5 Injection Well 10

Injection well 10 is located just north of SEPTS and has the ability to inject treated water directly into the perched groundwater in that area. Injecting water into injection well 10 is a final option for management of treated water because long-term focused injection at that location can push the plumes from Zone 12 source areas to the south making the plume more difficult to track and treat. Pantex utilized injection well 10 as a water outlet during the end of December 2024 and into the first half of 2025 because there were severely limited water outlet options for the SEPTS. Pantex plans to discontinue injecting treated water into injection well 10 as soon as the Playa 2 Injection Wellfield comes back online.

2.1.1.1.6 ISB Injection

The SEPTS has the ability to send treated water to the Zone 11 ISB or the Southeast ISB/Southeast ISB Extension to provide water for injection operations. Since the optimal time to inject ISB injection wells is during periods of the year that temperatures are above freezing, the water outlet is limited during the winter months. During the warmer months, sending treated water to the ISBs for injection is an optimal beneficial use outlet. In 2024 ISB injection was used as a beneficial use outlet during April through early December.

2.1.1.1.7 Center Pivot Irrigation

The construction of the center pivot irrigation system was completed in August of 2023. This system was utilized as a beneficial use water outlet through November 2023 but experienced a break near the wet well in early December 2023. The wet well break was repaired in February 2024 allowing the pivot system to start spring operations once temperatures increased in March 2024. During the months that the pivot system was under repair, P1PTS was operated minimally to prioritize the operation of the SEPTS, and SEPTS mainly released to the Playa 2 injection wellfield or Playa 1 via the WWTF lagoons. Once the wet well repairs were complete and temperatures were above freezing, P1PTS operations resumed and water was released to the pivot system consistently through early July.

Pivot operations were limited during the month of July due to heavy rainfall towards the end of the month and continued limited capacity at the WWTF lagoons as they undergo repairs. As the weather stabilized, pivot operations were continuous during August through early November when the Pivot System experienced an outage at the electrical overhead during a heavy thunderstorm. Electrical repairs were completed in January 2025 and pivot operations resumed in February 2025.

A monthly breakdown of water outlet availability and usage is presented in Table 2-1.

Table 2-1. Description of Water Outlet Usage at Each Pump and Treat in 2024

Month (2024)	Pump and Treat System	Operating?	Center Pivot Irrigation	Subsurface Drip Irrigation	ISB Injection	Playa 2 Injection Wellfield	Injection Well 10	Playa 1
Jan	SEPTS	Yes	Pivot Down	Inoperable	No	Yes	No	Yes
	P1PTS	No	Pivot Down	Inoperable	X	X	X	No
Feb	SEPTS	Yes	Pivot Down	Inoperable	No	Yes	No	Yes
	P1PTS	No	Pivot Down	Inoperable	X	X	X	No
Mar	SEPTS	Yes	Low, due to temperatures	Inoperable	No	Yes	No	Yes
	P1PTS	Yes	Low, due to temperatures	Inoperable	X	X	X	Limited
Apr	SEPTS	Yes	Yes	Inoperable	Yes	Yes	No	Limited
	P1PTS	Yes	Yes	Inoperable	X	X	X	Yes
May	SEPTS	Yes	Yes	Inoperable	Yes	Yes	No	No
	P1PTS	Yes	Yes	Inoperable	X	X	X	Yes
Jun	SEPTS	Limited by SCADA outage	Limited by crop harvest	Inoperable	Yes	Yes	No	No
	P1PTS	Yes	Limited by crop harvest	Inoperable	X	X	X	Limited
Jul	SEPTS	Yes	Yes	Inoperable	Yes	Yes	No	No
	P1PTS	Limited	Low due to rain	Inoperable	X	X	X	No
Aug	SEPTS	Yes	Yes	Inoperable	Yes	Yes	No	No
	P1PTS	Yes	Yes	Inoperable	X	X	X	No
Sep	SEPTS	Yes	Yes	Inoperable	Yes	Yes	No	No
	P1PTS	Yes	Yes	Inoperable	X	X	X	Yes
Oct	SEPTS	Yes	Yes	Inoperable	Yes	No, failed communication	No	No
	P1PTS	Yes	No	Inoperable	X	X	X	Yes
Nov	SEPTS	Yes	Yes, until electrical failure	Inoperable	Yes	No, failed communication	No	Yes
	P1PTS	Limited by SEPTS Priority	No, electrical failure	Inoperable	X	X	X	Very Little
Dec	SEPTS	Yes	No, electrical Failure	Inoperable	Yes	No, failed communication	Yes	Yes
	P1PTS	No, Prioritize SEPTS	No, electrical failure	Inoperable	X	X	X	No

The Playa 1 and Subsurface Irrigation outlets are routed from the WWTF lagoons
Outlets are listed in order of priority
X= the system cannot utilize the outlet, although the P1PTS will be routed into the ISB injection outlet for emergency use next year.

2.1.1.2 Playa 1 Pump and Treat System

A description of the P1PTS is provided in Section 1.4.2. The operational goals for the systems were redeveloped in 2023 to emphasize the operation of the SEPTS when there are limited outlets for water and can be reviewed in the highlight box in Section 1.4.1. These goals are prioritized and will be met as conditions allow.

The P1PTS was designed with a treatment capacity of 250 gpm or 360,000 gallons per day (gpd) and could potentially treat up to 131 million gallons (Mgal) of water per year running at design capacity and 100% operation.

Though the subsurface irrigation system remains down, P1PTS was able to operate in 2024 by releasing to the center pivot irrigation system or by routing water to Playa 1. Flow to Playa 1 is restricted by permit; therefore, Pantex reduced the P1PTS operation to allow higher recovery at the SEPTS when necessary. This action provides better control of the RDX plumes movement to the southeast. This reduction in operation is reflected in the reduced number of operational days and throughput for the system when water outlet capacity was limited. There were times in 2024 that the P1PTS was shut down completely due to limited availability of the water outlets as described in section 2.1.1.1

The following figures depict the P1PTS operation, throughput, and well operation, providing the percentage of design capacity or operation achieved as well as goals for the system. While operation and throughput were reduced in 2024 to allow better capture of the RDX plume through the SEPTS increased operation, the 90% goals are still depicted in the graphs and used to identify potential issues with system or well operation.

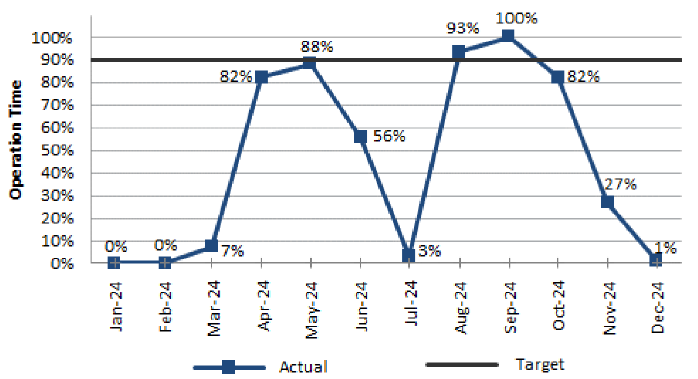

Fig. 2-1. P1PTS operation time vs target.

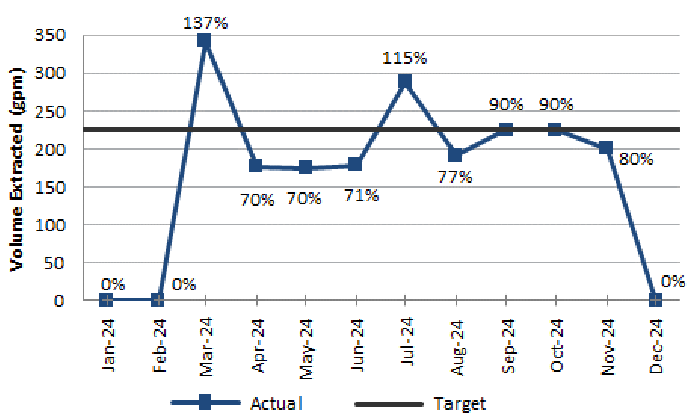

Fig. 2-2. P1PTS average GPM and % capacity.

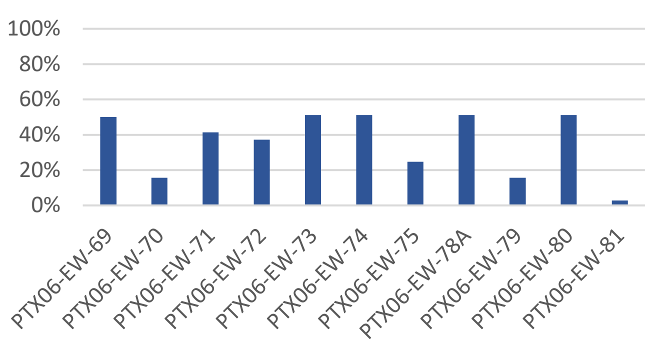

Fig. 2-3. P1PTS well operation time.

The P1PTS was operational for 186 days during 2024 with an average annual operational rate of 44.9%, based on total hours operated versus total possible operation time. The actual percentage of monthly system operational time versus the target percentage is depicted in Fig. 2-1.

Fig. 2-2 depicts the average gpm extracted from all wells by month. The P1PTS extracted an average of 222 gallons per minute (gpm) (about 89% of design throughput) from the well field while operating in 2024. The calculated gpm accounts for water extracted from the well field when the system operated and is affected by each well's yield, downtime, or reduced flow required by the WWTF or irrigation systems.

Fig. 2-3 reflects the operation time by well. The primary reasons for well downtime at P1PTS include scheduled well maintenance and limited water outlets. PTX06-EW-70 went down in October 2023, and was repaired September 2024. PTX06-EW-79 experienced issues in November 2023 and was repaired in July 2024. Additionally, PTX06-EW-81 was down for most of the year due to communication failures. This well is currently undergoing repairs. All other wells were running when the system was operated.

Fig. 2-4 reflects the P1PTS overall system efficiency considering system and well operation. The system treated an average of about 168,730 gpd when operating during 2024, which is approximately 47% of design capacity. The gpd is affected by the ability to extract water from the wells, reduced flow to the WWTF and irrigation system, and system downtime. The system treated approximately 47.8 Mgal during 2024, with an average treatment volume of about 5.3 Mgal per month when operating.

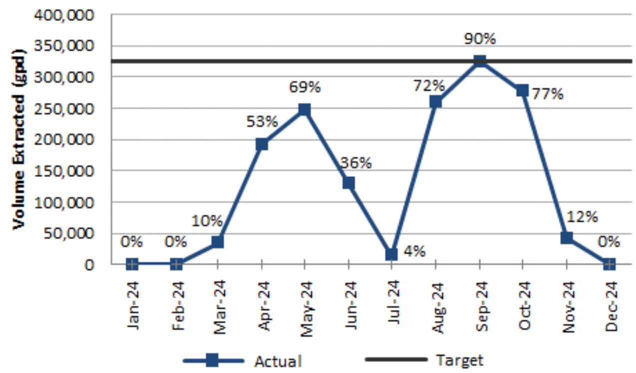

Fig. 2-4. P1PTS average GPD and % capacity.

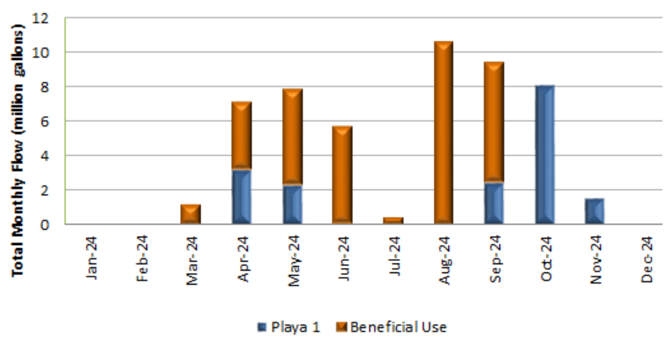

Fig. 2-5. P1PTS monthly total flow.

The monthly treatment flow volumes and treated water usage are depicted in Fig. 2-5. P1PTS is only able to release to the WWTF for distribution to Playa 1 or the subsurface drip irrigation system or to the pivot irrigation system (denoted as beneficial use in Fig. 2-5).

During 2024, the system removed approximately 8 pounds (lbs) of RDX and 3.1 lbs of all other HEs (see Fig. 2-6). The average removal rate of HEs was approximately 0.17 lbs/Mgal of treated water. Since startup in September 2008, the system has removed a total of 563 lbs of RDX and 227 lbs of all other HEs. PFAS is also removed by this system, but due to low concentrations of these COCs, only about 1 lb per year is estimated to be removed. Therefore, the mass removal for PFAS is not tracked.

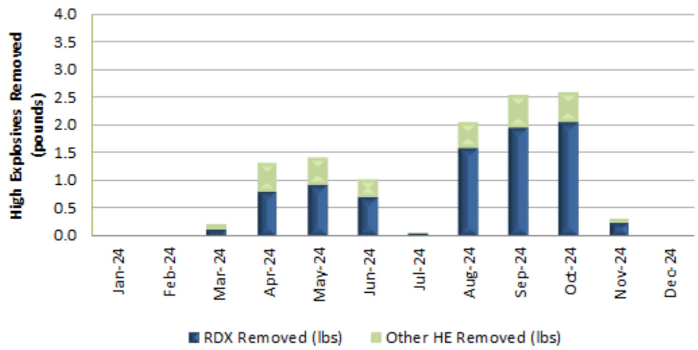

Fig. 2-6. P1PTS mass removal by month.

HE mass removal is dependent on the wells operated within the system, which affects influent concentrations and throughput. Source concentrations from Playa 1 are rapidly declining, with a small area directly beneath the Playa now demonstrating full treatment (see the plume maps in Section 3). Therefore, most wells are no longer in the higher-concentration HE plumes; thus, mass removal is low at P1PTS.

The average influent concentration of RDX was 148 ug/L in 2009 while the average influent concentration in 2024 was 19.9 ug/L. The maximum influent RDX concentration in 2009 was 200 ug/L and 26.3 ug/L in 2024. This system primarily reduces saturated thickness and head on the southeast perched groundwater, although mass removal is also achieved.

Evaluation of effluent data indicates that the system treated the recovered groundwater to concentrations below the GWPS. The complete set of effluent data collected during 2024 is included in the Appendix D electronic data tables.

In 2023, Pantex started evaluating PFAS at the pump and treat systems. PFAS is present at P1PTS. The GAC used at the system is effectively removing the PFAS to concentrations less than the TCEQ Texas Risk Reduction Program (TRRP) protective concentration levels (PCLs). Since the EPA promulgated a maximum contaminant level (MCL) for six PFAS constituents in April 2024, Pantex also compared effluent concentrations to those MCLs. In 2024, all PFAS constituent concentrations measured in the effluent was less than the lowest applicable standard (TCEQ PCL or MCL). There is one PFAS constituent found in the effluent that does not currently have a promulgated standard and no information can be found in literature. 6:2FTS (1h,1h,2h,2h-perfluorooctane sulfonic acid) has been detected in the effluent at concentrations ranging from 1.93 to 13 ng/L. 2024 effluent PFAS detections at P1PTS are summarized in Table 2-2.

Table 2-2. Summary of Effluent PFAS Detections at P1PTS

Sample Date	Analyte	Measured Value (ng/L)	Standard (ng/L)	> Standard?
3/26/2024	1h,1h,2h,2h-Perfluorooctane Sulfonic Acid (6:2 Fts)	2.57	NA	NA
3/26/2024	Perfluorobutanoic Acid (Pfba)	1.64	36500	N
3/26/2024	Perfluorooctane Sulfonamide (Pfosa)	0.277[J]	290	N
3/26/2024	Perfluoropentanoic Acid (Pfpea)	0.615	12000	N
4/2/2024	1h,1h,2h,2h-Perfluorooctane Sulfonic Acid (6:2 Fts)	3.25	NA	NA
4/2/2024	Perfluorobutanoic Acid (Pfba)	2.15	36500	N
4/2/2024	Perfluorooctane Sulfonamide (Pfosa)	0.154[J]	290	N
4/2/2024	Perfluoropentanoic Acid (Pfpea)	0.654	12000	N
5/6/2024	Perfluorobutanoic Acid (Pfba)	3.04[J]	36500	N
5/6/2024	Perfluoropentanoic Acid (Pfpea)	0.765[J]	12000	N
6/11/2024	1h,1h,2h,2h-Perfluorooctane Sulfonic Acid (6:2 Fts)	1.93	NA	NA
6/11/2024	Perfluorobutanoic Acid (Pfba)	12.4	36500	N
6/11/2024	Perfluorohexanoic Acid (Pfhxa)	0.428	12000	N
6/11/2024	Perfluorooctane Sulfonamide (Pfosa)	0.17	290	N
6/11/2024	Perfluoropentanoic Acid (Pfpea)	3.49	12000	N
7/1/2024	Perfluorobutanoic Acid (Pfba)	9.58	36500	N
7/1/2024	Perfluoropentanoic Acid (Pfpea)	4.73	12000	N
8/6/2024	1h,1h,2h,2h-Perfluorooctane Sulfonic Acid (6:2 Fts)	3.79	NA	NA
8/6/2024	Perfluorobutanoic Acid (Pfba)	6.06	36500	N
8/6/2024	Perfluoropentanoic Acid (Pfpea)	3.09	12000	N
9/4/2024	Perfluorobutanoic Acid (Pfba)	3.65	36500	N
9/4/2024	Perfluoropentanoic Acid (Pfpea)	3.26	12000	N
10/8/2024	1h,1h,2h,2h-Perfluorooctane Sulfonic Acid (6:2 Fts)	13	NA	NA
10/8/2024	Perfluorobutanoic Acid (Pfba)	8.51	36500	N
10/8/2024	Perfluoropentanoic Acid (Pfpea)	4.05	12000	N
11/5/2024	1h,1h,2h,2h-Perfluorooctane Sulfonic Acid (6:2 Fts)	2.67	NA	NA
11/5/2024	Perfluorobutanoic Acid (Pfba)	2.11	36500	N

Standard used for comparison is the lower of the TRRP PCL or the MCL

ng/L – nanograms per liter

PQL – Practical quantitation limit

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

2.1.1.3 Southeast Pump and Treat System

The SEPTS is designed to treat up to 300 gpm or 432,000 gpd and has the capability to treat 158 Mgal annually if operated at 100% design capacity.

During 2024, the SEPTS operated all or part of 351 days with an average operational rate of 95%, based on total hours operated versus total possible operation time. The percent operation time (i.e., hours per day) versus the target operation time is depicted in Fig. 2-7.

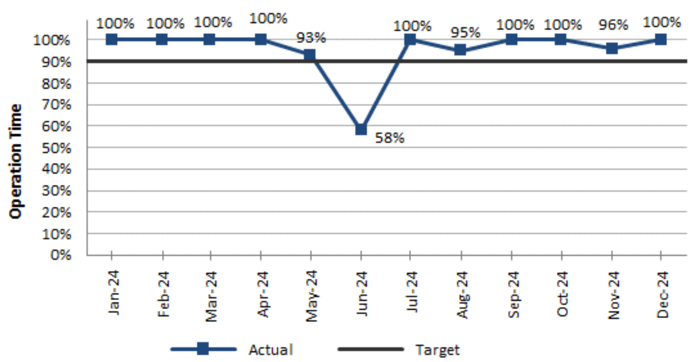

Fig. 2-7. SEPTS operation time vs target.

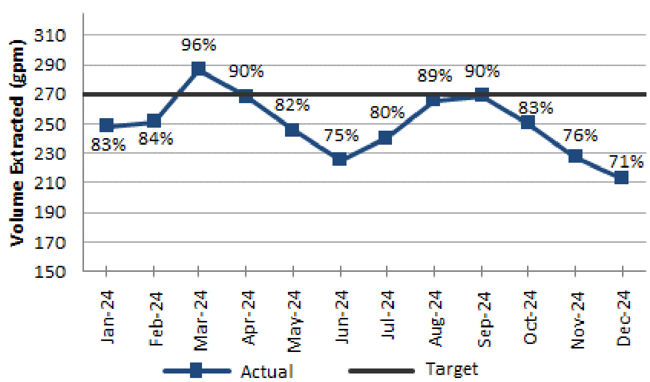

Fig. 2-8. SEPTS average GPM and % capacity.

System operation was consistent at the SEPTS through 2024 due to shutdown of P1PTS, in accordance with the revised operational goals for the systems. SEPTS operated above its target operation time for the whole year, with the exception of June. In June, a plantwide power outage caused a failure of the SEPTS computer hard drive, resulting in loss of the supervisory control and data acquisition (SCADA) software that controls the SEPTS flow. Repairs were made later in June, and SEPTS was able to operate as normal.

As a measure of well operation efficiency, Fig. 2-8 depicts the average gpm extracted from all wells by month, the percentage of design capacity achieved, and system goals. Unless flow is affected by reduction of treated water outlets, the system operational rate has been the prioritized goal since 2023. In 2024, the system was operated fully with the exception of the first part of June. Well operation was below the 270 gpm goal for three-fourths of the year due to maintenance shutdowns and scheduled repairs.

The system extracted an annual average of 249 gpm (about 83% 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 of each well, well downtime, or reduced flow required due to limited water outlets. Because the WWTF/irrigation system was unable to receive full flow from the pump and treat systems, flow was sent to Playa 1 in accordance with permit limits, and injection into the perched groundwater was utilized to ensure prioritization of the operation of SEPTS. Since Playa 1 also receives treated water from the WWTF, SEPTS must reduce flow to the WWTF to ensure that permit limits are not exceeded at Playa 1.

Well operation and throughput were also affected by the number of extraction wells that were down in 2024. Seventeen extraction wells in the SEPTS wellfield were down for at least part of the year in 2024 and required maintenance. Ten wells were completely offline for the duration of the year. Well repairs require the use of an electrical contractor and coordination of lockout/tagouts (LOTOs) with the Pantex Plant Maintenance Department. Multiple LOTOs were scheduled during 2024 to repair wells and to continue maintenance of wells in accordance with the *Well Maintenance Plan for USDOE/NNSA Pantex Plant Groundwater Remedial Action Projects* (Pantex, 2020). Because of this and the periodical inability to employ all water outlet options as described in section 2.1.1.1, throughput at SEPTS was below the 90% goal for a majority of 2024. Throughput improved during the months that Pantex was able to operate the center pivot irrigation system.

The SEPTS has 65 operating wells, however 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. Additionally, Fig. 2-9 includes the operation times for each SEPTS extraction well that was operated or sampled in 2024. Pantex struggled to meet the throughput goal of 270 gpm even when every available well was operating at the SEPTS by the end of 2024 due to a decrease in saturated thickness in areas of the SEPTS wellfield. Because of this, Pantex is no longer operating the SEPTS extraction wells in accordance with a priority scheme. Many wells do not have enough water in them to reliably pump. The wellfield now operates all wells that are online and available.

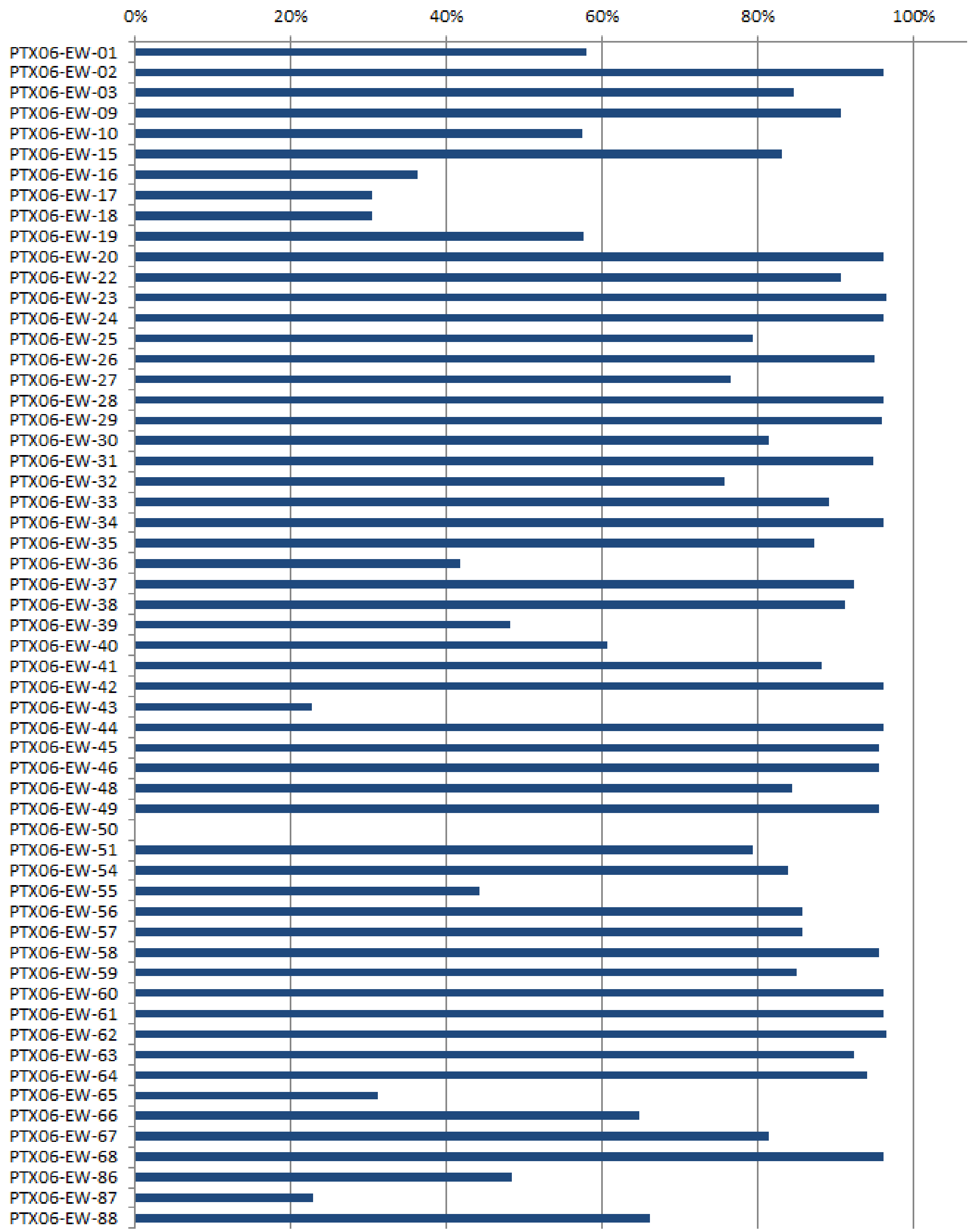

Fig. 2-9. Operation time of SEPTS wells operated or sampled in 2024.

Six extraction wells, PTX06- EW-83 through EW-88, were installed in 2016 to control the movement of HE plumes to the southeast. Those wells were connected to the SEPTS and began consistent operation in May 2019. Due to the declining water levels limiting operations in that area, these wells were taken offline in the latter part of 2024. Pantex is preparing to convert these wells into ISB injection wells as part of the County Road 8 ISB system.

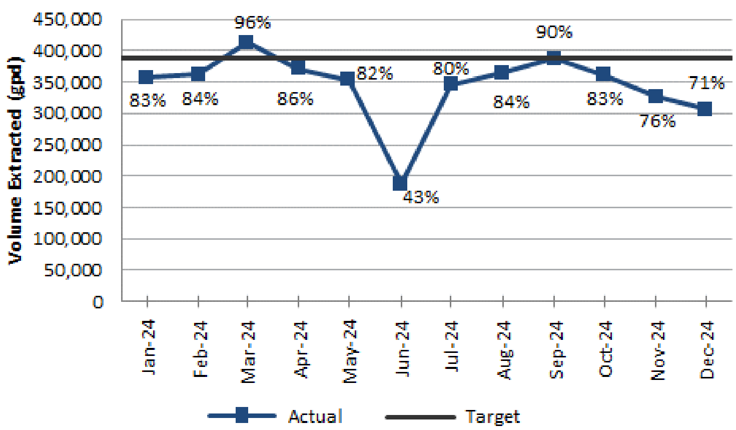

Fig. 2-10. SEPTS average GPD and % capacity.

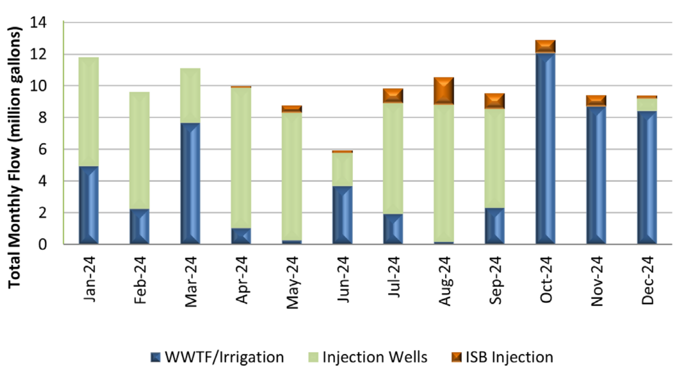

Fig. 2-11. SEPTS total flow volume and disposition of effluent.

Fig. 2-10 reflects the SEPTS overall efficiency considering system and well operation. The figure depicts the average daily treatment rate in gpd by month, the target, and the percentage of total capacity achieved at the SEPTS. In 2024, the SEPTS treated an annual average of approximately 344,775 gpd (about 80% of design capacity), based on total possible hours of system operation and total inflow from the well field. System operation time was high, but flow was impacted by well downtime and limited outlets for treated water.

Operation time was high during 2024, but throughput was limited as the system was primarily affected by the loss of wells that required repair, reduced throughput to the WWTF/irrigation, and limited injection capability at Playa 2 towards the end of the year.

The system treated approximately 126.1 Mgal of extracted water during 2024. The total volume treated by month and the final disposition of the treated water are depicted in

Fig. 2-11. Approximately 47% of the treated water at SEPTS was injected into the perched aquifer via the Playa 2 injection wellfield or injection well 10, 5% was used beneficially for ISB injection, 19% was beneficially used for irrigation, and the remainder was released to Playa 1 via the WWTF. The pivot irrigation system was unavailable during January, February, and the first part of March in 2024. Once the pivot system was available in March, SEPTS provided the system water every month until a thunderstorm caused a fuse to blow in early November. There were months that the water throughput to the pivot from SEPTS was low due to heavy rains, the failure of the SCADA system in June, or during times that the Playa 2 injection wells could be utilized to allow P1PTS to take advantage of the pivot outlet instead.

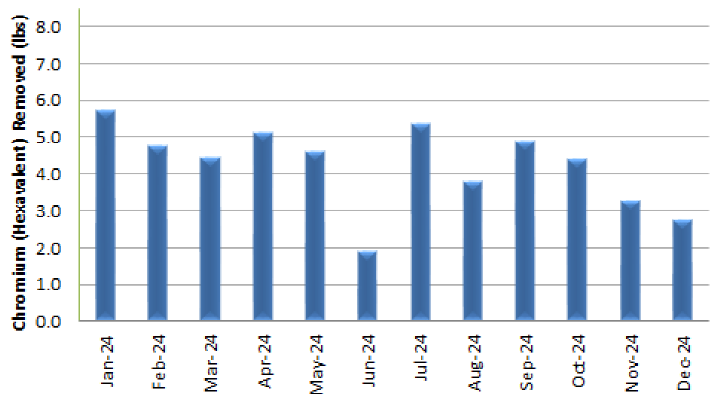

Fig. 2-12. SEPTS chromium mass removal by month.

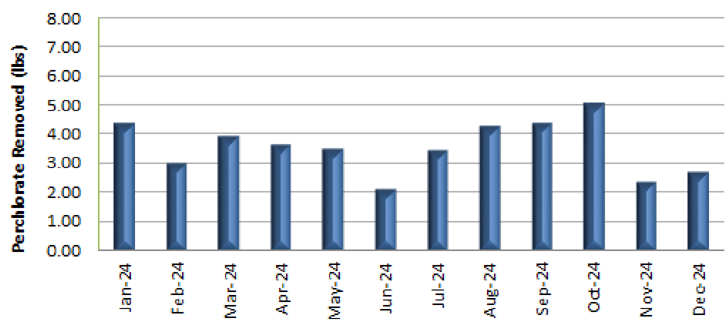

Fig. 2-13. SEPTS perchlorate mass removal by month.

The SEPTS primarily removes RDX, hexavalent chromium, and perchlorate from the perched groundwater. The system removed approximately 51 lbs of hexavalent chromium, 43 lbs of perchlorate, 191 lbs of RDX, and 173 lbs of all other HEs during 2024. The total mass removed for hexavalent chromium, perchlorate, and

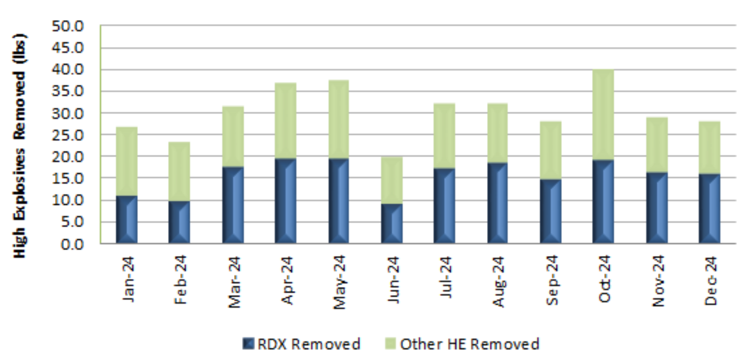

Fig. 2-14. SEPTS high explosive mass removal by month.

HEs, by month, is depicted in Fig. 2-12, Fig. 2-13, and Fig. 2-14. The average removal rate of hexavalent chromium was 0.41 lbs/Mgal of water and the average removal rate for perchlorate was 1.17 lbs/Mgal. The average removal rate for HEs was 2.73 lbs/Mgal of water.

Hexavalent chromium mass removal is declining because concentrations in PTX06-EW-51 and nearby extraction wells continue to decline. PTX06-EW-51 was located in the heart of the hexavalent chromium plume south of Zone 12 and contributed heavily to the hexavalent chromium influent concentrations at the SEPTS. The plume has moved downgradient, and other extraction wells now capture portions of it even though concentrations are much lower at these wells. Average influent concentrations of hexavalent chromium were approximately 214 ug/L in 2009 and approximately 45.8 ug/L in 2024.

HE mass removal is affected by wells that operate in higher-concentration portions of the RDX plume. Overall, average concentrations of RDX in the SEPTS influent have declined with average concentrations about 570 ug/L in 2009, the first year of the full remedial action, to about 183.7 ug/L in 2024. This system has treated approximately 14,639 lbs of HEs, 1,982 lbs of hexavalent chromium, and 201 lbs of perchlorate since it started operating. Evaluation of effluent data indicates the system treated the recovered groundwater to concentrations below GWPS.

A summary of COC effluent detections at the SEPTS is included in Table 2-3, with the exception of boron, which is detected in all samples and continues to remain below the GWPS. The complete set of effluent data collected during 2024 is included in Appendix D.

Table 2-3. Summary of Effluent COC Detections at SEPTS

Sample Date	Analyte	Measured Value (ug/L)	Bkgd (ug/L)	> Bkgd?	PQL (ug/L)	> PQL?	GWPS (ug/L)	> GWPS?
1/3/2024	Hexavalent Chromium	21.53	3.2	Y	2	Y	100	N
1/3/2024	Perchlorate	0.92	0.96	N	1	N	15	N
2/5/2024	Hexavalent Chromium	3.56	3.2	Y	2	Y	100	N
2/5/2024	Perchlorate	0.50	0.96	N	1	N	15	N
2/14/2024	Perchlorate	0.39	0.96	N	1	N	15	N
3/4/2024	Hexavalent Chromium	1.32	3.2	N	2	N	100	N
3/4/2024	Perchlorate	0.10	0.96	N	1	N	15	N

Sample Date	Analyte	Measured Value (ug/L)	Bkgd (ug/L)	> Bkgd?	PQL (ug/L)	> PQL?	GWPS (ug/L)	> GWPS?
3/18/2024	Perchlorate	0.12	0.96	N	1	N	15	N
4/1/2024	Hexavalent Chromium	5.67	3.2	Y	2	Y	100	N
4/1/2024	Perchlorate	0.14	0.96	N	1	N	15	N
4/15/2024	Perchlorate	0.04	0.96	N	1	N	15	N
5/1/2024	Hexavalent Chromium	2.15	3.2	N	2	Y	100	N
5/1/2024	Perchlorate	0.10	0.96	N	1	N	15	N
5/15/2024	Perchlorate	0.11	0.96	N	1	N	15	N
6/3/2024	Hexavalent Chromium	2.77	3.2	N	2	Y	100	N
6/3/2024	Perchlorate	0.10	0.96	N	1	N	15	N
6/13/2024	Perchlorate	0.14	0.96	N	1	N	15	N
7/1/2024	Hexavalent Chromium	0.77	3.2	N	2	N	100	N
7/1/2024	Perchlorate	0.06	0.96	N	1	N	15	N
7/15/2024	Perchlorate	0.06	0.96	N	1	N	15	N
8/5/2024	Hexavalent Chromium	4.98	3.2	Y	2	Y	100	N
8/14/2024	Perchlorate	0.07	0.96	N	1	N	15	N
9/3/2024	Hexavalent Chromium	1.08	3.2	N	2	N	100	N
9/3/2024	Perchlorate	0.04	0.96	N	1	N	15	N
9/18/2024	Perchlorate	0.03	0.96	N	1	N	15	N
10/2/2024	Hexavalent Chromium	3.68	3.2	Y	2	Y	100	N
10/2/2024	Perchlorate	0.11	0.96	N	1	N	15	N
10/15/2024	Perchlorate	0.21	0.96	N	1	N	15	N
11/4/2024	Hexavalent Chromium	26.77	3.2	Y	2	Y	100	N
11/4/2024	Perchlorate	0.80	0.96	N	1	N	15	N
11/22/2024	Perchlorate	0.03	0.96	N	1	N	15	N
12/2/2024	Hexavalent Chromium	6.08	3.2	Y	2	Y	100	N
12/2/2024	Perchlorate	0.07	0.96	N	1	N	15	N

PQL – Practical quantitation limit Bkgd - background
J = Estimated value representing a concentration detected less than the practical quantitation limit and equal to or greater than the method detection limit (MDL).
J+ = The associated numerical value is an estimated quantity with a suspected positive bias.

This system also treated PFAS that was found in the southeast pump and treat well field. PFAS removal is only estimated to be about 1 lb per year; therefore, the mass removal is not tracked for these COCs. The GAC used at the systems is effectively removing the PFAS to concentrations less than current TRRP PCLs or newly promulgated drinking water MCLs. 2024 effluent PFAS detections at the SEPTS are summarized in Table 2-4.

Table 2-4. Summary of Effluent PFAS Detections at SEPTS

Sample Date	Analyte	Measured Value (ng/L)	Standard (ng/L)	> Standard?
1/8/2024	Perfluorobutanoic Acid (Pfba)	4.04	36500	N
1/8/2024	Perfluorooctane Sulfonamide (Pfosa)	0.228	290	N
2/6/2024	Perfluorobutanoic Acid (Pfba)	6.2	36500	N
2/6/2024	Perfluoropentanoic Acid (Pfpea)	0.55	12000	N
3/4/2024	Perfluorobutanoic Acid (Pfba)	1.76	36500	N
4/1/2024	Perfluorobutanoic Acid (Pfba)	3.3	36500	N
6/3/2024	Perfluorobutanoic Acid (Pfba)	2.01	36500	N
7/1/2024	Perfluorobutanoic Acid (Pfba)	0.636 $^{J+}$	36500	N
9/3/2024	Perfluorobutanoic Acid (Pfba)	1.4	36500	N
10/8/2024	Perfluorobutanoic Acid (Pfba)	1.57	36500	N
11/4/2024	Perfluorobutanoic Acid (Pfba)	7.55	36500	N
12/2/2024	Perfluorobutanoic Acid (Pfba)	0.552	36500	N

Standard used for comparison is the lower of the TRRP PCL or the MCL
PQL – Practical quantitation limit
J+ = The associated numerical value is an estimated quantity with a suspected positive bias.
ng/L – nanograms per liter

Overall, the SEPTS continues to remove and treat water from the well field. The system was primarily affected by repairs, a plant power outage that caused a temporary failure in the SCADA system, and carbon/resin change-out. P1PTS was shut down periodically in 2024 to allow SEPTS to fully operate when water outlets were limited.

Pantex requested funding for 2022 through 2025 to design and install a new SCADA system at both pump and treat systems to ensure continued reliability of the system operations. The new SCADA system design was completed in April 2024. Construction is scheduled to begin in summer 2025, but will be phased across multiple years, depending on funding availability. The SCADA upgrade is anticipated to bring more reliable well communication and operations at the pump and treat systems.

Pantex will continue to manage SEPTS in 2025 to meet the realigned operational goals agreed upon by TCEQ, EPA and Pantex and discussed in Section 1 of this report, using a combination of release to the WWTF, pivot irrigation system, injection, and reduction of flow or ceasing operation of P1PTS, as needed. Operations will continue to prioritize capture of the RDX, perchlorate, and hexavalent chromium plumes.

2.1.2 ISB Systems

Pantex has installed six ISB systems as part of the final Remedial Action for groundwater and currently operates five of those systems. Of the systems that operated in 2024, two are southeast of the plant on TTU property, one is south of Zone 11, one is southeast of the main plant (i.e., east of FM 2373) at the extreme southeast boundary of USDOE/NNSA-owned property, and the fifth is located offsite to the southeast of Pantex property, south of Highway 60. System information and maps are provided in Section 1.4.2. In 2024, the ISB systems consisted of 244 treatment zone injection wells, 44 ISB extraction wells, 20 TZM wells, and 19 ISPM wells. Some wells were just installed in 2024 and were not yet actively used. Some of the wells are now dry or inactive due to changing conditions at the ISBs.

In the past, the systems were injected with Newman Zone®, an emulsified soybean oil (EVO or emulsified vegetable oil). Based on indications that the amendment was not distributing well, Pantex conducted studies at the Zone 11 ISB to determine an approach that could impact monitoring wells located between the injection points. Based on the study, Pantex has moved to the use of a more soluble carbon source, molasses, in the systems where wells are widely spaced. This change has also required more frequent injection of amendment to ensure continued treatment of COCs. With the exception of the Offsite ISB, frequency of injection at each system is determined by the amount of saturated thickness and water movement. The offsite ISB is currently injected twice every year to ensure the plume moving southeast is arrested and a treatment zone is established.

Injection volumes and amendment concentrations are planned based on a Zone 11 ISB study, which indicated that a higher volume of amended water was needed to affect areas between the wells. A dose response study was conducted early in the 2018 injection event to determine if a solution of molasses mixed with EVO would reach the areas between the wells at an appreciable concentration. Pantex also studied three TZM wells between the injected wells, allowing for a robust study on the effectiveness of injection.

For the study, fluorescein dye was injected into five injection wells (PTX06-ISB091, PTX06-ISB092, PTX06-ISB096, PTX06-ISB103, and PTX06-ISB104), and three monitoring wells (PTX06-1164, PTX06-1176, and PTX06-1177) were monitored to evaluate the distribution of the injection solution. Samples were collected for visual comparison to a pre-mixed fluorescein standard and for laboratory analysis for total organic carbon (TOC). Because TOC data analysis and reporting would be delayed, the fluorescein dye was used as a tracer to determine when injection should be discontinued. Dye arrival was not observed at the monitoring locations when the target volume was reached; therefore, injections were continued until dye arrival was confirmed or a volume equivalent to 20% mobile porosity was reached.

The study indicated that only the more soluble carbon (i.e., molasses) reached the monitoring points between the injection wells. Calculations using dye and TOC concentration results indicate that injection volumes must be increased. Information from this study is now used at all ISBs to determine injection volumes.

Based on the dose response study, future operation of the ISBs will focus on the use of a more soluble carbon (e.g., molasses) to achieve the distribution needed at the ISB systems when wells are widely spaced. Pantex has been infilling wells and installing some areas of the system with wells approximately 50 ft apart so that the EVO could be used at those locations with less frequent injection. The original wells installed in the Zone 11 ISB and all of the Southeast ISB systems are configured with 100-ft spacing between injection wells. The Southeast ISB Extension was configured with 75-ft spacing to overcome known problems with distribution. This approach will be evaluated through continued monitoring, and results and recommendations will be provided in future reporting.

Recently installed wells at the Zone 11 ISB were appropriately spaced (50-60 ft centers) for injection of Newman Zone®. Those wells have been injected and future injections are planned once every three years due to the longevity of the EVO. Future systems are also planned with closer spacing so that EVO can be used.

The Offsite ISB was designed using an updated perched groundwater fate and transport model and wells were located optimally to achieve cleanup within 25 years. The system was planned for injection with molasses twice annually at locations the modeling indicated would require injection. Monitoring will be used to evaluate against modeled data to determine the effectiveness of the treatment and whether adjustments in injection or additional wells may be needed to achieve cleanup goals.

2.1.2.1 Zone 11 ISB

2.1.2.1.1 History of Zone 11 ISB

The Zone 11 ISB system is on Pantex property, south of Zone 11. The system, as operated in 2024, consists of 91 injection wells, 8 TZM wells, and 9 downgradient ISPM wells installed in a zone of a saturated thickness of 18 to 28 ft. The system is detailed in Section 1.4.2.

Due to differences in the type of amendment injected throughout the system, not every well is injected each year. Some of the differences are based on well spacing, while others may be paused for injection due to build-up of amendment from past injections, as commonly found in wells that had EVO injected for a long period of time.

Injection frequency has been decreased in wells where EVO was previously used. This is based on evaluation of three factors: pilot study data, monitoring data from PTX06-ISB082, and long-term evaluation of the use of EVO.

Data at the monitoring wells installed for the pilot study indicated that complete treatment of HEs and hexavalent chromium occurred in less than two years at most downgradient wells. Where monitoring was continued at the downgradient wells, results indicated that the ISB continued to treat RDX and hexavalent chromium into 2024 at all but one well, with no further injections in the pilot study wells, even though the system was only injected in 2005 and 2006. These results indicate that treatment has continued for more than 10 years after the final injection. While conditions at the pilot study differ from those of the Zone 11 ISB, pilot study data indicate that longer wait times for injection are appropriate when EVO, such as Newman Zone® is used.

To evaluate the need for continued injection into the second-row wells on the eastern side of the ISB where build-up had occurred and injection was difficult, Pantex discontinued injection of EVO into PTX06-ISB082 after the fifth injection event in 2013. Data collected from 2014 through 2022 indicate that PTX06-ISB082 maintained deep reducing conditions and had ample food source for the continued degradation of perchlorate. PTX06-ISB079 has also been monitored since all treatment was discontinued in the second row of wells on the eastern side of the system, and data through 2022 indicate that treatment continued and that ample food source remains to continue treatment within the radius of influence of the well. 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. Pantex continued to monitor the wells paused for injection through 2022 but began successfully using them in 2023 to continue injections for treating the plume of

TCE that is moving into the eastern side of the ISB. Due to the wider spacing of the wells, molasses was used to ensure effective distribution. Pausing injection in these wells indicates that a pause at other wells where EVO was originally used can successfully allow rehabilitation and injection of the wells in the future. Pantex has paused injection in 15 other first-row wells that have reduced capacity for injection.

Pantex has moved to the use of a more soluble carbon source throughout the Zone 11 ISB where wells are more widely spaced (75-100 ft centers) and modified injection frequencies to twelve months in portions of the system where EVO has not been used.

Newer wells installed as a second row in the eastern side of the system were more closely spaced (50-60 ft centers) so that EVO could be used for injections. Based on data collected over time at the Zone 11 ISB and the results from the pilot study wells discussed above, the new wells are planned for injection every three years. However, data will be collected to validate timing of the injections.

Older EVO-injected wells that have been paused for injection will be evaluated at the end of three years to determine if they can be rehabilitated and injected again. Molasses will be injected in the widely spaced wells once rehabilitation indicates that injection is possible.

Four other wells have been paused for injection, due to issues with injection. These wells seem to be in a tighter area of the formation, so injection became difficult after a few injection events. Pantex has infilled wells in that area to replace injection of PTX06-ISB087, PTX06-ISB088, PTX06-ISB105 and PTX06-ISB106. However, Pantex will periodically evaluate the potential for re-injection into those wells.

2.1.2.1.2 Operation of Zone 11 ISB

During 2024, injection occurred across the Zone 11 ISB, with 53 wells rehabilitated and 55 injected. Two new wells were installed in 2024 to fill a gap in treatment and those wells did not require rehabilitation prior to injection. The rehabilitation and post-injection reports are included in Appendix H. Maintenance activities were not performed at PTX06-ISB164 or PTX06-ISB165 since they were newly installed in 2024.

Previously injected wells were first maintained to improve injection performance and mitigate the effects of biofouling so that the wells were suitable for amendment injection. Maintenance consisted of mechanical and chemical rehabilitation and was performed from March through June 2024. Maintenance was performed in the following steps:

1. An initial round of mechanical rehabilitation was conducted to remove gross deposits from the well and enhance the effectiveness of subsequent chemical rehabilitation. Mechanical rehabilitation consisted of an initial evaluation of the well followed by brushing, surging, and bailing to loosen and remove deposits from the well screen and filter pack.
2. Chemical rehabilitation involved the application of the Cotey Chemical Corporation Welgicide Cleaner (Welgicide). The purpose of chemical rehabilitation was to dissolve and remove mineral scale and/or biomass on the well screen and in the filter pack.
3. A second round of mechanical rehabilitation was conducted using brushing, surging, and bailing. Development was considered complete when extracted water color improved and pH was below 9.

After well maintenance, constant-rate injection tests were performed to calculate transmissivity and specific capacity values for each well. The objective of hydraulic testing was to evaluate present well performance compared to what is documented in historical testing results. Well maintenance effectively increased performance in 30% of the wells that were maintained. Based on results of injection testing and actual injection rates achieved, overall transmissivity has decreased across the well field, with the greatest decreases occurring in older wells. Because of this, target volumes have been adjusted in some wells to account for the change in performance since installation. Collectively, injection results indicated that target volumes were achievable at most wells.

Injection occurred from May through December 2024. For injection, Pantex used 80% strength molasses (diluted with water) to enhance the distribution of amendment across the treatment zone. The injected solution was approximately 2.0% pure molasses by volume. Pantex did not inject any EVO amendment during the 2024 injection cycle.

Injection activities consisted of injecting makeup water mixed with amendment followed by a clean water flush of 5% of the injected volume. Approximately 4,205,224 gallons of molasses solution were injected into 55 injection wells during the 2024 injection event. The typical average flow rate at locations where the target volumes were achieved was 2.5 gpm.

Target dosing of 2% pure molasses was achieved in 93% of the wells. The lowest target dose achieved was 1.9%. All planned injection wells received all or part of the target injection volume, with target volumes of molasses and water having been achieved at 89% of the wells before the injection cycle was ceased due to freezing temperatures. The two newly drilled injection wells, PTX06-ISB164 and PTX06-ISB165 were injected in 2024 and met the targeted dose of molasses and exceeded the injection volume goals.

2.1.2.2 Southeast ISB

2.1.2.2.1 History of Southeast ISB

The Southeast ISB system is on TTU property, southeast of the main plant. The system consists of 42 injection wells and 5 downgradient ISPM wells installed in a zone of saturated thickness of less than 4 ft throughout most of the system. The system is detailed in Section 1.4.2.

Due to upgradient pump and treat operations, areas within and surrounding the Southeast ISB continue to demonstrate declining water conditions. An upgradient monitoring well, PTX06-1118, has not been sampled since 2010 when it went dry. Three of the five downgradient ISPM wells south of the system went dry in 2009, 2015, and 2018, although water came back into PTX06-1045 in 2018 because of water retention ponds installed at the administrative complex. PTX06-1167, which was 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. Several areas inside the treatment zone are dry, and injection does not typically occur in those wells.

Across all data, water-level trends generally indicate that water is declining or there is no trend. This system was impacted by decreased operation of the SEPTS for a period of time when the subsurface irrigation system was under repair. SEPTS is now preferentially operated fully to continue to capture RDX plumes before they move to the Southeast ISB or offsite. Recent trends are now indicating reversal of the past increasing short-term trends. The system continues to have very little saturated thickness (i.e., <10 ft of water), as shown in Fig. 2-15. About 12% of wells inside the treatment zone demonstrate greater than 5 ft of water, with all downgradient wells having less than 5 ft of water.

Evaluation of water-level trends indicates that water levels have generally decreased since the start of remedial action, with nine ISB wells now dry. In 2023 the water-level map indicated that a small portion of upgradient perched water has reconnected to the central portion of the ISB. Where disconnected from the upgradient perched water source, any water remaining will continue to move through the system and be treated. With the focus on operating SEPTS at or near operational goals at all time, this connection is expected to reverse, and the ISB is expected to dry up over time and no longer require injections.

Note that downgradient well PTX06-1045, which was previously dry, demonstrated some recovery in water levels beginning in 2018. This is believed to be related to the construction of the Administrative Site Complex (ASC), south of the main Pantex property. Management of stormwater drainage required the installation of retention ponds at the northwest and southwest corners of the property. The northwest retention pond is near PTX06-1045 and believed to be a contributor to the increased water levels in that well, which has been sampled since 2019.

Pantex recommended in the *2016 Annual Progress Report* that injection at the Southeast ISB be repeated in 2019 (i.e., three years after the last injection event) and be re-evaluated thereafter. The latest injection event started in late 2021, finishing in early 2022. Due to declines in water levels, it is possible that much of this system will no longer require injection after the last injection event in 2022. However, monitoring data will be used to inform the timing and need for injection.

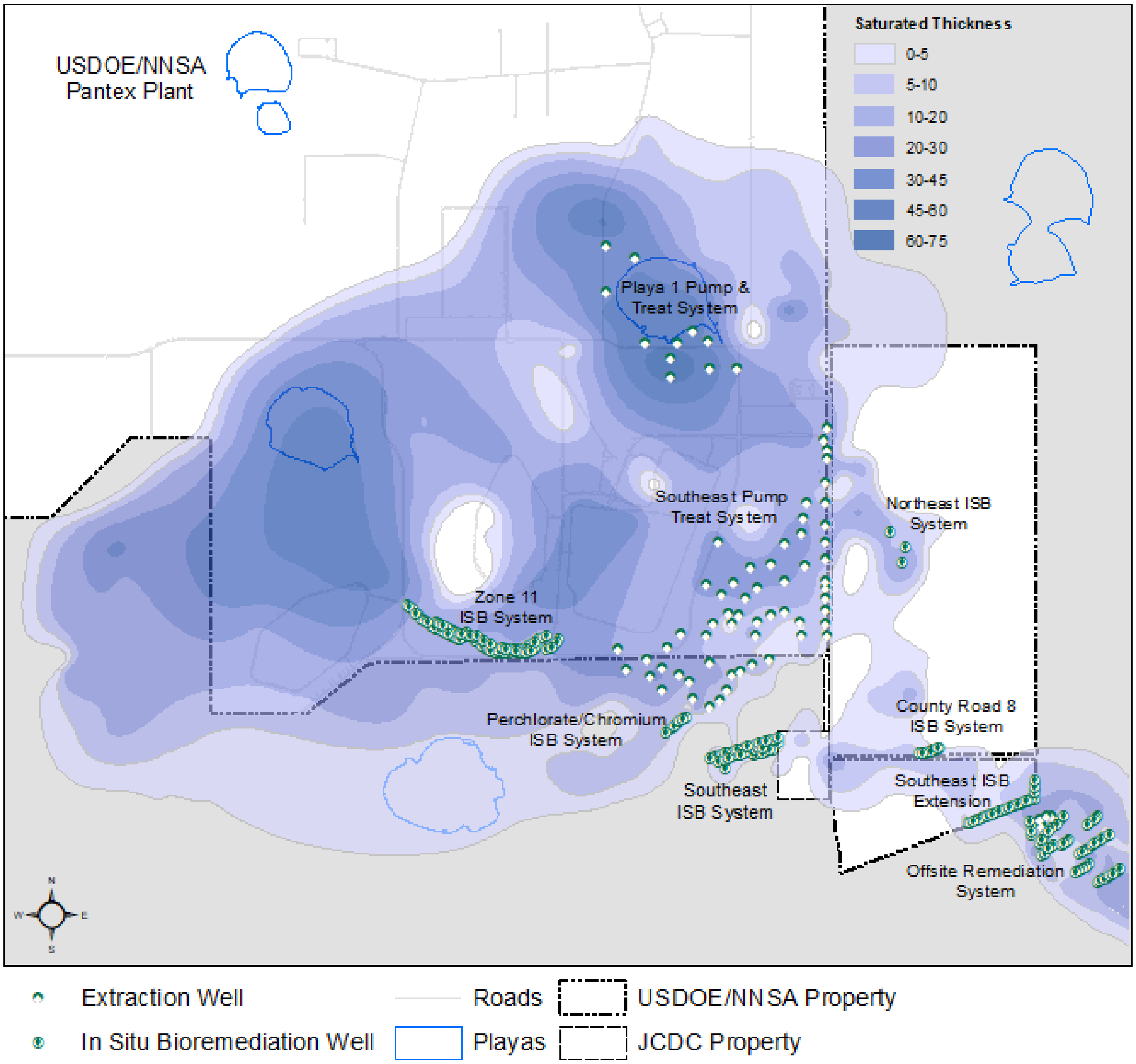

Fig. 2-15. Perched aquifer saturated thickness, 2024.

2.1.2.2.2 Operation of the Southeast ISB

No injection event occurred at the Southeast ISB during 2024. Pantex is planning to inject this system in 2025 to address some areas where the carbon is depleting and to address the areas around PTX06-1153.

2.1.2.3 Southeast ISB Extension

2.1.2.3.1 History of the Southeast ISB Extension

The Southeast ISB Extension system is on USDOE/NNSA property, southeast of the main plant, along the southeast fence line east of FM 2373. The system consists of 31 injection wells, 2 TZM wells, and 2 downgradient ISPM wells installed in a zone of saturated thickness of less than 12 ft throughout the system. The system is detailed in Section 1.4.2.

Similar to the Southeast ISB, this ISB extension will also be affected by the upgradient removal of water from the SEPTS. Water levels are anticipated to decline in this system over time, and future injections may be unnecessary. Currently, injections are budgeted every twelve months since this system has only been injected with a more soluble carbon source (i.e., molasses).

2.1.2.3.2 Operation of the Southeast ISB Extension

Injection and rehabilitation occurred at the Southeast ISB Extension in 2024. Twenty-seven wells were maintained during June to August. PTX06-ISB301 through PTX06-ISB304 were removed from injection as monitoring data indicate there is no longer a plume moving through that area of the ISB. If plume changes occur, those wells will be used for injection as needed. Maintenance was performed in three steps:

1. An initial round of mechanical rehabilitation was conducted to remove gross deposits from the well and enhance the effectiveness of subsequent chemical rehabilitation. Mechanical rehabilitation consisted of an initial evaluation of the well followed by brushing, surging, and bailing of the well to loosen and remove deposits from the well screen and filter pack. Bailing occurred until improvements were observed in solids content and clarity of the evacuated fluids, or the well was bailed dry.
2. Chemical rehabilitation involved the application of Welgicide, which consists primarily of sodium hydroxide (a strong base), with the well surged following application of the Welgicide. The purpose of chemical rehabilitation was to dissolve and remove mineral scale and/or biomass on the well screen and in the filter pack. After the Welgicide solution was allowed to react in the well for at least 24 hours, the solution was purged from the well.
3. A second round of mechanical rehabilitation was conducted using a combination of surging, brushing, and bailing. Development was considered complete when extracted water color improved, was free of suspended solids, and pH was below 9.

After well maintenance, constant-rate injection tests were performed to calculate transmissivity and specific capacity values for each well. The objective of hydraulic testing was to evaluate well performance compared to historical testing results. Although transmissivity is decreasing at the wells over time, overall transmissivity is good across the well field, indicating that system injection will continue to be effective.

The 2024 injection occurred from July to September 2024, with 27 wells injected. Injection activities consisted of the injection of makeup water mixed with amendment, followed by a clean water flush. The amendment injection averaged about 2.11% pure molasses by volume and a total of about 836,033 gallons of amendment solution. The wells were then flushed with clean water with about 5% of the total volume injected into each well.

Target injection volumes and dosing were exceeded at all wells during the 2024 injection event. Approximately 113% of planned injection volume and 2.11% pure molasses was achieved during this event.

2.1.2.4 Offsite ISB Extension

2.1.2.4.1 History of the Offsite ISB

The Offsite ISB is located to the southeast of Pantex property, south of Highway 60. This system currently consists of 56 ISB injection wells and 44 active ISB extraction wells (REC-named wells), 8 TZM wells, and 1 ISPM. The Offsite ISB injection consists of two injection areas: North and South. The system is detailed in Section 1.4.2.

The system operation was determined using fate and transport modeling with an optimization approach to minimize the amount of infrastructure and injections needed to complete cleanup within a 25-year timeframe. System wells will be injected as needed, with injections occurring twice each year for 15 years and monitoring of the system performance for the remaining 10 years. Molasses is the only planned amendment at this system.

2.1.2.4.2 Operation of the Offsite ISB

Injection occurred at this system for the first time in 2021, with only the wells at the leading edge of the plume being injected. System installation continued through 2023, with new wells injected the following year after installation. Because this system must derive all water from the site, ISB extraction wells are used to withdraw water and use for injection. However, due to limited saturated thickness, withdrawal of water is slow and injection rates exceed withdrawal rates. Additionally, challenges associated with new infrastructure required a conservative approach to ensure that spills would be avoided.

Injection and rehabilitation occurred at the Offsite ISB twice during 2024. During the spring event, 18 ISB wells (PTX06-ISB401 – PTX06-ISB416, PTX06-ISB438, and PTX06-ISB440) underwent maintenance from February to April. Spring maintenance did not occur at some wells in this system because they were not injected during the 2023 fall injection event. During the fall event, 47 ISB wells (PTX06-ISB401 – PTX06-ISB416, PTX06-ISB420 – PTX06-ISB434, PTX06-ISB437 – PTX06-ISB445, PTX06-ISB449 – PTX06-ISB451, and PTX06-ISB453 – PTX06-ISB456) underwent maintenance from September to November. Wells were first maintained to improve injection well performance and mitigate the effects of biofouling so that the wells are suitable for amendment injection. Maintenance was performed in three steps:

1. An initial round of mechanical rehabilitation was conducted to remove gross deposits from the well and enhance the effectiveness of subsequent chemical rehabilitation. Mechanical rehabilitation consisted of an initial evaluation of the well followed by brushing, surging, and bailing of the well to loosen and remove deposits from the well screen and filter pack. Bailing occurred until improvements were observed in solids content and clarity of the evacuated fluids, 30 gallons (approximately three well casings) was removed, or the well was bailed dry.
2. Chemical rehabilitation involved application of the Welgicide, which consists primarily of sodium hydroxide (a strong base). The purpose of chemical rehabilitation was to dissolve and remove mineral scale and/or biomass on the well screen and in the filter pack. After the Welgicide solution was allowed to react in the well for at least 24 hours, the solution was purged from the well.
3. A second round of mechanical rehabilitation was conducted using a combination of surging, brushing, and bailing. Development was considered complete when extracted water color improved, was free of suspended solids, and pH was below 9.

After well maintenance, constant-rate injection tests were performed to calculate transmissivity and specific capacity values for each well. The objective of hydraulic testing was to evaluate well performance compared to historical testing results. Transmissivity declined after each injection event, but the overall transmissivity is good across the well field, indicating that system injection will continue to be effective.

Injection occurred twice during 2024, from March to June and September through December. For the first injection, 47 wells were injected including PTX06-ISB401 through PTX06-ISB416, PTX06-ISB420 through PTX06-ISB434, PTX06-ISB437 through PTX06-ISB445, and PTX06-ISB449 through PTX06-ISB456 (with the exception of PTX06-ISB452). Injection activities consisted of the injection of makeup water mixed with amendment followed by a clean water flush. A total of 2,311,075 gallons of amendment solution was injected during the first injection event. About 150,832 gallons of flush water was then injected across the wells. Target dosing was 2.0% molasses by volume, with that amount achieved in almost every well. Target volumes of mixed amendment and water were achieved or exceeded across the system, except for one well, PTX06-ISB424, due to low flow rates after injection of 88,706 gallons of mixed amendment.

During the second injection event, 41 wells were injected, including PTX06-ISB401 through PTX06-ISB412, PTX06-ISB415, PTX06-ISB420 through PTX06-ISB434, PTX06-ISB441 through PTX06-ISB446, PTX06-ISB448 through PTX06-ISB450, and PTX06-ISB453 through PTX06-ISB456. This injection event focused on the leading edge of the plume and the central portion of the system where concentrations of RDX are the highest. A total of about 1,810,894 gallons of amendment solution was injected into 41 injection wells. About 105,514 gallons of flush water was then injected across the wells. Due to declining temperatures and shifts in injection priorities, not every well was flushed. Target dosing was 2% pure molasses by volume. Target dosing was met or exceeded at 83% of injected wells. Injection operations were affected by winter conditions and target volumes were not met at some lower priority wells. As temperatures decreased during this injection event, efforts were focused on prioritizing injections at the leading edge of the plume.

2.1.2.5 Perchlorate/Chromium ISB

2.1.2.5.1 History of the Perchlorate/Chromium ISB

The PCR ISB system was newly installed in 2024. The purpose of the PCR ISB is to treat the perchlorate and Cr(VI) plumes as they move towards the southeast. This system consists of ten ISB injection wells and two TZM wells as detailed in section 1.4.2.5.

2.1.2.5.2 Operation of the Perchlorate/Chromium ISB

Since the PCR ISB injection wells were newly drilled, they did not undergo any physical or chemical maintenance in 2024. Instead, they were inspected to ensure they were fit for injection and maintenance activities. It was found that all PCR injection wells were in good condition and did not convey any abnormalities. Constant-rate injection testing was performed on the injection wells to create a baseline that can be compared to future performance as the wells are injected and maintained in the future.

After inspections and hydraulic testing was complete, injection activities were conducted at all 10 injection well locations throughout October-December, 2024. The total metered volume of mixed amendment delivered to the wellfield was 465,712 gallons and the total metered volume of molasses was 11,757 gallons. The target injection volume was met or exceeded in all 10 wells, and the target pure-molasses concentration of 2.0% was met in every well. Pantex anticipates that 2025 data will begin to indicate an establishing treatment zone in this area.

2.2 Soil Remedial Actions

Soil remedial actions at Pantex include landfill covers, ditch liners, and institutional controls (see Section 1.3). The O&M of the soil remedies is discussed in these sections.

2.2.1 Engineered and Institutional Controls

The soil remedial actions at Pantex are discussed in Section 1. Since the closure of the SVE system, containment of landfills and ditch soils are the only active soil remedies at this time; however, other soil remedies require long-term stewardship to maintain controls. Pantex established all deed restrictions required as an institutional control and as part of the final remedy during 2009 and submitted them to TCEQ and EPA as part of the draft final 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 and groundwater deed restrictions are required in affected areas of perched groundwater. To support the deed restrictions, Pantex maintains long-term control of any type of soil disturbance in the SWMUs to protect human health and prevent spread of contaminated soils.

Pantex also regularly inspects and maintains soil covers on landfills to prevent infiltration of water into the contents of the landfills and any resulting migration of impacted water toward groundwater. In 2024, Pantex conducted landfill inspections in accordance with the updated *Maintenance Plan for Landfill Covers* (Pantex, 2017b). Pantex installed, inspects, and maintains a fence around FS-5 to control access and use of an area that is impacted by depleted uranium.

Additionally, 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 minimizes migration of contaminants because it prevents rainwater from infiltrating into soils. Inspections for the ditch liners were conducted in accordance with the updated *Maintenance Plan for SWMUs 2 and 5-05 Ditch Liner* (Pantex, 2017c). Inspections were also conducted for SWMU signs and postings at various times during 2024.

Maintenance is either contracted, as necessary, or work orders are placed with the onsite maintenance department. Findings from the inspections of landfills and ditch liners and maintenance actions are provided below.

2.2.1.1 Landfill Inspection and Maintenance

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 holes/voids from wildlife. Additionally, the landfills can be affected by heavy rainfall and drought conditions that frequently occur in the Texas Panhandle. Areas that become eroded from heavy rainfall can be impacted by loss of vegetation that can be worsened by drought conditions.

In the past, these smaller issues were addressed using Pantex maintenance personnel and equipment. However, to ensure consistent comprehensive support with the landfill covers, Pantex has contracted for long-term maintenance of the landfills. The landfills will be inspected each year and then maintenance will be contracted or assigned to onsite maintenance based on the evaluation. Larger issues are planned, budgeted, and contracted separately for design and construction. Each contracting effort is followed up with inspections to evaluate the effectiveness of the actions. Pantex continues to use onsite personnel for smaller maintenance projects, as needed.

Key findings and maintenance actions completed from past soil inspections, including those completed in 2024, are included in Table 2-5. The results of the landfill site inspections from the *Third Five-Year Review* (HGL and Pantex, 2023) are also included.

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

Findings	Corrective Actions
Previous Findings	
Landfill 3 (SWMU 54) geocell is exposed along edges of the landfill	A work order was submitted in 2023 for additional soil and reseeding of the area. This work was completed in September 2024. An additional soil cover will be applied to this landfill, and it will be reseeded in 2025.
SVS 7a prairie dog control, holes in four landfills and denuded areas	Prairie dogs have invaded newly covered landfills. Prairie dogs have been controlled and the filling and seeding of holes will be completed by onsite maintenance group.

Findings	Corrective Actions
SVS 6 large and small holes and lack of vegetation in some areas	Large and small holes that require fill material and reseeding of areas without vegetation. This is a low priority landfill and filling of holes and reseeding will be completed by onsite maintenance group as time and resources allow. A work order has been submitted to complete this work.
Landfill 10 (SWMU 61) replace SWMU signs	This is a low priority landfill and will be addressed as time and resources are available.
Landfill 5 (SWMU 56) multiple holes in cover	This is a low priority landfill. The holes in the cover have been addressed and it has been reseeded. A scope of work is currently being prepared to address the culvert.
SVS 7b has prairie dog holes in two of the landfill covers	The Pantex biologist treated this landfill for prairie dogs. This is a low priority landfill and holes will be addressed as time and resources are available.
New 2024 Findings	
Landfill 15 (SWMU 66) has minor voids and settling in some areas	This is a low priority landfill and will be addressed as time and resources are available. Work will be contracted to be completed.
Landfill 7 has evidence of prairie dog intrusion around the landfill cap	The Pantex Biologist treated this landfill for prairie dogs. This is a low priority landfill and will be addressed as time and resources are available.
Landfills 4-8 (SWMUs 40-44) at the Burning Grounds show evidence of prairie dog intrusion and patchy vegetation	The Pantex Biologist treated these landfills for prairie dogs. A work order is currently being created to address the prairie dog holes.
Zone 10, Unassigned Landfills showed signs of slight subsidence	This is a low priority landfill and will be addressed as time and resources are available. Work will be contracted to be completed.

SVS – supplemental verification site

Based on previous findings, Pantex will continue to prioritize landfill cover maintenance based on available funding. Some of the older construction debris landfills are given lower priorities than other landfills that had new additional cover placed at the end of the investigations, given their content. Pantex will always prioritize the following landfills for maintenance of the cover:

- Landfill 1 (SWMU 68b).
- Landfill 2 (SWMU 68c).
- Landfill 3 (SWMU 54).
- Landfill 12 (SWMU 63).
- Landfill 13 (SWMU 64).

- Burning Ground Landfills (SWMUs 37-44).
- Burning Ground Ash Disposal Trench.
- FS-5 facility cover located inside the berm (SWMU 70).

Other landfills will be addressed over time by a combination of available contract funding and onsite maintenance. Due to the settling caused by burrowing animal activity at some of these landfills, extensive maintenance is required and is typically covered by a combination of contracting and onsite maintenance support. This approach has been used to manage some of the larger areas to be filled and reseeded.

Pantex will continue to evaluate the landfills annually and report findings and plans developed to address holes, depressions, or bare areas. Problems identified will be addressed through the landfill cover maintenance contracts or limited onsite maintenance. The active landfill area at Pantex is continually maintained by the Waste Operations Department, and old landfills (i.e., SVS 8 and SWMU 68d) in that area continue to be addressed by onsite Waste Operations personnel.

2.2.1.2 Ditch Liner Inspection

Pantex installed a new liner over the old one, with construction completed in March 2017. As discussed above in Section 2.2.2, a new maintenance plan was developed for the new liner.

An inspection conducted in 2021 and 2022 at SWMUs 2 and 5/05 ditch liner indicated tears were present in the liner, and sedimentation and erosion of the anchor trench continue to be an issue. After issuing a contract for repairs, work commenced in May 2023 and was complete in July. The ditch liners were inspected again in 2024 and were in good condition. Pantex installed boundary marker posts around the ditch liner in 2024 to deter vehicles from driving over it.

2.2.1.3 Review of Soil Disturbance

Pantex also conducts reviews of projects that will disturb SWMU soils (referred to as SWMU interference). Project plans or work requests for repairs were reviewed to ensure that workers used necessary protective equipment and that soils were managed appropriately during the execution of work. Older listed projects from the completed project areas were verified after the completion of work to ensure that 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 this annual report as well as new SWMU interference projects from 2024. Five new projects were approved during 2024, and one emergency permit was issued. Other projects are ongoing.

Table 2-6. SWMU Interference Log

SIN#	State Approval Date	SWMU #	Explanation of Work
Previous SWMU Interference Notifications (SINs)			
SIN18-001	2/27/2018	SWMU 5-09; 148	Lightning-protection system testing and upgrades at 11-17, 11-17A, 11-25. Status: Active
SIN18-003	2/27/2018	WMG 6/7; SWMU 1	Lightning-protection system testing and upgrades at 12-62 and 12-62 Berm (Berm in 12/18). Status: Active
SIN19-001	4/2/2019	WMG 13	Burning Ground lightning-protection system upgrades. Status: Active
SIN19-003	6/20/2019	SVS 7b	Clearing ditches around 16-24 Range Complex. Status: Complete
SIN19-005	10/22/2019	WMG 5/ SWMU 68a	Zone 12 South paving - South of 12-R-79. Status: Active
SIN20-001	1/22/2020	Zone 10 Extents	Zone 10 Lot 3 Electrical equipment installation. Status: Complete
SIN20-002	2/26/2020	SWMU 97 & Extents	Building 12-34 SS demolition. Status: Complete
SIN20-003	6/30/2020	WMG 4, SWMU 87	Building 11-20 SS demolition. Status: Complete
SIN20-004	7/27/2020	WMG 6/7 extents	Building 12-26E chiller replacement. Status: Complete
SIN21-002	3/9/2021	SWMU 4	11-50 KRONOS Installation. Status: Complete
SIN21-004	4/7/2021	SWMU 5-15a	Zone 11 ISB Snow Fence Removal. Status: Complete
SIN21-005	7/6/2021	SWMU 5-11	HESE main location Status: Active
SIN22-001	12/20/2022	SWMU 14	HESE Early Works West of 11-050. Status: Active
SIN22-002	2/13/2023	SWMU 149, SVS 2, and SWMU 60	HESE communication Line North of 11-026 Status: Active

SIN#	State Approval Date	SWMU #	Explanation of Work
SIN23-002	9/11/2023	SWMU 1	12-63 Demolition Status: Active
2024 SWMU Interference Notifications			
SIN24-001	4/11/2024	SWMU 5-06	12-86 and 12-116 lightning protection system upgrades Status: Active
SIN24-002	11/19/2024	SWMU 1	12-63 Demolition Status: Active
SIN24-003	Emergency Permit	SWMU 1	12-17F1 Water Leak Repair Status: Closed
SIN24-004	10/7/2024	SWMU 5-13c	ESH Sampling Building Construction Status: Active
SIN24-005	8/20/2024	SWMU 5-11/5-15a	Zone 11 Contractor Road Status: Active
SIN24-007	11/6/2024	SWMU 5-03 a, b, c, d	12-68 Heat Treat Oven Facility Modifications Status: Active

SIN – SWMU Interference Notification

WMG – Waste Management Group

2.3 Long-Term Monitoring Well Network

2.3.1 Well Maintenance

As recommended in the *First Five-Year Review* (Pantex, 2013c), the *Well Maintenance Plan* (Pantex, 2013b) was completed in October 2013 and 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. The list of wells is updated yearly to add or remove wells and the plan underwent a comprehensive update in 2020 (Pantex, 2020) to change the frequency of maintenance where needed.

The plan comprises the following significant tasks:

- Assigns 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).
- Assigns a maintenance frequency of three years for all wells with stainless-steel screens that have documented well corrosion and elevated chromium concentrations.

- Assigns a default inspection frequency of five years for all perched aquifer LTM wells to comply with requirements for total depth measurement 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 field technicians. Water levels are measured at each sampling event and twice annually while total well depths are only measured when dedicated equipment is not present in the well.

The 2024 maintenance log for groundwater wells is included in Appendix C, which 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 as well as the disposition of the purge water from well activities.

Through well videos, Pantex has identified evidence of bacteria in many of the stainless-steel wells. This condition is common in monitoring wells, especially those with lower groundwater flux. 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. Stainless-steel corrosion indicators (i.e., chromium, manganese, molybdenum, and nickel) that become elevated in wells may be due to bacterial activity; well videos recorded during routine well inspections indicate that a large percentage of stainless-steel wells have some biofouling.

Pantex continues to evaluate rehabilitation methods for biofouling and in 2018 developed plans to evaluate a chemical rehabilitation program that addresses growth that has completely blocked portions of the screens in certain wells. A study was completed in 2020 on two parked wells that are not part of the active LTM network to evaluate the biofouling's impacts on water quality as well as the ability to effectively manage it. New perched wells are now installed with polyvinyl chloride (PVC) materials, rather than stainless steel, to avoid corrosion issues associated with the well materials; however, pumps still consist of stainless steel that is subject to corrosion.

When screens were found to be impacted by biofouling, calcium deposits, or sedimentation; or when elevated chromium levels were observed, Pantex redeveloped the wells by brushing, bailing, and pumping, as necessary. Based on well videos and total depth measurements, some wells were observed to have sediment in the sump, with a few having sediment built up into the bottom of the screen. However, no LTM wells had more than 20% of the saturated screen silted in, so Pantex will continue to monitor and sample the wells.

Pantex performed the following well maintenance activities in 2024:

- Forty-nine well videos to evaluate the wells' installation or condition and determine if re-development or other maintenance was required. The effectiveness of rehabilitation was also confirmed through well videos.
- Pump service (i.e., removal and installation of the pump and tubing bundles) at 12 locations to prepare for special sampling, change-outs of pump and tubing bundles, lengthening of sampling depths, and/or the replacement of pumps.
- Extraction well service at 24 wells to support repair and maintenance of pump and treat extraction wells.
- Miscellaneous maintenance including adding drop tubes to pumps and collection of total depth.

2.3.2 Well Casing Elevations

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

Pantex re-surveyed all LTM wells and wells used for water table mapping in 2020 using a real-time kinetic Global Positioning System (GPS) that is calibrated to the National Geodetic Survey. This system will be consistently used to re-survey wells in the future. The next survey is due in 2030.

The surveyed elevations for new wells are included in Table 2-7. Re-survey of wells was not completed in 2024.

Table 2-7. Well Elevations Collected in 2024

Well	Easting	Northing	Ground Surface Elevation (amsl)	TOC Elevation (amsl)
PTX06-1225	639910.39	3753190.01	3531.45	3533.53
PTX06-1226A	640029.72	3753287.86	3531.26	3533.40
PTX06-1231	641635.60	3753558.70	3529.92	3532.02
PTX06-1232	644456.90	3757673.60	3535.84	3538.00
PTX06-1233	646598.01	3759608.74	3533.33	3535.48
PTX06-1234	636518.53	3756515.49	3540.74	3542.92
PTX06-1236	635852.04	3756437.88	3542.31	3544.36
PTX06-1237	637363.50	3753017.90	3528.42	3530.61
PTX06-ISB164	636312.50	3755178.30	3530.47	3532.78
PTX06-ISB165	636354.06	3755201.91	3530.13	3532.40
PTX06-ISB601	639666.81	3753007.50	3531.81	3533.88
PTX06-ISB602	639738.59	3753066.46	3531.83	3533.87
PTX06-ISB603	639814.01	3753125.83	3531.42	3533.51
PTX06-ISB605	639890.39	3753175.99	3531.33	3533.46
PTX06-ISB606	639930.99	3753209.49	3531.41	3533.52
PTX06-ISB607	639969.93	3753239.12	3531.44	3533.61
PTX06-ISB608	640009.33	3753274.76	3531.12	3533.26
PTX06-ISB609	640077.36	3753320.05	3531.20	3533.35
PTX06-ISB610	640140.59	3753362.38	3531.13	3533.20
PTX06-ISB701	646163.50	3752450.78	3521.94	3524.17
PTX06-ISB702	646222.34	3752460.40	3522.08	3524.24
PTX06-ISB703	646280.47	3752469.83	3521.83	3524.00
PTX06-ISB704	646338.29	3752487.12	3521.66	3523.75
PTX06-ISB705	646396.42	3752503.69	3521.63	3523.73
PTX06-ISB706	646453.69	3752521.12	3521.99	3524.12
PTX06-ISB707	646510.45	3752538.55	3521.93	3524.12
PTX06-ISB708	646574.54	3752557.90	3522.12	3524.26
PTX06-ISB709	646631.66	3752582.01	3521.91	3524.00
PTX06-ISB710	646681.09	3752615.46	3521.62	3523.74

Northings and Eastings are Texas State Plane

amsl – above mean sea level TOC - top of casing

2.3.3 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 must 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 to map the water table. Water-level measurements are also taken during any well-maintenance activities. The measurements and corresponding water elevations and total depth measurements are included in Appendix C.

2.4 Management of Recovered/Purged Groundwater

In 2024, all purged, contaminated groundwater found to exceed the GWPS during sampling events and maintenance activities was containerized. Then, the volume of water was logged and treated through the SEPTS in accordance with Provision XI.B.8 of HW-50284, with the exception of purged water from ISB wells. Purge water from all ISB system wells was containerized and disposed of by the Plant's Waste Operations Department since the water contained biomass and residual not treatable by the pump and treat systems.

Most Ogallala Aquifer wells are unaffected and not required to be managed or their volumes tabulated, so the water is released to nearby ditches. Because Ogallala wells PTX06-1056, PTX06-1223, PTX06-1076, PTX06-1229, PTX06-1231, and PTX06-1232 had detections of HEs, Pantex containerized the purge water from sampling events and then logged and treated it through the SEPTS. All new wells that are being installed for the purpose of investigation of the Ogallala Aquifer will have water containerized and logged and treated through the SEPTS.

In accordance with Provision XI.B.8 of HW-50284, all recovered perched groundwater from the extraction wells is treated through the P1PTS or SEPTS. Treated water from the P1PTS is sent through subsurface lines to the WWTF's storage lagoon or through subsurface lines to the pivot irrigation lagoon. Treated water from the SEPTS is sent through subsurface lines to four ISB systems (Zone 11, Southeast, Southeast Extension, and Perchlorate/Chromium) for use in injecting amendment, WWTF storage lagoon, pivot irrigation lagoon, or onsite perched injection wells. Lagoon water is sent through the WWTF filter building and subsequently released to the subsurface irrigation system, when operating, or the water is released to Playa 1.

Pantex has been authorized by permit (TLAP #0004397000, issued August 2020) to release treated wastewater for the irrigation of crops. Provisions were added in the permit, which allow treated water obtained directly from the SEPTS or P1PTS to be used in other ways, such as for construction projects, so long as the treated water meets the GWPS and criteria specified by the State of Texas. Pantex constructed a bulk water station at the SEPTS to deliver treated water for beneficial use at Pantex. Pantex set up procedures and record-keeping for this station, which became operational in July 2016.

A break at the irrigation system's filter bank caused all of the water from the WWTF to be routed to Playa 1 via Outfall 001 after June 2017, in accordance with TCEQ Permit #WQ00002296000. Repairs have been made, but the system is now having communications problems. Additionally, Pantex began repairing/upgrading the WWTF lagoons in 2022, and work is ongoing. During this time, water cannot be released to the subsurface irrigation system, so water is released to Playa 1. Pantex completed the installation of the new center pivot surface irrigation system in 2023. Since that time, water has been managed through the pivot system unless repairs were required. All treated water from the SEPTS was either injected back into the perched groundwater, released to Playa 1 via the WWTF, or beneficially used by the pivot irrigation system or for ISB injection or well drilling. P1PTS treated water was released to the pivot system unless it was unavailable, then it was released to the WWTF.

As authorized by the Underground Injection Control, Authorization No. 5X2600215, Pantex injects treated water into select wells. Portions of the SEPTS treated water are injected through injection well PTX06-INJ-10, PTX06-INJ-13, PTX06-INJ-14, and PTX06-INJ-15 when needed. Some of the SEPTS treated water is also used for 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/irrigation, or sent to the ISB system are provided in Section 2.1.

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3.0 Groundwater Remedial Action Effectiveness

In this section, the groundwater remedial action is evaluated for overall effectiveness during 2024 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 and early detection
4. Natural attenuation

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

3.1 Plume Stability

Plume stability is evaluated through the examination of water level and concentration data. Water-level data 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) support this analysis.

Concentration data are used to perform concentration trend analyses. Concentration trend data are mapped for the four major COCs (RDX, TCE, hexavalent chromium, and perchlorate) to identify trends in their spatial distributions. The concentration data are used to generate plume maps for each COC. The maps and trends, together, form the basis for an evaluation of overall plume stability.

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, 2019a). Therefore, a comparison of observed versus expected conditions is conducted as part of the evaluation process. Appendix E includes the LTM expected conditions and current conditions based on 2024 analytical and water-level data.

3.1.1 Water Level Mapping

Groundwater beneath the plant and vicinity occurs in two stratigraphic horizons within the Ogallala and Dockum Group Formations. The most significant quantities of groundwater in the vicinity of the plant are found in the Ogallala/Dockum Aquifer system. Considerably less water occurs in the upper Ogallala Formation since perched groundwater overlies an FGZ.

Presented in this section are water table maps of the Ogallala/Dockum Aquifer and the primary perched aquifer underlying the plant. Water-level measurements used to create these maps were collected primarily during January 2025 from Pantex Ogallala and perched aquifer monitor wells. Water level measurements were delayed from December 2024 because of adverse weather conditions in the fourth quarter that prevented access to the wells. These data were supplemented with recent water-level measurements in the Ogallala/Dockum Aquifer collected by the Panhandle Groundwater Conservation District.

Fig. 3-1 presents the Ogallala/Dockum Aquifer water levels while Fig. 3-2, Fig. 3-3, and Fig. 3-4 present perched aquifer water levels.

3.1.1.1 Ogallala/Dockum Aquifer

As shown in Fig. 3-1, flow in the Ogallala/Dockum Aquifer underlying the plant is to the northeast. The northeast hydraulic gradient results from agricultural pumping as well as from the City of Amarillo's well field to the north and from the Pantex water supply wells in the northeastern part of the USDOE/NNSA property. The Amarillo well field produces approximately 12.7 Mgal per day from the Ogallala Aquifer, based on the City of Amarillo's 2018 data. The hydraulic gradient in the Ogallala Aquifer underlying the northern part of the plant is approximately 0.005 feet per foot (ft/ft).

3.1.1.2 Perched Aquifer

As shown in Fig. 3-2, Fig. 3-3, and Fig. 3-4, perched groundwater occurs as a number of separate flow systems beneath the 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 approximately 2.5 miles northeast of the USDOE/NNSA property boundary, but this body of groundwater is not hydraulically connected to the perched aquifer underlying the Pantex Plant.

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 upward slope of the surface 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 to 0.007 ft/ft near Playa 1, around 0.002 ft/ft near Playa 2, 0.005 to 0.007 ft/ft downgradient of Zone 12, and around 0.001 ft/ft south of Zone 11.

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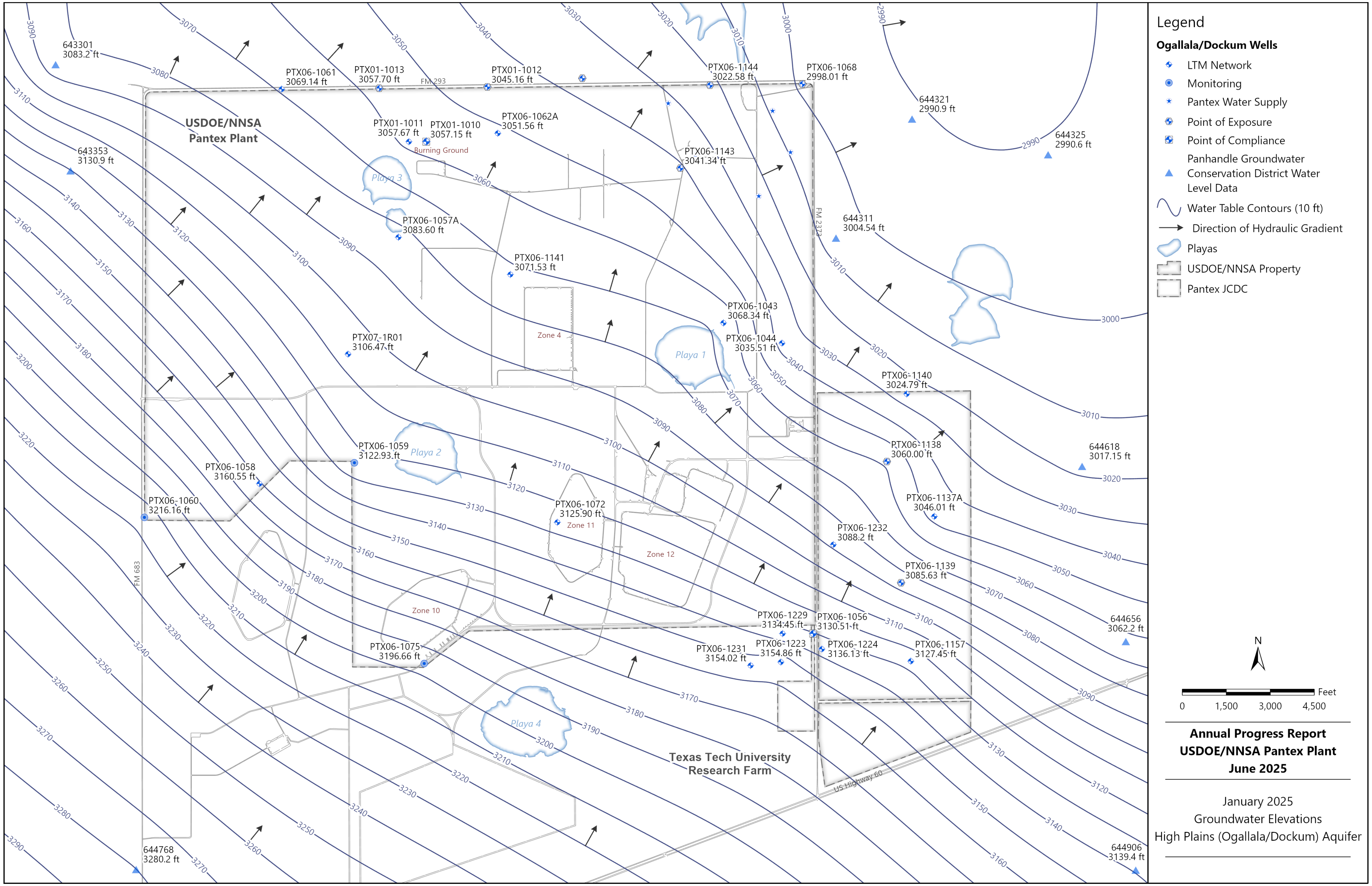

Fig. 3-1. Ogallala Aquifer water levels.

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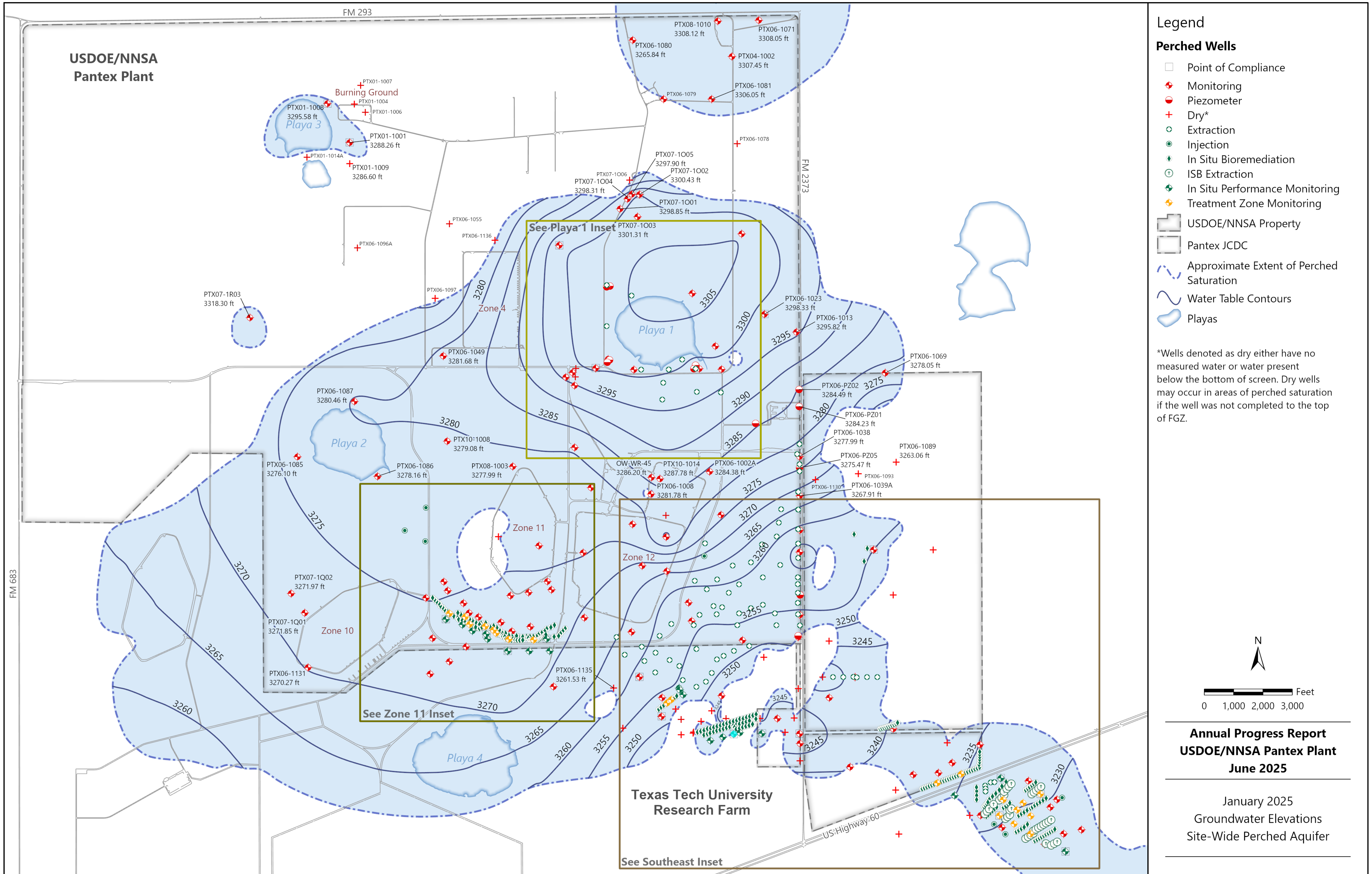

Fig. 3-2. Perched aquifer water levels.

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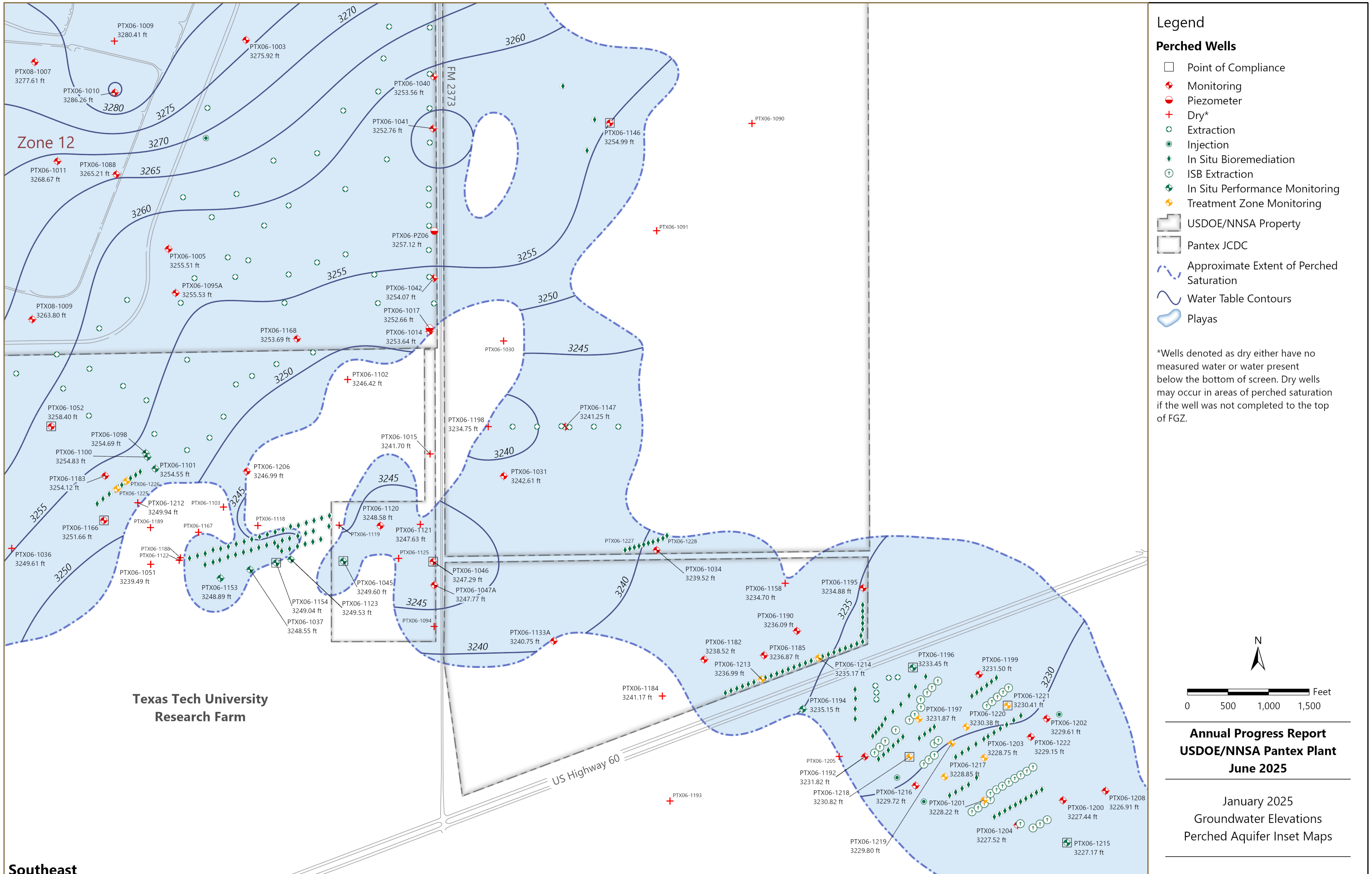

Fig. 3-3. Perched aquifer water levels, southeast inset map.

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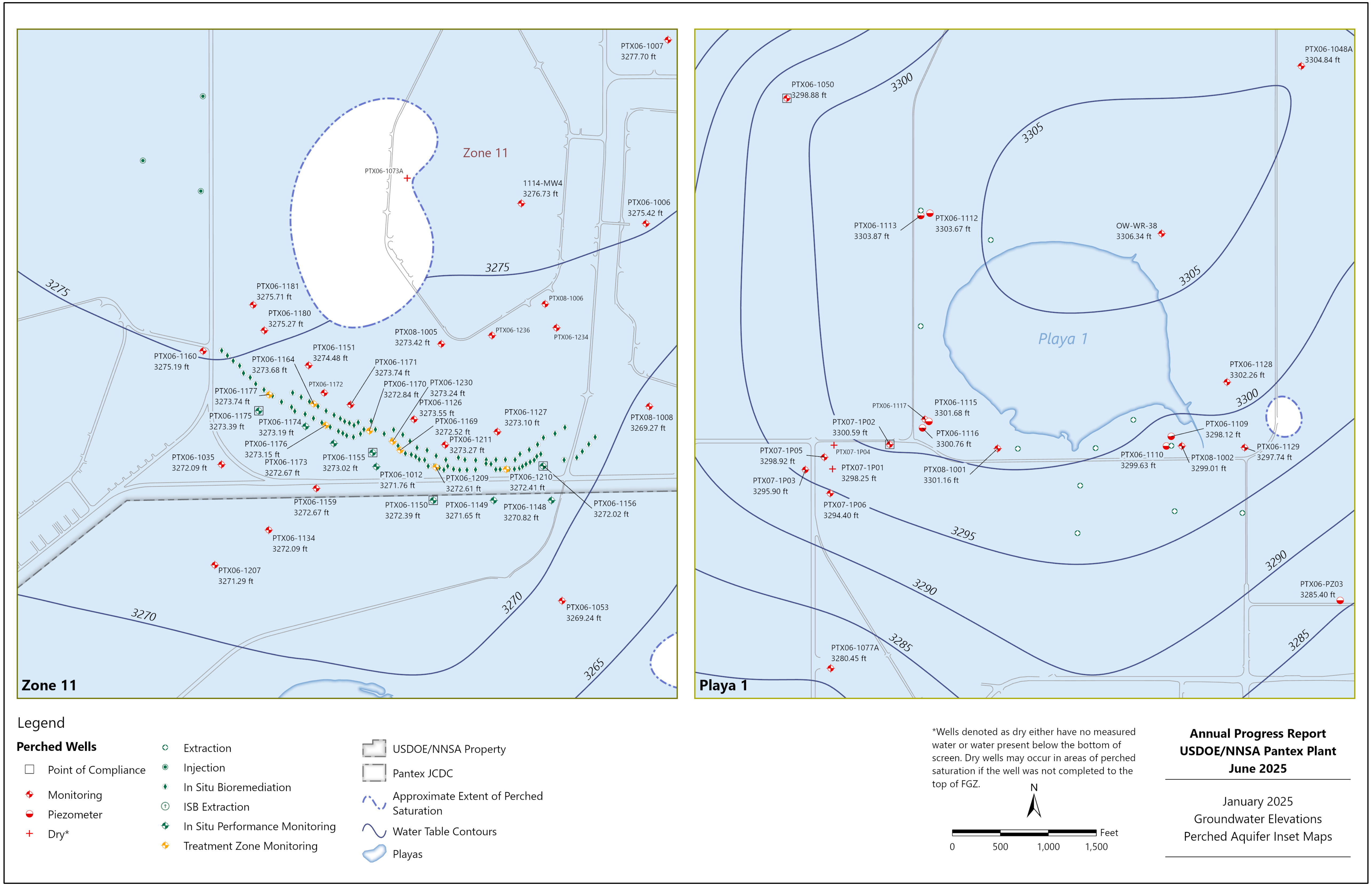

Fig. 3-4. Perched aquifer water levels, Zone 11 and Playa 1 inset maps.

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3.1.2 Water Level Trending

The Monitoring and Remediation Optimization System (MAROS) software linear regression methodology (AFCEE, 2007) outlined in the LTM Design Report was used to trend water levels at each well. Trends were calculated for the dataset of water levels collected since the start of remedial actions in 2009, in addition to the most recent two years of data at each well. Trends since the start of remedial action are expected to give more accurate measurements of the effectiveness of the two pump and treat systems since the P1PTS began operating in late 2008 and the SEPTS was operating near full capacity by April 2009. Long-term trends were also calculated using all data for a well, including measurements taken before the start of remedial action. These trends represent overall historical conditions of the perched aquifer and depict whether conditions are returning to baseline.

Fig. 3-5 depicts the water-level trends in all LTM perched aquifer wells. Well hydrographs are included in Appendix E.

Trending results show positive effects of the remedial actions. A sizable majority of monitoring wells within the SEPTS wellfield, upgradient of SEPTS in Zone 12, and downgradient of SEPTS show declining trends in water level since the start of remedial action in 2009. The ability to operate the pump and treat systems is largely dependent on the availability of outlets for release of treated water. When possible, effluent is beneficially used for irrigation, general Plant needs, and/or for amendment injections at the ISB systems. Irrigation can occur through a subsurface drip irrigation system or a pivot irrigation alternative on the property east of FM 2373. In addition to release of water to all beneficial use outlets, SEPTS has the capability to inject the treated water back into the perched aquifer when beneficial use is not possible; injection can occur within the SEPTS wellfield or at injection wells near Playa 2. P1PTS can release water to the pivot irrigation system directly or to the WWTF storage lagoons, which can discharge to Playa 1 or a subsurface drip irrigation system. Operational priorities for the pump and treat systems emphasize beneficial use of water. In addition, operation of the SEPTS is prioritized over the P1PTS when water outlets are limited.

Operation of the pump and treat systems was affected in 2024 by ongoing construction of repairs at the WWTF and ongoing radio communication failures at the subsurface drip irrigation system. During periods the drip irrigation system is unavailable, Pantex continues to release WWTF water to Playa 1 as approved in the Texas Commission on Environmental Quality wastewater permit. However, the permit restricts the amount of water that can be released to the playa, so pump and treat throughput is reduced if other outlets are not available for use.

Pantex finished installation of five irrigation pivots on the property east of FM 2373 in August 2023 to provide additional long-term use of the treatment system water. The pivot system is operated during warmer months (primarily April – November), decreasing water released to Playa 1. Operation of the pivot system will be limited during winter due to freezing temperatures. Additionally, a break at the pivot irrigation system wet well in December 2023 required the P1PTS to be shut down until evaluation and repairs were completed in March, but operations were hindered further by freezing temperatures once operational. The pivot irrigation system was utilized throughout the summer and autumn months, interrupted only by harvest events and heavy rainfalls in the months of June and July. Additionally, the pivot system experienced an outage at the electrical overhead in early November that limited its operation through the end of 2024.

Also, loss of the radio communication system at the Playa 2 injection wellfield in the fourth quarter of 2024 limited the use of the P1PTS because SEPTS operations were prioritized.

The experience of 2024 demonstrates that current and future operations will be impaired by the restricted flow to the WWTF. The SEPTS has the capability to reinject, so that system has operated at a higher capacity, with the treated water being injected into the four SEPTS injection wells, sent to the pivot irrigation system, and/or released to the WWTF and Playa 1. Reduced extraction of perched groundwater at P1PTS, combined with injection or release of treated water to Playa 1, limits the ability of the remedial actions to influence water levels. For a further discussion of water outlet issues, reference Section 2.1.1.

In the past, the SEPTS wellfield was operated by a prioritization scheme to optimize the treatment and control of the groundwater plume; however, the saturated thickness in that area has decreased so that some SEPTS extraction wells are unable to fully operate, and the prioritization scheme no longer applies. Instead, all available wells are now operated. A discussion of the remedial action effectiveness is included in Section 3.2.

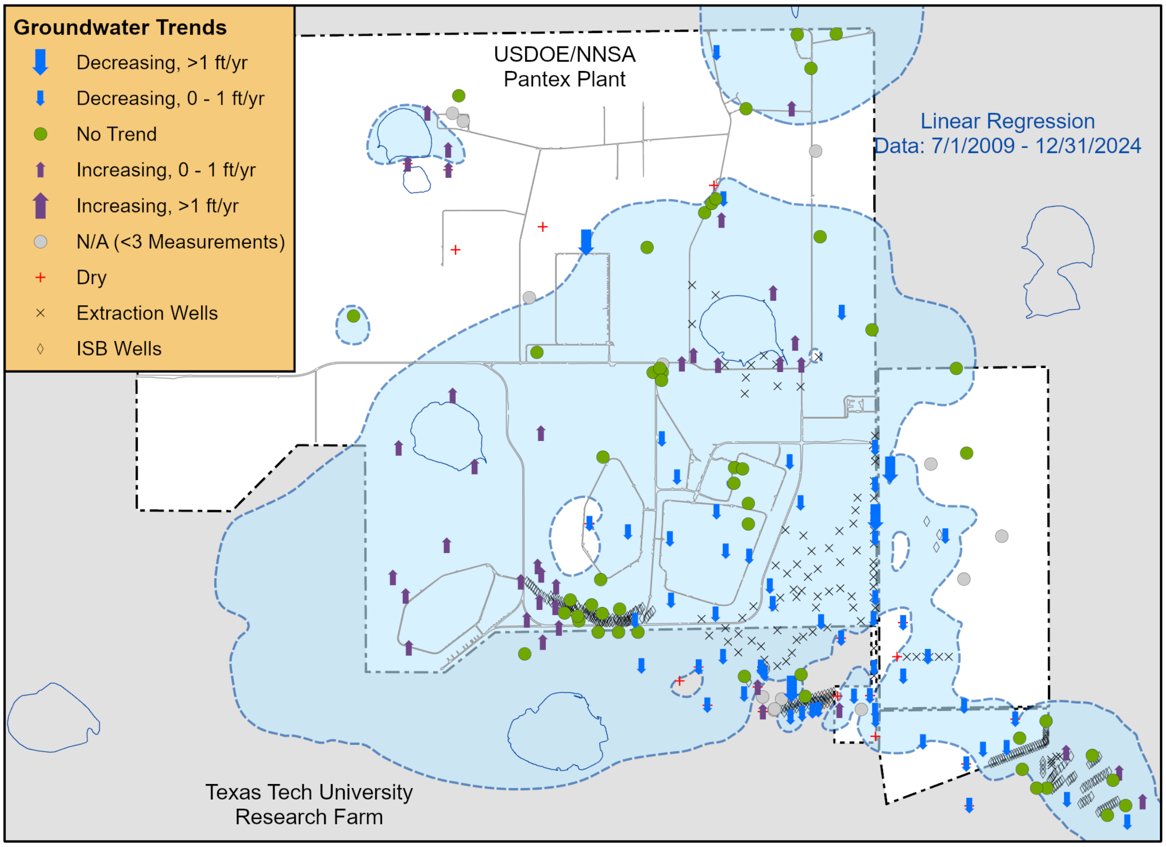

Fig. 3-5. Water level trends in the perched aquifer since start of remedial action.

3.1.3 Water-Level Trends Compared To Expected Conditions

Overall, calculated groundwater level trends since start of remedial action are consistent with expected conditions defined in the LTM Design Report, which is summarized in Appendix E. Of the 43 monitoring wells with expected decreasing water-level trends, limited water, or dry conditions defined in the *Update to the Long-Term Monitoring System Design Report* (Pantex, 2019a), eight wells depicted in Fig. 3-6 exhibited conditions inconsistent with current expected conditions or trends since the start of remedial action. These include six wells exhibiting apparent increasing trends and two wells with "no trend" conditions. Hydrographs for all active perched wells are found in Appendix E.

An increasing trend was observed at three wells in the northern part of the perched aquifer near Playa 1 (OW-WR-38, PTX08-1001, and PTX08-1002) with two wells in this area (PTX06-1013, PTX06-1050) exhibiting no trend since remedial action began. These trends are associated with a combination of increased recharge through the playa resulting from the discharge of treated wastewater effluent and treated perched groundwater to the playa along with decreased extraction of perched groundwater from the P1PTS. Water levels at these wells declined from the start of remedial action through about 2015, then began increasing for several years. Since about 2020, water levels in most wells near Playa 1 have been more stable. For example, PTX08-1002 shows a decreasing trend for recent data. In addition, the long-term water-level trend considering all monitoring data is decreasing or demonstrating "no trend" for all wells near Playa 1 except OW-WR-38 and PTX08-1001, which are increasing but remain below historically observed high levels.

An apparent increasing trend was identified for PTX06-1051 west of the Southeast ISB system, although recent data (last two years) indicate no trend, and the well was dry when measured in January 2025. This well has historically been dry, with no water measured, or limited water present near the bottom of the well screen. The water level indicated by these measurements is approximately 10 ft below the elevation where perched water would be expected if it occurred in this area. Pantex completed a well video survey in July 2018 to evaluate the condition of the well and potential sources of this water. The video showed seepage of water into the well screen at and just above the level of standing water in the well but did not identify any structural issues with the well. This well will continue to be monitored for changes in water level.

Increasing water levels have been observed at PTX01-1009 near Playa 3 which was expected to remain dry. This well has historically been dry, but water was first measured in the screen in June 2019, and increasing water levels have been observed since June 2020. These recent increased water levels may be associated with above-normal precipitation in recent years and increased recharge through the playa. In addition, a documented leak from a water line on the south side of the Burning Ground loop road that has occurred for a long period of time may also be contributing to increasing water levels in this well (refer to Section 3.4.1).

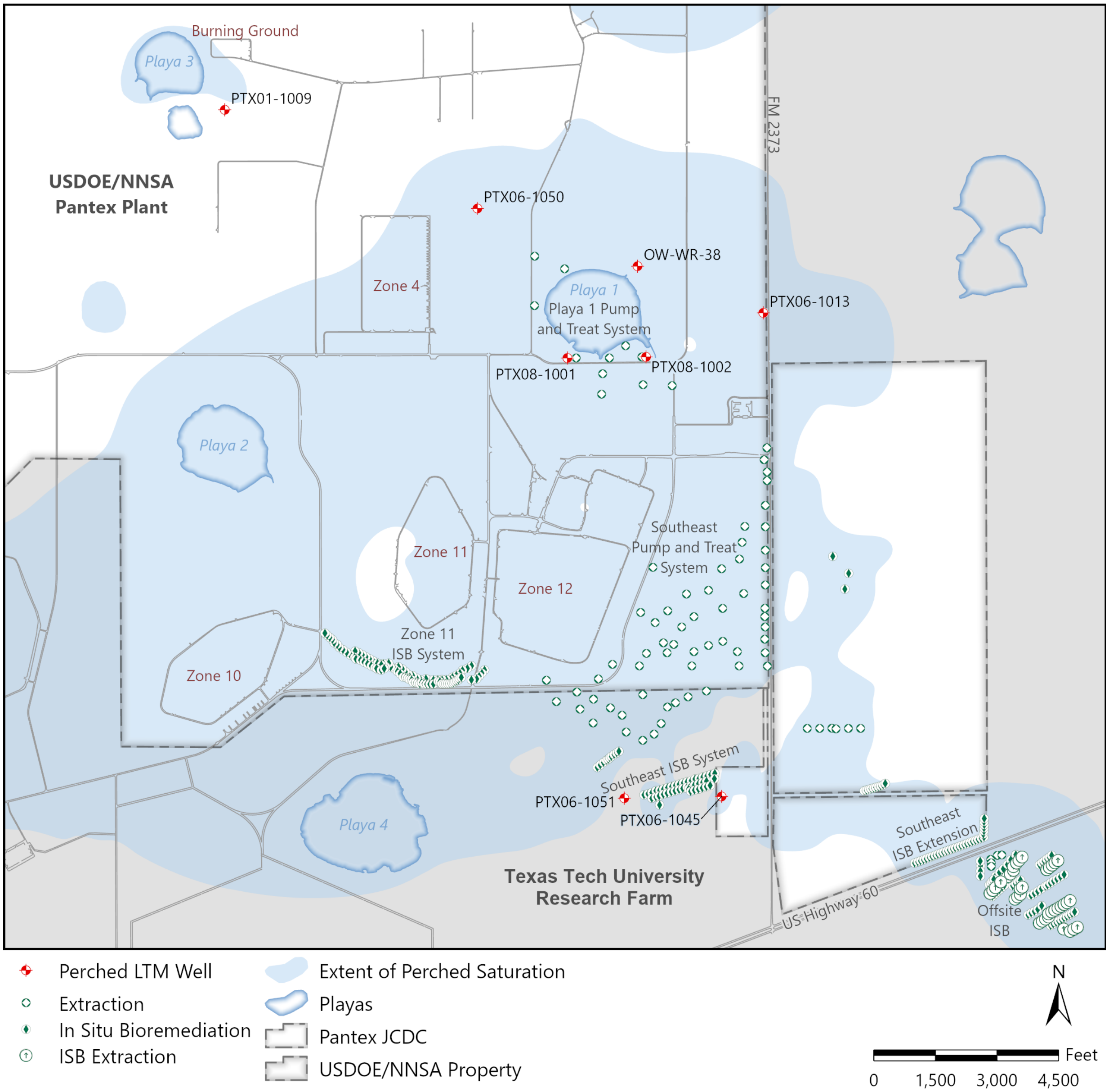

Fig. 3-6. Perched wells with unexpected water level trends.

In addition to evaluating trends since start of remedial action, recent increasing trends across the last two years are also evaluated to identify possible issues with wells that are showing a decreasing trend since start of remedial action. Wells in this category include PTX06-1002A, 1023, 1038, 1039A, 1046, 1047A, 1120, and 1121. The observed increases may be associated with three factors: (1) recharge to the ditches and areas that pond in Zone 12, (2) continued release of water from the WWTF and pump and treat systems to Playa 1, and potentially (3) variable operation of SEPTS in the past. Prioritization of operation of SEPTS in accordance with newer goals is expected to reverse the short-term trends in the future for those wells affected by the past limited operation of the SEPTS. Pantex continues to work on the goal to remove water discharge to Playa 1. Once the communication system is repaired to the subsurface irrigation system, the P1PTS can be operated consistently to affect the increasing perched saturation near and downgradient of Playa 1. Once the systems are operating optimally, short-term fluctuations in rainfall and recharge from the ditches in Zone 12 will have a lower impact.

3.1.4 COC Concentration Trending

COC concentration trends were calculated using both the non-parametric Mann-Kendall and parametric linear regression statistical methods adapted from the MAROS software (AFCEE, 2007). Trends were calculated for the entire dataset for each LTM network well, data from the four most recent sampling events, 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 start of remedial actions for RDX, hexavalent chromium, perchlorate, and TCE are depicted in Fig. 3-7, Fig. 3-8, Fig. 3-9, and Fig. 3-10, respectively, to illustrate the effectiveness of the groundwater remedial actions. Trends are displayed on these maps only for wells exhibiting concentrations above the GWPS in the most recent sample.

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) and can be used with data sets that include irregular sampling intervals and missing data (i.e., non-detects). More information on these statistical methods can be found in the *Update to the Long-Term Monitoring System Design Report* (Pantex, 2019a).

3.1.4.1 RDX Trends

Evaluation of concentration trends indicates that RDX is decreasing or does not demonstrate a trend at all monitoring points near the ditch along the eastern side of Zone 12. This continued condition is expected, given that the source areas are predicted to continue contributing to the perched aquifer for at least 20 years, if not longer, but at lower concentrations than in the past (Pantex, 2006).

Some wells near Playa 1 are exhibiting increasing trends because of system operations at the P1PTS and release of water to Playa 1, which have dramatically affected water levels and gradients in this region of perched groundwater. In the past, the operation of P1PTS provided some control of the plume, but recent operations have been affected by the loss of water outlets for the treated water, release to Playa 1, and prioritization of SEPTS operation, allowing radial movement of RDX away to the west and northwest while concentrations of RDX are decreasing along the southeast side of Playa 1.

Within the SEPTS well field, the system has had some effect on the plume since the majority of wells show declining RDX or exhibit no trend in this area. The trends are depicted in Fig. 3-7.

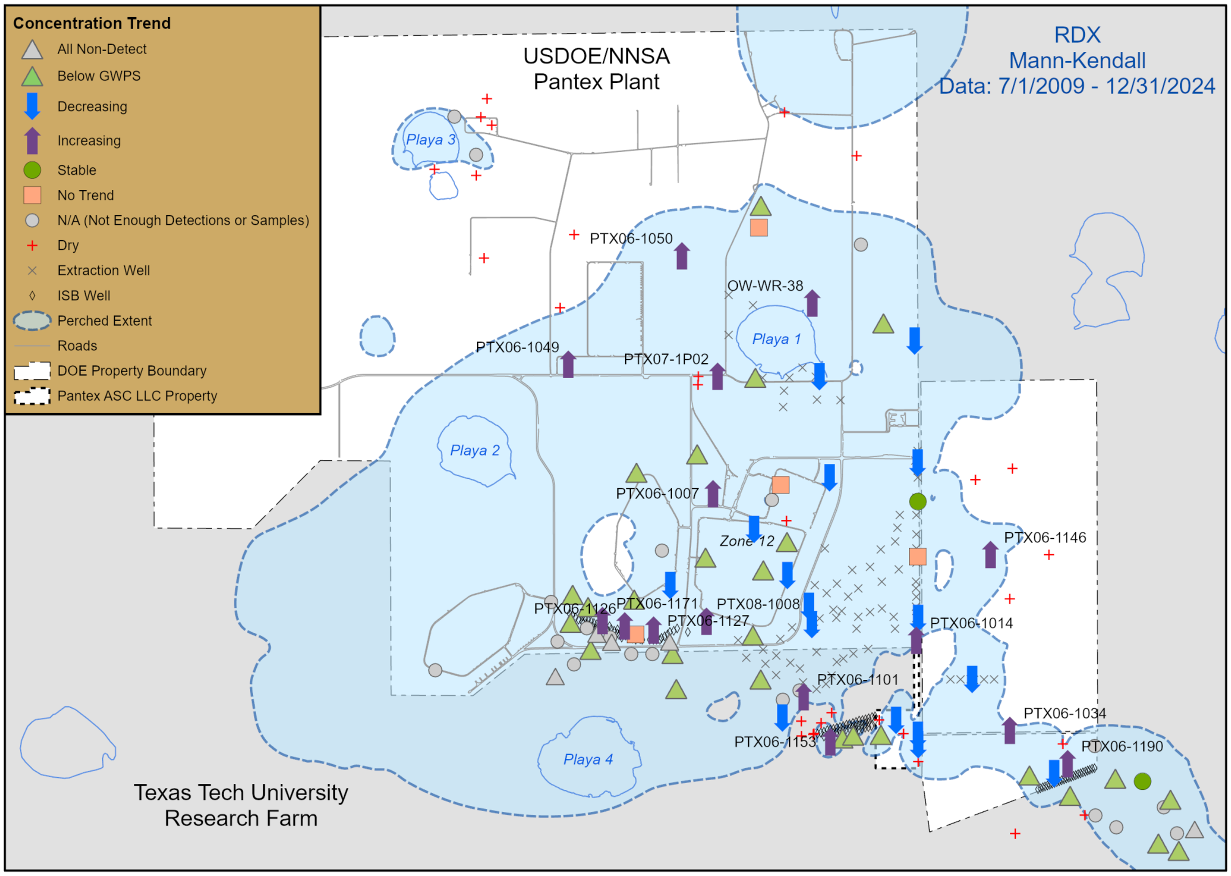

Fig. 3-7. RDX trends in the perched aquifer.

According to data collected since the start of remedial actions, the following 15 monitoring wells exhibited increasing trends in RDX, as depicted in Fig. 3-7:

- OW-WR-38, located north of Playa 1, is exhibiting an increasing trend in RDX. RDX concentrations fluctuated near the GWPS since 2009 but increased to near 50 μg/L in 2020. A concentration of 38 μg/L was observed in the most recent sample collected in 2024. Although elevated RDX had not previously been observed at this well, other wells north of Playa 1 (e.g., PTX06-1050 and PTX07-1O03) have exhibited higher concentrations of RDX in the past. The trend may be due to the P1PTS operation or recent changes in the discharge of treated water to Playa 1, which have dramatically affected water levels and gradients in this region of perched groundwater.
- PTX07-1P02, located southwest of Playa 1, is exhibiting an increasing but variable trend above the GWPS, but fluctuating concentrations remain below historical levels for this well. The increasing trend may be due to the effects of the P1PTS operation, which has dramatically affected water levels and gradients in this region of perched groundwater.
- PTX06-1050 located northwest of Playa 1 is exhibiting probable increasing trends in RDX. Concentrations have fluctuated substantially in this well over time, and were higher in 2003 than now. The weakly increasing trend since 2009 may be due to P1PTS effects as system operations have dramatically affected water levels and possible gradients in this region of perched groundwater.
- RDX was first observed at low concentrations in PTX06-1049 in 2011 and has since 2020 risen to 14 ug/L, above the GWPS. This well is located on the far western side of the perched aquifer, which is outside the direct influence of remedial action. These trends are likely due to groundwater flow from the Playa 1 vicinity.
- PTX06-1007, located between and north of Zones 11 and 12, is exhibiting an apparent increasing trend in RDX. In 2024, RDX was measured above the GWPS (2 μg/L) at 2.8 μg/L. This value is similar to concentrations in 2022 and 2023 and is a decrease from 2020 and 2021 where RDX was detected around 26 μg/L. No remedial action directly affects this area of the aquifer, although it also is affected by flow from around Playa 1.

- PTX08-1008, located southwest of Zone 12, is exhibiting an increasing trend. Concentrations of RDX began increasing in this well in 2022, likely the result of general plume movement to the southeast in this area, which may also be influenced by the SEPTS operations. This well is upgradient of the remedial actions.
- PTX06-1014 is exhibiting an increasing trend, although data for the last two years shows no trend. This well is within the influence of the SEPTS well field, which may be drawing in RDX from the core of the plume flowing to the east of the plant. Recently observed concentrations are not much higher than levels observed since 2009 and remain far below historical maximums for this well.
- PTX06-1146, located east of FM 2373, is exhibiting an increasing trend although recent data indicate no trend. RDX concentrations have been elevated and generally fluctuate above 1,000 µg/L in this well since it was installed. This well is located in the eastern part of perched groundwater beyond the influence of a remedial action. Recently, three new ISB injection wells have been installed in this area; Pantex is planning to install additional infrastructure in the future to allow these wells to be injected.
- PTX06-1101 is located immediately downgradient of the Southeast ISB pilot study well field. RDX was not detected in this well between its installation in 2007 and 2014; it has increased since then, although recent data indicate no trend. The increasing trend results from loss of treatment effectiveness in the ISB pilot area and concentrations returning to baseline conditions.
- PTX06-1153, a downgradient ISPM well for the Southeast ISB system, is exhibiting an increasing but highly variable trend in RDX since the start of remedial actions. The recent data show a nominally increasing trend, but concentrations are lower than they were in 2021 and 2022. This well is detailed in Section 3.2.3.2.
- PTX06-1034 and PTX06-1190, located in the core of the plume in the southeast lobe of perched groundwater east of FM 2373, show increasing trends in RDX associated with plume movement downgradient. Recent data show no trend. The Southeast ISB Extension system and the Offsite ISB (a combination ISB/pump and treat system) were installed downgradient of these locations to address the plume. Because these wells are located upgradient of the treatment system, stable or potentially increasing concentrations are expected to continue for a number of

years as the plume moves into the treatment system. Upgradient activity planned for the Northeast ISB and County Road 8 ISB systems will eventually result in decreases in RDX concentration upgradient of these wells, as will natural attenuation of the historic plume.

- PTX06-1126, PX06-1127, and PTX06-1171, located south of Zone 11 and outside the effects of remedial action, are exhibiting long-term increasing RDX trends. However, concentrations at PX06-1126 have been decreasing since 2018 with one non-detect in recent data, and recent data indicate no trend at PTX06-1127 and PTX06-1171. These wells are located upgradient of the Zone 11 ISB system which has been effective at treating RDX.

A comparison of current trends to expected conditions for specific wells in the LTM network is included in Section 3.1.5.

3.1.4.2 Hexavalent Chromium Trends

As depicted in Fig. 3-8, no perched aquifer monitor wells are exhibiting increasing trends in hexavalent chromium above the GWPS since remedial actions began.

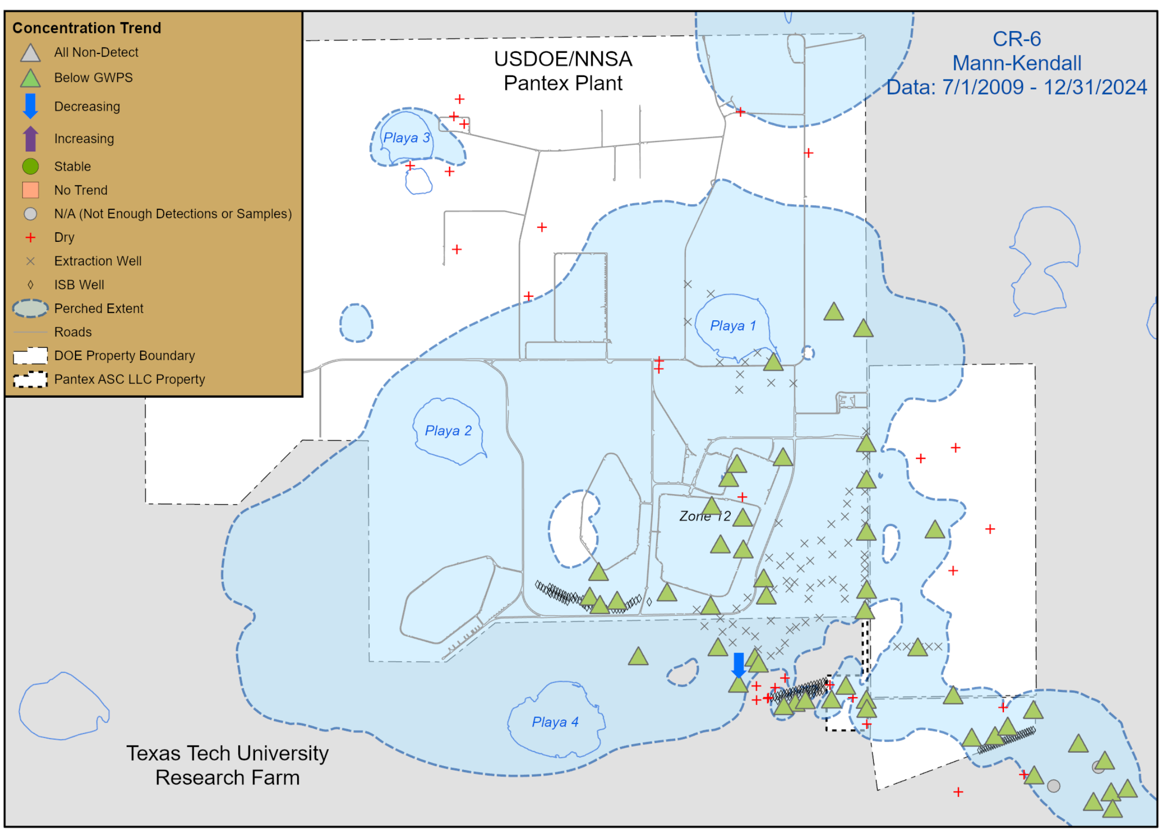

Fig. 3-8. Hexavalent chromium trends in the perched aquifer.

3.1.4.3 Perchlorate Trends

As depicted in Fig. 3-9, five monitoring wells are exhibiting increasing trends in perchlorate concentration:

- PTX06-1035, PTX06-1134, and PTX06-1207, which are located southwest of the Zone 11 ISB system, are demonstrating increasing trends in perchlorate concentrations because of general plume movement downgradient. However, recent data indicate no trend for these wells. These wells are located downgradient of the Zone 11 ISB system, and treated water was not expected to reach these wells for many years following the establishment of reducing conditions in the treatment zone. Upgradient wells are demonstrating stable trends or have dropped below GWPS so these downgradient well trends will improve with time.

- PTX06-1006 was exhibiting a decreasing trend in perchlorate from the time it was first detected in the well until 2014; the Mann-Kendall analysis indicates a probably increasing trend based on data collected since the start of remedial actions in 2009. However, concentrations were highest in 2017, and no trend is indicated for the last four samples. These fluctuations could be caused by changes in gradients and plume movement from the SWMU 5-13A ditch due to SEPTS operation. Another possible cause of these shifting trends could be caused by historical injection of treated water near Zone 12 and the resulting return to unaffected perchlorate concentrations after injection ceased. As discussed in several prior annual progress reports, historical injection from 1996 to 2006 at the SEPTS injection well PTX06-INJ-02 affected COC concentrations and trends in wells installed east of PTX06-1006.

- Perchlorate increased in PTX08-1008 from 2014 into 2017; however, perchlorate has been relatively stable with fluctuations in this well since 2017. Recent data indicate no trend for this well. The variation in perchlorate in this well may be due to general plume movement to the southeast in this area, which has been influenced by the SEPTS operations.

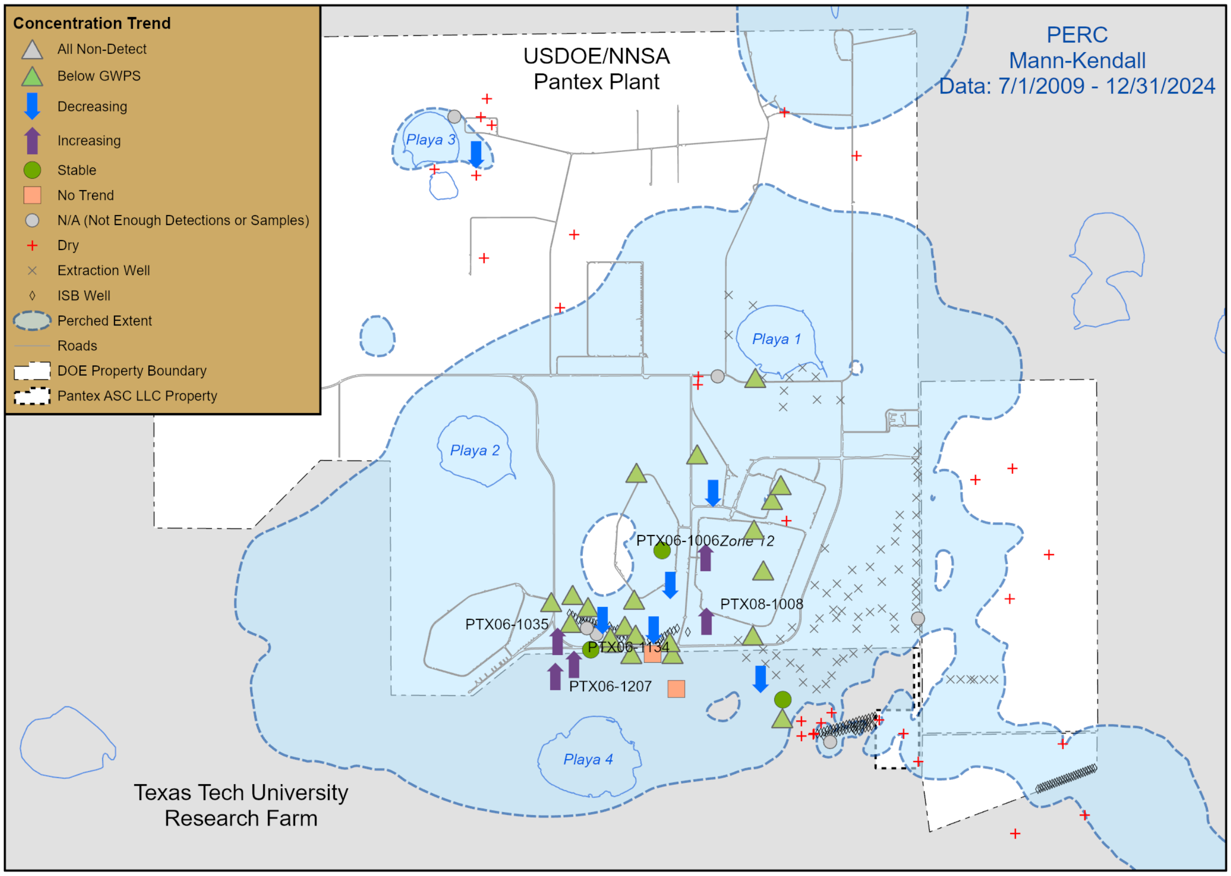

Fig. 3-9. Perchlorate trends in the perched aquifer.

3.1.4.4 TCE Trends

As depicted in Fig. 3-10, the following 10 monitoring wells are exhibiting increasing or probably increasing trends in TCE concentration above GWPS since the start of remedial actions:

- 1114-MW4 is exhibiting a probably increasing trend in TCE concentrations since the start of remedial actions in 2009. TCE concentrations had been declining through 2017, then generally increased through 2023 to near 20 µg/L. The most recent concentration in 2024 was lower at 15 µg/L. These shifting trends could be due to changes in gradients related to SEPTS operation and past removal of water from Playa 1 or general plume movement downgradient. Regardless, 1114–MW4 is installed upgradient of the Zone 11 ISB system and the SEPTS; TCE will be treated as it flows through the ISB system or captured by the SEPTS.

- A probably increasing trend was identified for PTX06-1151 located upgradient of the western part of the Zone 11 ISB system. Concentrations have approximately doubled in this well since 2021, when they were about the same as in 2009 after years of oscillation. This well is located downgradient from the identified sources in Zone 11, so the observed concentrations in this well reflect general plume movement to the south due to removal of water from the SEPTS.

- PTX06-1011, located in Zone 11, is exhibiting a probably increasing trend in TCE concentrations since the start of remedial actions in 2009. TCE concentrations in this well have fluctuated just above the GWPS since 1995. No trend is indicated for the last four samples and for all data.

- PTX08-1006 is exhibiting an increasing trend for TCE, although the expected condition is a long-term decreasing trend. 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 that may also be influenced by SEPTS operations. Concentrations have been highly variable in this well, and observed concentrations since 2022 are lower than higher concentrations that occurred in 2021.

- An increasing trend was identified for PTX06-1127 located upgradient of the Zone 11 ISB system. Concentrations increased starting in 2015 through 2019 and have generally stabilized or decreased since 2020. The last four samples indicate no trend. This well is located downgradient from the identified sources in Zone 11, so the variations likely reflect impacts by the SEPTS withdrawal that has changed general flow of the plumes in that area to the southeast.

- PTX06-1035, located downgradient of the western side of the Zone 11 ISB, has experienced an increasing trend in TCE concentration due to general plume movement downgradient. TCE concentrations in PTX06-1134 have fluctuated between 10 and 100 ug/L in recent years. The ISB system conceptual site model predicted treated water would not reach these wells until 10 years or longer after system operations began (the ISB wells upgradient of these monitoring wells were installed in 2014). Upgradient ISPM wells PTX06-1174, 1175 experienced sharp declines in TCE concentrations, now below the GWPS, and this change will propagate downgradient.

- PTX06-1148, PTX06-1149, and PTX06-1150 are downgradient of the original part of the Zone 11 ISB. TCE concentrations in these wells rose above the GWPS between

2016 and 2021. At each well, the concentration declined significantly between the two sampling events in 2024. The recent increasing trends are likely due to general plume movement to the southeast. Pantex has added new ISB injection wells to affect the TCE concentrations to the south and those changes are expected to be observed in these wells as the treated water moves downgradient. Additional evaluation of the ISB system performance is provided in Section 3.2.3.1.

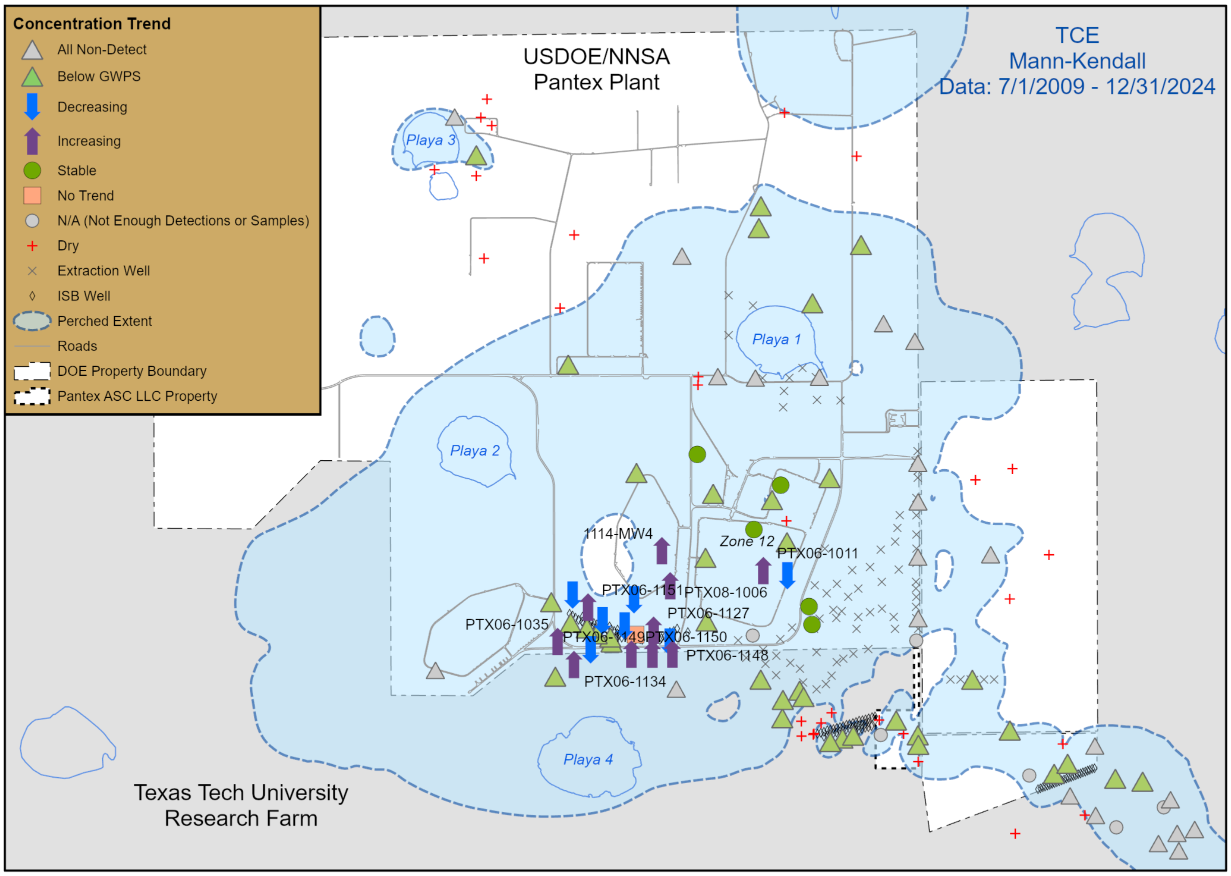

Fig. 3-10. TCE trends in the perched aquifer.

3.1.5 Concentration Trends Compared To Expected Conditions

Of the 120 monitoring wells with expected COC concentration conditions defined in the LTM Design Report (2019), including wells PTX06-1211, 1212, 1215, and 1216 that have been added since 2019, the 26 wells depicted in Fig. 3-11 did not exhibit trends consistent with the expected conditions since the start of remedial actions. These wells were discussed in Section 3.1.4. Seven additional wells with stable trends or no trend for one or more COCs, but whose expected condition is “Long-term decreasing trend,” are not included. Additional detail on all LTM wells is located in Appendix E.

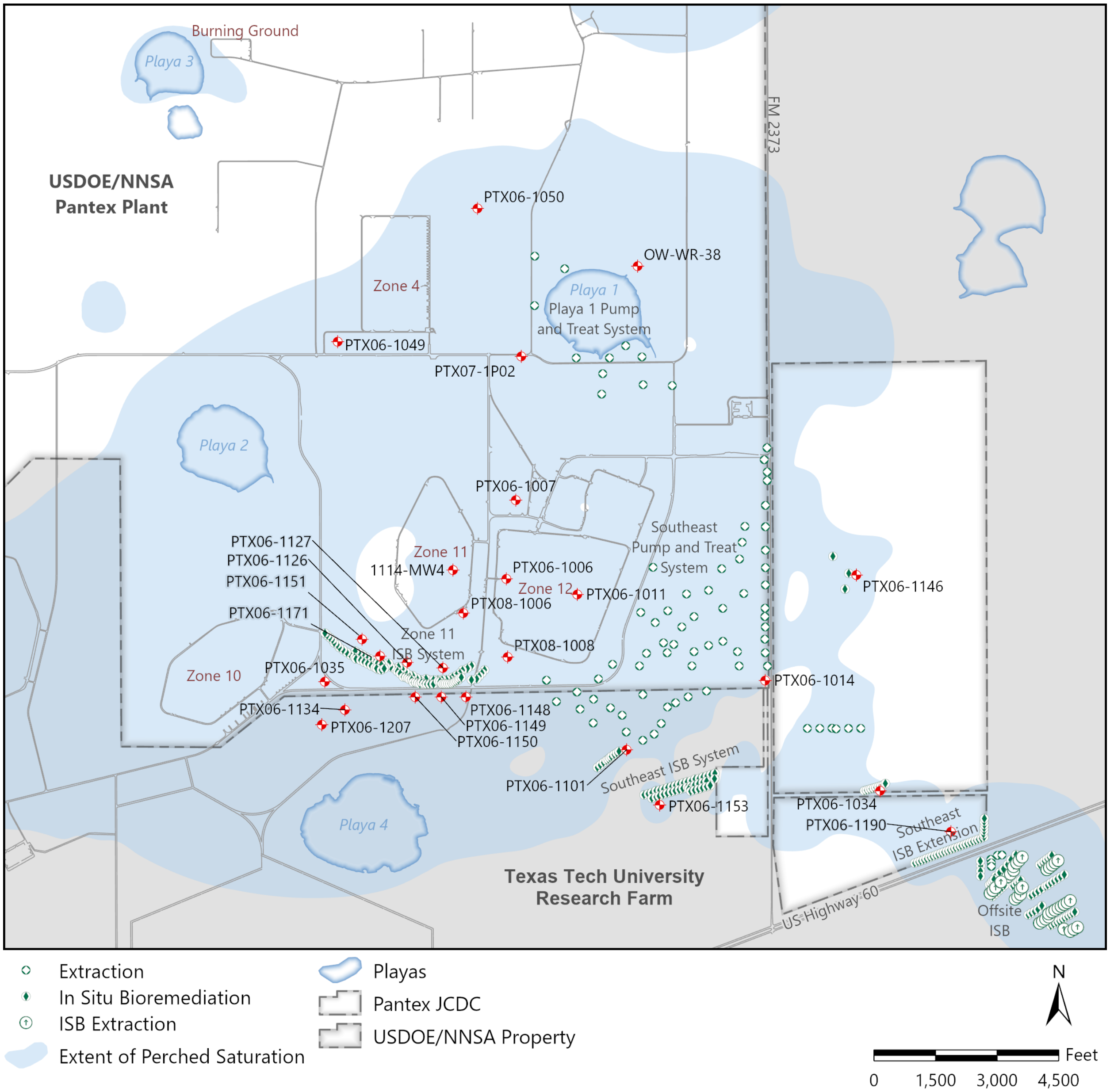

Fig. 3-11. Perched wells with unexpected COC trends.

3.1.6 *Plume Mapping*

This section presents isoconcentration maps of indicator constituents (i.e., COCs and breakdown products of RDX and TCE) in the perched aquifer. Perched aquifer indicator parameters are documented in CP Table IIIA of HW-50284 and included in the SAP. Isoconcentration maps for this annual report were produced from groundwater data collected in 2024.

Each isoconcentration map presents the highest detected concentration for each constituent using validated analytical data from January to December 2024. COC plumes were delineated to the approved GWPS as was first done for the *2014 Annual Progress Report* (Pantex, 2015). 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 wellfields were used to generate the isoconcentration contours, but the analytical concentration data from these wells may differ from those of the 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. Remediation wells are identified on the maps only if the well was sampled.

Constituent concentrations for samples collected from wells within the ISB treatment zones and downgradient zones of influence were generally used to generate 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 indicating treatment effects of the ISB treatment zone as well as the 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, they were not included in the contouring process. The estimated downgradient areas under the influence of the ISB systems are 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 to generate 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. Fig. 3-12 through Fig. 3-26 are isoconcentration maps for RDX; 4-amino-2,6-dinitrotoluene (DNT4A); hexavalent chromium; perchlorate; and TCE. Maps for hexahydro-1-nitroso-3,5-dinitro-1,3,5-triazine (MNX);

hexahydro-1,3-dinitroso-5-nitro-1,3,5-triazine (DNX); hexahydro-1,3,5-trinitroso-1,3,5-triazine (TNX); 2,4,6-trinitrotoluene (TNT); 2-amino-4,6-dinitrotoluene (DNT2A); 1,3,5-trinitrobenzene; 1,4-dioxane; 1,2-dichloroethane (DCA); cis-1,2-DCE; and vinyl chloride are presented in Appendix F.

Table 3-1. Perched Aquifer Indicator Parameters

HEs	Metals	Inorganics	Volatile Organics
RDX	Boron	Perchlorate	Chloroform
HMX	Chromium		1,2-DCA
MNX	Hexavalent Chromium		1,4-Dioxane
DNX			*cis*-1,2-DCE
TNX			*trans*-1,2-DCE
TNT			PCE
1,3-Dinitrobenzene			TCE
DNT2A			Vinyl Chloride
DNT4A			
2,4-DNT			
2,6-DNT			
1,3,5-Trinitrobenzene			

Isoconcentration maps for other indicator constituents, such as octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX); 1,3-dinitrobenzene; 2,4-dinitrotoluene (DNT); 2,6-DNT; boron; *trans*-1,2-DCE; tetrachloroethylene (PCE); and chloroform, 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 paragraphs provide specific information detailing the reasons maps were not prepared for these constituents as well as for total chromium.

HMX

HMX was not detected above the GWPS of 360 µg/L in any perched aquifer well sampled in 2024. Therefore, an isoconcentration map was not prepared for this compound.

__1,3-Dinitrobenzene__

1,3-Dinitrobenzene was not detected above the PQL or GWPS in any perched aquifer well sampled in 2024. Therefore, an isoconcentration map was not prepared for this compound.

__2,4-Dinitrotoluene__

2,4-Dinitrotoluene was detected above the GWPS of 1 µg/L in a single perched aquifer monitor well in 2024. This isolated exceedance could not be used to map a distinct plume. Low levels of 2,4-dinitrotoluene are expected within the capture zone of the SEPTS. Therefore, an isoconcentration map was not prepared for this compound.

__2,6-Dinitrotoluene__

2,6-Dinitrotoluene was detected above the GWPS of 1 µg/L in a single perched aquifer monitor well in 2024. This isolated exceedance could not be used to map a distinct plume. Low levels of 2,6-dinitrotoluene are expected within the capture zone of the SEPTS. Therefore, an isoconcentration map was not prepared for this compound.

__Boron__

Boron did not exceed the GWPS of 7,300 µg/L in any perched aquifer well sampled in 2024. Therefore, an isoconcentration map was not prepared for this compound.

__Chromium__

A map of total chromium isoconcentrations for the perched aquifer was not prepared for 2024. Historically, wells constructed with stainless-steel well screens have exhibited elevated concentrations of chromium and other components of stainless steel. Several of these wells have been shown by video observation to be corroded and/or have bacterial growth present, and statistical analyses of the concentrations of chromium and other components of stainless steel (i.e., manganese, molybdenum, and nickel) show 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. A map of total chromium is unlikely to represent real concentrations of total chromium in the aquifer at large and instead would only reflect the distribution of wells with stainless steel screens and their corrosion rate.

Chloroform

Chloroform was not detected above the GWPS of 80 µg/L in any perched aquifer well sampled in 2024. Therefore, an isoconcentration map was not prepared for this compound.

Trans-1,2-Dichloroethene

Trans-1,2-DCE was not detected above the PQL or GWPS in any perched aquifer monitor well sampled in 2024. Therefore, an isoconcentration map was not prepared for this compound.

PCE

PCE was detected above the GWPS of 5 µg/L in three perched aquifer wells sampled in 2024. These isolated exceedances could not be used to map a distinct plume. Therefore, an isoconcentration map was not prepared for this compound.

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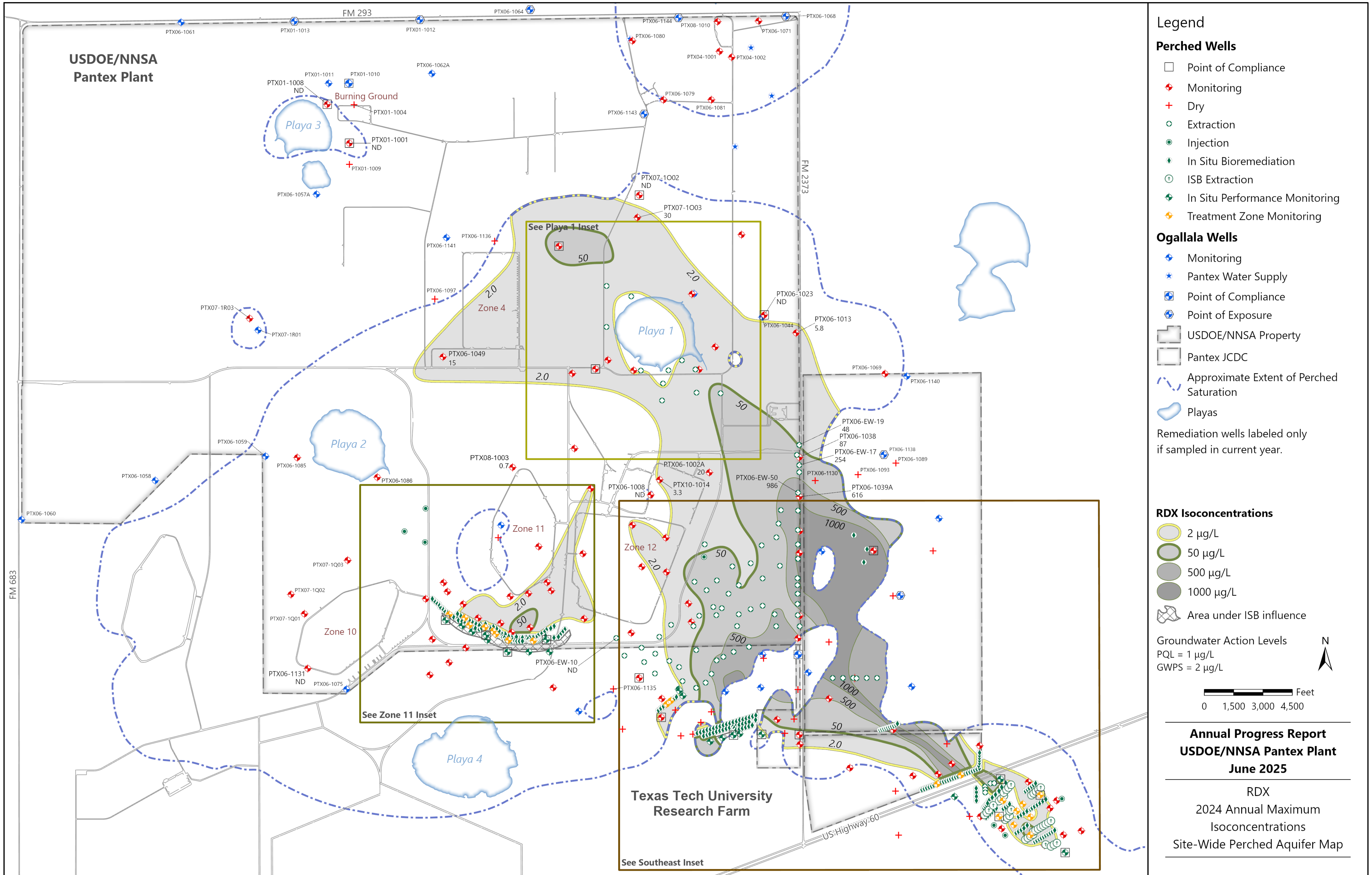

Fig. 3-12. RDX isoconcentration map.

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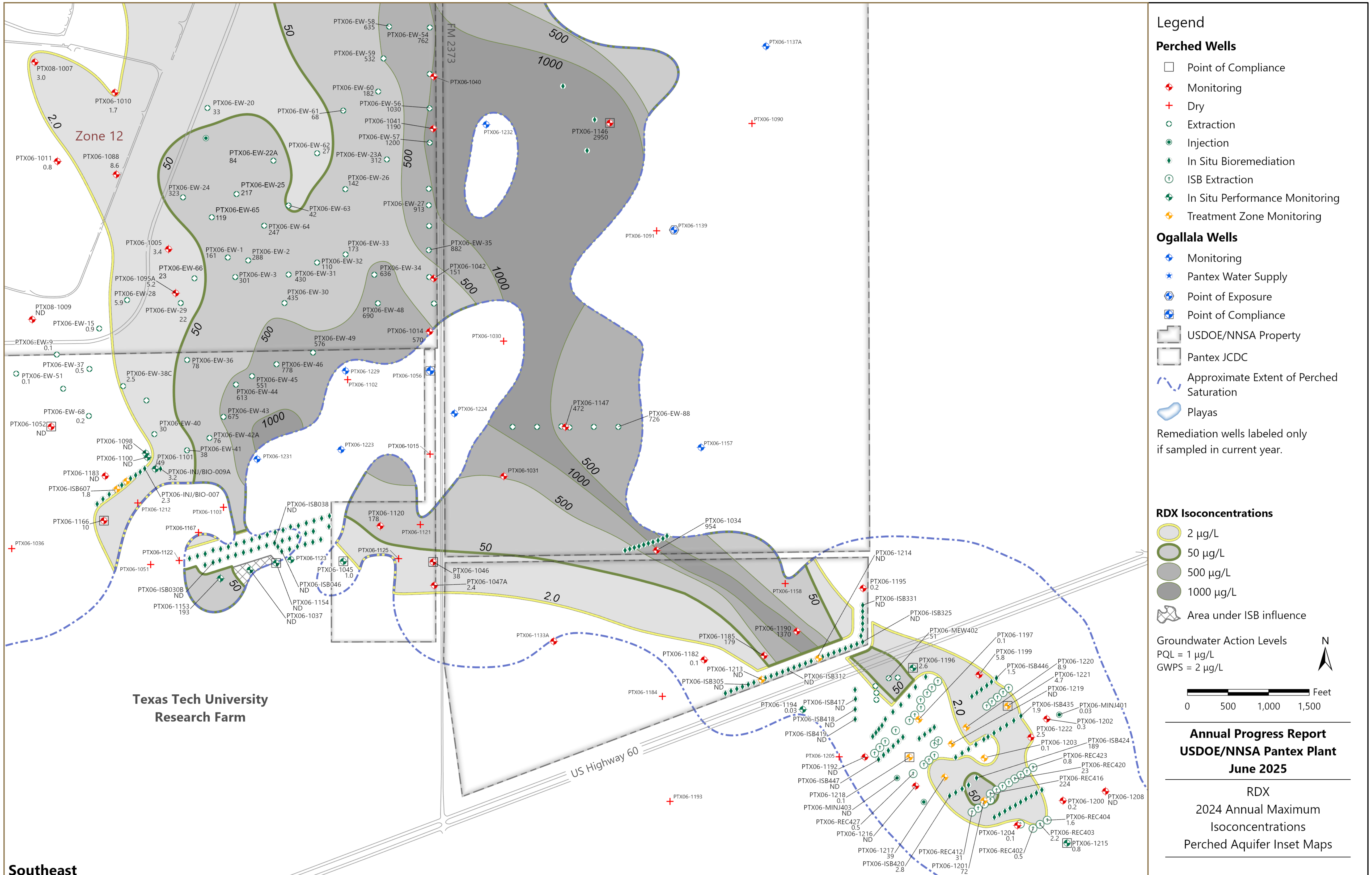

Fig. 3-13. RDX isoconcentration southeast inset map.

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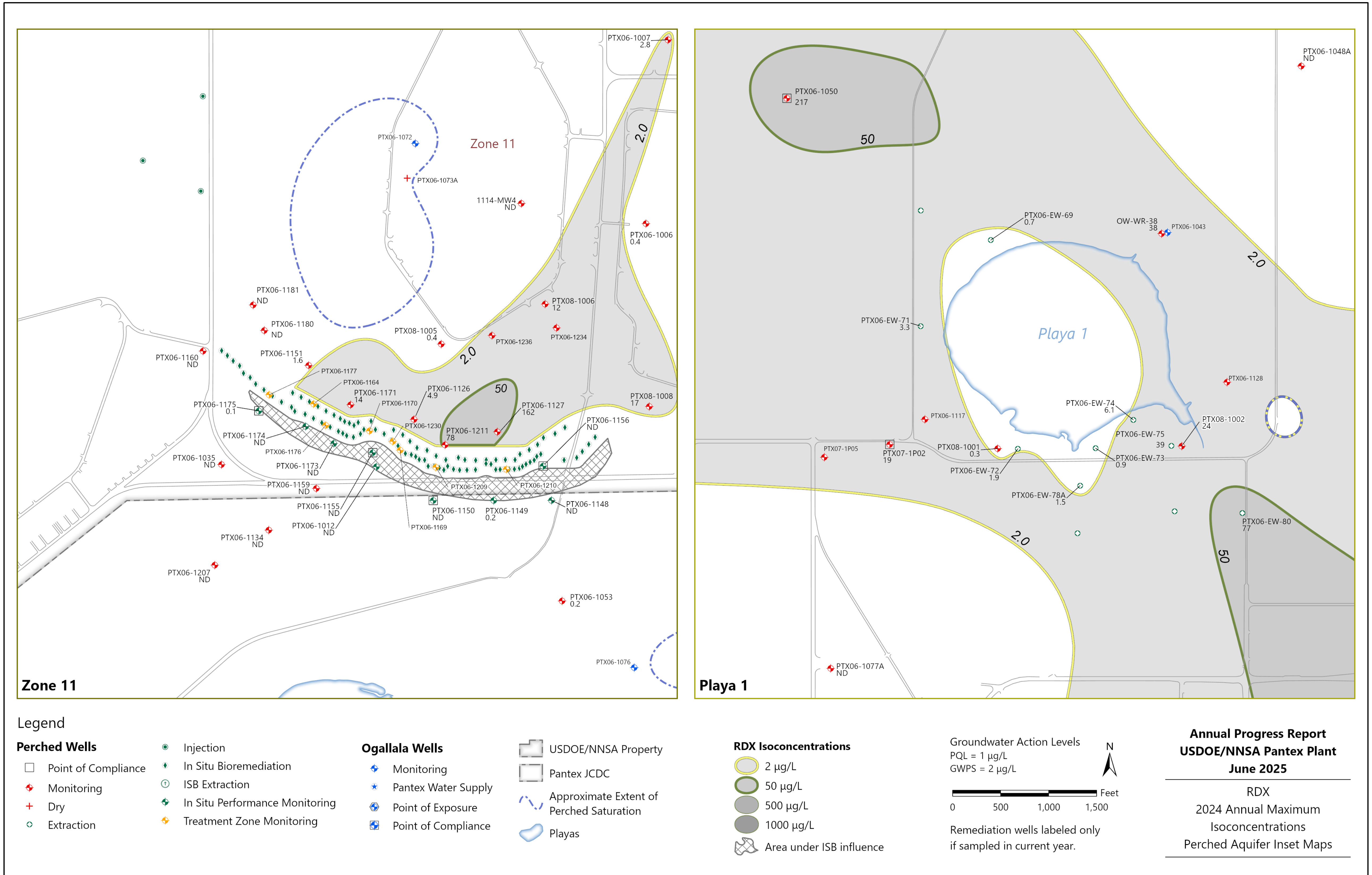

Fig. 3-14. RDX isoconcentration Zone 11 and Playa 1 inset maps.

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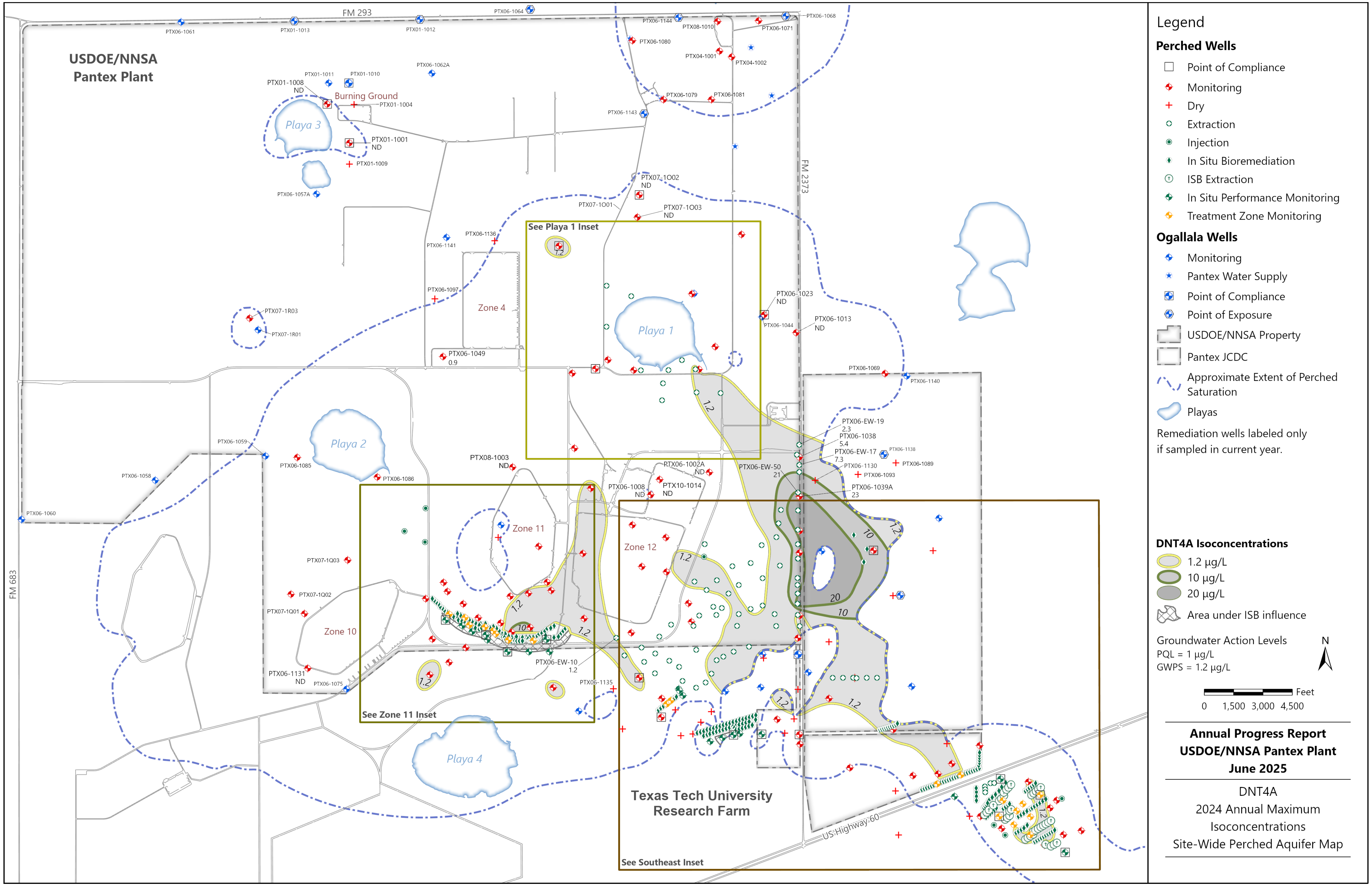

Fig. 3-15. DNT4A isoconcentration map.

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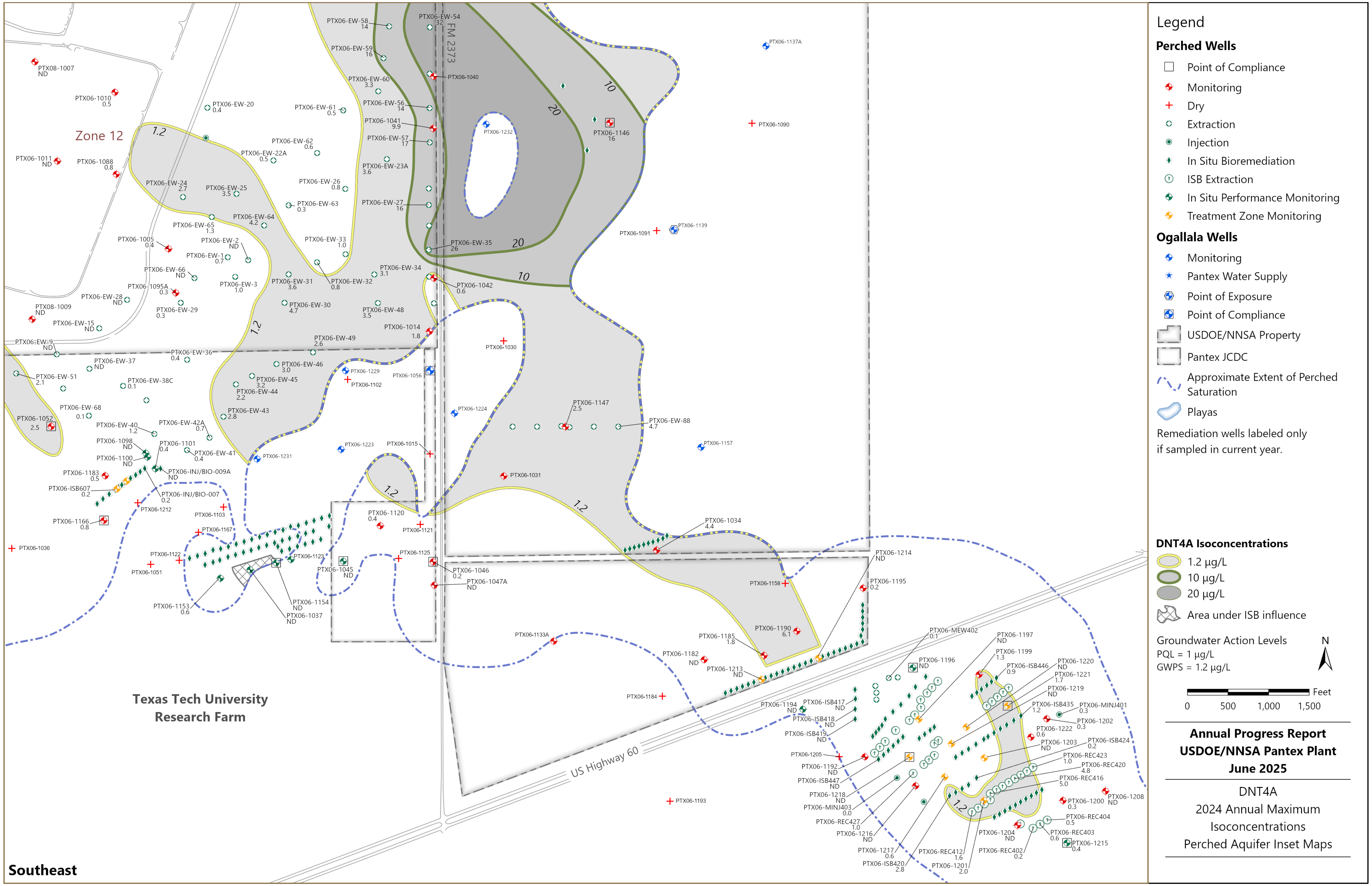

Fig. 3-16. DNT4A isoconcentration southeast inset map.

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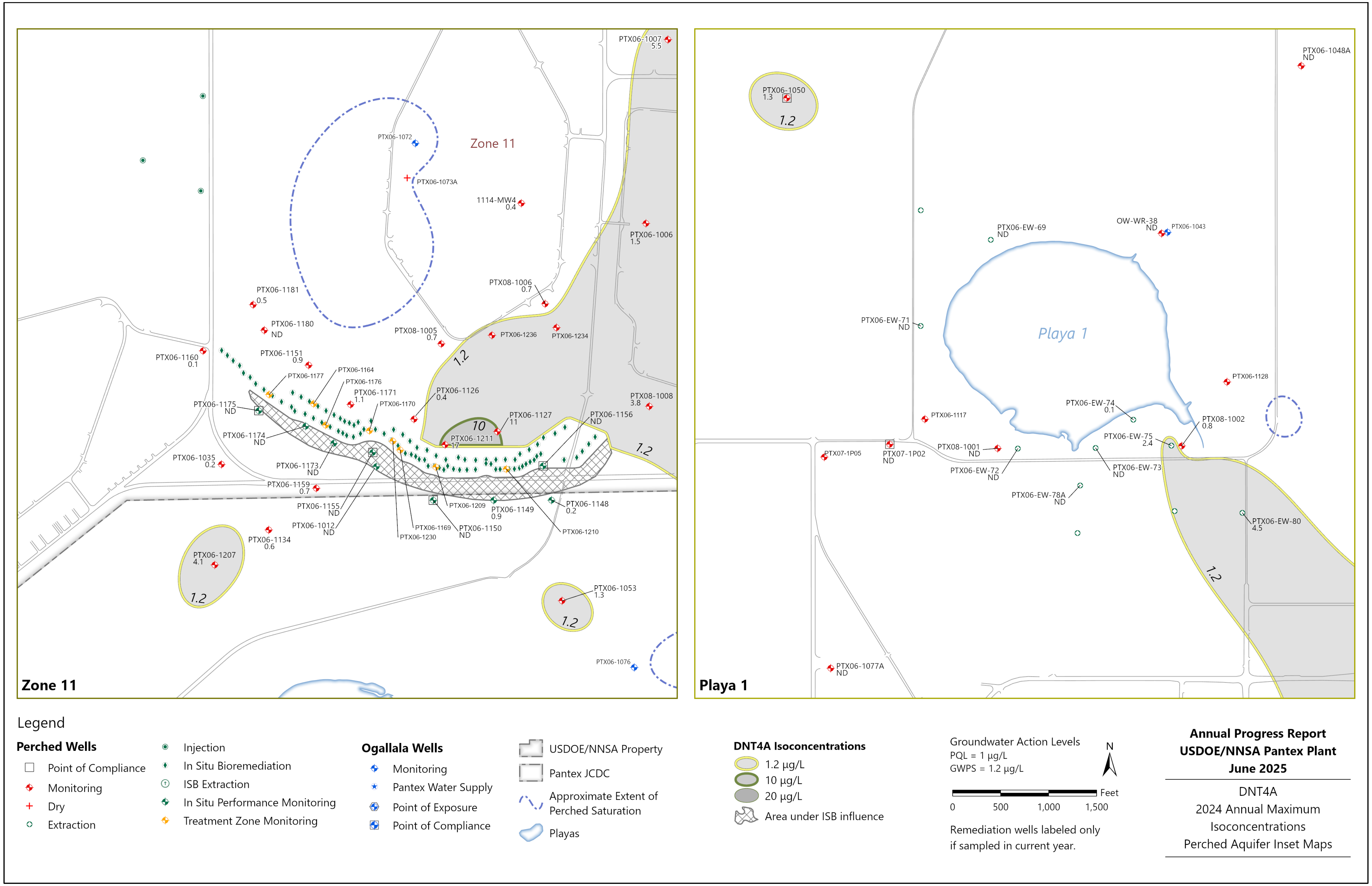

Fig. 3-17. DNT4A isoconcentration Zone 11 and Playa 1 inset maps.

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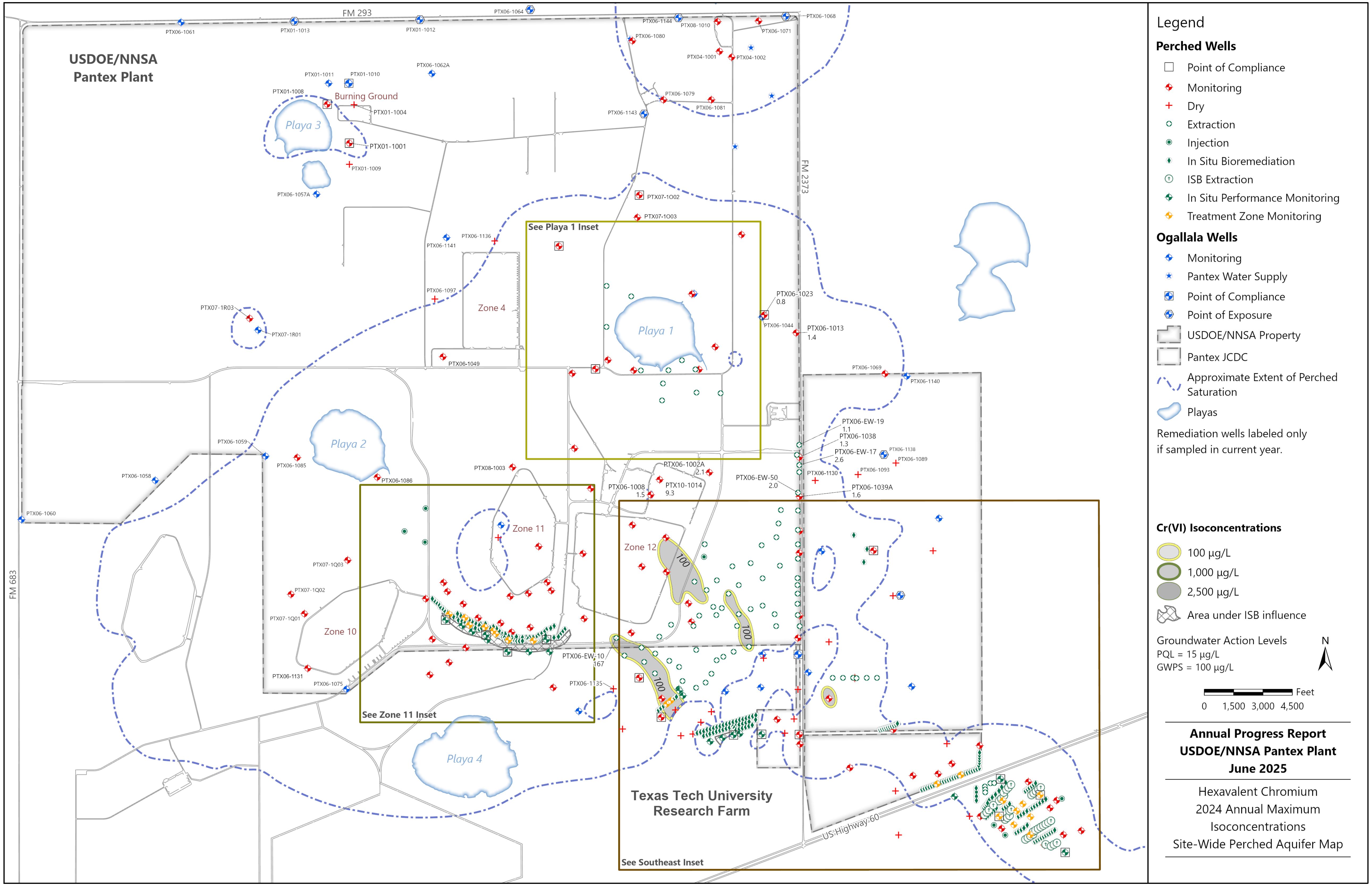

Fig. 3-18. Hexavalent chromium isoconcentration map.

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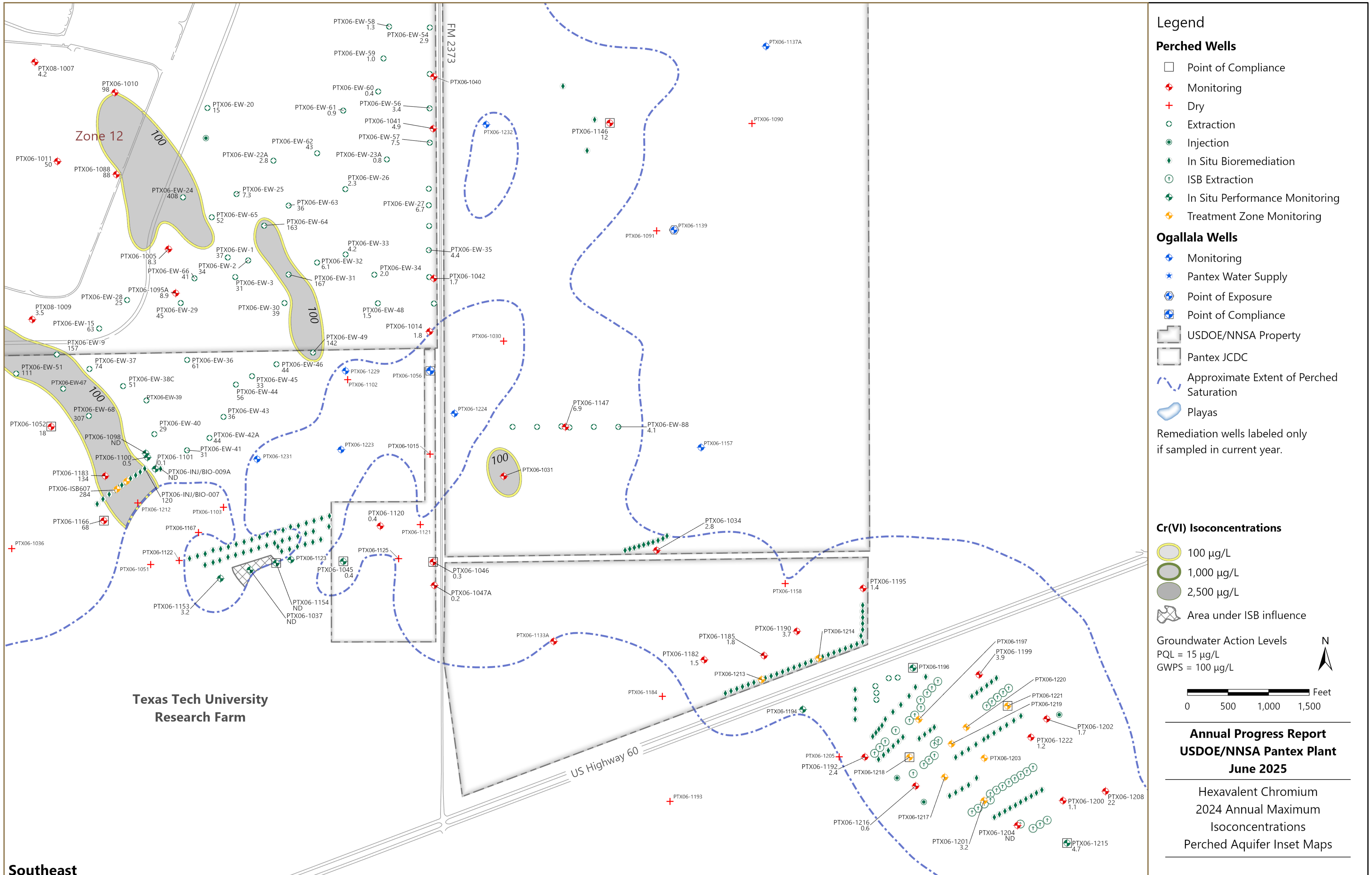

Fig. 3-19. Hexavalent chromium isoconcentration southeast inset map.

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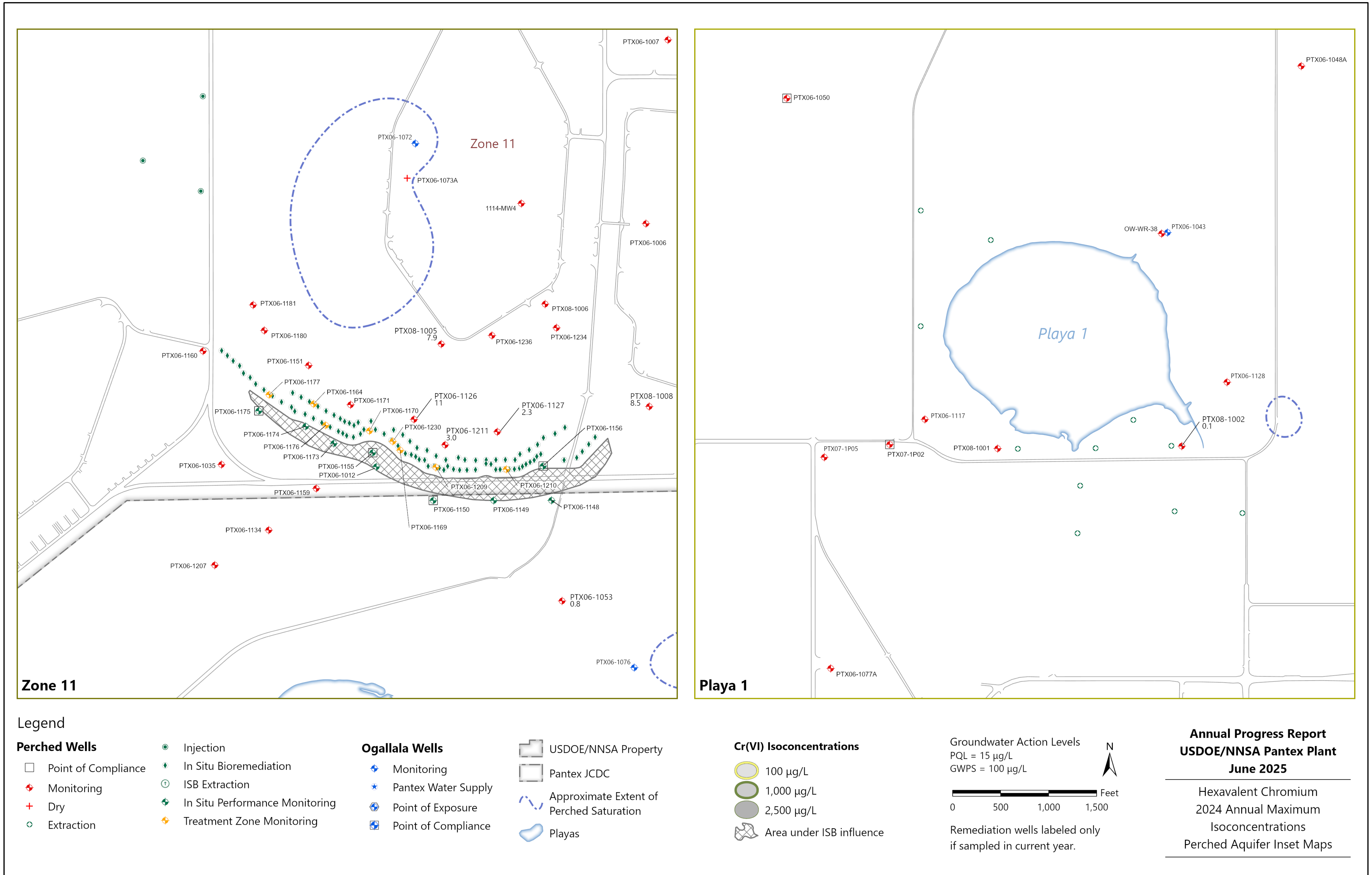

Fig. 3-20. Hexavalent chromium isoconcentration Zone 11 and Playa 1 inset maps.

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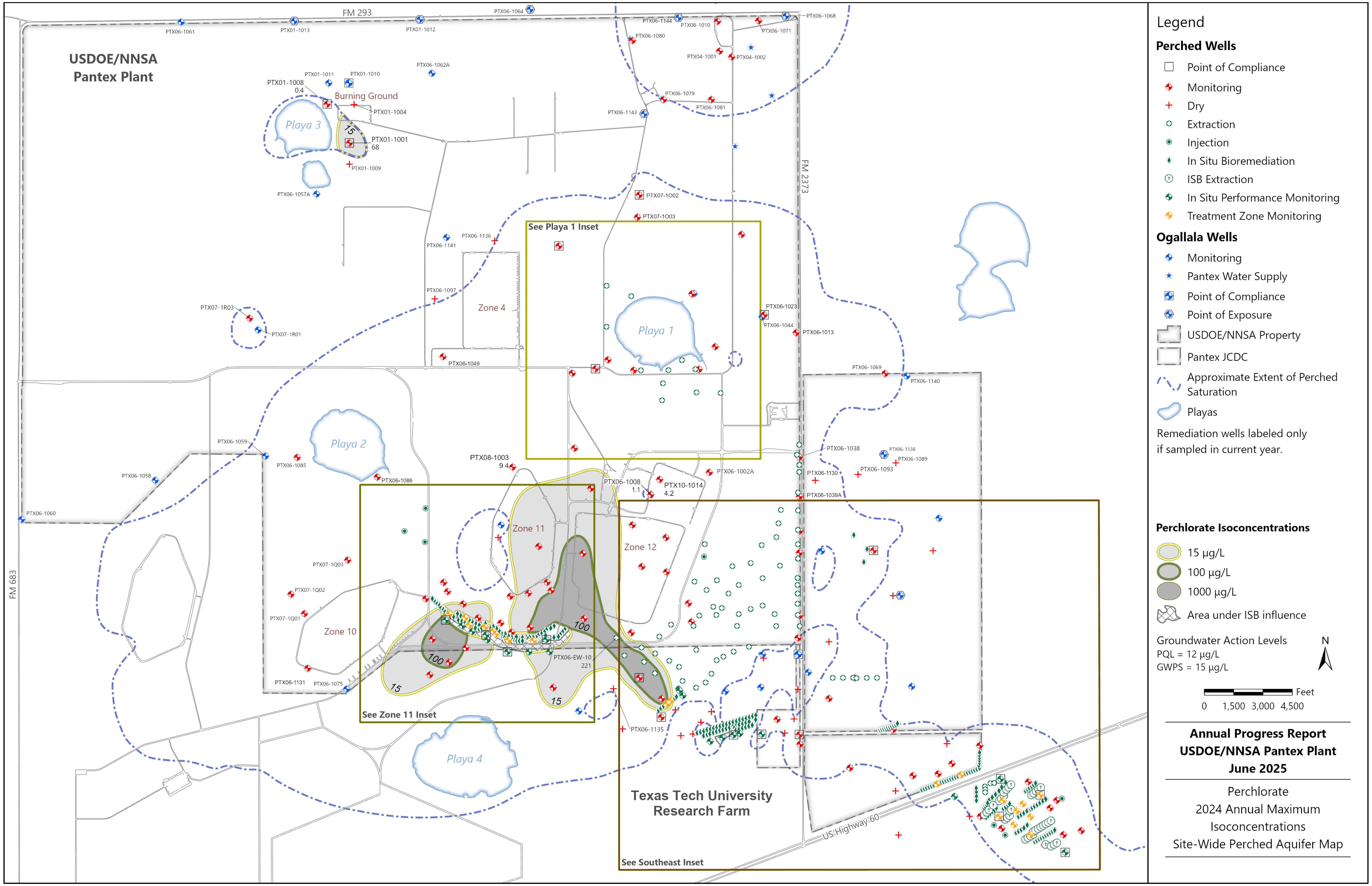

Fig. 3-21. Perchlorate isoconcentration map.

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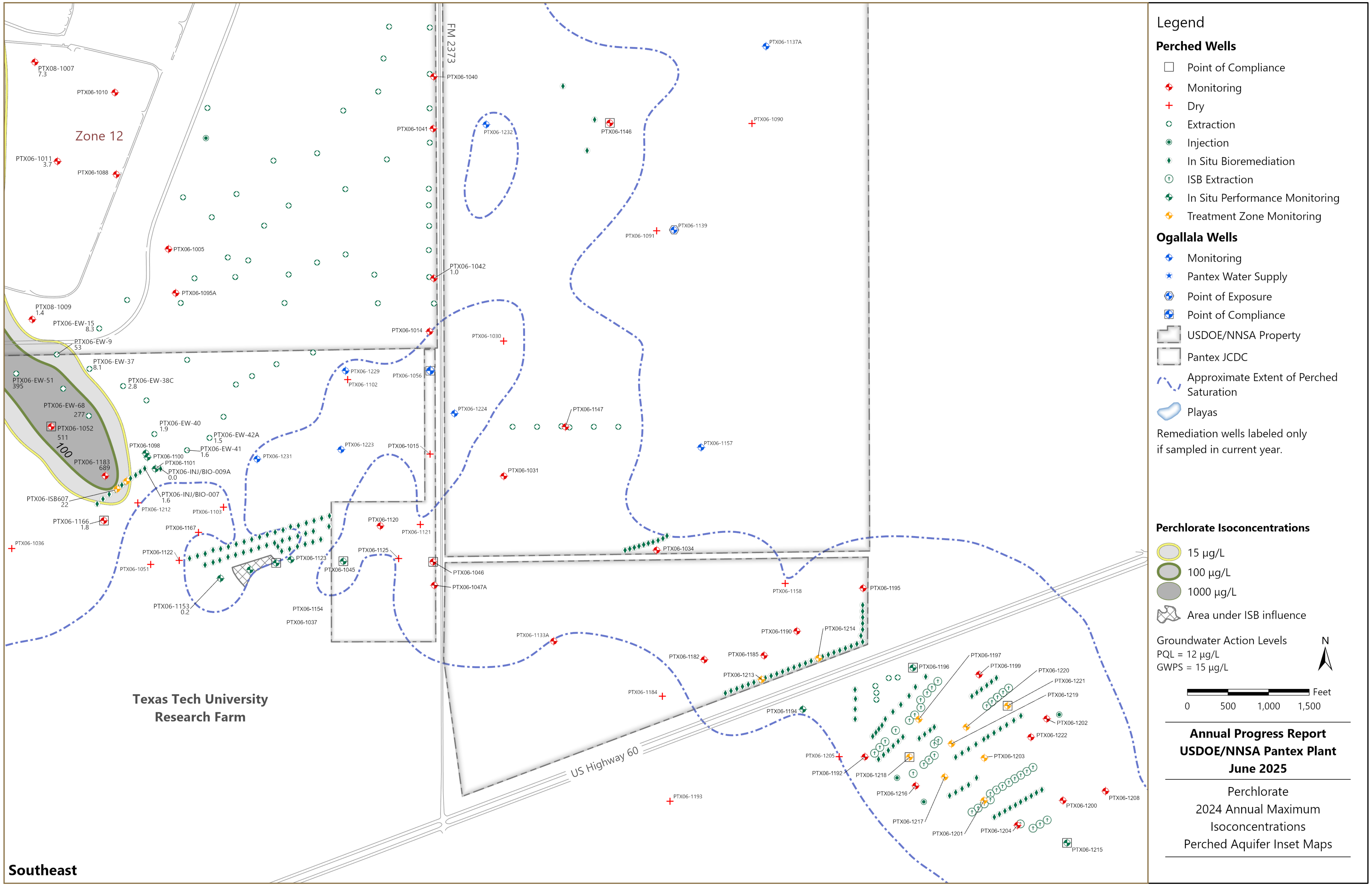

Fig. 3-22. Perchlorate isoconcentration southeast inset map.

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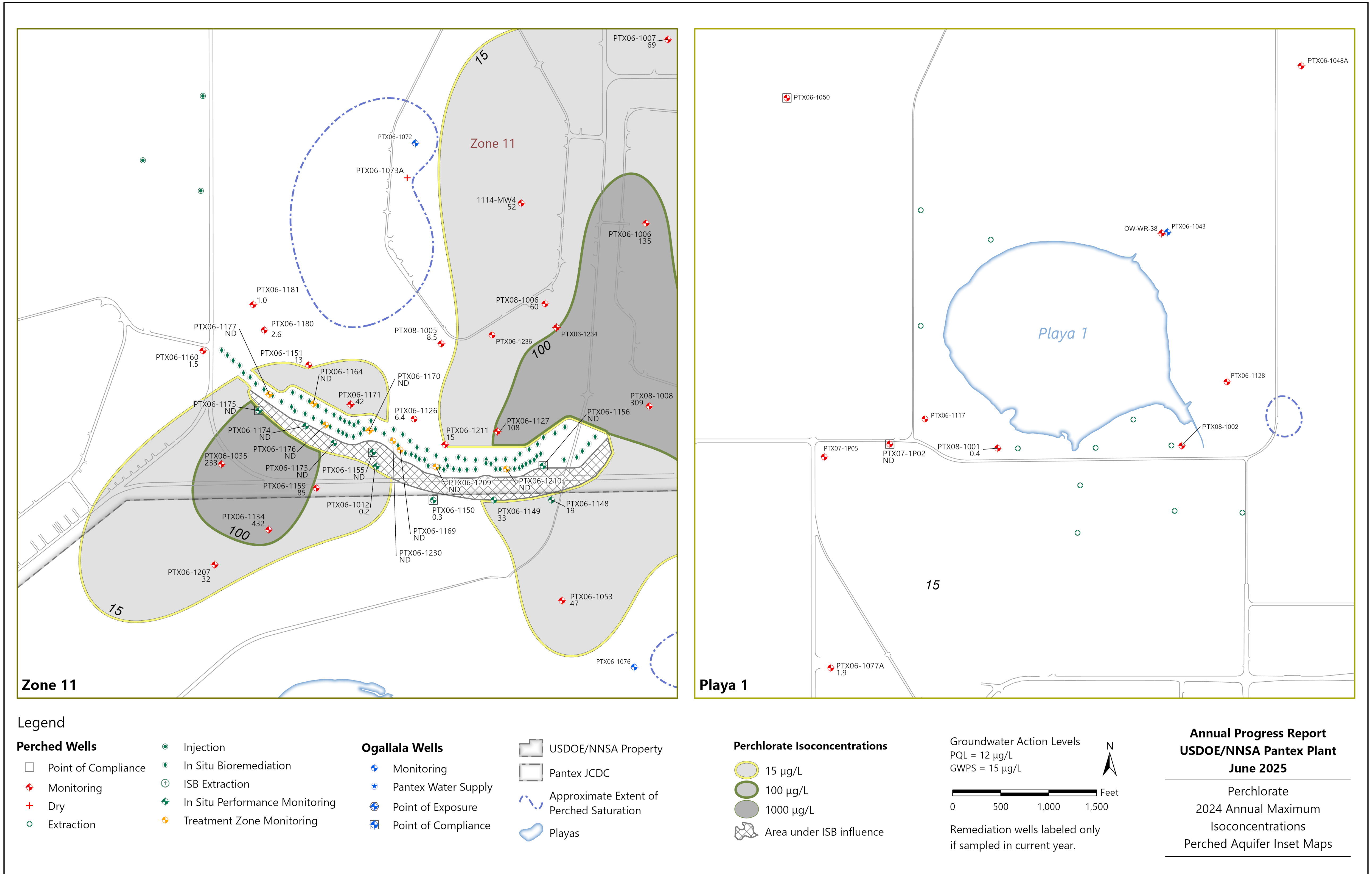

Fig. 3-23. Perchlorate isoconcentration Zone 11 and Playa 1 inset maps.

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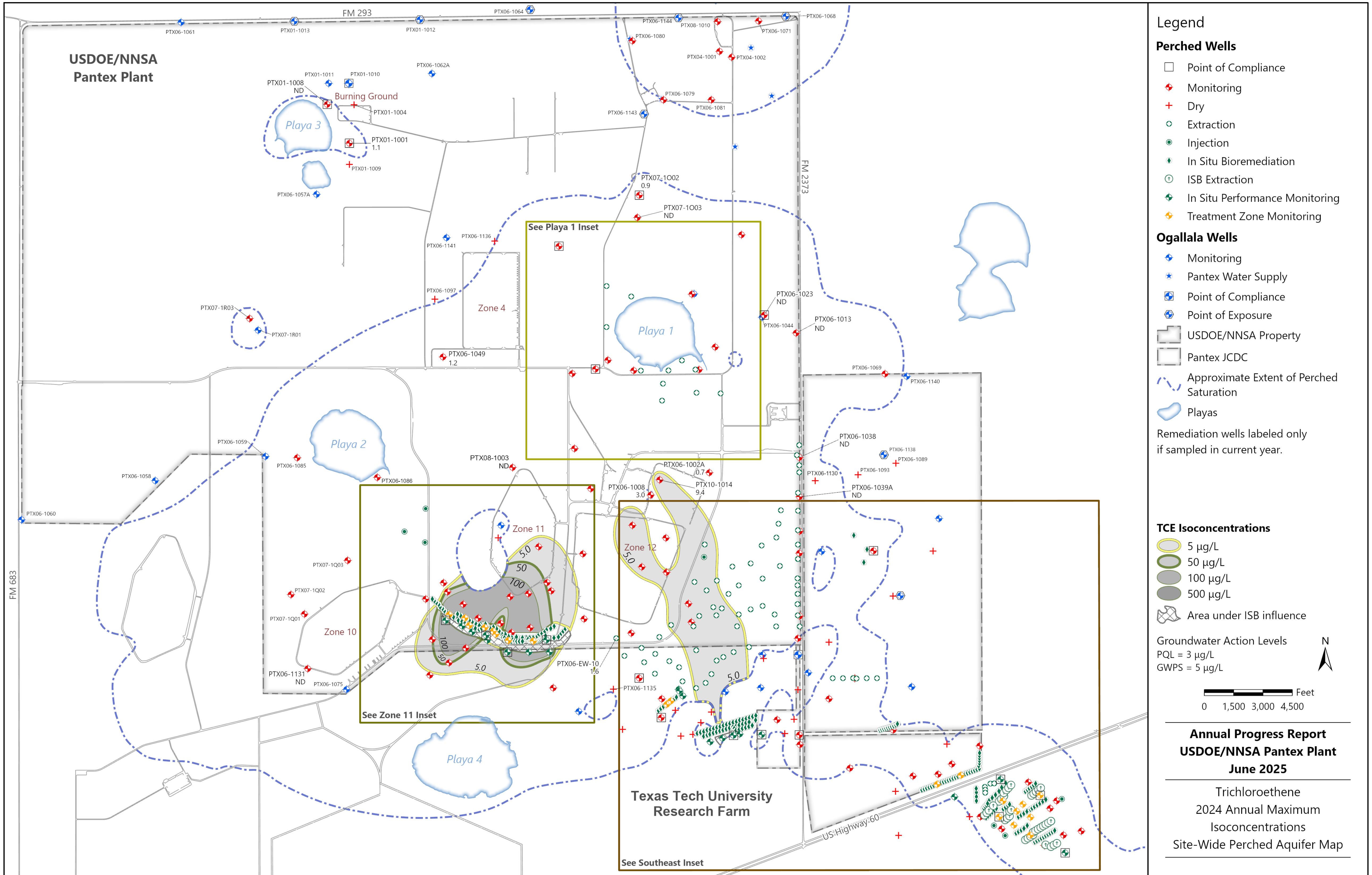

Fig. 3-24. TCE isoconcentration map.

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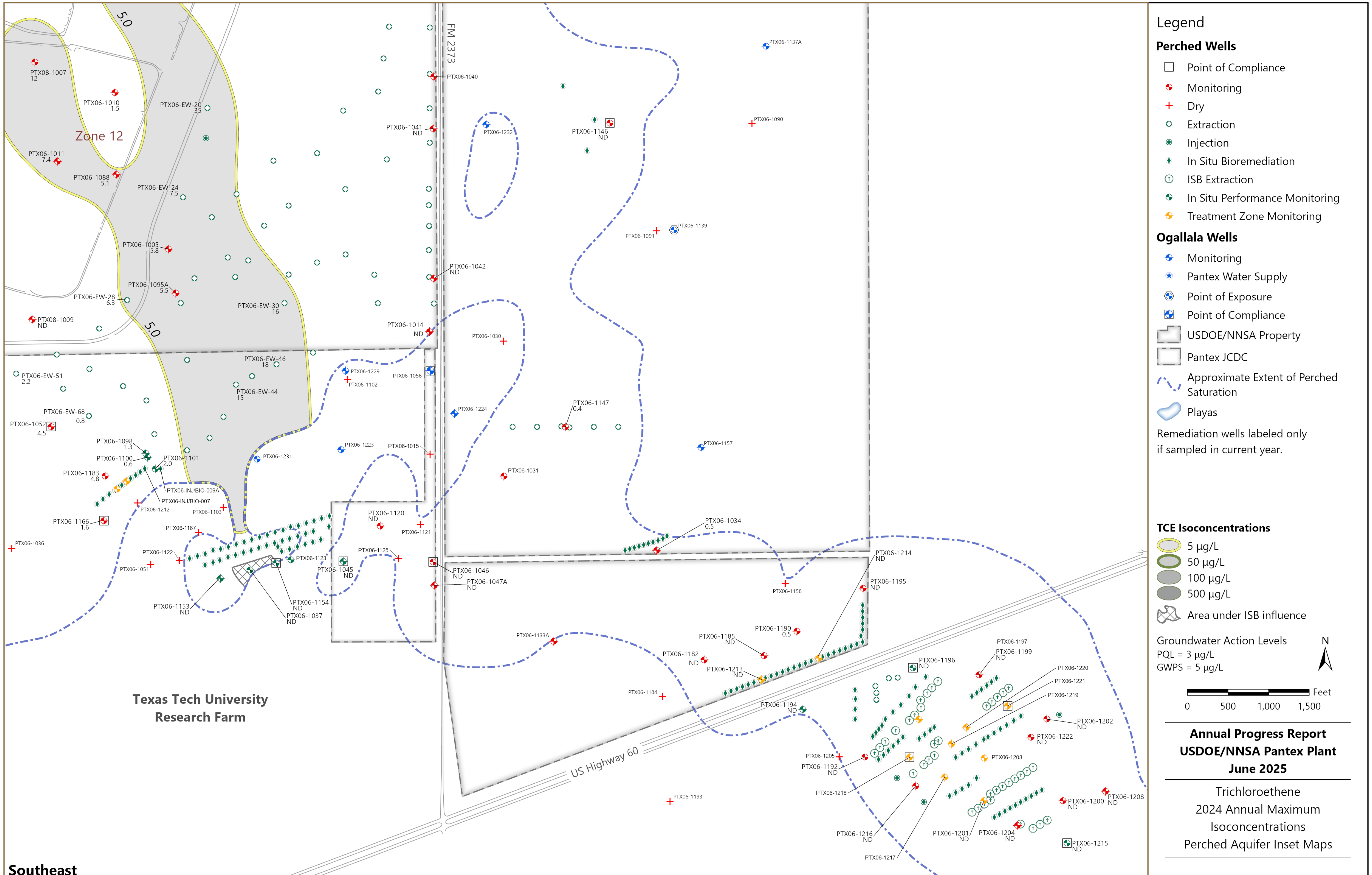

Fig. 3-25. TCE isoconcentration southeast inset map.

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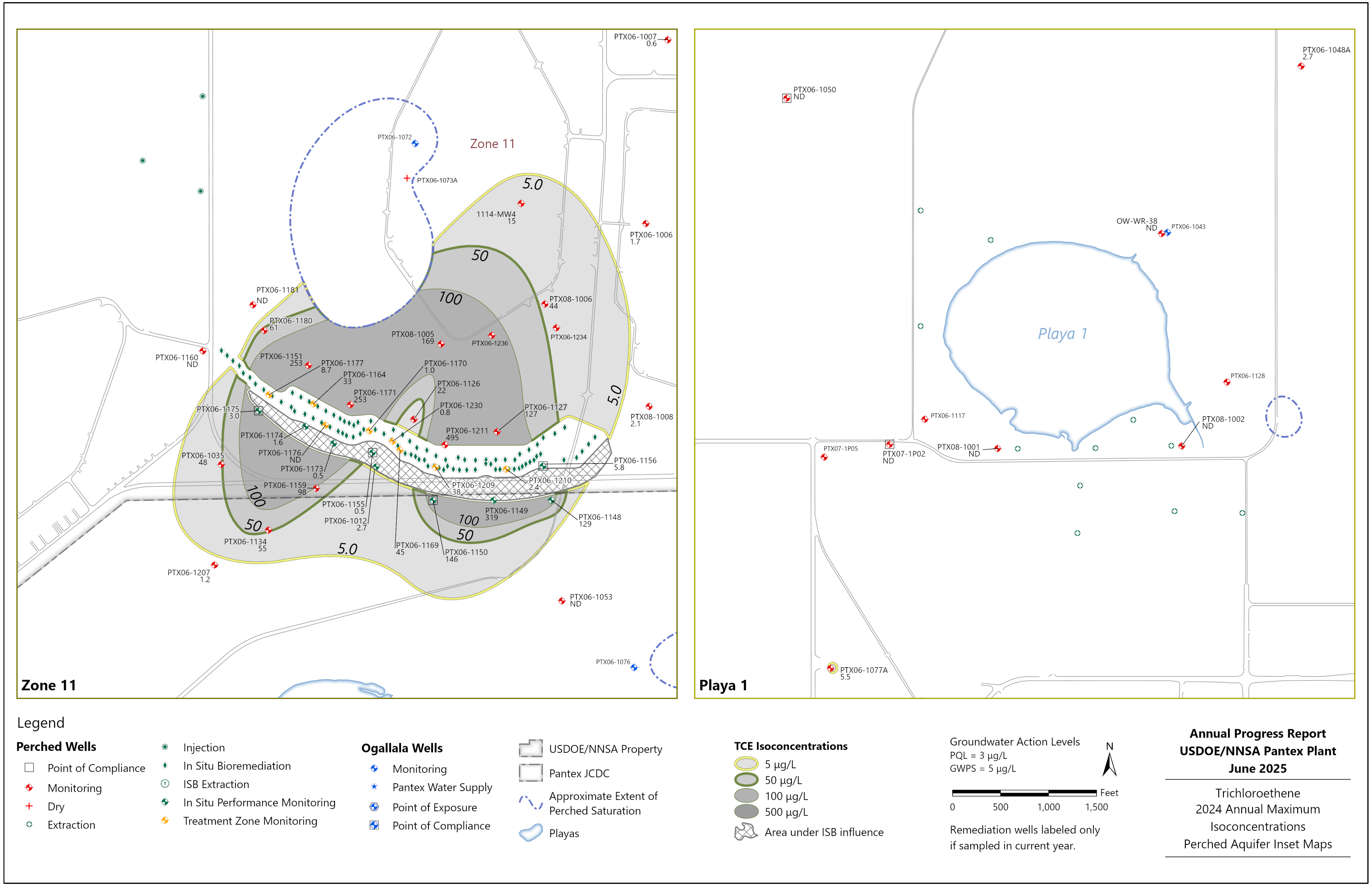

Fig. 3-26. TCE isoconcentration Zone 11 and Playa 1 inset maps.

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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 when estimating the rate of migration of groundwater contaminants. Unlike a typical contaminant plume in a regional aquifer, the HE plumes associated with Pantex (see Fig. 3-12) 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, the 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 presented 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 to 2024 is included in the following sections. Estimated plume boundaries for 2024 and/or select contours were compared with the 2009 isocontour maps. 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. 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 historical 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.

Trends in historic analytical data associated with this plume indicate that source areas along the ditches continue to leach HEs into perched groundwater but at lower concentrations than what has occurred historically.

This plume is being actively remediated by the SEPTS, which limits further migration of contaminants to the east. In addition, the P1PTS is actively treating the remaining 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 inside Zone 11 are stable or decreasing, although TCE is increasing in two areas due to changing flow gradients associated with removal of water by the SEPTS. Locations downgradient of Zone 11 are increasing near the ISB, and downgradient of some areas of the ISB. 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 are likely associated with water infiltrating from the playa. Some wells installed near Landfills 1 and 2 along with OW-WR-38 and PTX06-1049 are exhibiting some increasing trends or no trend results for HEs. However, these trends are likely due to the reduction of saturated thickness and shifting gradients in the northern perched groundwater due to the P1PTS operations rather than sourcing from the landfills. Trends will continue to be monitored at these locations.

To evaluate HE plume movement from 2009 to 2024, 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 it is defined by the perched aquifer extent in many areas, the 1,000-µg/L contours were included in the evaluation. These two contours represent the "hearts" of the two original plume sources (i.e., 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 Fig. 3-27, the 1,000-µg/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 the SEPTS operations and general plume movement in areas that are not under the SEPTS influence. For 2024, the RDX contour has extended into the far eastern and southern lobe of the perched groundwater. This shift is the result of increases in RDX to above 1,000 µg/L at PTX06-1034, PTX06-1146, and PTX06-1190 coupled with recent additional investigation of the perched groundwater in this area. Movement of the plume in this area appears to be associated with faster groundwater flow paths along channel-type features on the top of the FGZ. Pantex determined the downgradient extent of the plume in early 2019 with the installation of six new wells to the southeast and, to intercept this plume as it migrates to the southeast, has completed a line of injection wells as part of an extension of the Southeast ISB remedy.

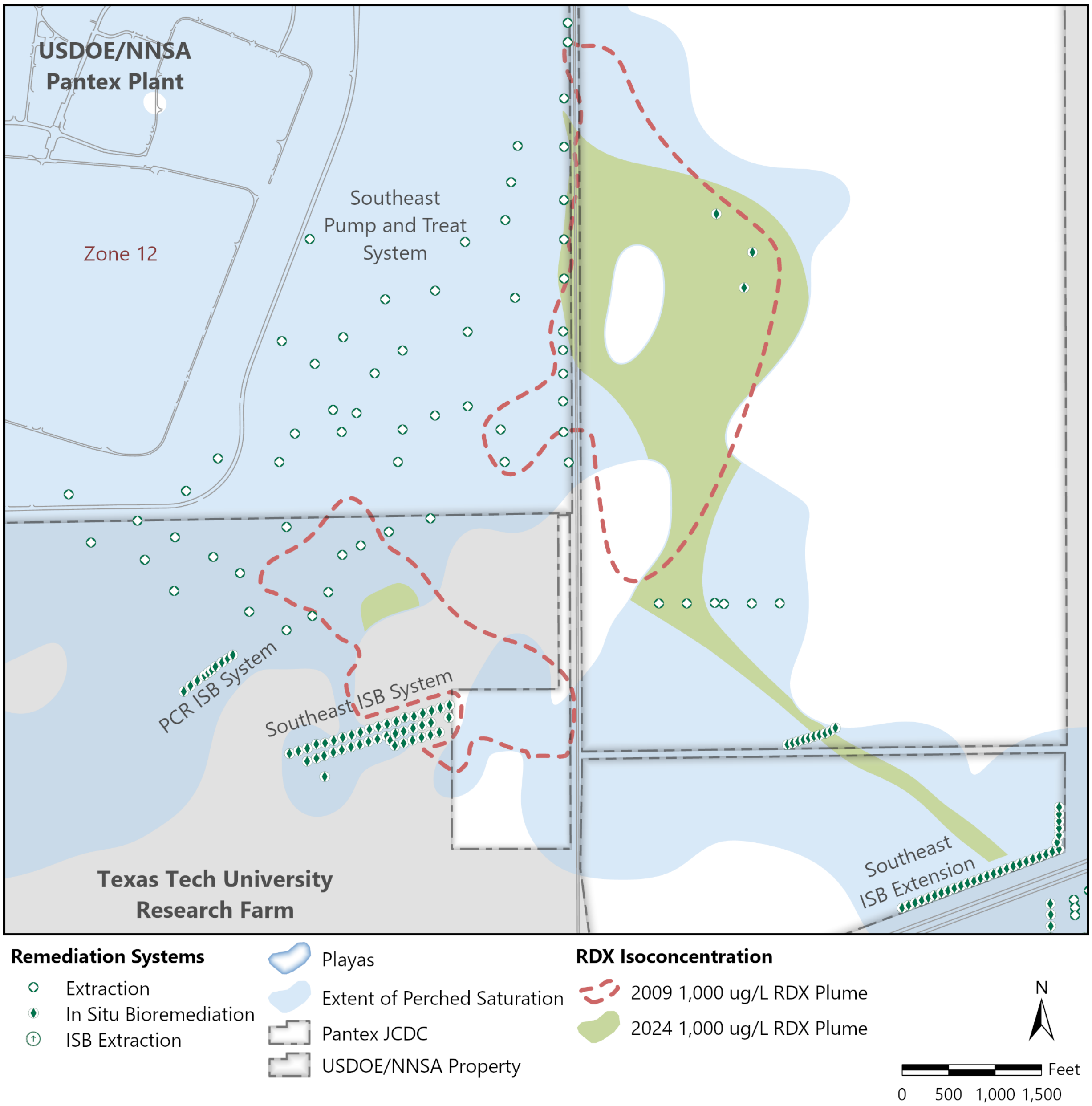

Fig. 3-27. RDX plume movement, 2009-2024.

3.1.7.2 Hexavalent Chromium Plumes

As shown in Fig. 3-18 and Fig. 3-19, hexavalent chromium is present in the perched aquifer in two plumes originating in Zone 12. These plumes are being actively remediated by the SEPTS.

The highest concentrations are associated with a source in Waste Management Group 5 outside the southwestern corner of Zone 12. Concentrations near the source area are decreasing (based on trend analysis of nearby wells), indicating that the source is declining. Concentrations within the plume and in downgradient wells have also decreased; the plume continues to move offsite to the southeast and extends to the limit of perched aquifer saturation on TTU property. Pantex has installed a new PCR ISB near the leading edge of the southeast hexavalent chromium plume to limit further migration of the southeastern plume.

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, including at PTX06-1010 nearest the source area. These trends may indicate a decline in the leaching of contamination from the source area to the perched groundwater.

When compared with the 2009 hexavalent chromium maps (see Fig. 3-28), the shapes are similar, with the following exceptions:

- The northern lobe of the plume has shifted to the east, likely due to a combination of the SEPTS extraction well pumping and reduction of injection in the area. This plume has also been split into multiple individual areas above the GWPS as the plume is remediated by the SEPTS. These portions of the plume are expected to be captured by SEPTS.
- The southern plumes have migrated away from the source area toward the southeast with portions extending beyond the SEPTS system.
- A smaller area of hexavalent chromium exceeding the GWPS was identified east of FM 2373 in samples collected from PTX06-1031 in 2022 and 2023. This well did not have sufficient water to collect a sample in 2024.

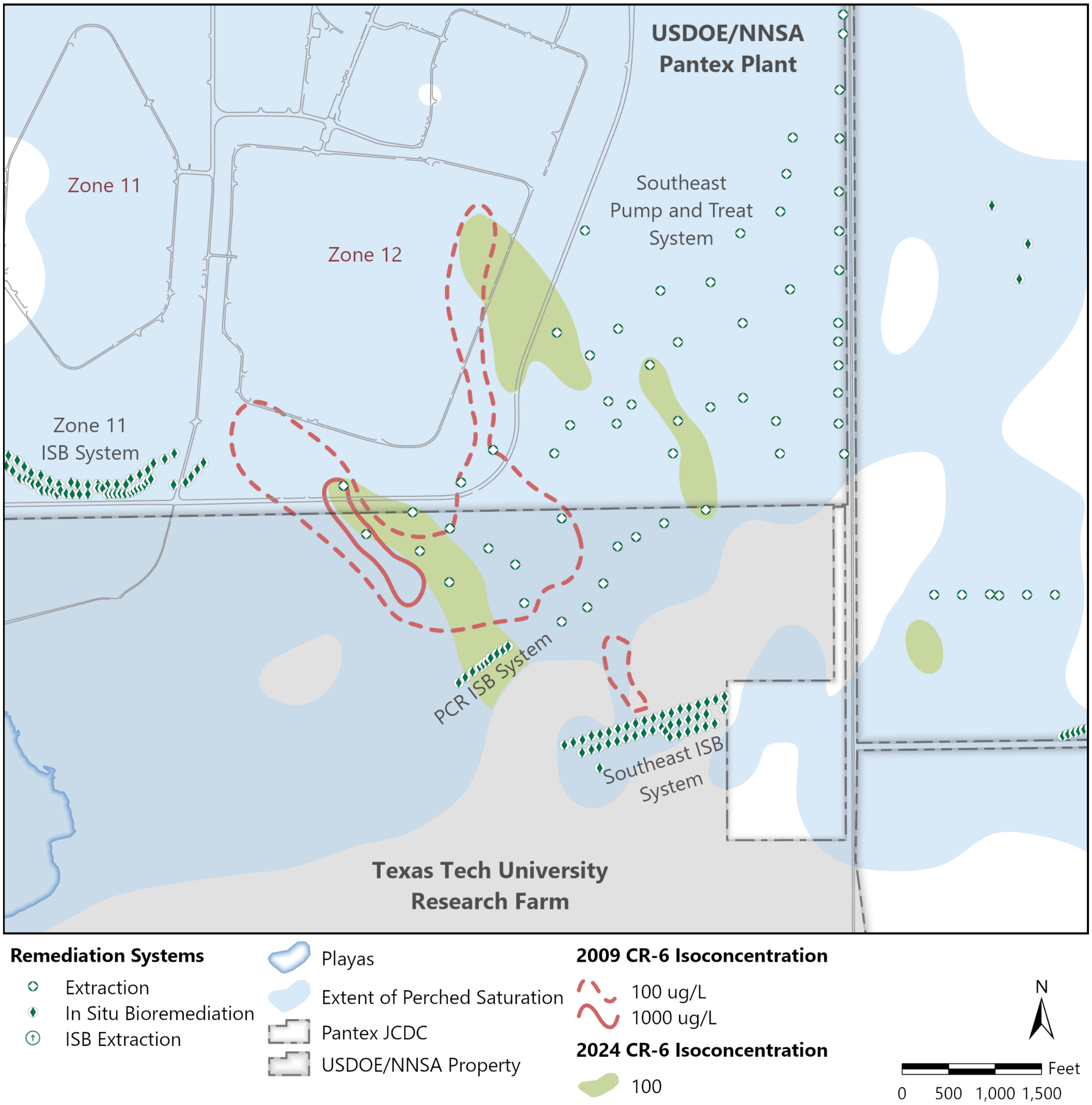

Fig. 3-28. Hexavalent chromium plume movement, 2009–2024.

3.1.7.3 Perchlorate Plume

Multiple plumes of perchlorate occur in the perched aquifer underlying Zone 11 and the western portion of Zone 12 and south of the Burning Ground. The Zone 11 plume extends south beneath the TTU property, as shown in Fig. 3-21, Fig. 3-22, and Fig. 3-23. This plume is associated with the historical release of perchlorate from processes in Zone 11 to unlined ditches that carried the untreated water to Playa 1.

In 2024, perchlorate was detected above the GWPS in well PTX01-1001, on the south side of the Burning Ground, for the first time since 2012. Perchlorate is this area is associated with historical releases from the former Wash Rack at the Burning Ground; recent elevated detections may be caused by an ongoing water leak in this area as well as movement of perched water away from Playa 3. Additional information is provided in Section 3.4.1.

Concentrations of perchlorate in areas underlying the potential source areas in Zone 11 are generally decreasing, and perchlorate concentrations near the ditch to Playa 1 have decreased. Perchlorate concentrations near the southern boundary of the plant continue to generally increase. This plume is being actively remediated by the Zone 11 ISB system, though portions of the plume have moved outside of the Zone 11 ISB area of influence and have migrated to the southwest, while a portion of the plume has migrated southeast into the SEPTS wellfield and beyond.

In 2022 as part of the ESD, the action level (GWPS) was updated for perchlorate from 26 µg/L to 15 µg/L. Therefore, the change in the extent of perchlorate from 2009 to 2024 indicated on Fig. 3-29 not only reflects movement of the plume based on available data but also is affected by the use of a lower level for more recent plume mapping. As depicted in Fig. 3-29, the perchlorate plume shape is similar to the 2009 plume map, with the following notable exceptions:

- The southwestern lobe of the plume has shifted to the southwest likely due to advection and dispersion, as indicated by data collected from monitoring wells on TTU property southwest of Zone 11. Recharge from Playa 4 to the south may also have an influence on plume movement south of Zone 11.
- The southeastern portion of the plume has shifted both south and east. A portion of the plume appears to be migrating directly south toward PTX06-1053. This part of the plume is being actively remediated by the Zone 11 ISB system. An increase of perchlorate in PTX08-1008 was first observed in 2008 and later in the westernmost SEPTS extraction wells south of Zone 12. Perchlorate has since been observed at concentrations exceeding 500 µg/L in two wells located south of the SEPTS wellfield indicating further expansion of the plume to the southeast.

The hydraulic gradient in the area between the southern parts of Zones 11 and 12 has shifted more eastward because of the influence of the SEPTS and the decline in perched water levels. This shift in the hydraulic gradient has allowed perchlorate to migrate east and southeast, with perchlorate moving into the SEPTS well field.

Portions of the perchlorate plume are being actively remediated by SEPTS at this time. In 2022, extraction wells with the highest perchlorate concentrations were tied into a new treatment process at SEPTS. However, the southern portion of the plume is beyond the SEPTS capture zone. Pantex has installed a new PCR ISB near the leading edge of the southeast perchlorate plume to limit further migration.

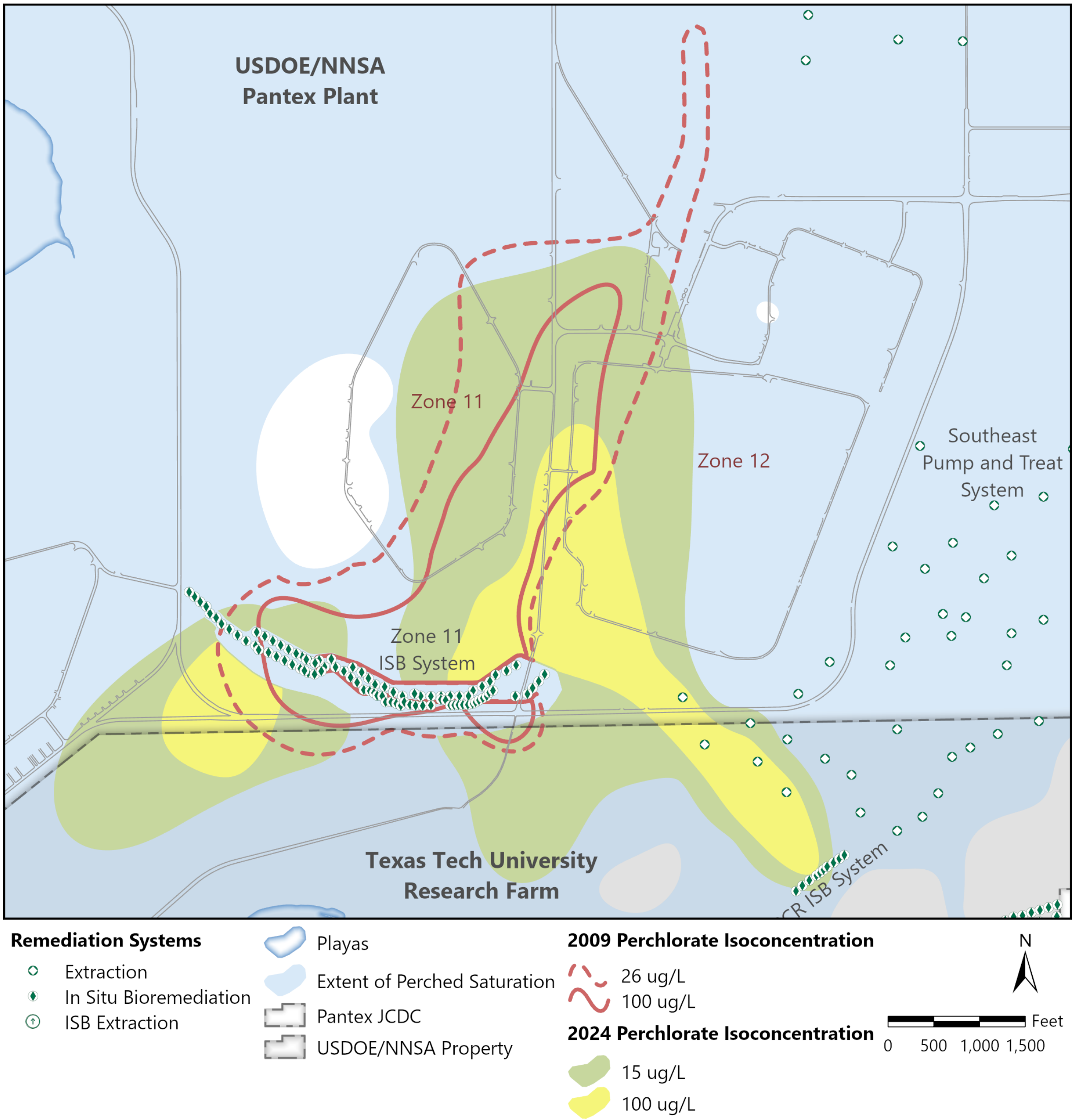

Fig. 3-29. Perchlorate plume movement, 2009-2024.

3.1.7.4 TCE Plumes

Several TCE plumes are present in the perched aquifer, as shown in Fig. 3-24, Fig. 3-25, and Fig. 3-26. TCE plumes in Zone 12 originate in the north (source area in WMG 10) and the east (source area in SWMU 122b) side of Zone 12 and extend to the southeast. Another TCE plume originates beneath Zone 11 and extends offsite to the south. TCE in the perched aquifer occurs from partitioning of TCE in soil gas into perched groundwater and TCE-contaminated process water associated with legacy discharges leaching into 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 stable trend in TCE.

The TCE plume underlying Zone 11 is associated with legacy HE operations that resulted in industrial wastewater infiltrating into the subsurface as well as TCE in soil gas originating from several areas within that zone. Concentrations in this plume are increasing at 1114-MW4 and PTX08-1006 beneath Zone 11; this indicates continuing migration of TCE in the perched groundwater from beneath Zone 11. This plume is migrating southward and observed concentrations at the TTU property boundary are increasing. As discussed in Section 3.2.3.1, this plume is being actively remediated by the Zone 11 ISB system.

As depicted in Fig. 3-30, the 2009 and 2024 TCE plume shapes are similar, with the following notable exceptions:

- The plume originating from Zone 12 has contracted and split into two plumes near the source areas; these combined downgradient in the SEPTS wellfield. The Zone 12 plume has shifted directions over time due to injection of treated water into injection wells near Zone 12. Data collected in the Southeast ISB System ISPM wells indicate the plume has been treated and the plume has contracted upgradient of the Southeast ISB.

- The plume originating from Zone 11 has shifted to the south and southwest due to the general gradient in the area. The Zone 11 TCE plume beneath Zone 11 continues to expand to the east as a result of the shifting flow gradients in perched groundwater.

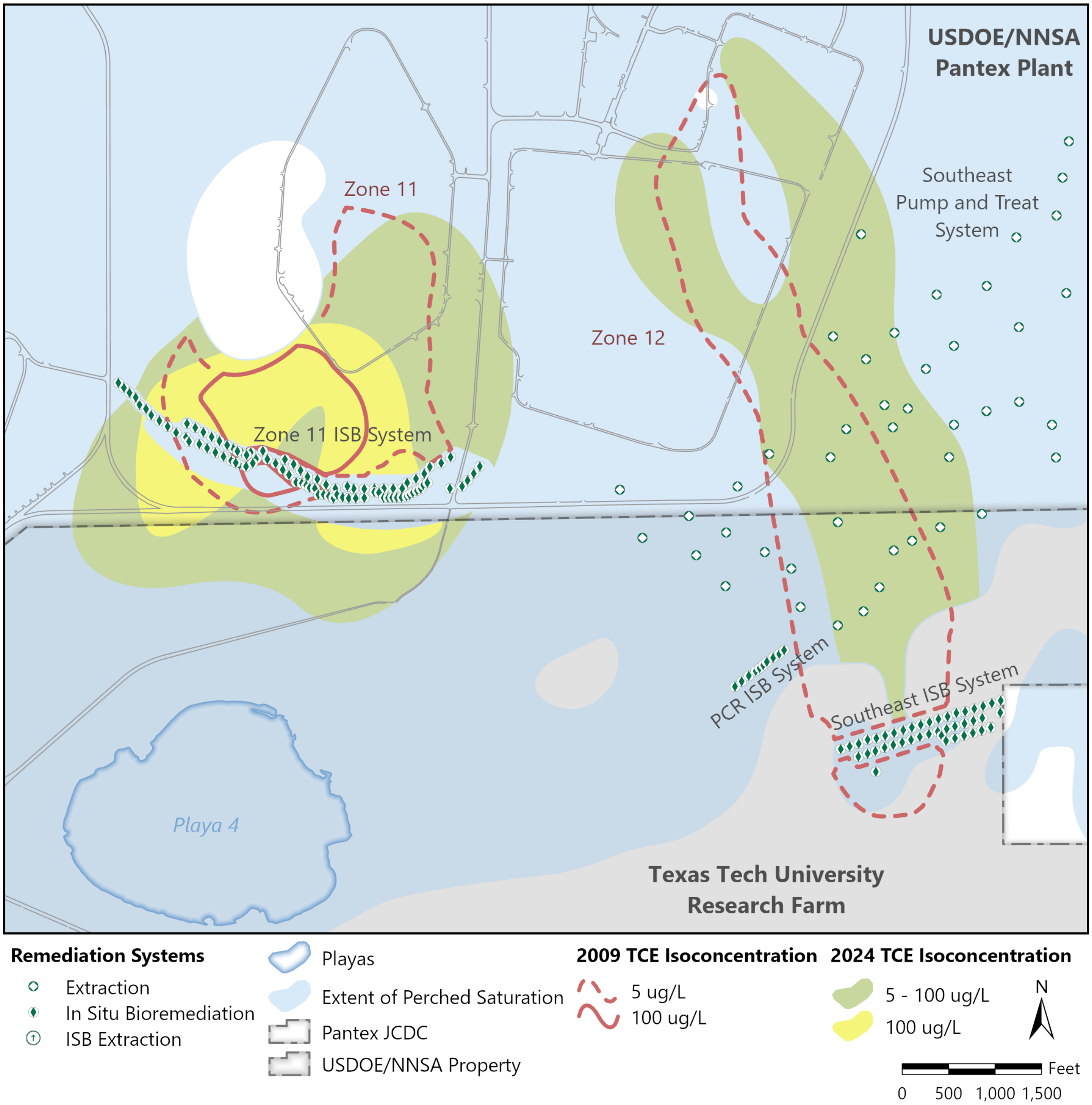

Fig. 3-30. TCE plume movement, 2009-2024.

3.2 Remedial Action Effectiveness

3.2.1 *Southeast Pump and Treat System*

The objective of the SEPTS (see Fig. 1-7) 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 and to achieve the following two important goals:

- A gradual reduction of the volume of perched groundwater and contamination moving downgradient toward the extent of saturation
- A reduction in the head (i.e., 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. Fig. 3-31 illustrates the influence of this pump and treat system and the P1PTS. Water levels measured at the 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 the formation of an extensive cone of depression throughout the system is limited by the thin saturated thickness in the perched aquifer.

The water table map indicates groundwater is still flowing southeastward across the USDOE/NNSA property boundary onto TTU property. However, extraction wells located on the TTU property limit the further migration of perched groundwater contaminants to the south. Water table contours along FM 2373 indicate groundwater is flowing primarily to the south 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 Hydrodynamic Control

By using extraction wells to alter the hydraulic gradient, hydrodynamic control limits the horizontal migration of contaminants. Because of the limited saturated thickness of the perched aquifer, complete hydraulic containment of the contaminant plume is not possible. However, the SEPTS has effectively altered 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. In addition, removing perched groundwater has caused the extent of perched saturation on TTU property to retreat significantly. Fig. 3-31 shows the approximate radius of influence of the groundwater treatment systems and the directions of perched groundwater flow gradients outside the radius of influence. Capture zones, shown in Fig. 3-31 for the extraction wells, were calculated using a single-layer groundwater flow model of the perched aquifer. Average 2024 extraction flow rates for each well were used in the calculations.

Operation of new wells east of FM 2373 that were tied into the system in March 2019 improved the capture of water to the east of FM 2373, but the ability to extract water from these wells has rapidly declined. They have been disconnected from SEPTS and will be converted to ISB injection wells.

The ability to operate the pump and treat systems is largely dependent on the availability of outlets for release of treated water. When possible, effluent is beneficially used for irrigation, general Plant needs, and/or for amendment injections at the ISB systems. Irrigation can occur through a subsurface drip irrigation system or a pivot irrigation alternative on the property east of FM 2373. In addition to release of water to all beneficial use outlets, SEPTS has the capability to inject the treated water back into the perched aquifer when beneficial use is not possible; injection can occur within the SEPTS wellfield or at injection wells near Playa 2. P1PTS can release water to the pivot irrigation system directly or to the WWTF storage lagoons, which can discharge to Playa 1 or a subsurface drip irrigation system. Operational priorities for the pump and treat systems emphasize beneficial use of water. In addition, operation of the SEPTS is prioritized over the P1PTS when water outlets are limited.

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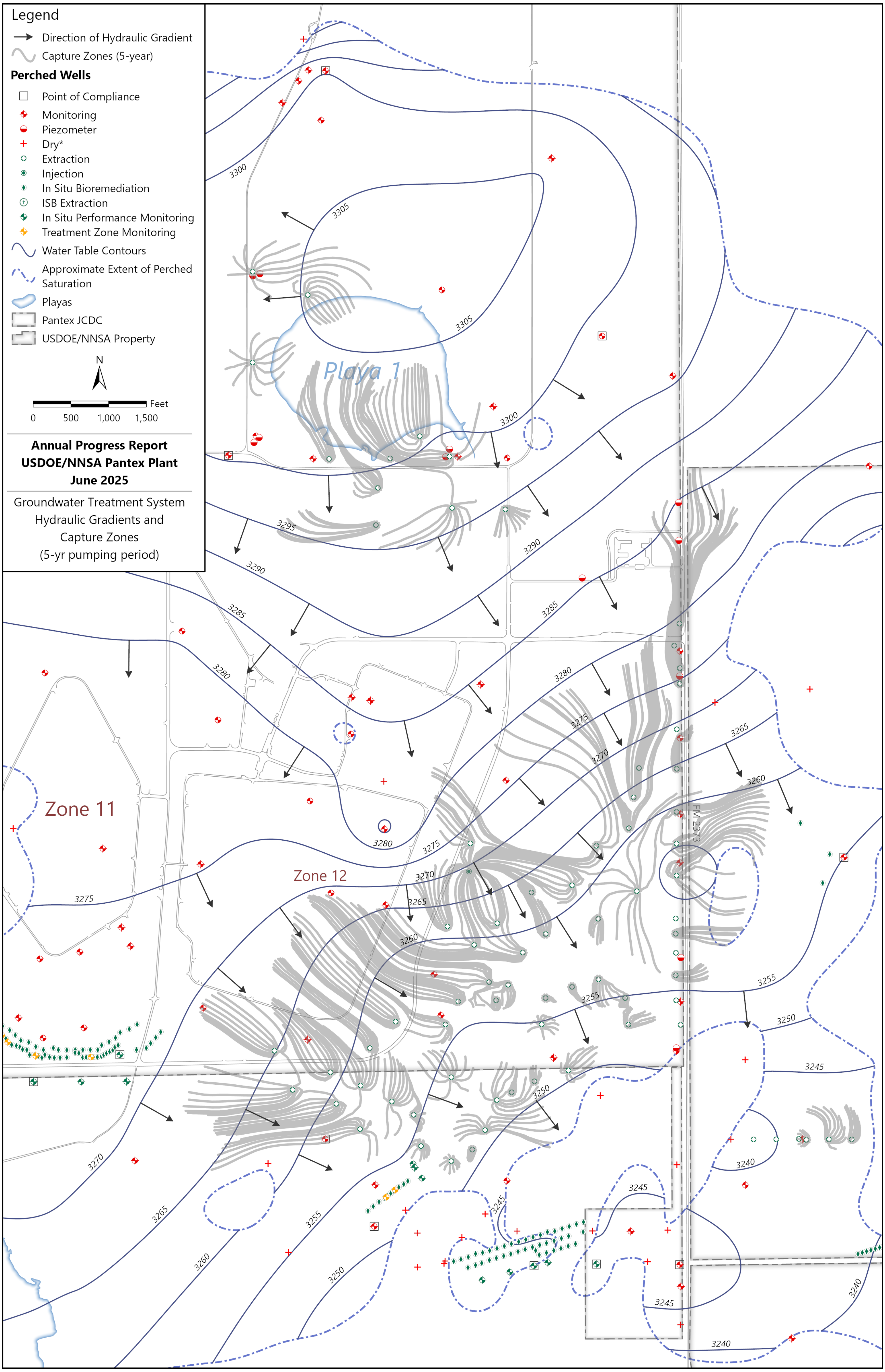

Fig. 3-31. Pump and Treat System capture zones.

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Operation of the pump and treat systems was affected in 2024 by ongoing construction of repairs at the WWTF which prevented use of the subsurface irrigation system; limited operation of the pivot irrigation system because of a break between the wet well and the pivots, freezing temperatures, and harvest operations; unexpected maintenance issues at both systems; scheduled granulated activated carbon exchanges; extraction well maintenance/repairs; and loss of the radio communication system at the Playa 2 injection wellfield. Because SEPTS operations were prioritized, SEPTS was operated at about 83% of design capacity, near the 90% throughput goal for the year (Section 2.1.1.3), and the SEPTS capture zone is not expected to be impacted by water disposal limitations.

3.2.1.2 System Effectiveness

Because 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 in Section 3.1 can be used to determine the effectiveness of these systems. Overall, when operating, the pump and treat systems continued to be effective in 2024. When comparing 2024 conditions to the LTM design's expected conditions, the majority of monitoring wells are meeting expected conditions in the fifteenth year of the remedial action. The LTM wells not meeting expected conditions for water levels are summarized in Section 3.1.4. The wells have primarily been impacted by the inability to send water to the onsite subsurface irrigation, requiring release of wastewater and treated perched water to Playa 1 and reduced operation of P1PTS, as well as an above-average yearly rainfall.

As a part of the secondary goal of contaminant mass removal for the SEPTS, the system continued to remove HEs, hexavalent chromium, and perchlorate and treated 126.1 Mgal of extracted water to concentrations below the PQL and the GWPS during 2024. The SEPTS consistently operated near throughput goals during 2024; however, P1PTS was shut down or operated minimally to allow SEPTS to operate continuously.

In 2023, Pantex started evaluating PFAS at the pump and treat systems. PFAS is present in the influent water treated by SEPTS and is also found in the extraction wellfield. The GAC used at the systems is effectively removing the PFAS to concentrations less than current TRRP PCLs or newly promulgated drinking water MCLs. One detected PFAS, 6:2FTSA, has no PCL or MCL available.

Pantex conducted a formal optimization analysis for the SEPTS and P1PTS using a fate and transport model of the perched aquifer. The results of the analysis were delivered to Pantex in September 2021 and will be used to develop an extraction strategy that maximizes mass removal and plume control while reducing saturation and guide the operation of the pump and treat systems in the future. It was determined through the optimization, the systems may only be feasibly operated for another 10-15 years, due to reduction in saturated thickness across the extraction wellfield.

3.2.2 Playa 1 Pump and Treat System

The P1PTS was completed in 2008 with operations starting in September 2008. This system extracts water from 11 wells near Playa 1 (see Fig. 1-6) 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 achieve mass removal and reduce the mound of perched groundwater associated with Playa 1, which affects the movement of the Southeast Plume by reducing the hydraulic head.

The P1PTS appears to be influencing local water levels, as well as the hydraulic gradient, in the Playa 1 area, when operating. Fig. 3-31 illustrates the influence of both groundwater pump and treat systems. Water levels measured at the extraction wells were not used in the interpretation of water table contours so that cones of depression would not be overestimated.

The water table map indicates the mound of groundwater beneath Playa 1 has been reduced since the groundwater high in the perched aquifer is now to the north; however, groundwater levels near the playa are increasing because of the limited volume of water extracted by the P1PTS and discharge of treated water to the playa because of limitations of beneficial reuse. Groundwater is still generally flowing away from the Playa 1 region then to the south and southeast across the USDOE/NNSA property boundary onto TTU property or the offsite property to the southeast. As the perched aquifer saturated thickness continues to be reduced in this region, this flow should decrease and reduce the driving head. In addition, the SEPTS extraction wells limit further migration of perched groundwater contaminants to the south.

The hydraulic gradient is 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 Effectiveness

As noted for the SEPTS, the pump and treat systems continue to be effective in 2024. When comparing 2024 conditions to the expected conditions detailed in the LTM design, most wells are meeting expected conditions.

During 2024, the system treated approximately 47.8 Mgal of extracted water. As discussed in Section 2.1.1, total flow at the P1PTS was affected by construction activities or limited to allow for higher recovery at the SEPTS because increased recovery at SEPTS provides better control of the RDX plume movement to the southeast.

Impacts from ongoing construction of repairs at the WWTF, limited operation of the pivot irrigation system because of a break at the wet well and freezing temperatures, and loss of the radio communication system at the Playa 2 injection wellfield were the primary reasons for reduced operations at the P1PTS. Evaluation of effluent data indicates P1PTS treated the recovered groundwater to concentrations below the PQL and GWPS.

PFAS is present at P1PTS, but the GAC used at the system is effectively removing the PFAS to concentrations less than the TCEQ TRRP PCLs and EPA MCLs. None of those PFAS constituents that were detected in the effluent had MCLs and detection limits were less than the TRRP PCLs. There is one PFAS constituent found in the effluent that does not currently have a promulgated standard, and no information can be found in literature. 6:2FTS has been detected in the effluent at concentrations ranging from 1.9 to 13 ng/L in 2024.

3.2.3 ISB Systems

Pantex has installed and operates five ISB systems: the Zone 11 ISB, Southeast ISB, Southeast ISB Extension, Offsite ISB, and the new PCR ISB. The objective of the ISB systems is to establish anaerobic biodegradation treatment zones capable of reducing COCs to the GWPS by injecting the necessary amendments and nutrients to stimulate resident bacteria. 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, geochemical conditions and amendment longevity become important. These indicators are used to determine if conditions are within an acceptable range for oxidation-reduction (i.e., redox) potential, electron acceptor concentrations (i.e., dissolved oxygen, nitrate, and sulfate), and nutrient supply (i.e., TOC). These parameters are important because reducing conditions and adequate nutrients must be present to treat COCs.

Because of problems with plugging of the wells, Pantex has moved to increasing soluble carbon during injection events and reducing the EVO, as recommended in the *2018 Annual Progress Report* (Pantex, 2019d). An amendment dose response study performed in 2018 found that the use of more soluble carbon source amendments, such as molasses, in combination with the use of larger volumes of water and amendment results in better distribution of amendment between the injection wells and produces deeper reducing conditions within the treatment zone.

Based on the dose response study, future operation of all ISBs is primarily focused on using a more soluble carbon (e.g., molasses) to achieve the distribution needed at the systems. Molasses was injected at the Zone 11 ISB in 2023 and 2024, at the Southeast ISB in 2023 (the last time this system was injected), and for the first injection at the new PCR ISB; molasses is used exclusively at the Southeast ISB Extension and the Offsite ISB. Pantex plans to use a combination of EVO and molasses at the PCR ISB and County Road 8 ISB. This measure is expected to help avoid issues with well plugging or stagnation by the EVO and resulting biomass. Pantex moved to closer spacing of newly installed wells at the Zone 11 ISB in 2021 and then injected the new wells with a molasses and EVO mixture, allowing less frequent injections of EVO while maintaining a proper radius of influence for treatment. Other areas may use this approach when feasible. Pantex will continue to evaluate available data and make appropriate recommendations for treatment in future progress reports. Geochemical conditions can be evaluated to determine if adequate reducing conditions exist to achieve reduction. Fig. 3-32 presents the redox ranges for the 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 most widespread and have the potential to affect human health if the water were to be used for residential purposes (note that 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.

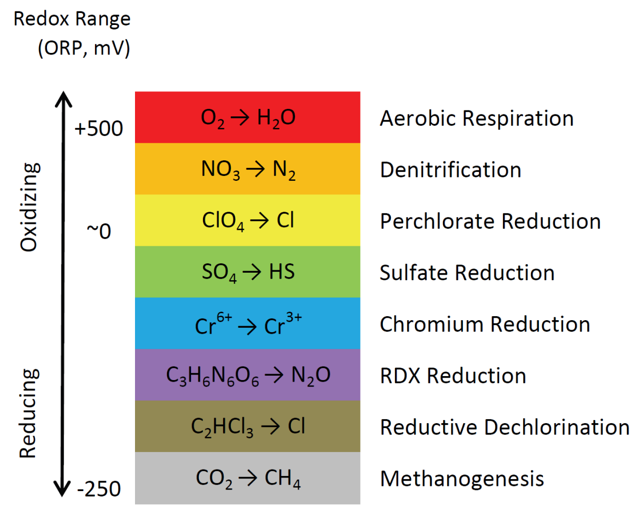


Fig. 3-32. Typical Geochemical Redox Ranges

In addition to specific indicators that help determine if additional injections are required, Pantex monitors for TOC, metals, and general chemistry parameters. TOC was selected as an indicator for adequate carbon sources that have remained available for continued ISB treatment. Specific metals are monitored in downstream ISPM 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 naturally occurring metals in the formation soils. However, as water moves away from reducing conditions, the metals are expected to precipitate onto 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 (see Fig. 1-8) has a well-established treatment zone in the original portion of the system where injection has occurred since 2009. Portions of the expansion area have received more than three injections, so deeper reducing conditions are likely established at the injection wells. In 2021, a second row of wells was added across the southeastern side of the system and was injected with a mixture of molasses and EVO. More frequent injections are anticipated for molasses and are planned at least annually for the Zone 11 ISB due to the need to continue reducing conditions. Pantex will continue to evaluate the system to ensure appropriate timing of injections using molasses and a mixture of molasses/EVO.

COCs targeted for treatment by this system are perchlorate and TCE. Indicator constituents evaluated for trends at downgradient ISPM wells include TCE and its degradation products (i.e., cis-1,2-DCE and vinyl chloride) along with perchlorate. Indicator constituent concentrations are expected to decline at the downgradient monitoring wells at their estimated travel times from the treatment zones, which are discussed later in this section.

Dissolved oxygen, redox potential, nitrate, sulfate, and TOC are evaluated in the ISB treatment zone performance wells to determine if the treatment zone is rebounding to baseline conditions, thus requiring amendment injection. Redox potential and electron acceptor (i.e., dissolved oxygen, nitrate, and sulfate) concentrations in the treatment zone wells are expected to decline after injection. As shown in Fig. 3-32, strongly reducing conditions must be achieved for the reductive dechlorination of TCE to occur. The redox potential should decline from the baseline and be below –50 millivolts (mV) to reduce TCE and near 0 mV to reduce perchlorate. Concentrations of TOC should increase after injection but decline over time as the amendment is consumed.

During 2024, Pantex monitored eight TZM wells, two injection wells, and nine downgradient ISPM wells in accordance with the SAP to evaluate the Zone 11 ISB (see Section 1.4.2 map). The ISPM wells are used to monitor characteristics indicative of overall performance of the remedial system.

Table 3-2 summarizes the current and maximum COC concentrations in each ISB, TZM, and ISPM well. One of the monitored treatment zone wells (PTX06-1230) was installed in 2012 as a replacement of the damaged original ISB injection well PTX06-ISB075 and was renamed in 2023 to avoid confusion. Although damaged, the original PTX06-ISB075 well continues to receive amendment and will be used until the well fails.

The Zone 11 ISB has a well-established treatment zone in the original portion of the system, as well as in the northwest expansion area; therefore, deeper reducing conditions are likely established at those injection wells. Improved conditions have been noted across the western side of the Zone 11 ISB after moving to the use of molasses in recent years. However, some wells have limited ability to accept injection, and those areas will likely continue to demonstrate milder reducing conditions until the wells can be replaced. All ISPM wells downgradient of the system have indicated the arrival of treated water.

Evaluation of data in the treatment zone indicates very mild to strong reducing conditions, with the oxidation-reduction potential (ORP) ranging from -122 to 69 mV and sulfate from 0.3 to 58 mg/L across the Zone 11 ISB. At this time, sulfate is not used as an indicator of reducing conditions, due to potential addition of high level of sulfates in the treatment zone from molasses used during injections. Monitored conditions inside the treatment zone indicate negative ORP was observed in all treatment zone wells, indicating deeper reducing conditions in most areas. Additionally, arsenic, barium, and methane remain high in most treatment zone wells indicating that deeper reducing conditions exist across most of the ISB.

In 2024, perchlorate was not detected at any monitored injection well or treatment zone monitoring well. TCE continues to be reduced to *cis*-1,2-DCE, with TCE concentrations below the GWPS in seven of the 12 monitored wells inside of the treatment zone and *cis*-1,2-DCE present at concentrations below the GWPS in all but one of the sampled wells.

When greater amounts of TCE and *cis*-1,2-DCE are being degraded, ethene and vinyl chloride are expected to be detected. Vinyl chloride was detected in eight of the 12 sampled wells inside the treatment zone, and ethene was detected at low concentrations in two wells. The low vinyl chloride results, coupled with the detection of ethene, indicate that a portion of the TCE is being completely degraded in most areas of the treatment zone. When TCE concentrations inside the treatment zone are low (i.e., <300 µg/L), these low degradation rates are enough to treat TCE and its breakdown products to the GWPS, as indicated by downgradient monitoring well data. Upgradient data still indicate TCE concentrations periodically fluctuating up to almost 500 µg/L, with a maximum concentration of 495 µg/L indicated at an upgradient monitoring well in 2024.

Pantex evaluates performance at nine downgradient ISPM wells for the Zone 11 ISB. Perchlorate was detected above the GWPS in two downgradient ISPM wells in 2024 but was not detected or was below the GWPS in the other seven wells. TCE concentrations are below the GWPS in five of nine ISPM wells.

At the end of 2024, TCE was detected at or above the GWPS in four downgradient ISPM wells, PTX06-1148, PTX06-1149, PTX06-1150, and PTX06-1156. The first breakdown product of TCE, *cis*-1,2-DCE, was not detected above the GWPS in any downgradient ISPM well in 2024, although *cis*-1,2-DCE was detected in all downgradient wells and was above the GWPS at LTM well PTX06-1159 (Appendix F).

In 2024, perchlorate was detected at or above the GWPS in two downgradient ISPM wells, PTX06-1148 and PTX06-1149, but only in one of the two samples collected at each well. Perchlorate was below the GWPS or not detected in the other sample. PTX06-1148 and PTX06-1149 had demonstrated complete treatment of perchlorate until early in 2020 when perchlorate was detected above the GWPS. These exceedances may indicate problems with injection in the upgradient ISB wells. Pantex added an additional row of injection wells upgradient of the eastern located wells to ensure the treatment of TCE, as well as perchlorate. The two TZM wells, PTX06-1209 and PTX06-1210, installed in the second row of wells indicate overall increased treatment of all COCs across the second row, but downgradient wells will not see impacts of increased treatment for another 3 – 5 years. The results for upgradient wells PTX06-1127 and PTX06-1211 indicate that TCE is increasing above the GWPS on the eastern side of the ISB.

In previous years, the downgradient well PTX06-1175 was not demonstrating strong treatment of RDX and TCE. PTX06-1175 is downgradient of the expansion area on the northwest side of the system and downgradient of a single row of injection wells. Because of its distance downgradient of the injection wells and expected time of travel, this well was not expected to show strong treatment for several years. However, overall decreasing concentrations of RDX and TCE, coupled with increase of *cis*-1,2-DCE, indicates that treated water is now reaching this well.

Metals concentrations have been increasing in all downgradient ISPM wells since the start of remedial actions and some are exceeding GWPS. For example, arsenic concentrations in PTX06-1012, PTX06-1149, PTX06-1155, PTX06-1156, PTX06-1173, and PTX06-1174 and barium concentrations in PTX06-1012 and PTX06-1156 exceeded the GWPS in 2024. 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.

Table 3-2. Summary of 2024 Zone 11 ISB Monitoring Well Data for Perchlorate and TCE

Well ID	Perchlorate			TCE		
	Max[a]	1S	2S	Max[a]	1S	2S
In-Situ Bioremediation Wells						
PTX06-ISB055	3000	<50	--	16	<25	--
PTX06-ISB059	970	<50	--	<25	<25	--
PTX06-ISB064	<100	<50	<10	<250	<2.5	<12.5
PTX06-ISB137	2.2	<50	<10	12.2	<2.5	<12.5
In-Situ Treatment Zone Monitoring Wells						
PTX06-1164	130	<1	<5	180	33J	2.1
PTX06-1169	<12	<1	<5	45	45J	38J-
PTX06-1170	<120	<1	<5	500	0.45J	0.97J-
PTX06-1176	240	<1	<5	220J	<2.5UJ	<2.5
PTX06-1177	210	<1	<5	130	1.3J	8.7
PTX06-1209	52J	<1	<1UJ	329	38J	38J-
PTX06-1210	<20UJ	<1	<20UJ	230	2.4J	<2.5UJ
PTX06-1230[b]	97	<1	<5	440	0.83J	0.37J-
In-Situ Performance Monitoring Wells						
PTX06-1012	341	0.2	<1UJ	580	2.7	0.33
PTX06-1148	1290	19	0.23J-	129	129	67
PTX06-1149	1290	<1	33	319	319	159
PTX06-1150	235	0.27	0.21NJ	146	146	107
PTX06-1155	487	<1	<1UJ	660	0.47	<2.5
PTX06-1156	2140	<1	<1UJ	43.3J	<2.5	5.8
PTX06-1173	16J	<5	<5	140J	0.49	<2.5
PTX06-1174	170J	<5	<5	160J	<2.5	1.6
PTX06-1175	340J	<5	<5	150	0.86	3.0

Concentrations provided in µg/L. 1S and 2S denote first and second semiannual sampling events.
Highlighted cells indicate concentrations less than or equal to the GWPS. GWPS: Perchlorate = 15 µg/L and TCE = 5 µg/L.
When COC was not detected, a "<" 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 on which it was collected.
[b]Due to well damage, PTX06-ISB075 was replaced in September 2012. In 2023, the well that was previously named PTX06-ISB075_1 was renamed to PTX06-1230. The replacement well (now PTX06-1230) has been sampled in place of PTX06-ISB075 since 2013.
J Analyte was detected below the PQL but above the MDL.
J- The associated numerical value is an estimated quantity with a suspected negative bias.
NJ Analyte was tentatively identified.
UJ The material was analyzed for but was not detected. The sample quantitation limit is an estimated quantity.

3.2.3.2 Southeast ISB

The Southeast ISB system is on TTU property south of Pantex (see Fig. 1-9). Constituents targeted for treatment by this system are RDX, other HE COCs (e.g., dinitrotoluenes and

1,3,5-trinitrobenzene), and hexavalent chromium. Indicator constituents evaluated for trends at downgradient performance monitoring wells include RDX and its degradation products (i.e., DNX, MNX, and TNX) and total and hexavalent chromium. Concentrations of indicator constituents in the performance monitoring wells are expected to decline over time, and all degradation products of RDX are anticipated to be non-detect or present in only low concentrations, thus indicating complete breakdown is occurring. Dissolved oxygen, redox potential, nitrate, sulfate, and TOC are also evaluated at the ISB treatment zone performance wells.

Redox potential and electron acceptor (i.e., dissolved oxygen, nitrate, and sulfate) concentrations in the treatment zone wells are expected to decline after injection. Redox potential should be less than 0 mV for the reduction of RDX and hexavalent chromium.

As provided in the SAP, six treatment zone wells and four downgradient performance monitoring wells are used to evaluate the Southeast ISB. One ISPM well (PTX06-1123) for the Southeast ISB has gone dry and has not been sampled since 2015. PTX06-1045, a point of compliance well, was dry from 2011 until the fourth quarter of 2018 when water was reported in the well. Water levels were sufficient to collect samples in the third quarter of 2024. However, PTX06-1045 is the furthest downgradient ISPM well and may have little to no hydraulic connection to the Southeast ISB treatment zone. Discussion of data for this well is not included for this reason. Limited sampling has occurred at PTX06-1037 since November 2017 because of declining water levels; this well had sufficient water to allow sampling in 2024. Three of the six treatment zone wells were sampled in 2024. PTX06-ISB030B, PTX06-ISB038, and PTX06-ISB048 were unable to be sampled because of insufficient water or dry conditions. As SEPTS operates consistently, saturated thickness is expected to decrease in the Southeast ISB and more wells will be unable to be sampled due to insufficient water.

Table 3-3 summarizes the current and maximum COC concentrations in each ISB and ISPM well. Graphs of the amendment indicators and COCs for the sampled ISB injection wells, as well as concentrations for target indicators at the performance monitoring wells for this system, are included in Appendix E. The conditions in the treatment zone and performance monitoring wells are discussed below.

Evaluation of treatment zone data indicates that during 2024 mild to deep reducing conditions were present for the treatment of HEs and hexavalent chromium. The ORP was between –122 and -39 mV at the treatment zone wells sampled in 2024. TOC results indicated that a continued food source was available to maintain reducing conditions. RDX was not detected at the treatment zone wells sampled in 2024; MNX, DNX, and TNX also were not detected in the sampled treatment zone wells.

The Southeast ISB system has effectively treated HEs and hexavalent chromium at two of the closest downgradient ISPM wells, PTX06-1037 and PTX06-1154. RDX and hexavalent chromium concentrations in these wells are non-detect. These wells indicate that the reducing zone has extended beyond the treatment zone because nitrate and sulfate concentrations have been reduced and organic carbon is present. The ORP was negative at both ISPM wells in the second quarter samples but had increased in the third quarter samples, possibly indicating a reduction in treatment effectiveness since the last injection in 2022. This system is planned for injection in 2025.

Table 3-3. Summary of 2024 Southeast ISB Monitoring Well Data for RDX and Hexavalent Chromium

Well ID	Hexavalent Chromium or Total Chromium			RDX		
	Max[a]	1S	2S	Max[a]	1S	2S
In-Situ Bioremediation Wells						
PTX06-ISB021*[b]	287	--	--	3570	--	--
PTX06-ISB030B*	33.4	4.7	12	2.7	R	<1.0UJ
PTX06-ISB038*	45	26	24	421	R	<1.0UJ
PTX06-ISB042*[b]	667	--	--	2920	--	--
PTX06-ISB046*	160	13	3.1	4350	R	<1.0UJ
PTX06-ISB048*[b]	--	--	--	0.82	--	--
In-Situ Performance Monitoring Wells						
PTX06-1037	109	<0.02	<0.02	2800	<0.10	<0.10
PTX06-1123[b]	10	--	--	4300	--	--
PTX06-1153	159	3.2	2.4	838	193	183
PTX06-1154	29.2	<0.02	<0.02	630	<0.10	<0.10

Concentrations provided in µg/L. 1S and 2S denote first and second semiannual sampling events.
Highlighted cells indicate non-detect or concentrations less than the GWPS. GWPS: Cr(VI) = 100 µg/L and RDX = 2 µg/L.
* – Hexavalent chromium was not evaluated in the ISB treatment zone due to interference from the amendment. In lieu of hexavalent chromium, total chromium data is presented for these wells.
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] This well was dry or had limited water and could not be sampled in 2024.
Data from ISPM Well PTX06-1045 is 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.
R The data is unusable (compound may or may not be present).
UJ The material was analyzed for but was not detected. The sample quantitation limit is an estimated quantity.

Although PTX06-1153 continues to exhibit RDX concentrations above the GWPS, a steep decline in RDX has occurred since the peak observed in August 2019. Hexavalent chromium concentrations continue to demonstrate a decreasing trend and have remained below the GWPS since 2016. Pantex is continuing to investigate the cause of the unexpected results in PTX06-1153. The conditions could be due to any number of hydrologic issues and proving (or disproving) them may be difficult, though it is possible that this well is not hydraulically connected to the Southeast ISB. Several confounding issues complicate the investigation efforts in the area, including significant heterogeneity in the FGZ, potential changes in formation properties due to biologic growth or other injection effects, and the potential reduction of saturated thickness upgradient due to the pump and treat operations.

Pantex injected this system with molasses during the 2019 injection to attempt better distribution of amendment. Additionally, to affect treatment at PTX06-1153, Pantex extracted water from the well at a flow rate of approximately 1.25 gpm for two weeks during the fourth quarter of 2019. During 2020, PTX06-1153 demonstrated signs of partial treatment with the sharp decline in RDX, and breakdown products of RDX were detected at concentrations above the GWPS. In 2024, RDX concentrations decreased between sampling events and the continued presence of breakdown products suggests partial treatment.

Metals concentrations have increased in all downgradient performance monitoring wells, with some exceeding the GWPS. Arsenic and barium concentrations exceeded the GWPS in PTX06-1037 and PTX06-1154 during 2024. TOC data suggest the treatment zone has expanded into these wells, and the reduced conditions continue to mobilize 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 or not complete breakdown is occurring. Monitoring results for the system indicate that RDX and breakdown products (i.e., MNX, DNX, and TNX) are not present in downgradient performance monitoring wells. 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). Both RDX and TNX have been reduced to concentrations below the GWPS at PTX06-1037 and PTX06-1154 since 2011 and 2015, respectively, indicating complete breakdown of RDX. Neither RDX nor TNX were detected at either well in 2024. These results indicate that near-complete treatment of RDX is occurring in all wells except PTX06-1153, as discussed previously.

3.2.3.3 Southeast ISB Extension

The Southeast ISB Extension was installed in 2017 as an extension of the chosen remedy for the southeast perched groundwater. Four additional wells were installed in late 2020 and an additional two in 2021 along the eastern property line in a north-south alignment to further encompass the plume. These new wells were injected for the first time in April 2021, with the exception of PTX06-ISB331, which was injected in August 2022. Two TZM wells were also installed in late 2021. Overall, eight injection events have been completed at this system, with the most recent injection finishing in August 2024. Due to the success with distribution of a more soluble carbon (molasses), Pantex began injection at the Southeast ISB Extension using only molasses, as recommended in the *Fourth Quarter 2018 Progress Report* (Pantex, 2019e). Pantex plans to continue injection at this system using only molasses to improve distribution and treatment. Because this system has not been treated with EVO, injections have been scheduled approximately every twelve months.

Table 3-4 summarizes the current and maximum COC concentrations in each ISB and ISPM well. As part of the SAP, four ISB wells, two TZM wells, and two downgradient ISPM wells were sampled for 2024. Treatment zone data indicates very strong to mild reducing conditions are present for treatment of HEs. ORP was negative in 2024, and nitrate was reduced in all sampled wells. Soluble metals (arsenic and manganese) have increased, indicating that reducing conditions are established. Total organic carbon results indicate that a sufficient food source is available to maintain reducing conditions at the wells.

Downgradient wells demonstrated treatment of HEs in 2024. TOC has increased in downgradient wells since beginning of sampling in 2018. Monitoring results for the system indicate that RDX concentrations have decreased in these wells, while DNT4A and RDX breakdown products were largely not detected in 2024 indicating complete treatment. Soluble metals (i.e., arsenic and manganese) are starting to increase.

Table 3-4. Summary of 2024 Southeast ISB Extension Monitoring Well Data for RDX

Well ID	RDX Max[a]	RDX 1S	RDX 2S
In-Situ Bioremediation Wells			
PTX06-ISB305	2.84J	<1.8UJ	<0.99UJ
PTX06-ISB312	718	<0.11UJ	<0.99
PTX06-ISB325	21.8	<1.0UJ	<1.0
PTX06-ISB331	7.4J+	<0.48UJ	<1.0
In-Situ Treatment Zone Monitoring Wells			
PTX06-1213	1.25	<0.10UJ	<0.10UJ
PTX06-1214	0.26	<0.10UJ	<0.10UJ
In-Situ Performance Monitoring Wells			
PTX06-1194	0.15	<0.10	0.032
PTX06-1196	33.5	2.6	1.1

Concentrations provided in µg/L. 1S and 2S denote first and second semiannual sampling events.
Highlighted cells indicate non-detect or concentrations less than the GWPS. RDX GWPS = 2 µg/L.
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 on which it was collected.
J Analyte was detected below the PQL but above the MDL.
J+ The associated numerical value is an estimated quantity with a suspected positive bias.
UJ The material was analyzed for but was not detected. The sample quantitation limit is an estimated quantity.

3.2.3.4 Offsite ISB

The installation of the first phase of wells for the Offsite ISB system was completed in 2020. The first phase of the installation focused on treatment at the leading edge of the plume. Infrastructure to support an injection event was completed in June 2021, with first injection of molasses completed in October 2021 at the leading edge of the plume. Three new ISB wells were installed on the neighboring property in late 2021 and were injected in 2022. The system was further expanded in 2022 with nineteen new ISB wells, which were injected for the first time in 2023. The last phase of wells was installed in summer 2023; these wells were injected in spring 2024. Based on the use of molasses, injections are planned every six months at differing parts of the system. Injection plans will follow the schedule that was designed using fate and transport and optimization modeling.

All water used in the injection process must be withdrawn from beneath the offsite property, so downgradient ISB extraction wells were installed. These wells were installed downgradient of the injection wells and assist in pulling the amendment towards the removal wells, providing an expanded zone for COC treatment.

Table 3-5 summarizes the current and maximum COC concentrations in each ISB and ISPM well. Eight ISB extraction wells (labeled REC wells due to the recirculation they provide) and eight TZM wells were sampled in 2024. Evaluation of the baseline data from 2022 at these wells indicated ORP ranging from 19 to 281 mV. As of the end of 2024, reducing conditions improved and ORP ranged from -103 mV to 189 mV. Concentrations of HEs remain low in the REC wells at the leading edge of the plume. Total organic carbon was also present at a higher concentration in all eight REC wells. Treatment zone data for the new TZM wells indicates the treatment zone is being established, but portions of the plume are not expected to fully establish treatment until 2025 or later. Concentrations at the downgradient ISPM well PTX06-1215 indicate that all high explosives remain below the GWPS indicating that the system is arresting downgradient movement of the plume.

Table 3-5. Summary of 2024 Offsite ISB Monitoring Well Data for RDX

	RDX		
Well ID	Max[a]	1S	2S
In-Situ Bioremediation Recirculation Wells			
PTX06-REC402	1.3	0.46J	0.17
PTX06-REC403	10.9	2.2J	1.0
PTX06-REC404	12.5	1.6	--
PTX06-REC412	34J+	31	--
PTX06-REC416	224	224	--
PTX06-REC420	23	23	--
PTX06-REC423	0.84	0.52J+	0.84
PTX06-REC427	0.47	0.47	--
In-Situ Treatment Zone Monitoring Wells			
PTX06-1197	279	0.11	<0.10UJ
PTX06-1201	72	72	61
PTX06-1203	318	0.12	<0.10UJ
PTX06-1217	39	33	39
PTX06-1218	14.9	0.12	<0.10UJ
PTX06-1219	443	<0.10UJ	<0.11UJ
PTX06-1220	0.89	8.9	7.8
PTX06-1221	4.7J+	4.4J+	4.7J+
In-Situ Performance Monitoring Wells			
PTX06-1215	0.78	0.40	0.78

Concentrations provided in µg/L. 1S and 2S denote first and second semiannual sampling events.
Highlighted cells indicate non-detect or concentrations less than the GWPS. RDX GWPS = 2 µg/L.
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 on which it was collected.
J Analyte was detected below the PQL, but above the MDL.
J+ The associated numerical value is an estimated quantity with a suspected positive bias.
UJ The material was analyzed for but was not detected. The sample quantitation limit is an estimated quantity.

3.2.3.5 PCR ISB

Pantex fully injected the new PCR ISB system during fourth quarter 2024, but that system has not yet been fully sampled. Sampling for that system will be completed during 2025.

3.3 Natural Attenuation

Natural attenuation is the result of processes that naturally lower concentrations of contaminants over time. Pantex monitors this process to help determine where and under what conditions natural attenuation is occurring and to possibly identify 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.

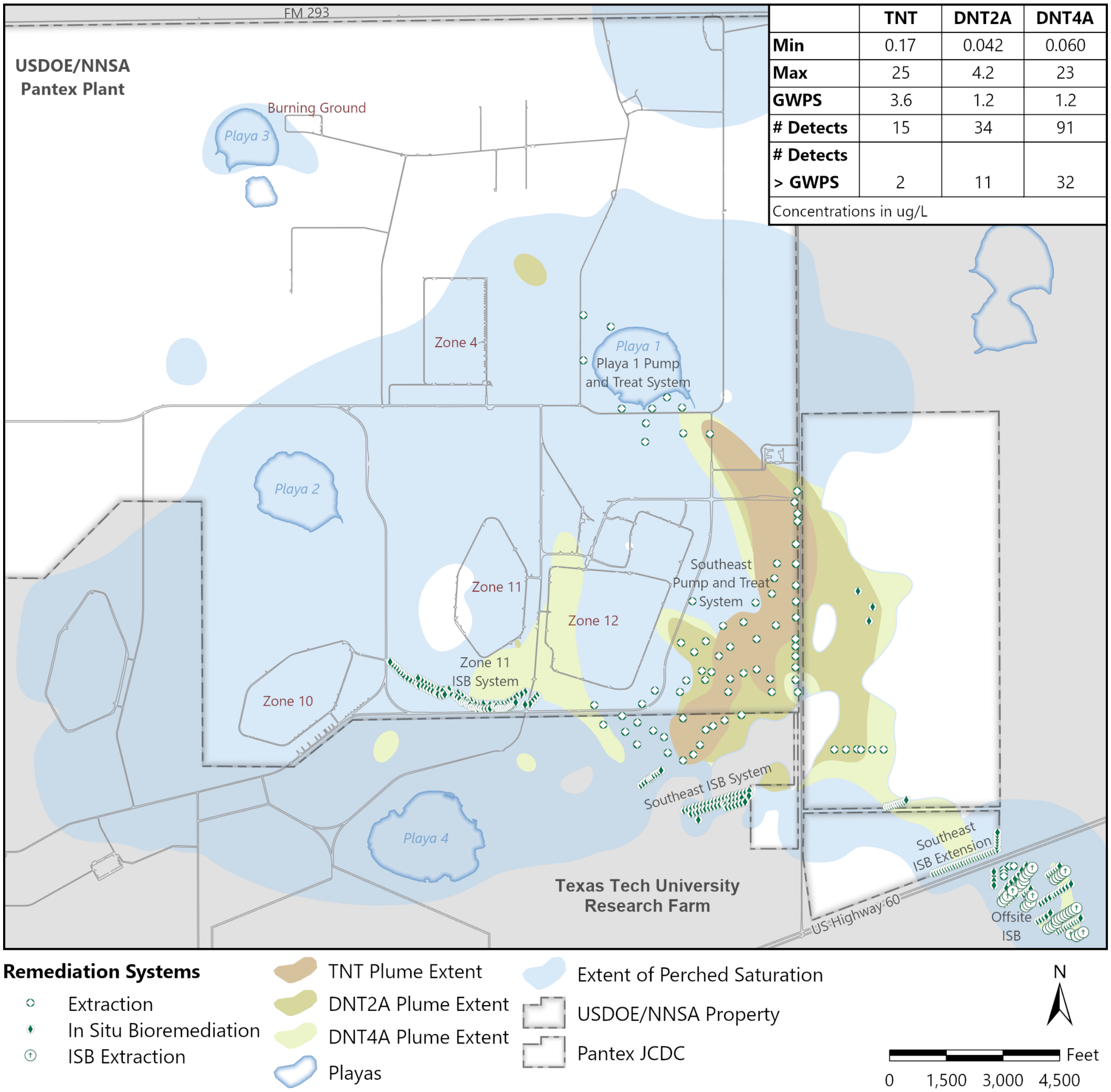
> ***Natural Attenuation Processes***
>
> - Biodegradation: Soil microbes cause the contaminants to break down into less harmful products.
> - Sorption: Contaminants are bound to soil particles so that movement through groundwater is stopped or slowed, allowing time for other processes to work.
> - Dispersion: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

Because the right microbes for biodegradation are present in the perched sediments, Pantex is also interested in monitoring for breakdown products of RDX. In July 2009, Pantex started monitoring for degradation products of RDX in all monitoring wells after testing analytical methods to ensure they can reliably detect and quantify those products. Since analytical methods are readily available, Pantex has monitored degradation products of TNT and TCE in the past and continues to monitor them in key areas.

Other groundwater conditions that may affect 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 the best reduction under anaerobic conditions. As more data are collected, trending and statistical analyses 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, DNT2A and DNT4A, TNT has naturally attenuated over time (see Fig. 3-33). TNT has been manufactured at Pantex since the 1950s and yet is only present in the central portion of the overall southeastern plume, within the SEPTS well field and near Playa 1. The first TNT breakdown product, DNT2A, occurs near the TNT plume and extends slightly beyond.



	TNT	DNT2A	DNT4A
Min	0.17	0.042	0.060
Max	25	4.2	23
GWPS	3.6	1.2	1.2
# Detects	15	34	91
# Detects > GWPS	2	11	32

Concentrations in ug/L

Fig. 3-33. TNT and degradation product plumes.

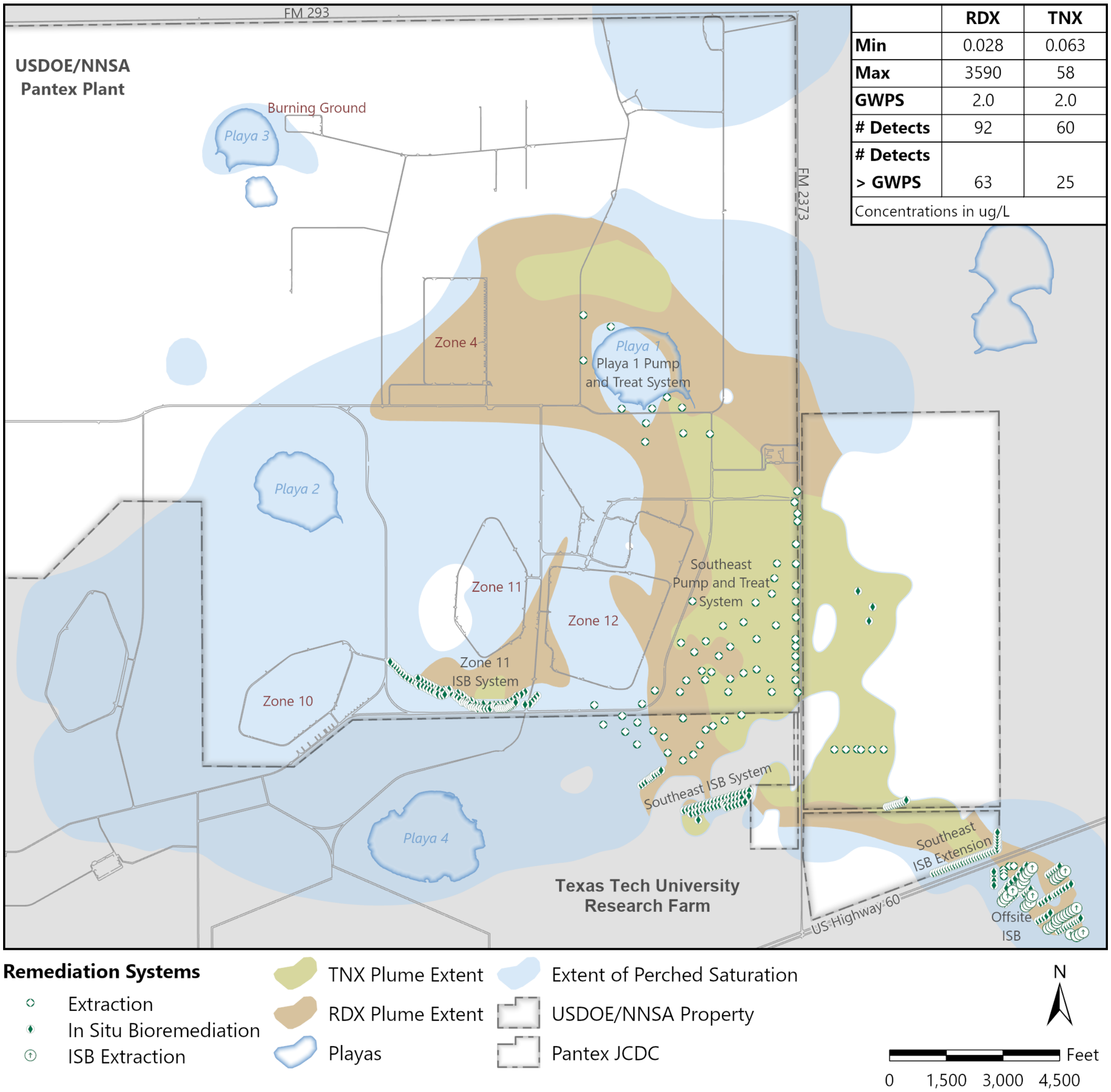
The final monitored breakdown product, DNT4A, extends out to the edges of the perched aquifer saturation at low concentrations. Only TNT breakdown products are present in perched groundwater beneath Zone 11 and north of Playa 1. Concentrations of the breakdown products are still above the GWPS, but most wells with detections have recently shown decreasing or stable trends. A table of natural concentration ranges for wells outside the influence of the ISB systems is included in Fig. 3-32.

Perched aquifer sampling results for RDX and breakdown products (i.e., MNX, DNX, and TNX) indicate that the breakdown products are present throughout most of the RDX plume, with TNX, the final degradation product, being the most widespread. If complete biodegradation of RDX were occurring, RDX and all breakdown products would be expected to decrease over time. Fig. 3-34 depicts the overall RDX and TNX plume as well as a table of concentration ranges for wells outside the influence of the ISB systems.

A Strategic Environmental Research and Development Program (SERDP) study (2014) provided evidence that aerobic degradation is occurring in the Pantex RDX plume but was unable to quantify the rates of attenuation. This study provided new methods for evaluating RDX degradation including carbon and nitrogen fractionation (Compound Specific Isotope Analysis) approaches. These approaches, along with the ability to quantify 4-nitro-2,4-diazabutanal (NDAB), an aerobic degradation product, allow Pantex to better evaluate the degradation of RDX.

Pantex subsequently contracted with the SERDP study leading researcher, Dr. Mark Fuller with APTIM Corporation, for a project to evaluate lines of evidence for the natural attenuation of RDX at the plant (Fuller, 2018). The study included both aerobic and anaerobic degradation with evidence of both occurring. The predominant attenuation process is aerobic biodegradation by bacterial strains. Biodegradation rates of 0.016 to 0.168 per year were calculated, translating into RDX half-lives of approximately 5 to 50 years.

The project found that the rates of RDX biodegradation are likely limited by the available labile organic carbon in the groundwater. The project went on to identify several lines of evidence for natural attenuation of RDX as well as the potential to enhance aerobic biodegradation of RDX by introducing low levels of labile organic carbon. Recommendations were presented for additional treatability studies, bioaugmentation, and additional proteomics analyses of degrading bacterial strains.



	RDX	TNX
Min	0.028	0.063
Max	3590	58
GWPS	2.0	2.0
# Detects	92	60
# Detects > GWPS	63	25
Concentrations in ug/L		

Fig. 3-34. RDX and degradation product plumes.

Pantex has monitored breakdown products of TCE for many years, and a strong indication of natural attenuation of TCE has not been observed in the perched aquifer. Quantitative polymerase chain reaction (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 ISB treatment zones.

3.4 Uncertainty Management/Early Detection

The uncertainty management wells in perched and Ogallala groundwater have the following purposes:

- To confirm expected conditions identified in the RCRA facility investigations and ensure there are not any deviations
- Fill in potential data gaps
- Fulfill long-term monitoring requirements for soil units evaluated in a baseline risk assessment.

Meanwhile, the purpose of early detection wells is to monitor for the breakthrough of constituents to the Ogallala Aquifer from the overlying perched aquifer or from potential source areas in the unsaturated zone before potential points of exposure are impacted. These wells were proposed in the LTM design to evaluate the effectiveness of the soil and groundwater remedial actions. Additionally, the perched aquifer data were evaluated with respect to field observations. In 2024, no evidence of NAPL was observed in the sampled perched aquifer wells.

This report focuses on subsets of the uncertainty management/early detection wells, as depicted in Fig. 3-35. The wells are evaluated with respect to the following groups:

- Group 1: 34 locations (designated by boxes in Fig. 3-35) where contamination has not been detected or confirmed, or previous plume locations where concentrations have fallen below the GWPS, background, or PQL (e.g., Burning Ground and OSTP areas). These are typically Ogallala Aquifer wells, although some perched aquifer wells are located in areas without active groundwater remedial actions. These wells were evaluated in the quarterly reports.
- Group 2: 28 uncertainty management wells (all other wells in the perched aquifer in Fig. 3-35) near groundwater contamination source areas. This group is established 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 frequencies in sampling, all available data for the uncertainty management/early detection wells are used in this evaluation.

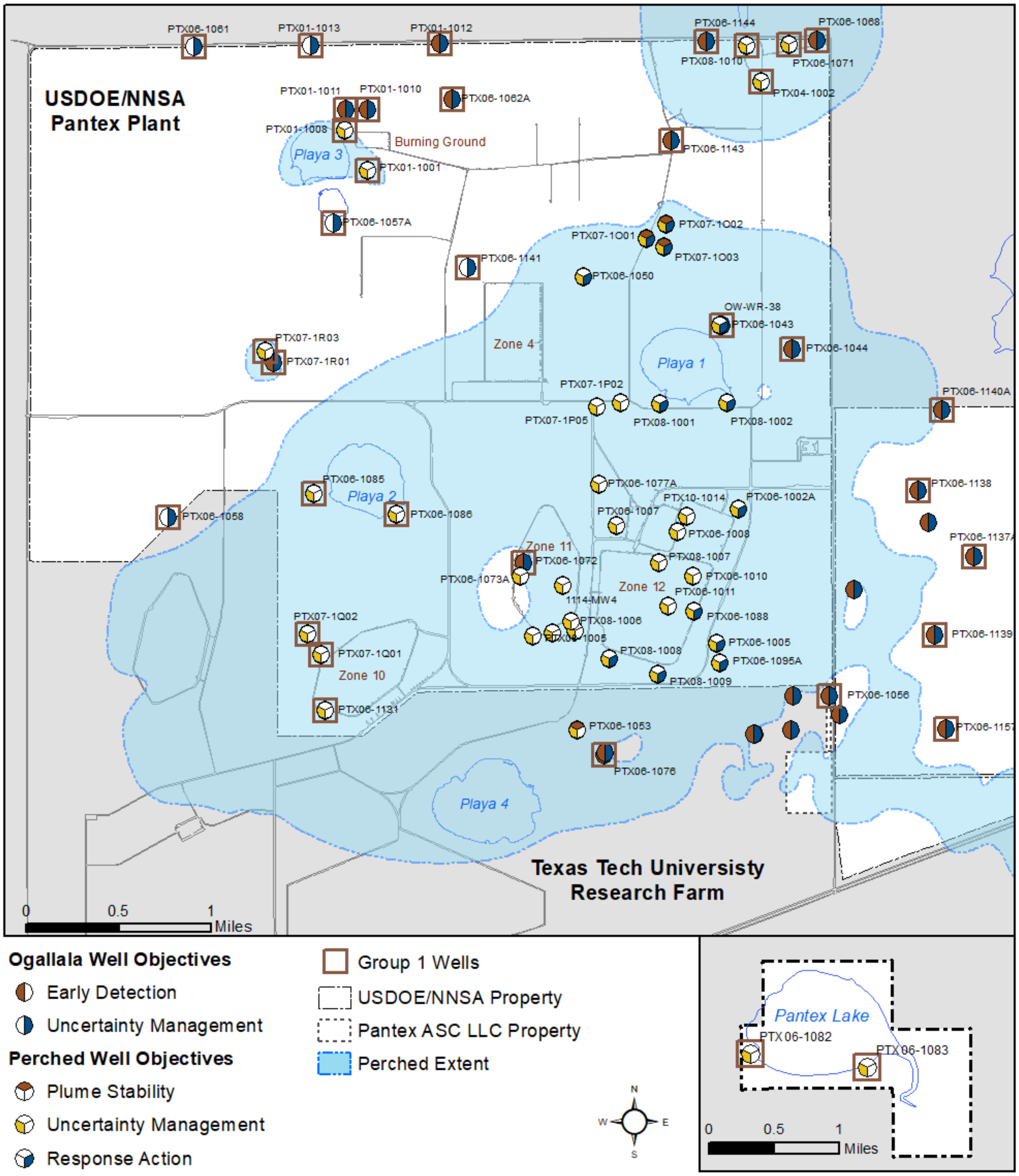


Fig. 3-35. Uncertainty management and early detection wells for 2024.

3.4.1 Group 1 Perched Aquifer Wells

Only one Group 1 perched aquifer well had an unexpected condition in 2024. Perchlorate and TCE were detected at PTX01-1001, a perched monitor well located in the Burning Ground area. Perchlorate was detected at 68 µg/L, above the GWPS (15 µg/L), and TCE was detected at 1.11 µg/L, above the PQL (1 µg/L), but below the GWPS (5 µg/L). Previous detections in PTX01-1001 have been associated with releases from the wash rack at the southwest corner of the loop road inside the Burning Ground area. A documented leak from a water line on the south side of the loop road has occurred for a long period of time, as evidenced by the cattails growing in that area and increasing water level trends in PTX01-1001 while other locations at the Burning Ground do not demonstrate a similar trend. Pantex has taken actions to minimize the leak; however, the leak cannot be fully stopped until the maintenance crew receives needed parts for the repair. It appears likely that the water leak has affected deeper soil contamination that remains at the wash rack. It is expected that with the removal of water from the area, concentrations and water levels will decline with time, as observed in past data.

No additional detections of indicator COCs above applicable background values occurred in Group 1 perched aquifer wells in 2024.

3.4.2 Group 1 Ogallala Aquifer Wells

In 2024, detection of indicator constituents above background occurred in five Ogallala wells. Data for these detections are provided in Table D-3, Appendix D. Detections of boron, hexavalent chromium, perchlorate, and TCE are discussed in the following paragraphs. HEs and VOCs were detected in five Ogallala wells beneath the southeast area in 2024; these detections are discussed in Section 3.4.6.

As presented in Table D-4, boron was detected at concentrations slightly above the background value of 194 µg/L in 11 Ogallala wells in 2024, including PTX06-1043, PTX06-1044, PTX06-1056, PTX06-1058, PTX06-1137A, PTX06-1140, PTX06-1144, PTX06-1157, PTX06-1223, PTX06-1224, and PTX06-1229. Because boron concentrations at these wells were very close to background and observed boron concentrations tend to vary considerably, these concentrations also appear to represent background. Evaluation of historic boron data in these wells results in variable trends. However, the measured concentrations are significantly below the GWPS of 7,300 µg/L. Pantex will continue to monitor these wells according to the SAP.

Hexavalent chromium was detected slightly above background in three wells, PTX06-1044, PTX06-1157, and PTX06-1229, in 2024; these detections were below the GWPS of 100 µg/L and represent natural variability in background. At PTX06-1012, perchlorate was detected at a measured value of 1.04 µg/L, slightly above the background value of 0.96 µg/L; τhis detection also represents background variability.

TCE was detected at PTX01-1010, located just north of the Burning Ground, in the third quarter at 0.67 µg/L, below the GWPS (5 µg/L) and the PQL (1 µg/L). Although resampling is not required when the detection is less than the PQL, Pantex initiated a resampling event during fourth quarter to validate this detection as a precaution. The verification sample was split and sent to two separate labs; both TCE verification samples support the initial detection results. In accordance with the Contingency Plan and requirements established in the approved *Draft Final Burning Ground SVE System Closure Report* (Pantex, 2023a), Pantex will continue to monitor this well and evaluate the data. Sampling results from 2024 for PTX01-1010 are included in Appendix D, Table D-10.

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

The Mann-Kendall trending results, summarized in Table 3-6, indicate that across all data 13 wells are indicating increasing or probably increasing trends.

Table 3-6. Increasing Trends in Ogallala Aquifer Wells

Well	COC	Concentration Trend
PTX01-1012	B	Probably Increasing
PTX06-1043	CR	Increasing
PTX06-1043	MO	Probably Increasing
PTX06-1044	B	Increasing
PTX06-1056	DNT4A	Increasing
PTX06-1056	CR	Increasing
PTX06-1056	MO	Increasing
PTX06-1058	B	Increasing
PTX06-1058	CR	Increasing
PTX06-1061	B	Increasing
PTX06-1072	B	Increasing
PTX06-1137A	CR	Increasing
PTX06-1138	MO	Increasing
PTX06-1140	CR	Increasing
PTX06-1144	B	Increasing
PTX06-1157	B	Increasing
PTX06-1157	CR	Increasing
PTX06-1157	MN	Probably Increasing
PTX06-1157	MO	Increasing

B = Boron
CR = total chromium
DCA12 = 1,2-dichloroethane
DNT4A = 4-amino-2,6-dinitrotoluene
MN = manganese
MO = molybdenum

Six wells indicate increasing trends for chromium. However, chromium was not detected in four of the wells in 2024; detections in the other wells were below background. These chromium trends may be related to the stainless-steel screens and the confirmed presence of bacterial growth that has been found in many perched aquifer and Ogallala Aquifer wells at Pantex. Typically, chromium levels drop in these wells after they are brushed and bailed. PTX06-1033 was plugged and abandoned in 2017 because well damage made it unusable; that well had similar chromium detections, which may indicate that corrosion of the stainless-steel well screens is also affecting these five wells.

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

As discussed above, PTX06-1056 exhibited an increasing trend in DNT4A.

Mann-Kendall trending across all data indicates a probably increasing trend for molybdenum in PTX06-1043, PTX06-1056, PTX06-1138, and PTX06-1157. However, molybdenum was detected at levels far below background, and recent data indicate no trend for three of these wells. Molybdenum is a component of stainless steel and can indicate corrosion of the wells is occurring.

3.4.3 Group 2 Wells

These wells are near source areas and generally have contamination at levels above the GWPS. These wells all occur in the perched aquifer. The purpose of this evaluation is to determine if source strength is declining and if new COCs have migrated to wells near source areas.

The ditches and playas are expected to continue contributing contamination to the perched aquifer for at least 20 years or more but at much lower concentrations than in the past (Pantex, 2006). For many of these wells, concentrations are expected to stabilize, with an eventual long-term decreasing trend below the GWPS.

Table D-5 in Appendix D presents the evaluation of the 24 Group 2 well 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 D-5:

- HE breakdown products (i.e., MNX, TNX, DNX, 1,3-dinitrobenzene, DNT2A, and DNT4A) were not included since increasing trends are not indicators of continued sourcing.
- TCE breakdown products (i.e., cis-1,2-DCE; *trans*-1,2-DCE; and vinyl chloride) were not included since increasing trends are not indicators of continued sourcing.
- Total chromium was not included in lieu of hexavalent chromium.

Fourteen wells that have detections of COCs are already meeting the expected conditions. Two show stable or no trend when long-term decreasing trends are expected. Ten wells have increasing or probably increasing historical COC trends.

The ten wells that are exhibiting increasing trends, when the expected condition is a decreasing or stable trend, are discussed below. The trends in these wells are affected by changing flow gradients in perched groundwater that have been caused by the remedial actions and a decline in perched water levels. Thus, all of the increasing trends discussed below are associated with changes in plume movement rather than the continued or increasing release of contaminants from source areas.

- 1114-MW4, located in central Zone 11, is exhibiting an increasing trend for TCE, possibly due to changing flow gradients and plume movement away from the source (i.e., Hypalon pond and nearby ditches). The last four samples indicate no trend for TCE.
- OW-WR-38, located northeast of Playa 1, is exhibiting an increasing trend for RDX. RDX concentrations have been fluctuating near the GWPS since 2009 but increased to near 50 µg/L starting in 2020. RDX was near 40 µg/L in the most recent sample collected in 2024. Other wells north of Playa 1 (e.g., PTX06-1050 and PTX07-1O03) have exhibited higher concentrations of RDX in the past. The trend may be due to the effects of the P1PTS or recent changes in the discharge of treated water to Playa 1, which have dramatically affected water levels and gradients in this region of perched groundwater. The last four samples indicate no trend for RDX.
- PTX06-1007, located between and north of Zones 11 and 12, is exhibiting an increasing trend in RDX. RDX has been detected at levels near the PQL in this well since 2002 with only one detection above the GWPS of 5 µg/L in 2017. However, in 2020 and 2021, RDX increased from near the PQL to greater than 25 µg/L but subsequently declined to near the GWPS. In 2024, the RDX was measured at 2.8 µg/L. This short-term increasing trend could be caused by changes in flow gradients and plume movement from the SWMU 5-13c ditch. The last four samples indicate no trend for RDX, although the actual concentration has dropped sharply.
- PTX06-1008, located in Zone 12, is exhibiting increasing concentrations of 1,2-DCA above the GWPS. 1,2-DCA has been gradually increasing in this well and has been above the GWPS since 2009. Recent data indicate no trend. 1,2-DCA is associated with a soil gas plume from SWMU 136. Historic water leaks have been repaired in Zone 12 since 2009. The leaking water from the surface may have diluted VOC concentrations in groundwater beneath Zone 12; termination of those leaks may therefore have caused the apparent increase in concentrations of 1,2-DCA in this

area. If this plume migrates from beneath Zone 12 to the southeast, the plume should be captured by the SEPTS, and the constituent will be effectively treated by GAC.

- PTX06-1011, also located in Zone 12, is exhibiting a probably increasing trend in TCE, although the expected condition is a stable or decreasing trend below the GWPS. TCE has fluctuated in this well since 1998 and has remained in the range of about 4 to 10 µg/L since 2013. The identified probably increasing trend may reflect the variable influence of the remedial actions and general plume movement in this area; however, data for the last four samples indicate no trend.

- PTX06-1050, located north of Playa 1, is exhibiting a probably increasing trend in RDX. However, this well has exhibited higher RDX concentrations in 2003 and exhibits a decreasing trend considering all data. The increasing trend may be due to P1PTS effects as system operations have dramatically affected water levels and possible gradients in this region of perched groundwater.

- PTX07-1P02, located southwest of Playa 1, is exhibiting an increasing but variable trend in RDX, but concentrations remain below historical levels for this well and dropped by about 50% in 2024 compared to 2023. The apparent increasing trend may be due to the effects of P1PTS since system operations have dramatically affected water levels and gradients in this region of perched groundwater. The last four samples indicate no trend for RDX.

- PTX08-1006, located in the southeast part of Zone 11, is exhibiting an increasing trend in TCE, although the expected condition is a long-term decreasing trend. The increasing trend in PTX08-1006, which is downgradient from the identified sources in Zone 11, is likely due to general plume movement to the southeast that may also be influenced by SEPTS operations. Concentrations have been highly variable in this well, and observed concentrations since 2022 are lower than the maximum concentrations from 2021.

- PTX08-1007, located in central Zone 12, is exhibiting an increasing trend in 1,2-DCA, although the expected condition is a long-term decreasing trend. 1,2-DCA was detected near the PQL for many years and has been above the GWPS since 2017; concentrations continued increasing through 2022 but have declined for the past two years. Concentrations of 1,2-DCA are associated with changing gradients and

Zone 11 discharge to the SWMU 5/13A ditch. As noted for PTX06-1008, the increasing trend may be linked to the repair of historic water leaks in Zone 12 which may have diluted VOC concentrations in groundwater beneath Zone 12.

- PTX08-1008, located on the south border of Zone 12, is exhibiting probably increasing or increasing trends in RDX, DNT4A, and perchlorate, although the expected condition is a long-term stabilization of concentrations. Concentrations for these constituents decreased in the most recent sample from previous values. As discussed in Section 3.1.1.3, these increasing trends may be due to general plume movement to the southeast, which has been influenced by SEPTS operations.

Table D-6 in Appendix D summarizes all detections of analytes above the laboratory PQL and site-specific background, if calculated, that are not considered indicator parameters.

Aluminum, manganese and nickel were detected above background in 2024. Aluminum was detected in PTX08-1002 at 596 μg/L, above the background value of 329 μg/L but far below the GWPS of 36,500 μg/L. Detections of manganese occurred in PTX08-1002 and PTX10-1014 above the background value of 16 μg/L at measured values of 1120 and 50 μg/L, respectively. Nickel was detected in PTX10–1014 760 μg/L, slightly above the GWPS of 730 μg/L. Aluminum, manganese, and nickel are naturally occurring. Manganese and nickel can also be indicators of corrosion of stainless-steel screens such as found in PTX10-1014.

3.4.4 Other Unexpected Conditions

Pantex routinely evaluates data as results are received from the laboratory to determine if data are off-trend, at an all-time high, or represent a new detection that may require further sampling or evaluation. Through the well maintenance program, Pantex also inspects wells at least every five years to ensure they are not silting in and evaluate whether or not the wells remain in contact with the formation. One unexpected condition was noted in 2024.

POE well, PTX06-1064, was damaged by agricultural equipment in 2024. Pantex requested approval from the TCEQ to plug and abandon this well by letter on November 20, 2024. TCEQ approved this request by letter on December 4, 2024. This well was plugged and abandoned on January 28, 2025 and PTX06-1062A was designated as the replacement POE well. A class 2 modification application will be submitted for this change once the updated permit is issued.

3.4.5 Per- and Polyfluoroalkyl Substances at Pantex

PFAS are a group of emerging chemicals of concern for regulatory agencies due to their toxicity at low concentrations and their ability to resist breakdown causing them to remain in the environment for long time periods. PFAS have been manufactured since the 1950's and used in many commercial products. PFAS can be found in a wide variety of consumer products such as carpets, clothing, furniture, outdoor equipment, herbicides, pesticides, cleaning products, personal care products, and food packaging. PFAS compounds have been widely used in firefighting applications as key components of aqueous film-forming foam (AFFF).

The USEPA developed a PFAS Strategic Roadmap: EPA's Commitments to Action 2021–2024, to develop a strategy to research, restrict use, and remediate these compounds. Several measures have been taken by the USEPA in 2024, including regulation under CERCLA and the development of a drinking water MCL for five PFAS and a mixture of PFAS. Additionally, the State of Texas has included PFAS in their cleanup regulations developed in accordance with RCRA.

In response to the emerging concerns with PFAS, USDOE also developed a *PFAS Strategic Roadmap: DOE Commitments to Action 2022-2025*, with USDOE committing to:

- Research current and past uses and known or potential releases of PFAS.
- Investigate PFAS concentrations in DOE-supplied drinking water and in the environment at DOE sites.
- Proactively prevent PFAS from entering air, land, and water at levels that can adversely impact human health and the environment.
- Clean up PFAS identified contamination to protect human health and ecological systems.
- Leverage the expertise at DOE National Laboratories to enhance PFAS research.
- Support inter-agency and cross-sector collaboration to identify and employ promising technologies.
- Provide clear and credible information to our employees, local communities, and regulators.
- Engage with stakeholders to help inform an effective Departmental PFAS strategy.

The Environmental Projects Department at Pantex used the USDOE Strategic Roadmap as a guide to begin preliminary assessment of PFAS uses and known or potential releases of PFAS. The preliminary assessment determined that there were known releases of AFFF used in fire training and fire-suppression demonstrations at Pantex and releases related to cleaning fire-fighting equipment. Use of AFFF was started in the 1970s or 1980s, but its use was discontinued in 2020 as PFAS became an emerging concern for human health and the environment. Four areas were identified as AFFF release areas with a fifth area having potentially been used for fire training exercises. Research also determined that PFAS has been used in the manufacture of high explosives after World War II. The previous RCRA Facility Investigation Reports were also reviewed to determine past practices that could have led to the release of PFAS to the environment. The review indicated the potential for PFAS releases in a few SWMUs in Zone 11 and Zone 12, Firing Sites, Burning Ground, onsite materials testing laboratories, Old Sewage Treatment Plant, and landfills.

Based on the information collected regarding use of PFAS at Pantex, limited testing in the perched groundwater began in 2023 to determine if PFAS was present in the current pump and treat systems well fields and whether the systems were adequately treating any PFAS present in groundwater. At the same time, Pantex was also developing a *Preliminary Per- And Polyfluoroalkyl Substances Sampling Plan* (Leidos, 2023) that documents the preliminary assessment of potential releases of PFAS at Pantex and a plan to collect preliminary data across the perched groundwater to gain an understanding of potential soil sources to inform a future investigation work plan.

The *Preliminary Per- And Polyfluoroalkyl Substances Sampling Plan* provided a plan to evaluate 26 extraction wells and 37 monitoring wells as a beginning step to understand the presence of PFAS in perched groundwater. To prepare for sampling monitoring wells, Pantex had to gather information to develop sampling procedures, purchase a PFAS-free portable pump and tubing bundle to test wells, find a large PFAS-free deionized water source for decontamination of equipment, complete sampling studies to determine if dedicated sampling bundles could be used for groundwater well sampling in lieu of the PFAS-free bundles, and provide training of sampling technicians to meet the challenges of sampling for PFAS. After completing all necessary steps to prepare for sampling perched groundwater, the sampling began in late 2023 and was completed in 2024. Based on the initial results of that sampling and the promulgation of very low MCLs for PFAS that were confirmed to be present in the southeast plume of perched groundwater, Pantex decided to expand the sampling to the southeast, including one offsite area. The expanded sampling was completed by the end of 2024 with a total of 72 monitor and extraction wells sampled. Pantex detected 17 PFAS compounds in perched monitoring wells, with perfluoropentanoic acid (PFPEA) being the most widely detected. However, PFOA was widely detected across the southeast perched groundwater, making it a concern also because of the very low MCLs. Samples collected at the pump and treat systems extraction wells indicated 23 detections of different PFAS, with PFOA of greatest concern in the extraction well field due to higher concentrations in that area. Three of the detected PFAS (PFOA, Perfluorooctane Sulfonic Acid (PFOS), and Perfluorohexane Sulfonic Acid (PFHXS)) in perched groundwater were detected above regulatory standards (the MCL and/or the TCEQ TRRP PCLs) in monitor and extraction wells. However, the highest concentrations for all three PFAS above regulatory standards occurred within the pump and treat well field. Those detections above regulatory standards are summarized in Table 3-7. The complete 2023-2024 PFAS data discussed in this section are included in the electronic data file.

Table 3-7. Summary of Perched Groundwater PFAS Data, 2023-2024

PFAS	Minimum MV	Maximum MV	No. MWs Detected	No. EWs Detected	EPA MCL	TCEQ PCL
PFOA	0.757	720	25	20	4	290
PFOS	4.21	302	2	7	4	560
PFHXS	0.99	375	20	17	10	93

All concentrations in ng/L
MV – Measured Value
EW – Extraction Well
PCL – Protective Concentration Level
MW – Monitor Well
MCL – Maximum Contaminant Level

The detected concentrations of PFOA, PFOS, and total PFAS are depicted in Figures 3-36, 3-37, and 3-38. Because the extraction wells were sampled under an annual Data Quality Objective in 2023 and 2024, the most recent data from 2024 are depicted on the maps. All detected PFAS measured values were totaled for each sample at each sampling location to provide a total PFAS concentration for that location. PFAS plume maps can be provided in the future, once more data are gathered to help fully understand the PFAS presence and to help fully define the plumes of contamination.

Pantex is continuing the evaluation of PFAS in perched groundwater in 2025. Extraction wells are monitored once per year to evaluate changes within the pump and treat well field. Pantex also conducts monitoring at the pump and treat system to evaluate the influent water, verify the removal of PFAS at the effluent, and process monitoring to ensure the GAC is appropriately exchanged. Additionally, the wells included in the Sampling Plan will be sampled again to verify previously detected concentrations. New well locations were included in 2025 to further define plumes in areas where there was a lack of data.

Additionally, PFAS were detected at low concentrations at an offsite area. Pantex is planning to sample most of those wells using the dedicated sampling bundle, then removing the bundle and sampling with the portable PFAS-free sampling bundle to verify the detected concentrations of PFAS. Because analytical Method 1633 that is used for evaluation of PFAS only evaluates 43 PFAS, Pantex is collecting a Total Oxidizable Precursor (TOP) Assay sample in select monitoring locations to verify if other undetected PFAS may be present that could oxidize and form other more toxic PFAS compounds that can be detected by Method 1633. The data are planned for collection throughout 2025, with the results of the sampling event expected to be available in 2026.

Pantex has fulfilled the strategic roadmap goal of collecting information for a preliminary assessment. With the information gathered during the assessment and from well sampling, Pantex can now move forward with developing a work plan for investigation of PFAS in soil, sediment, surface water, and groundwater at locations of known and suspected contamination. Pantex plans to complete the work plan in March 2026, in accordance with recommendations in the regulatory approved *Third Five-Year Review Report* (Pantex and HGL, 2023). The investigation work plan will inform future budgetary needs and will provide the roadmap for collecting data to satisfy CERCLA and State of Texas TRRP rules. Pantex will begin full investigation of PFAS when funds become available for PFAS investigation.

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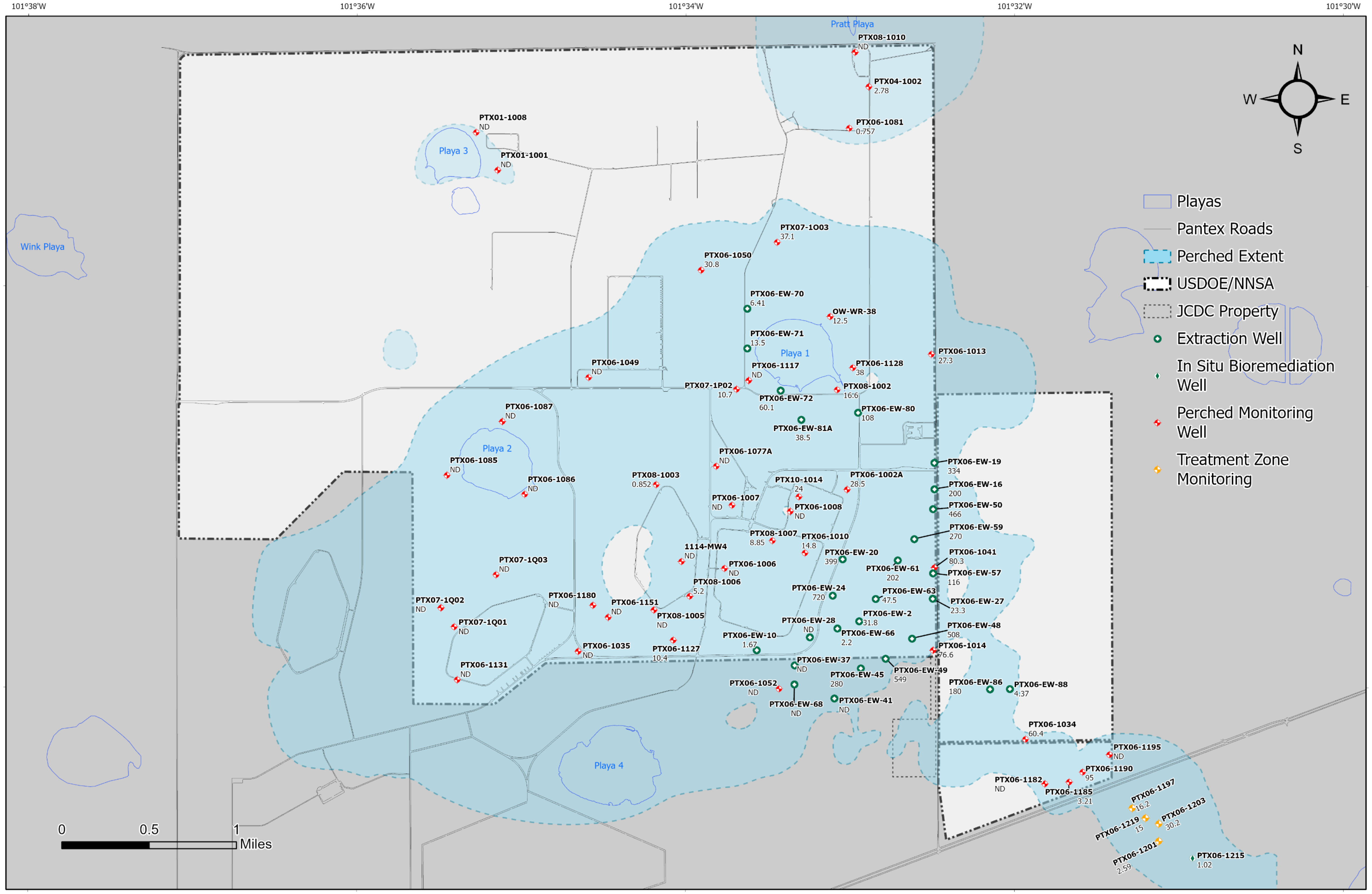

Fig. 3-36. PFOA Detections (ng/L) in Perched Groundwater Wells, 2023-2024.

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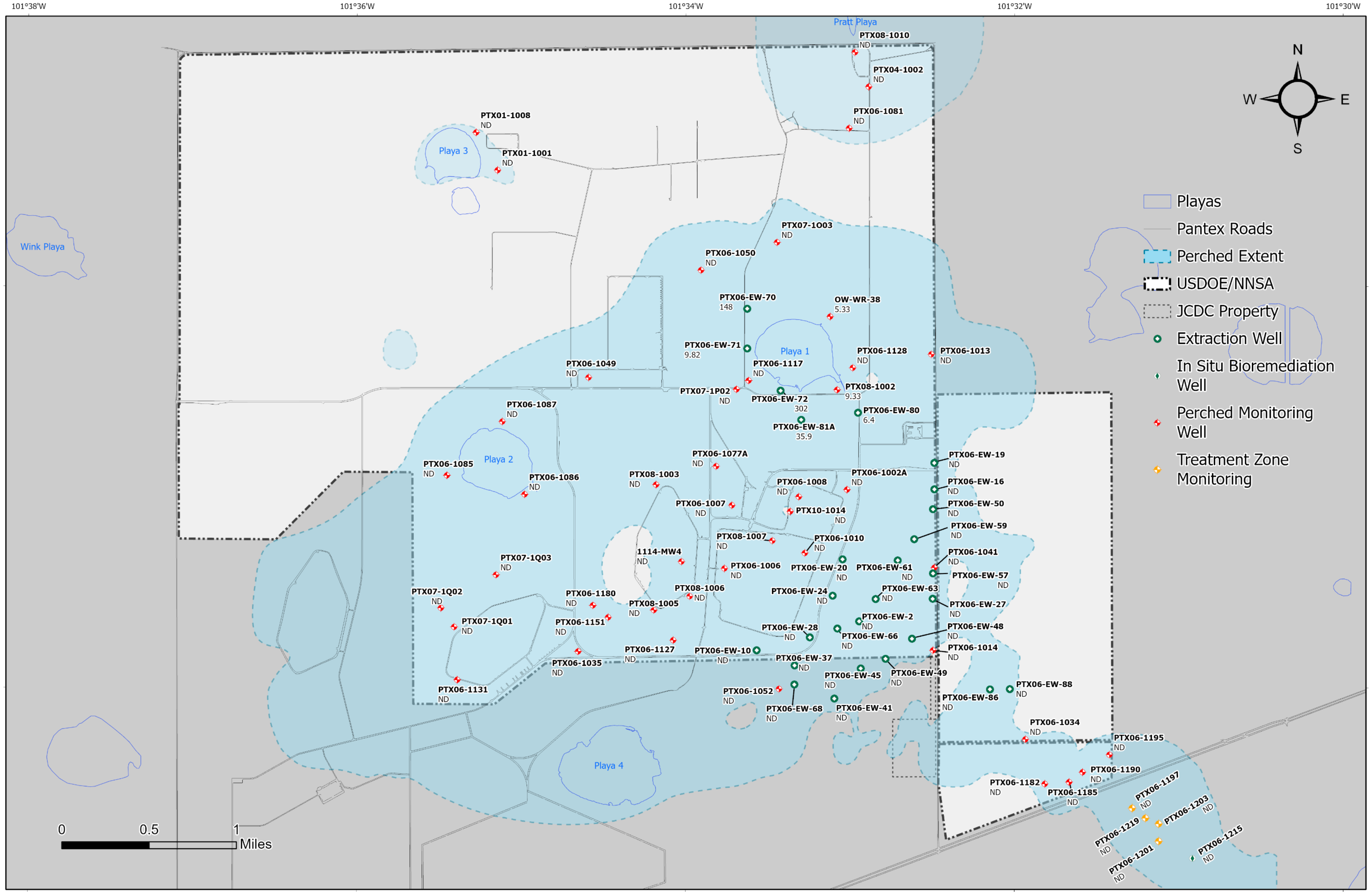

Fig. 3-37. PFOS Detections (ng/L) in Perched Groundwater, 2023-2024

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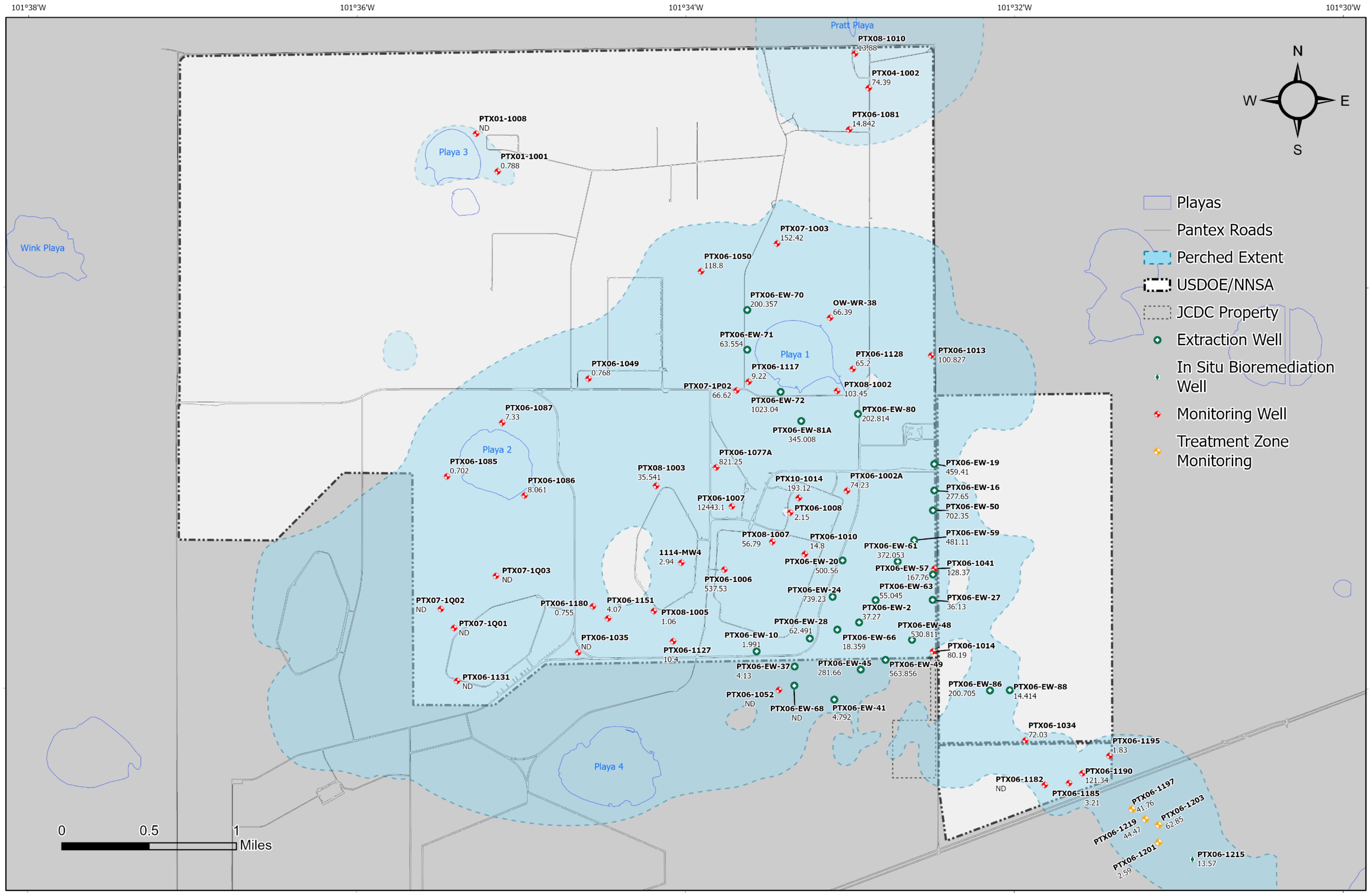

Fig. 3-38. Total PFAS Detected (ng/L) in Perched Groundwater Wells, 2023-2024

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3.4.6 Investigation of the Ogallala Aquifer

Pantex has evaluated HE data at well PTX06-1056 since 2001 when it was installed. This well has served as a sentinel well for the possible cross-contamination of the Ogallala Aquifer from impacted perched groundwater in areas where the FGZ was known to be more permeable. In 2014, DNT4A was observed at this well at low concentrations (0.2 μg/L) below the PQL and GWPS. Pantex conducted a high-volume purge/time-series sampling event after DNT4A was confirmed at the well. This sampling event demonstrated that the DNT4A was limited in extent since DNT4A was observed in only the first sample of the purge event. Other possible contributors were also evaluated to ensure that nearby wells might not be serving as a conduit for contamination due to poor well construction or that PTX06-1056 may not have been constructed properly and was acting as a conduit for vertical movement of contamination. A cement bond log demonstrated that the seal at the FGZ was competent in PTX06-1056; therefore, it was not believed to be acting as a conduit for perched groundwater contamination. A nearby perched well (PTX06-1108) was determined to be constructed deeply into the FGZ and, therefore, could be serving as a conduit for movement of impacted perched groundwater to the underlying Ogallala Aquifer. PTX06-1108 was plugged and abandoned in November 2014. Additionally, fate and transport modeling was conducted to assess the feasibility of the perched well concentrations contributing to the measured concentrations of DNT4A at Ogallala well PTX06-1056. Modeling indicated that it was feasible that PTX06-1108 could be impacting the water sampled at PTX06-1056. In accordance with the Groundwater Contingency Plan, Pantex continued to sample and evaluate data at PTX06-1056; however, DNT4A continued to slowly increase over time until the measured concentration exceeded the GWPS of 1.2 μg/L for the first time in 2022. In accordance with the Groundwater Contingency Plan, Pantex began investigation of the detections in PTX06-1056. DCA12 has also been detected at PTX06-1056, but the concentrations have never exceeded the GWPS. Detections through 2022 in PTX06-1056 are included in Table D-7 in Appendix D.

In 2023, Pantex installed three new Ogallala wells (PTX06-1223, PTX06-1224, and PTX06-1229) to evaluate the potential source of contamination for PTX06-1056. The three wells were placed in areas to evaluate the potential for impact from perched groundwater that was not treated until the Southeast ISB was installed in 2007. The Southeast ISB was installed in an area where the FGZ was known to be more permeable and remediation was required to mitigate effects to the deeper drinking water aquifer. Additionally, the new Ogallala wells were installed in areas where the perched groundwater was no longer present due to the upgradient removal and treatment of the water by the SEPTS. This approach was taken to avoid potential cross-contamination from wells that would be drilled through highly contaminated perched groundwater, if water was present. No perched groundwater saturation was identified during drilling at the locations of the three installed wells; nevertheless, the wells were appropriately cased to ensure no perched groundwater would impact the well if resaturation occurred in the future.

Sampling results from PTX06-1224 after installation demonstrated no detection of any HE or other COCs associated with impacted perched groundwater. PTX06-1223, which was drilled in an upgradient location from PTX06-1056, demonstrated DNT4A concentrations similar to those in PTX06-1056, as well as low concentrations of RDX. PTX06-1229 demonstrated much higher concentrations of RDX (307 µg/L) and the presence of six other HEs and one VOC. Confirmation sampling was conducted and the original detections were confirmed. To determine how widespread the impact was at the PTX06-1229 location, Pantex conducted a high-volume purge/time-series sampling event that occurred from March 18 to 20, 2024. HE data were collected at various time intervals to ensure that the impact of HEs near that well could be adequately evaluated due to the strong signature of those contaminants. RDX data indicated a decrease in concentration of approximately 47% (from 334 to 176 µg/L) by the time the sampling event was completed. This indicated that the plume completely encompassed the well, but also demonstrated that lower concentrations were nearby. Four other sampling events were conducted during 2024 with the data indicating RDX at concentrations ranging from 267 to 313 µg/L.

Additionally, PTX06-1229 was installed with two screened intervals within the groundwater. The original sampling was conducted for the upper screened interval where impact from vertical movement of perched groundwater would be the greatest; however, two samples collected in the lower screened interval indicated that RDX concentrations were similar to concentrations in the upper screened interval. Because of the consistency in the data for the upper and lower screened intervals, Pantex conducted testing in the well to determine if the flow through the screens was horizontal or vertical. The study indicated vertical flow occurs from the top screened interval to the lower screened interval. Pantex has currently installed a packer that will effectively seal off the upper screened interval while still allowing for samples to be obtained from the lower screened interval. A sample will be collected from the lower screened interval of the well by June 2025 so that the lower groundwater unit can be appropriately evaluated for the possible presence of perched groundwater contamination in the deeper aquifer unit. Data through 2024 for PTX06-1223, PTX06-1224, and PTX06-1229 are included in Table D-8 in Appendix D.

In addition to sampling, Pantex also contracted a fate and transport modeling evaluation of the concentrations at PTX06-1229 to determine the feasibility of contribution from an upgradient perched well (PTX06-1103) that was found to be contributing water to the Ogallala in the past but was plugged after discovery of the connection to the Ogallala Aquifer. Other options were also evaluated to determine the possible location of impact from other areas where the FGZ might be more permeable. The modeling indicated that the perched well PTX06-1103 contribution could not feasibly cause the observed mass or concentrations of RDX at PTX06-1229. Modeling indicated the most likely source was the result of natural migration across the FGZ near PTX06-1229. Review of changes in perched groundwater saturation indicate the line of saturation moved northward as the SEPTS removed water, with the line becoming stable south of the SEPTS extraction wells after a period of time. PTX06-1229 was installed in the dry area just south of that line of saturation. This may indicate an area where the FGZ is more permeable, allowing natural migration of impacted perched groundwater to the deeper drinking water aquifer.

Based on the detection discovered at PTX06-1229 and the information collected from the well, Pantex began preparation for installation of three new Ogallala wells in 2024 with the goal of understanding the extent in the downgradient direction and immediately upgradient of PTX06-1229. Upgradient and downgradient locations were identified by evaluating the last 20 years of flow directions in the Ogallala Aquifer to ensure the wells were optimally located to evaluate the plume impact. Based on evaluation of flow direction, it was indicated that the plume would likely move between two existing wells in the Ogallala Aquifer (PTX06-1137A and PTX06-1138). Although no detections of HEs or other contaminants associated with perched groundwater have occurred in those two Ogallala wells, more wells would be needed to understand the plume emanating from the PTX06-1229 area.

Based on this evaluation of potential plume movement, Pantex installed three wells, PTX06-1231, PTX06-1232, and PTX06-1233, within the projected migration path of the plume and in areas where perched groundwater was absent to avoid potential cross-contamination from impacted perched groundwater. Two of the wells were installed with a single screened interval in the top of the aquifer; PTX06-1233 was installed with two screened intervals, after evaluation of multi-screened wells in that area indicated no vertical flow. Although installation of the wells was completed by January 2025, Pantex has been continuing well development at PTX06-1233. This well continues to exhibit issues with a white cloudiness in samples collected from the well, particularly at a deeper level in the second screened interval. Despite these issues, Pantex collected a sample in the upper interval of PTX06-1233 and at the other two newly installed wells so that the presence of HE could be evaluated.

The data from the most recent sampling event for the Ogallala wells in the vicinity or downgradient of PTX06-1229 are depicted on Fig. 3-39 along with the maximum observed concentration in 2024 at all other Ogallala wells. Table D-9 provides the complete set of data collected at these wells.

Sample results for the upper screened interval at PTX06-1233 indicate that RDX and other HEs are defined at the farthest downgradient extent of the plume because all measured concentrations are below the GWPS. Sampling of the deeper screened interval of PTX06-1233 will occur at a later date, once Pantex is satisfied with the well development. Sampling of the upgradient well, PTX06-1231, indicates RDX at higher concentrations than found in PTX06-1229, possibly indicating another area of impact from a more permeable area of the FGZ near that well. PTX06-1232, located downgradient between PTX06-1229 and PTX06-1233, indicated the presence of RDX at 27 µg/L, lower than observed at PTX06-1229 but above the GWPS of 2 µg/L. Pantex will continue to evaluate the wells as new samples are collected. Once enough data are gathered to fully define the extent of HEs, plume maps will be developed and provided in later progress reports and in the investigation reporting.

Pantex continues to plan for installation of new wells and to complete full investigation of nature and extent of the newly discovered plumes in the Ogallala Aquifer. Pantex is contracting support for the completion of the investigation and plans for installation of up to eight new wells in 2025, as well as the development of an investigation work plan, in accordance with a recommendation provided in the *Third Five-Year Review* (HGL and Pantex, 2023). The investigation work plan is planned for completion in March 2026.

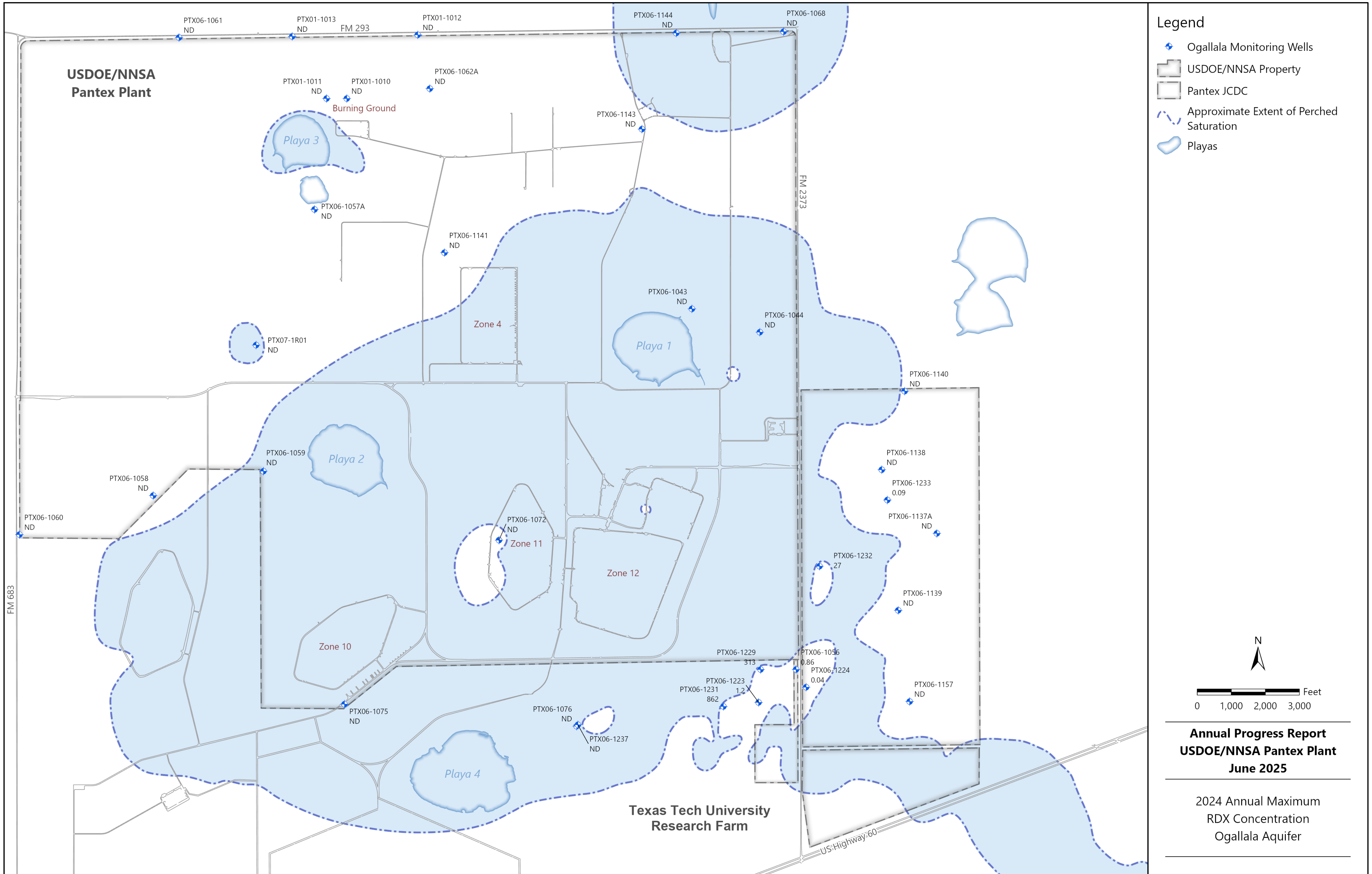

Fig. 3-39. RDX Measured Concentrations at Pantex Ogallala Monitoring Wells, 2024.

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3.5 Point of Compliance and Point of Exposure Well Evaluation

POC/POE Wells

- 20 perched aquifer POC wells, with 13 exceeding the GWPS.
- 2 Ogallala Aquifer POC wells, with one GWPS exceedance.
- 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, POC wells demonstrate compliance with the GWPS and are used to evaluate the effectiveness of the remediation program. POE wells demonstrate compliance with the GWPS.

The remediation program must continue until the POC and POE wells are compliant with the GWPS. The POC and POE wells approved in HW-50284 are depicted in Fig. 3-37. 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 and POE wells were evaluated against the established GWPS. Evaluation of the data indicates twenty perched aquifer POC wells had concentrations below the GWPS for some or all COCs. All COCs (with the exception of arsenic and barium in ISPM wells) are below the GWPS at the following seven wells in 2024: PTX01-1008, PTX06-1023, PTX06-1045, PTX06-1154, PTX06-1215, PTX06-1218, and PTX07-1O02. Thirteen wells with exceedances of the GWPS is an expected condition because the full remedial actions were started in 2009, and full treatment across all wells will take time. The Ogallala Aquifer wells were evaluated as early detection wells in Section 3.4 to determine if any COCs were detected above the background or PQL. One Ogallala POC well (PTX06-1056) had detections of a single COC above GWPS. All well data, along with comparisons to the laboratory PQL, background, and GWPS, are provided in the electronic data supplement; all perched well results above the GWPS are in Table D-1.

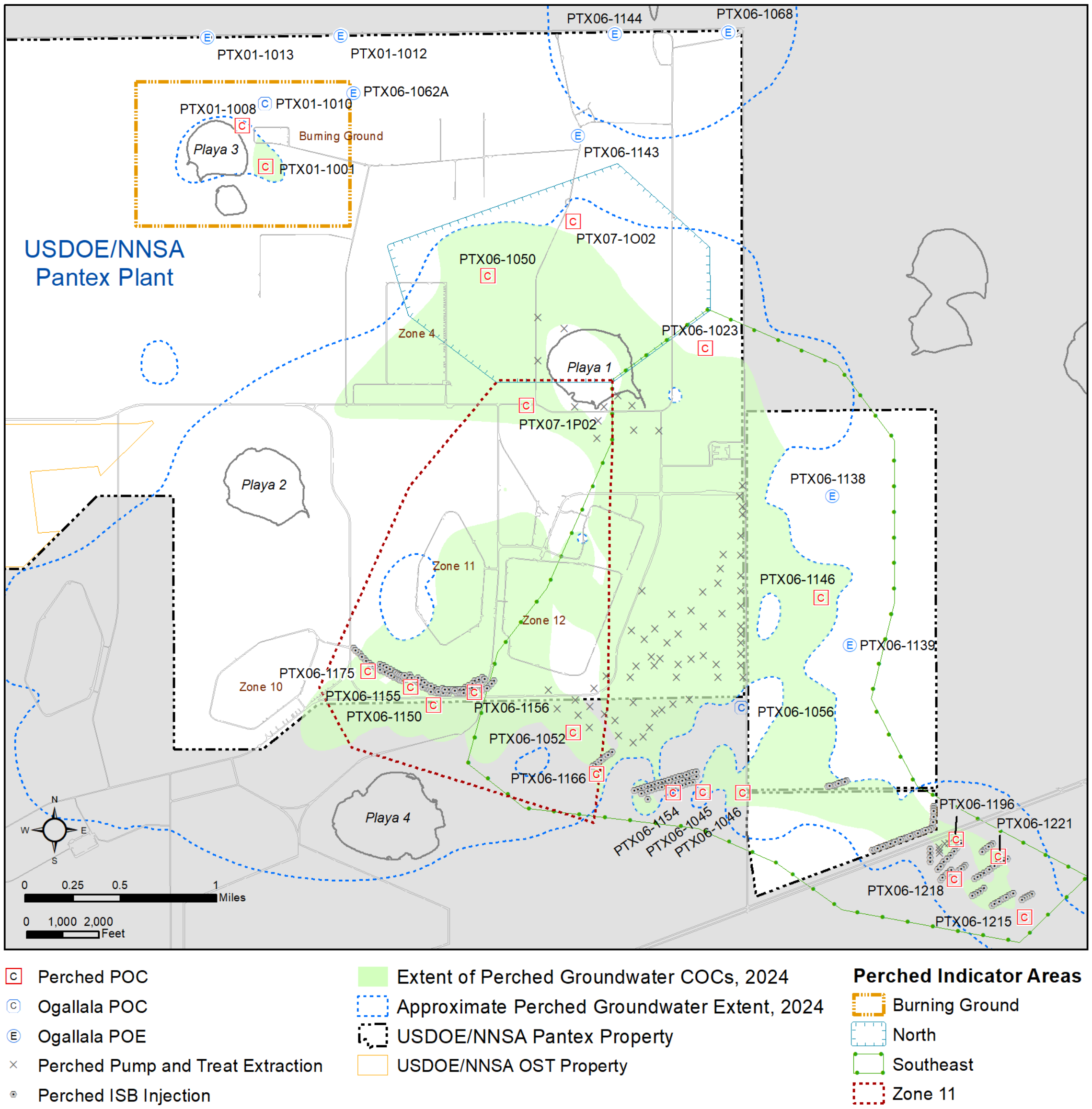

Fig. 3-37. POC and POE wells.

4.0 Soil Remedial Action Effectiveness

To prevent cross-contamination from soils to groundwater, three soil remedial actions were implemented, including (1) soil covers on landfills, (2) ditch liner in Zone 12, and (3) 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. Soil Vapor Extraction Remedial Action Effectiveness

Pantex received regulatory approval to end SVE operations at the Burning Ground in December 2023. SVE has been used to remediate soil gas and a residual NAPL source in deeper soils beneath SWMU 47. System closure was based on data that indicate the estimated NAPL source has been adequately removed for protection of the environment and human health, and groundwater concentrations demonstrate no impact from soil gas or NAPL at the Burning Ground since 2018. Additionally, SVE system influent concentrations and mass removal rates declined drastically, further indicating that the primary NAPL source has been significantly remediated. Long-term protectiveness of the groundwater pathway, as stated in the ROD and RAO for subsurface soil has been achieved at this SWMU. This closure is in accordance with Environmental Protection Agency Superfund policy and guidance.

The combined SVE systems have been estimated to have removed over 21,400 lbs of VOCs through October 2022 when the system shut down. Over 12,000 lbs of VOCS were removed in the first three years, with more than 16 years required to remediate the remaining residual NAPL source. The total removed to date is similar to the amount estimated at the time of the risk assessment, which estimated about 19,100 lbs of VOCs at the Burning Ground (amount removed by large-scale catalytic oxidation (CatOx) at beginning of risk assessment plus estimated remaining residual NAPL source).

Soil gas and groundwater data at the Burning Ground indicate the source has been adequately addressed and closure of the SVE system is appropriate, with continued monitoring of perched and Ogallala groundwater to ensure protection of groundwater resources. Monitoring will continue at perched monitor wells PTX01-1001 and PTX01-1008 and Ogallala monitor well PTX01-1010, which are designated as POC wells in CP Table V of HW-50284. Pantex remains under a continuing obligation to remediate, if VOCs significantly increase above the GWPS in groundwater samples.

4.2. Uncertainty Management

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

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

In accordance with the SAP, Pantex analyzes indicator constituents at all wells to determine possible impacts to 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.

Only one Group 1 perched aquifer well had an unexpected condition in 2024. Perchlorate and TCE were detected at PTX01-1001, a perched monitor well located in the Burning Ground area. Perchlorate was detected at 68 µg/L, above the GWPS (15 µg/L), and TCE was detected at 1.11 µg/L, above the PQL (1 µg/L), but below the GWPS (5 µg/L). Previous detections in PTX01-1001 have been associated with releases from the wash rack at the southwest corner of the loop road inside the Burning Ground area. A documented leak from a water line on the south side of the loop road has occurred for a long period of time, as evidenced by the cattails growing in that area and increasing water level trends in PTX01-1001 while other locations at the Burning Ground do not demonstrate a similar trend. Pantex has taken actions to minimize the leak; however, the leak cannot be fully stopped until the maintenance crew receives needed parts for the repair. It appears likely that the water leak has mobilized deeper soil contamination that remains at the wash rack. It is expected that with the removal of water from the area, concentrations and water levels will decline with time, as observed in past data.

No additional detections of indicator COCs above applicable background values occurred in Group 1 perched aquifer wells in 2024.

In 2024, detection of indicator constituents above background, including boron, hexavalent chromium, perchlorate, and TCE, occurred in nine Ogallala wells. Data for these detections are provided in Table D-3, Appendix D. Boron frequently shows higher detections in wells that are towards the southern side of Pantex, due to the influence of the Dockum Aquifer. Detections of hexavalent chromium and perchlorate are likely the results of background variability. HEs and VOCs were detected in five Ogallala wells beneath the southeast area in 2024; these detections are discussed in Section 3.4.5.

TCE was detected at PTX01-1010, located just north of the Burning Ground, in the third quarter at 0.67 µg/L, below the GWPS (5 µg/L) and the PQL (1 µg/L). Although resampling is not required when the detection is less than the PQL, Pantex initiated a resampling event during the fourth quarter to validate this detection as a precaution. The verification sample was split and sent to two separate labs; both TCE verification samples support the initial detection results. In accordance with the Contingency Plan and requirements established in the approved Draft Final Burning Ground SVE System Closure Report (Pantex, 2023a), Pantex will continue to monitor this well and evaluate the data.

Other than the detection of TCE at PTX01-1010, no Ogallala Aquifer uncertainty management wells indicated impacts from a soil source area in 2024.

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5.0 Conclusions and Recommendations

5.1 Conclusions from the 2024 Annual Report

Overall, the groundwater remedial actions have been effective in 2024. They continue to operate and meet short-term expectations for cleanup of the perched groundwater in areas under the influence of the remediation systems. The remedial actions continue to operate to meet long-term goals, perched water levels are declining in most areas, COC mass is being removed or reduced, and institutional controls protect against the use of impacted groundwater. The influence of both pump and treat systems will continue to expand as saturated thickness is reduced in the perched aquifer.

The groundwater remedies are considered to be protective for the short term since untreated perched groundwater use is controlled to prevent human contact. Results of samples at four Ogallala Aquifer wells, PTX06-1056 and PTX06-1229, PTX06-1231, and PTX06-1232, demonstrate the presence of high explosives above the GWPS, indicating the possible migration of perched groundwater to the Ogallala Aquifer. In response to these detections, Pantex has completed the following actions in accordance with the *Pantex Plant Ogallala Aquifer and Perched Groundwater Contingency Plan* (2019):

- A high-volume time-series sampling event was conducted August 8, 2022 at PTX06-1056 to determine if DNT4A was part of a wider plume area (Pantex, 2023b). Detections were confirmed throughout the sampling event, although they declined immediately from around 1.2 ug/L to below 0.2 ug/L upon the start of purging. This indicated that DNT4A was more widespread in the aquifer than was concluded after a similar sampling event conducted August 5, 2014, after the first detections of DNT4A occurred, where concentrations declined from below 0.1 ug/L DNT4A and around 0.2 ug/L RDX to non-detect for both COCs once purging started (Pantex, 2015).
- Pantex drilled three new Ogallala wells in 2023. Samples were collected from the wells and data indicate the presence of low-level detects of RDX and DNT4A in PTX06-1223. Higher detects were observed in PTX06-1229. No detections of high explosives or VOCs were observed in PTX06-1224.

- Pantex contracted support for an evaluation of HE mass observed at PTX06-1229 and Plume Seeker fate and transport modeling to determine optimal placement of Ogallala wells to be drilled to understand the extent of the plume. The results of this study will be updated and considered in the investigation of the Ogallala Aquifer that is currently underway.
- Three additional Ogallala wells were drilled in 2024 to understand the nature and extent of the HE plume. Samples were collected from the wells and data indicate that DNT4A, RDX, and RDX breakdown products exceed the GWPS in PTX06-1231. Samples from PTX06-1232 contained lower levels of RDX, still exceeding the GWPS, but RDX breakdown products were below their respective GWPSs. PTX06-1233 indicated low level detects of RDX well below the GWPS.

Further work is planned to evaluate the extent of the HE plume in the Ogallala Aquifer including the drilling of new Ogallala wells in 2025. Pantex will also provide an investigation work plan in March 2026 to detail work completed to date, as well as future work that will be performed to complete investigation of nature and extent of the HE plume.

The throughput performance of the pump and treat systems was affected by shutdowns for repairs to the WWTF lagoons, which caused reduced storage capacity. Pantex utilized the new center pivot irrigation system throughout 2024 as a beneficial outlet for treated water. In accordance with Permit #WQ0002296000, treated wastewater effluent and treated water from the pump and treat systems was routed to Playa 1 when other water outlets were not available. The P1PTS was shut down in December 2023 while repairs were completed on the pivot system near the wet well. That system was not operated until those repairs were made and temperatures were above freezing in mid-March 2024. Operation of P1PTS was adjusted based on water outlet availability throughout the year. This allowed SEPTS to operate throughout most of 2024 to capture water in high-priority locations. This operation scheme was implemented to control downgradient migration of plumes. Pantex formalized this operational priority by setting new operational goals for both systems.

The Zone 11 ISB system has a well-established treatment zone throughout most of the system. Improved conditions have been noted across the western side of the Zone 11 ISB after moving to the use of molasses amendment in recent years. However, some wells have limited ability to accept injection. Pantex has paused injection in some wells which has been proven to improve injection capability and has in-filled wells on the western side to address some of the low-performing locations. Pantex will continue to evaluate pausing injections in older wells to allow the well to clear out the EVO. In-filling of wells will be used when necessary to continue treatment in portions of the system. To address the change in flow directions that are causing plumes to move to the southeast, a second line of injection wells was installed across the southern portion of the Zone 11 ISB and TZM results from that area indicate improvement in treatment conditions.

All wells downgradient of the Zone 11 ISB have indicated the arrival of treated water, including PTX06-1175, which had been slower to respond, but data indicate that TCE is trending downward now and RDX is below its GWPS. In 2024, perchlorate was detected above the GWPS in two downgradient ISPM wells, but was not detected or was below the GWPS in the other seven wells. By the third quarter 2024 sampling event, perchlorate was detected above GWPS in only one downgradient well indicating effective treatment throughout the year. TCE concentrations are below the GWPS in five of nine ISPM wells. Three wells downgradient of the eastern part of the system (PTX06-1148, PTX06-1149, and PTX06-1150), where the second row of injection wells were added in 2021, have shifted from an increasing trend to no trend for TCE over the last four sampling events while the other well (PTX06-1156) indicates TCE concentrations near the GWPS. The second row of wells is expected to continue to improve the treatment of TCE in that area of the ISB within the next five years. Overall, implementation of a new amendment and infill of wells across the system have improved reducing conditions across the Zone 11 ISB.

The Southeast ISB system has been effectively treating HEs and hexavalent chromium at two of the closest downgradient ISPM wells, PTX06-1037 and PTX06-1154, and historically at PTX06-1123. PTX06-1123 has limited or no water and can no longer be sampled. These wells indicate that the reducing zone has extended beyond the treatment zone and RDX and hexavalent chromium concentrations in these wells are either non-detect or below the GWPS.

PTX06-1153 continues to exhibit RDX concentrations above the GWPS at the Southeast ISB, but hexavalent chromium concentrations continue to demonstrate a decreasing trend and have remained below the GWPS since 2016. This well has demonstrated signs of partial treatment since 2019. TNX, an RDX breakdown product, was detected at concentrations above the GWPS with other breakdown products being present, indicating partial treatment has occurred. The concentration of RDX in this well is currently lower than the peak concentration in 2019, but concentrations are variable indicating that full RDX treatment may be stalled at this location. Pantex is removing this well from the Hazardous Waste Permit as a POC well and plans to inject it to ensure treatment in that area.

The Southeast ISB Extension was injected once during 2024, using molasses. Treatment zone data indicated that reducing conditions were established in this system and demonstrated complete treatment in 2024 as concentrations of RDX were below the GWPS in both TZM wells and are expected to remain below GWPS. Downgradient well PTX06-MEW402 has a clear decreasing trend in RDX. PTX06-1194 and PTX06-1196 were below GWPS for all HE compounds at the second sampling event in 2024.

The Offsite ISB was injected twice during 2024, using molasses. The system was designed to clean up the offsite area within 25 years, with approximately 15 years of injections planned. This system was fully installed by the end of 2023. Concentrations of HEs remain low in the recirculation extraction wells at the leading edge of the plume. Total organic carbon increased in most treatment zone wells indicating that an effective treatment zone is beginning to establish. Treatment zone expansion will occur with time and repeated injections across the system. Concentrations at the downgradient ISPM well PTX06-1215 indicate that all high explosives remain below the GWPS indicating that the system is arresting downgradient movement of the plume.

The new PCR ISB was installed in 2024 to treat the perchlorate and hexavalent chromium plumes that are moving outside of the influence of SEPTS. The PCR ISB was injected once in 2024, and early 2025 TZM data indicate that a treatment zone is beginning to establish in that area.

Soil remedies have been effective at Pantex. 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 and ditch liner are operating as designed and occasional rainfall continues to improve vegetative cover on the landfills.

Yearly inspections and the third FYR indicated that several landfills require the soil covers to be maintained. Pantex has completed most of the third FYR landfill actions using a combination of onsite and contract resources. Pantex will continue to address the needed landfill maintenance observed during annual inspections, as budget and availability of onsite resources allow.

The ditch liners prevent the infiltration of water that would cause HEs in soils to migrate to the perched aquifer. Maintenance of the ditch liners is required to ensure continued conveyance of runoff through the ditch system. Contracting and maintenance was completed in 2023. The annual ditch liner inspection in 2024 indicated that debris had accumulated on the ditch liners, and work to clear out the debris was completed in January 2025.

The Former Burning Ground SVE system removed soil gas and residual NAPL in soils at the Burning Ground, thereby mitigating vertical movement of VOCs to the Ogallala Aquifer. Data indicate a strong decline in influent concentrations since the system was modified in 2017. Data from 2021 and 2022 indicated that the NAPL source was near depletion. A closure report was prepared in August 2023. TCEQ and EPA approved closure of the system in late 2023 and the system has been requested for removal from HW-50284. This system was not operated in 2024, although groundwater monitoring will continue at the Burning Ground to evaluate the effectiveness of the removal.

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 currently under the influence of active remedies to determine if additional actions are needed to provide permanent, long-term protection.

Pantex updated the conceptual and fate and transport models in 2021 and completed an evaluation to optimize pump and treat and/or ISB remedies to affect the southeast plume of RDX, perchlorate, and hexavalent chromium. The optimization indicated that further work would be required to control the continued movement of RDX that extends offsite. Further work is also required to address the hexavalent chromium and perchlorate plume that is outside the influence of the SEPTS. Pantex implemented the construction of the PCR ISB and the CR8 ISB to aid in the treatment of these plumes. The PCR ISB was injected once during 2024, and infrastructure at the CR8 ISB is contracted to be installed in 2025, with injection planned for 2026.

5.2 Conclusions from the Five-Year Reviews

Pantex has completed three FYRs. The latest FYR Report was approved in September 2023.

The results of the FYRs indicate that the selected remedy is performing as intended and is protective of human health and the environment in the short term because there are no completed exposure pathways to human receptors for soil or perched groundwater. Ecological pathways that are complete were determined to be within acceptable risk ranges and no further actions are necessary to protect ecological receptors.

To achieve long-term protectiveness of human health, operation and maintenance of the remedial action systems must continue, and enhancements to existing systems and institutional controls must be evaluated, planned and implemented.

This section is provided to track the recommendations and actions from the FYRs to completion. All items from the second FYR were complete by the end of 2022, with the exception of evaluating the SVE System for shutdown after completion of upgrades in 2017 (HGL and Pantex, 2018). Pantex prepared a closure report for the system and submitted that to TCEQ and EPA in August 2023. Both agencies approved the closure report in 2023. Pantex removed the SVE System from the application to renew HW-50284 when it was submitted in December 2023. The system has been shut down and is not planned for further operation. Pantex committed to continuing to evaluate groundwater at the Burning Ground to ensure long-term effectiveness of the action to remove residual NAPL in soils.

One recommendation from the first and second FYR was carried into the third FYR: the issue of incomplete treatment at the Southeast ISB at well PTX06-1153. While previous work had improved conditions at PTX06-1153, concentrations of RDX persist in that area, indicating that complete treatment is not occurring. It was recommended that this well be injected. Pantex has requested the removal of PTX06-1153 as a POC well in the application to renew HW-50284. This well will be planned for injection in 2025, pending approval from the TCEQ while the permit renewal continues.

Table 5-1 details the issues and recommendations contained in the third FYR. Plans for completion or summary of work completed are provided for each item.

Table 5-1. Third FYR (2023) Issues and Recommendations

Issue	Recommendations & Followup	Milestone Date	Completion Date	Actions
Concerns				
Soil Remedies				
Minor deficiencies in protective soil covers, including erosion, animal burrows, and settling.	Prepare and implement a work plan to fill holes on soil cover surfaces and investigate erosion around a culvert at Landfill 5 (SWMU 56).	Sep 2025		This work will be scheduled either through contracting or onsite resources.
Tears observed in the SWMU 2 and 5-05 Ditch Liners during the 2021 inspection, and sedimentation and erosion of the anchor trench.	Prepare and implement contracting to repair tears in the ditch liner.	Apr 2024	Sep 2023	Completed through contracting at end of FY 23.
Groundwater Remedies				
Perched groundwater elevations and RDX concentrations are increasing around Playa 1.	1. Eliminate all treated perched groundwater discharges to Playa 1 and resume operating the P1PTS at operational goals once the center-pivot irrigation system is operational. 2. Continue to monitor LTM wells near Playa 1 to verify that perched groundwater elevations drop during the next FYR period and RDX concentrations decrease.	Initial: July 2024 Extension: May 2025 Now May 2026 Continuing		Pivot irrigation operational in Sept 2023. PFAS in wastewater was evaluated through October 2023 to determine if release to the pivot system is feasible. Although release of wastewater to the pivot system is possible, release to the system is limited during winter months. Repair of WWTF lagoons and needed repairs to the subsurface irrigation system communication system will continue to require release of water to Playa 1. Evaluate water levels annually in progress report.

Issue	Recommendations & Followup	Milestone Date	Completion Date	Actions
Incomplete treatment of contaminants (HEs and Cr[VI]) downgradient of the west end of the Southeast ISB (at PTX06-1153).	Continue to collect and evaluate data from the Southeast ISB area and consider targeted injections in the area of PTX06-1153. Evaluate options for optimized injection of amendments to address contamination in this area.	Sep 2025		Pantex requested removal of PTX06-1153 as a point of compliance well in the application to renew HW-50284 so that the well can be injected. Permit issue is pending. Well will be injected in 2025 while permit renewal continues, pending approval by TCEQ.
DNT4A was detected above the GWPS in Ogallala monitoring well PTX06-1056.	1. Install additional Ogallala monitoring wells near PTX06-1056 and upgradient between the Southeast ISB and PTX06-1056 to define the extent of the impacts to the Ogallala Aquifer and evaluate migration potential toward Site boundaries. 2. Prepare a workplan to complete the investigation of DNT4A in the Ogallala Aquifer.	Sep 2025 Mar 2026		Four new wells were installed in FY24. Additional impacts were observed in new FY23 and FY24 wells, especially RDX in PTX06-1229 and PTX06-1231. Downgradient extent appears to be delineated at PTX06-1233 and neighboring wells. A workplan will be prepared to complete the investigation of contaminants that exceed GWPS in the Ogallala Aquifer.
1,4-dioxane is present in the perched aquifer and is not treated by the active remedies.	Incorporate 1,4-dioxane into the next Pantex Plant Ogallala Aquifer and Perched Groundwater Contingency Plan update with steps to take if concentrations increase.	Mar 2025	Mar 2025	Contingency Plan updated to include items from SVE Closure Report and 1,4-dioxane strategy.

Issue	Recommendations & Followup	Milestone Date	Completion Date	Actions
PFAS were present in products used at the Pantex Plant and have been detected in SEPTS influent groundwater.	1. Sample a strategic subset of existing perched groundwater LTM wells to determine the extent of PFAS impacts at the Pantex Plant.	Sep 2024	Dec 2024	The sampling conducted in accordance with a preliminary PFAS Groundwater Sampling Plan was completed by the end of 2024.
	2. Assess whether existing remedies are removing PFAS, and assess if existing remedies are spreading PFAS through injection of treated water or in waste streams for spent ion exchange resin or GAC.	Sep 2024	Jun 2023	Have completed GAC study at the pump and treat system and have implemented automated change-outs. Pantex is currently evaluating effluent from WWTF before sending to the pivot system and has implemented monthly sampling.
	3. Prepare a work plan to complete a PFAS site investigation.	Mar 2026		Work Plan has been contracted and is planned for completion in March 2026.
Sections of the Zone 11 ISB demonstrate mixed results, with incomplete degradation of TCE near TZM wells PTX06-1164 and PTX06-1169.	1. Review amendment injection volumes to confirm that they are sufficient to distribute amendment away from the injection wells.	Sep 2024	Dec 2024	Reporting added to ISB contractor requirements. Injection volumes were reviewed in 2024.
	2. Test alternative well maintenance approaches, such as sequential application of different chemical agents, longer surge times, or a heated water maintenance approach, to improve transmissivities around the well screens.	Sep 2024		Alternative approaches for well maintenance to be added to contract and completed in FY25, per letter for submittal of 2023 Annual Report.

Issue	Recommendations & Followup	Milestone Date	Completion Date	Actions
Recommendations for Remedy Optimization and Monitoring				
Soil Remedies				
Request that the current operating permit for the SVE system be modified to terminate operation of the system.	1. Provide evaluation of the Burning Ground SVE system performance and request concurrence to cease operations.	Sep 2024	Aug 2023	Draft Final Burning Ground Closure Report was submitted to regulatory agencies in August 2023. EPA and TCEQ approval provided by the end of 2023. The SVE System was requested for removal in the application to renew HW-50284 in December 2023. Permit renewal is pending.
	2. Continue the groundwater sampling program at wells PTX01-1001, PTX01-1010, and PTX01-1011 to obtain data to support termination of the Burning Ground SVE system.	Sep 2024	Nov 2024	Pantex committed to continuing to sample the point of compliance and exposure wells identified for the Burning Ground. Pantex incorporated evaluation and response requirements into the Pantex Plant Ogallala Aquifer and Perched Groundwater Contingency Plan, completed in March 2025. The sampling requirements were also retained in the updated LTM Design and SAP that were completed in November 2024.
Groundwater Remedies				
Consider reassessing P&T system operational goals as water levels in extraction wells reach practical limits for extraction.	Develop a planned approach to transition away from the current extraction rate goal when extraction rates can no longer feasibly be met.	Sep 2025	Mar 2023	Operational goals related to water outlets were updated in early 2023 and are included in Section 1 of this report.

Issue	Recommendations & Followup	Milestone Date	Completion Date	Actions
Prioritize locations for groundwater extraction from recommendations in the 2021 optimization study (HGL, 2021).	1. Operate the P1PTS and SEPTS with wells prioritized based on the results of the 2021 optimization study. 2. Continue evaluating the benefit of adding new wells in areas recommended in the 2021 optimization study.	Sep 2025	Jun 2025 Dec 2024	Water levels have declined and maximum wellfield extraction rates have dropped to the point that the need to prioritize wells for extraction is no longer required. Inclusion of new wells has been evaluated. Northeast pump and treat wells were added east of FM 2373, but pump tests indicated that the wells yielded very little water so the system will be used for ISB injection. No new perched extraction wells will be included in the pump and treat system. New wells have been installed for new ISB systems proposed in the study.
Consider periodically measuring pH in injection wells and adding buffering agents as needed.	Add pH to monitoring of the ISB wells during pre-injection activities and add a buffering agent such as sodium bicarbonate as needed, to counteract the acid production by microorganisms.	Sep 2025		Extension was requested from 2024 to 2025 with the 2023 Annual Report to ensure this could be included on the ISB contract. The contractor has gathered pH data after well maintenance. These data indicate a pre-maintenance pH of 5 to 7 standard units. Additional data will be acquired via changes to the ISB O&M contract in 2025. Monitoring to be carried out in 2025 along with an evaluation of all pH data collected since molasses injections began.
Consider increasing the duration between injection events at the Southeast ISB Extension.	Increase the time until the next injection event at the Southeast ISB Extension to assess if TOC concentrations remain elevated for longer than expected and the system can be injected less frequently.	Sep 2024	June 2024	Pantex has been evaluating lengthening the injection timeframes at the Southeast ISB Extension. Injection was completed in December 2021, September 2022 and October 2023. TZM data have indicated that reducing conditions have been adequate to treat the high explosives. Pantex plans to continue yearly injections as discussed in the 2023 annual progress report.

Issue	Recommendations & Followup	Milestone Date	Completion Date	Actions
LTM Network				
Update LTM Network Design and SAP documents to capture changes and recommendations from the Third FYR, after regulatory approval.	Long-Term Monitoring System Design and Sampling and Analysis Plan documents need to be updated to reflect applicable recommendations from the 2022 LTM optimization review after approval by TCEQ/EPA. Adjust sampling frequencies and add analytes where identified. Other needed revisions resulting from this FYR should be incorporated in this effort.	Dec 2024	Nov 2024	LTM Design and SAP documents were submitted to TCEQ and EPA in November 2024.

5.3 RECOMMENDATIONS

Pantex plans to continue currently approved remedial actions. The groundwater remedies are considered protective for the short term since untreated perched groundwater use is controlled to prevent human contact and Ogallala Aquifer data continues to indicate COC concentrations are either non-detect or below the GWPS in areas near onsite and offsite water resources. The systems are also proving to be effective in reaching long-term objectives for cleanup in areas that are under the influence of a remedial action. Pantex has some recommended changes provided below to address areas outside of the influence of the remedial action.

Soil remedies have also been effective at Pantex; 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.

Based on issues identified in the third FYR and this report, changes are recommended or have already been implemented to enhance the effectiveness of the remedies in some areas and improve monitoring of the overall effectiveness of the actions. Those recommendations are provided in the following sections.

5.3.1 RECOMMENDED CHANGES TO THE SELECTED REMEDIES

In accordance with the Explanation of Significant Difference (Pantex, 2022) wells for two additional ISB systems have been installed, one of which (the County Road 8 ISB System) has not yet begun operation. Pantex is planning to install infrastructure in 2025 and begin injection of this system to treat the east region of significant HE contamination in 2026, pending funding availability. Former SEPTS extraction wells east of FM 2373 are being converted to injection wells and are planned to be connected to this system. Three wells north of this area have been installed and are planned to become part of a separate Northeast ISB System. Injection infrastructure for this system will be installed pending funding availability.

5.3.2 RECOMMENDED CHANGES TO THE PUMP AND TREAT SYSTEMS

Pantex has implemented the new operational goals that prioritize operation of the SEPTS to more effectively capture perched groundwater and contaminant plumes moving to the southeast. The subsurface irrigation system is projected to come back online, and coupled with the pivot irrigation system, this will alleviate or eliminate the need to shut down P1PTS in order to allow SEPTS to operate; both systems will be operated to capacity if adequate water outlets are available.

Pantex had planned to further evaluate priority of pumping at the SEPTS to ensure that plumes and water are efficiently removed. This evaluation was also recommended in the third FYR. Water levels have declined across SEPTS to the degree that a prioritization scheme for individual wells is no longer needed, and all wells will be pumped at their capacity while SEPTS is operational.

5.3.3 Recommended Changes to the ISB Systems

Pantex continues to evaluate the ISBs and make changes, as appropriate, to address incomplete treatment in certain areas. The third FYR recommended changes to ISB operations in some areas and Pantex is working toward implementing those changes.

5.3.3.1 Southeast ISB

Although Pantex has injected a more soluble carbon (i.e., molasses) to improve the distribution of amendment at the ISB and injected in dry upgradient wells, RDX continues to persist above GWPS at PTX06-1153. Pantex has requested the removal of PTX06-1153 as a point of compliance monitoring well from HW-50284 and plans to inject the well in 2025 after requesting approval from the TCEQ to move forward with injection in the planned timeframe of completion while the permit renewal continues to be processed.

5.3.3.2 Southeast ISB Extension

Pantex evaluated moving to yearly injections at the Southeast ISB Extension system, and recommended yearly injections were implemented at this system in FY24. Annual injections will be continued so long as monitoring data indicate that this is adequate to maintain treatment conditions.

5.3.3.3 Zone 11 ISB

Pantex has installed additional infrastructure to address the hydraulic changes in the system and has in-filled wells where old injection wells will no longer accept amendment injections. In accordance with recommendations in the FYR, amendment volumes were reviewed for the wells surrounding PTX06-1164 and PTX06-1169 to determine if extra volume was required during injections or if changes made to the network (additional wells) would be adequate to achieve the desired performance downgradient. Pantex evaluates the injection of the system annually and will continue to optimize amendment injections across the system to ensure the most favorable amendment distribution is achieved considering the reduced transmissivity, injection season, and other logistical issues related to injection operations at the Zone 11 ISB.

Pantex was able to install two wells that were planned as part of the second row of wells on the southeastern side of this ISB system in FY 24 to address a gap in treatment. Treatment data will be evaluated and reported in future reports.

5.3.3.4 Offsite ISB

Injections began in 2021 with injections occurring the year following installation of each phase. All phases of installation were complete by the end of 2023 and the system was fully operational in FY 24. No changes to this ISB system are recommended at this time.

5.3.3.5 Perchlorate/Chromium ISB

This system was installed and fully injected in 2024 and a second injection event is planned for 2025. No changes to this ISB system are recommended at this time.

5.3.4 Recommended Changes to the Monitoring Network

Pantex continues to implement select recommendations from the MAROS monitoring evaluation completed for the third FYR. Some of these changes are included in the updated *Long-Term Monitoring System Design* and *Sampling and Analysis Plan* completed in 2024. In 2025, the suggestion for a monitoring well downgradient of the Zone 11 ISB system is scheduled to be implemented (PTX06-1238) provided adequate funding is available.

Due to detections of three high explosives above GWPS at the new Ogallala well PTX06-1229, Pantex has begun assessing the nature and extent of the HE plume in the Ogallala Aquifer. As recommended in the third FYR, Pantex will develop a work plan to evaluate the nature and extent of these detections. Pantex has installed new Ogallala monitor wells (PTX06-1231 and PTX06-1232), distant from water resource locations, that demonstrated detections of high explosives above the GWPS. A new well (PTX06-1233), together with existing Ogallala wells, provides downgradient delineation of the HE plume at this time. Pantex is following the recommendations in the *Pantex Plant Ogallala Aquifer and Perched Groundwater Contingency Plan* and will install new wells to delineate this plume in the deep aquifer horizontally and vertically. Up to eight wells will be installed based on funding availability in 2025.

Pantex is also planning to install two perched aquifer wells in the southeast area during 2025. An additional TZM well will be installed at the Southeast ISB Extension and a new well to monitor conditions near the southwestern edge of the Offsite ISB system. A third well is planned to be installed on TTU property southwest of the Zone 11 ISB to continue to evaluate the perchlorate and TCE that was untreated by the ISB when the system was first installed.

5.3.5 Recommended Changes to Soil Remedies

No changes to the landfill or ditch remedies are recommended.

Pantex prepared a closure plan for the Burning Ground SVE. The system closure was approved by regulatory agencies in 2023. Pantex plans to continue groundwater monitoring at the point of compliance and exposure wells at the Burning Ground to evaluate the long-term effectiveness of this remedial action. Pantex also included requirements for response to detections in those wells in an updated *Pantex Plant Ogallala Aquifer and Perched Groundwater Contingency Plan* (March 2025).

5.3.6 Recommended Changes Based on Regulatory Comments

Pantex received comments from the TCEQ on the supporting documents for the recommended changes to the Pantex Remedial Action (TCEQ, 2022). Pantex has agreed to complete some additional work and track the actions to completion in the annual progress reports, per letter dated February 15, 2023 (USDOE/NNSA, 2023). Table 5-2 provides the two items and their current status: both have been completed.

In letters dated December 4, 2024, February 28 and March 13, 2025 (TCEQ 2024, 2025a, b), the TCEQ requested additional information and work to be completed. Items from this list that were requested in the next Progress Report or that relate to ongoing work are also referenced in Table 5-2. Responses to requests for the following have been or will be sent under separate cover:

- Submittal of a Class 2 Modification application to remove the abandoned PTX06-1064 Ogallala well from the list of POE wells and designate PTX06-1062A as a POE well to replace it. The Class 2 Modification will be submitted following the issuance of the new permit.
- Submittal of the *Preliminary Per- and Polyfluoroalkyl Substances Sampling Plan for the Pantex Plant.* This plan was submitted to the TCEQ in March 2025.
- Submittal of an interim investigation report documenting PFAS investigations completed to date. Pantex started preliminary assessment of PFAS use at Pantex.

That assessment was documented in the *Preliminary Per- and Polyfluoroalkyl Substances Sampling Plan for the Pantex Plant* that was submitted to TCEQ in 2025.

- Revision of the LTM Design Report and SAP to maintain the following wells on a semiannual sampling schedule: PTX01-1012, PTX06-1005, PTX06-1041, PTX06-1154, PTX06-1183. Sampling DQOs were updated to ensure these wells continue to be sampled semiannually. Revised LTM and SAP documents that reflect these changes will be submitted by December 2025.

Table 5-2. Status of Actions from Regulatory Correspondence

Recommended Actions to Complete	Milestone Date	Completion Date	Status
Review/update the well information data table to include updated bottom of FGZ picks from Ogallala wells.	Dec 2026	Dec 2024	The table update is complete; new information from newly installed wells has been incorporated based on data collected during drilling.
Put in two additional wells at the southeast and southwest perimeter of Zone 11 to better evaluate the Zone 11 plumes.	Dec 2026	Nov 2024	Pantex contracted to have those wells installed in 2024. Pantex was able to install one of the wells on the southeast perimeter of Zone 11, but encountered issues with a high in the fine-grained zone at the chosen location for the second well on the southwest perimeter of Zone 11. That boring was plugged and another location was drilled, but another high in the fine-grained zone was encountered at that location as well. A third location was not drilled because other wells were already present in the area. Therefore, Pantex has installed one well in accordance with this request, but a second location will not be feasible on the southwestern perimeter of Zone 11. No further well installations are planned for this request.
Provide HE data collected to date from wells PTX06-1056, 1223, 1224, and 1229.	June 2025 (next Progress Report)	June 2025	This data is provided in Appendix D, Tables D-7 and D-8.

Recommended Actions to Complete	Milestone Date	Completion Date	Status
Provide laboratory analytical results from PTX01-1010.	June 2025 (next Progress Report)	June 2025	This data is provided in Appendix D, Table D-10.
Install two wells southwest and southeast of PTX06-1207 to delineate the southern extent of COCs in the perched aquifer.	Dec 2025		The need to install these wells has been added to Pantex planning documents. For 2025 a well (PTX06-1238) will be installed west of PTX06-1207 to delineate contamination migrating southwest from Zone 11 (Section 5.3.4).

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