

**FOURTH FIVE-YEAR REVIEW REPORT
FOR
PETRO-CHEMICAL SYSTEMS, INC. (TURTLE BAYOU) SUPERFUND SITE
LIBERTY COUNTY, TEXAS**



August 2016



Prepared by

**U.S. Environmental Protection Agency
Region 6
Dallas, Texas**

**FOURTH FIVE-YEAR REVIEW REPORT
PETRO-CHEMICAL SYSTEMS, INC. (TURTLE BAYOU) SUPERFUND SITE
EPA ID#: TXD980873350
LIBERTY COUNTY, TEXAS**

This memorandum documents the U.S. Environmental Protection Agency's performance, determinations and approval of the Petro-Chemical Systems, Inc. (Turtle Bayou) Superfund site (Site) fourth five-year review under Section 121 (e) of the Comprehensive Environmental Response, Compensation, and Liability Act, 42 U.S. Code Section 9621 (c), as provided in the attached Fourth Five-Year Review Report.

Summary of the Fourth Five-Year Review Report

The site remedy consists of short-term removal actions and long-term remedial actions. The long-term remedial actions for operable unit 1 (OU1) include excavation of contaminated soil on County Road 126 (CR126) and placement of the material in a Resource Conservation and Recovery Act (RCRA) storage facility at OU2. In addition, institutional controls are in place to prevent exposure to any residual contaminated soils remaining under CR126. The OU2 long-term remedy addresses soil and groundwater contamination at seven areas along CR126. The OU2 soil remedy consists of treatment, on-site consolidation, capping of contaminated soils, surface restoration and stormwater controls. The OU2 groundwater remedy consists of treatment, containment, and long-term maintenance and monitoring. Technical Impracticability (TI) Waiver Zones have been established for different areas of the Site and long term ground water monitoring is being conducted in these areas to ensure that the plume is not migrating. Not all institutional controls in the form of groundwater and land use restrictions are in place.

Human Exposure Status: Under Control

Contaminated Groundwater Status: Under Control

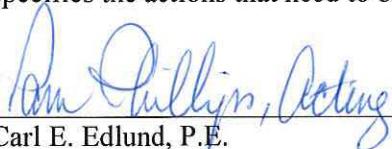
Actions Needed

The following actions must be taken for the remedy to be protective over the long term:

- Evaluate the protectiveness of the groundwater protection standards for 1,1-dichloroethane, acetone and naphthalene in light of current toxicity values or drinking water criteria.
- Evaluate the technical impracticability (TI) and Compliance Zone boundaries southwest of the Main Waste Area (MWA) and Office Trailer Area (OTA) in the vicinity of MW-035 and evaluate whether the TI boundary and compliance boundary needs to be expanded in the vicinity of this well
- Install a well south of MW-161 in the MW-10 subarea of the OTA to monitor any plume expansion before it reaches the TI boundary.
- Complete the implementation of remaining institutional controls at all parcels impacted by the Site.
- Establish a TI waiver once the groundwater contamination delineation is completed at the MW-109 Area

Determination

I have determined that the selected remedy for the Petro-Chemical Systems, Inc. (Turtle Bayou) Superfund site is currently protective of human health and the environment in the short term. This Five-Year Review Report specifies the actions that need to be taken for the remedy to be protective over the long term.




Carl E. Edlund, P.E.
Director, Superfund Division
U.S. Environmental Protection Agency Region 6

8/19/16

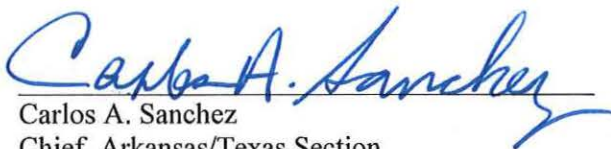
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CONCURRENCES

FOURTH FIVE-YEAR REVIEW REPORT
PETRO-CHEMICAL SYSTEMS, INC. (TURTLE BAYOU) SUPERFUND SITE
EPA ID#: TXD980873350
LIBERTY COUNTY, TEXAS


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ISSUES/RECOMMENDATIONS

FOURTH FIVE-YEAR REVIEW REPORT PETRO-CHEMICAL SYSTEMS, INC. (TURTLE BAYOU) SUPERFUND SITE EPA ID#: TXD980873350 LIBERTY COUNTY, TEXAS

Issues/Recommendations
OU(s) without Issues/Recommendations Identified in the Five-Year Review:
OU1

Issues and Recommendations Identified in the Five-Year Review:

OU(s): OU2	Issue Category: Remedy Performance			
	Issue: The groundwater protection standards for 1,1-dichloroethane, acetone and naphthalene may not be stringent enough for monitoring the TI and Compliance Zones.			
	Recommendation: Evaluate whether groundwater protection standards should be revised for 1,1-dichloroethane, acetone and naphthalene to reflect current toxicity values. If so, determine if the TI and Compliance Zones need to be revised.			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
No	Yes	EPA	EPA/State	6/11/2017

OU(s): OU2	Issue Category: Remedy Performance			
	Issue: Contamination has been detected above cleanup goals outside of the Compliance Zone southwest of the Main Waste Area (MWA) and Office Trailer Area (OTA) in well MW-035.			
	Recommendation: Evaluate whether the TI and Compliance Zones requires expansion in the vicinity of well MW-035.			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
No	Yes	PRP	EPA/State	6/11/2017

OU(s): OU2	Issue Category: Remedy Performance			
	Issue: TBA concentrations appear stable but remain well above the cleanup goal of 2,200 µg/L in MW-161 in the MW-10 subarea. However, there are no wells south of this well to monitor whether this contaminant remains below the cleanup goal in the Compliance Zone.			
	Recommendation: Install a well south of MW-161 to evaluate whether TBA in the MW-10 subarea remains below the cleanup goal within the Compliance Zone.			

Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
No	Yes	PRP	EPA/State	6/11/2017

OU(s): OU2	Issue Category: Institutional Controls			
	Issue: Not all institutional controls have been implemented by the potentially responsible parties (PRPs) and Trustee as outlined in site decision documents.			
	Recommendation: Complete implementation of remaining institutional controls at all parcels impacted by the Site.			

Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
No	Yes	PRP	EPA/State	6/11/2017

OU(s): OU2	Issue Category: Monitoring			
	Issue: A technical impracticability waiver for the MW-109 Area needs to be established based on the delineated groundwater plume.			
	Recommendation: Establish a TI waiver once the groundwater contamination delineation is completed.			

Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
No	Yes	EPA	EPA	12/1/2016

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LIST OF ABBREVIATIONS & ACRONYMS

ARAR	Applicable or Relevant and Appropriate Requirement
AROD	Amended Record of Decision
BDA	Bayou Disposal Area
C1	Clay Unit 1
C2	Clay Unit 2
CalEPA	California Environmental Protection Agency
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	Contaminant of Concern
CR126	County Road 126
EA	Easement Area
EPA	Environmental Protection Agency
EPEC	El Paso Energy Corporation Polymers, Inc.
ESD	Explanation of Significant Differences
FWRA	Far West Road Area (another name for CR126 West Area)
FYR	Five-Year Review
HQ	Hazard Quotient
IC	Institutional Control
ICP	Institutional Controls Plan
IDW	Investigation Derived Waste
ISB	In-situ Bioremediation
ISCO	In-situ Chemical Oxidation
ISTD	In-situ Thermal Desorption
M1	Silt Unit
MCL	Maximum Contaminant Level
µg/L	Microgram per Liter
mg/kg	Milligram per Kilogram
mg/L	Milligram per Liter
MOA	Memorandum of Agreement
MNA	Monitored Natural Attenuation
MWA	Main Waste Area
MW	Monitoring Well
NA	Natural Attenuation
NAPL	Non-aqueous Phase Liquid
NCP	National Contingency Plan
ND	Not Detected
NPL	National Priorities List
OU	Operable Unit
O&M	Operation and Maintenance
OTA	Office Trailer Area
PAH	Polycyclic Aromatic Hydrocarbon
PCL	Protective Concentration Limit
PRP	Potentially Responsible Party
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RPM	Remedial Project Manager
RSL	Regional Screening Level
SAP	Sampling and Analysis Plan

S1	Sand Unit 1
S2	Sand Unit 2
SVE	Soil Vapor Extraction
SVOC	Semi-volatile Organic Compound
TBA	Tert-butyl Alcohol
TBC	To-Be-Considered
TCEQ	Texas Commission on Environmental Quality
TI	Technical Impracticability
TNRCC	Texas Natural Resource Conservation Commission
TRRP	Texas Risk Reduction Program
TRSF	Temporary RCRA Storage Facility
TWC	Texas Water Commission
UAO	Unilateral Administrative Order
USACE	United States Army Corps of Engineers
UU/UE	Unlimited Use and Unrestricted Exposure
VOC	Volatile Organic Compound
WRA	West Road Area

I. INTRODUCTION

The purpose of a five-year review (FYR) is to evaluate the implementation and performance of a remedy to determine if the remedy is and will continue to be protective of human health and the environment. The methods, findings and conclusions of reviews are documented in FYR reports such as this one. In addition, FYR reports identify issues found during the review, if any, and document recommendations to address them.

The U.S. Environmental Protection Agency (EPA) is preparing this FYR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121, consistent with the National Contingency Plan (NCP)(40 CFR Section 300.430(f)(4)(ii)), and considering EPA policy.

This is the fourth FYR for the Petro-Chemical Systems, Inc. (Turtle Bayou) Superfund site (Site). The triggering action for this statutory review is the completion date of the previous FYR. The FYR has been prepared due to the fact that hazardous substances, pollutants or contaminants remain at the Site above levels that allow for unlimited use and unrestricted exposure (UU/UE). The documents used in preparing this FYR are summarized in Appendix A.

The Site consists of two operable units (OUs); this FYR addresses both of them. OU1 addresses the soil remedy for the Frontier Park Road area (now known as County Road 126, or CR126). OU2 addresses the soil and groundwater remedies at seven other areas of the Site located along CR126, including the West Road Area (WRA), Main Waste Area (MWA), Office Trailer Area (OTA), Power Easement Area (EA), Far West Road Area (FWRA), Bayou Disposal Area (BDA) and MW-109 Area.

The FYR was led by EPA remedial project manager (RPM) Rajalakshmi Josiam. Participants included Audrey Kirtley with the Texas Commission on Environmental Quality (TCEQ); Joseph Wiley with Kinder-Morgan Inc., project manager for its subsidiary and potentially responsible party (PRP) El Paso Energy Corporation Polymers, Inc. (EPEC); Angela DeDolph with Ramboll Environ (contractor for the Lyondell Trust); and EPA contractor support from Eric Marsh and Claire Marcussen of Skeo Solutions. The review began on 9/29/2015.

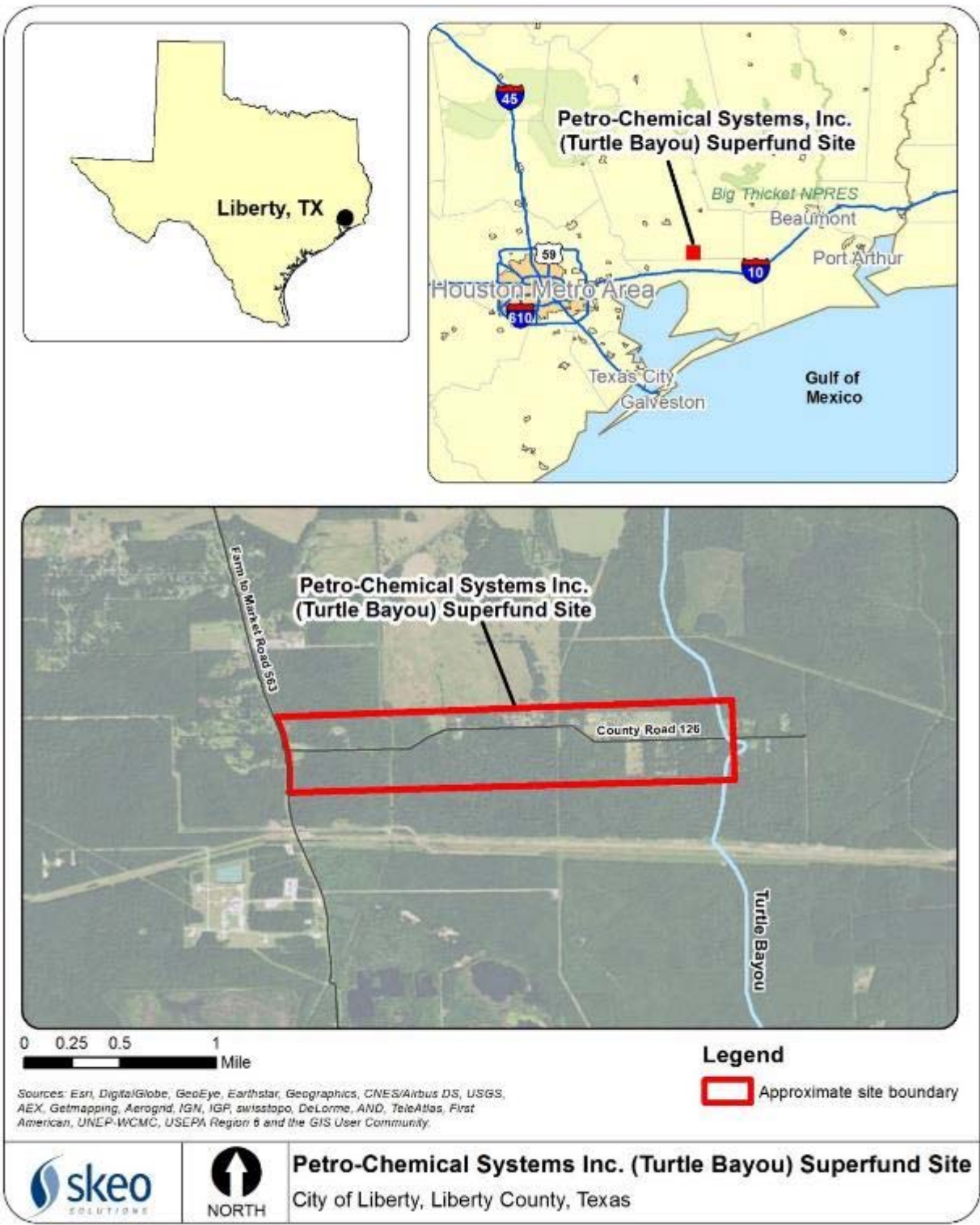
Site Background

The 500-acre area is located in rural Liberty County, 15 miles southeast of the town of Liberty, Texas (Figure 1). The Texas Water Quality Board has records of waste disposal as early as 1971. They indicate that waste oils from nearby petroleum refining activities were disposed of in unlined pits and on Frontier Park Road for dust suppression. Because the Site was never an authorized waste disposal facility, the exact nature of disposal activities is uncertain. However, it appears that the waste was dumped indiscriminately from trucks at eight areas identified by EPA, including dumping of contaminated soil and groundwater with volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs). The eight waste disposal areas that comprise OU1 and OU2 are shown in Figure 2. EPA proposed the Site for listing on the Superfund program's National Priorities List (NPL) in October 1984. EPA listed the Site on the NPL in May 1986.

Historical and current land uses continue to consist of cropland, pasture, range, forest and small rural communities. Following waste disposal activities, the Site's owner subdivided the area into 5-acre and 15-acre plots and sold them for residential development. Residential use of the Site has been continuous since 1974, except when remedial activities required temporary relocation of residents. No residents live on any of the identified waste disposal areas. Seven families live near four disposal areas (FWRA, MW-109, EA and BDA), with four residences on-site and three residences off-site. The Site's contaminated groundwater is present in two sand zones (S1 and S2). The S1 zone lies below an uppermost clay unit (C1) and silt unit (M1). A second clay layer (C2) lies at the base of the S1 zone, isolating the S1 zone from the S2 zone.

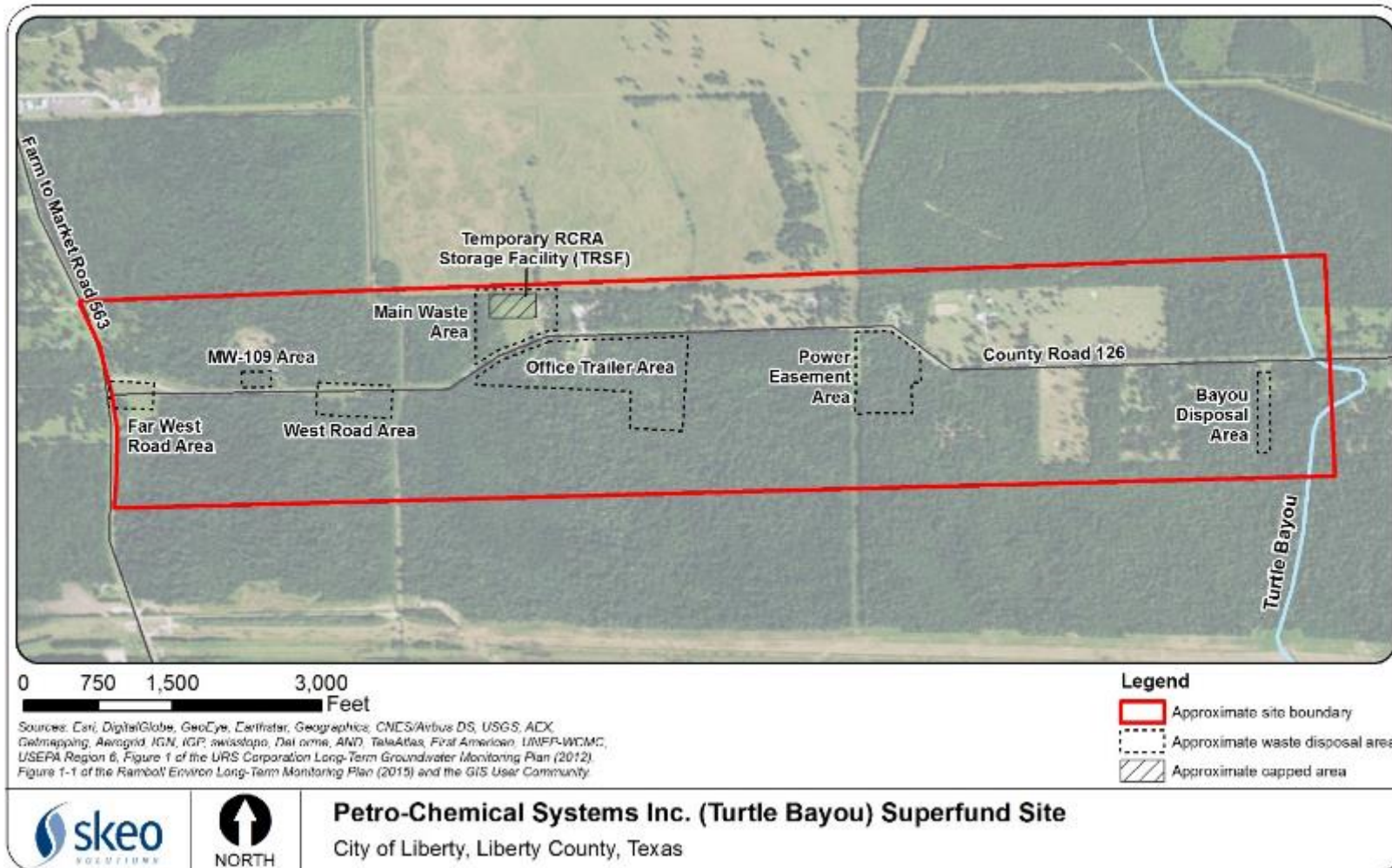
The shallow zones are not currently in use as a source of drinking water on site. However, the shallow aquifer does have the potential for use as a source for drinking water in the future. Shallow water supply wells near remediation areas have been plugged and abandoned. Appendix C provides a detailed summary of the Site's physical characteristics and history.

Figure 1: Site Map



Disclaimer: This map and any boundary lines within the map are approximate and subject to change. The map is not a survey. The map is for informational purposes only regarding the EPA's response actions at the Site.

Figure 2: Site Detail



Disclaimer: This map and any boundary lines within the map are approximate and subject to change. The map is not a survey. The map is for informational purposes only regarding EPA's response actions at the Site.

FIVE-YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION		
Site Name: Petro-Chemical Systems, Inc. (Turtle Bayou)		
EPA ID: TXD980873350		
Region: 6	State: TX	City/County: Liberty County
SITE STATUS		
NPL Status: Final		
Multiple OUs? Yes	Has the site achieved construction completion? Yes	
REVIEW STATUS		
Lead agency: EPA		
Author name: Rajalakshmi Josiam, with additional support provided by Skeo Solutions		
Author affiliation: EPA Region 6		
Review period: 9/29/2015 - 7/15/2016		
Date of site inspection: 1/12/2016		
Type of review: Statutory		
Review number: 4		
Triggering action date: 9/16/2011		
Due date (five years after triggering action date): 9/16/2016		

II. RESPONSE ACTION SUMMARY

Basis for Taking Action

The agencies concluded that the risk of exposure to contaminants was high for people living along CR126 due to the presence of contaminated soils at or near surface and because CR126 is the primary access route for people living on site. The baseline risk assessment for OU2 demonstrated that exposure to contaminated soil and groundwater were the primary exposure pathways resulting in unacceptable human health risks. Table 1 summarizes the primary exposure media and contaminants of concern (COCs) for OU1 and OU2. The ecological risk assessment showed that exposure to contaminated site areas was not expected to be significant. The highest soil contaminant concentrations were detected at depth, and surface water and sediment were not significantly impacted. No federally endangered species were identified at the Site.

Response Actions

To manage the cleanup, EPA and TCEQ divided the Site into two OUs. OU1 addresses contaminated soil along CR126. OU2 addresses contaminated soil and groundwater at the remaining seven areas of the Site: the WRA, MWA, OTA, EA, FWRA, BDA and MW-109 Area.

Table 1: Summary of Contaminated Media and COCs at OU1 and OU2

OU	Media	COC
OU1 ^a	Soil	Benzene
		Naphthalene
OU2 ^b	Soil	Benzene
		Lead
		Naphthalene
		Vinyl chloride
	Groundwater	1,1,2-trichloroethane
		1,1-dichloroethane
		1,1-dichloroethylene
		1,2-dichloroethane
		1,2-dichloropropane
		Acetone
		Benzene
		Cis-1,2-dichloroethylene
		Ethylbenzene
		Lead
		Naphthalene
		Styrene
		Tert-butyl alcohol (TBA)
		Toluene
		Trans-1,2-dichloroethylene
		Trichloroethylene
Vinyl chloride		
Xylene		
<i>Notes:</i> a. COC list from 1987 Record of Decision (ROD). b. COC list from 2006 Amended ROD.		

OU1

EPA issued the OU1 Record of Decision (ROD) in March 1987. It did not establish formal remedial action objectives (RAOs). However, the ROD did list the following goals:

- Prevent direct contact with highly contaminated soil = soils > 100 milligrams per kilogram (mg/kg) total polycyclic aromatic hydrocarbons (PAHs) and total VOCs.
- Minimize direct contact with moderately contaminated soil = soils between 10 mg/kg and 100 mg/kg total PAHs and total VOCs.
- Improve access to the Site for heavy equipment to facilitate remedial investigation sampling and monitoring as well as future remedial actions at other areas of the Site.

The remedy selected in the OU1 ROD included:

- Excavation and removal of highly contaminated soil and storage on site in a Temporary Resource Conservation and Recovery Act (RCRA) storage facility (TRSF) until selection of a permanent remedy.
- Backfilling of excavated areas with clean soil.
- Construction of a road over excavated areas and existing roadway to provide access to the Site.
- Maintenance of the road and TRSF.
- Temporary relocation of on-site residents during excavation.

OU2

EPA issued a 1991 ROD, two Amended RODs (ARODs) in 1998 and 2006, respectively, and three Explanations of Significant Differences (ESDs) – one in 2010 and two in 2012 – documenting that restoring groundwater at OU2 is technically impracticable. Thus EPA selected technical impracticability (TI) waivers as the groundwater remedy for each of the seven disposal areas in OU2 (Table 3) that includes a 2-year transitional period to indicate that natural attenuation (NA) is occurring. EPEC is the PRP for the FWRA and BDA. The Lyondell Custodial Environmental Trust (formerly known as the Lyondell Chemical Company) is the Trustee for the WRA, MWA, OTA and EA. EPA is responsible for implementing the remedy at MW-109.

The remedial components for soil and groundwater vary for each source area within OU2. Due to localized areas of elevated groundwater contamination within the OTA, the Trustee identified three subareas for the purposes of designating TI Zone boundaries in the OTA; the subareas include the B-53, MW-45 and MW-10 areas. The components applicable to each source area and subarea are presented in Table 2. A detailed summary of the Site’s chronology is presented in Appendix D. The appendix also includes a summary of the decision documents, RAOs and remedy components for each of the waste disposal areas in OU2.

Table 2: OU2 Source Area-Specific Remedial Components

Source Area	Media	Remedial Action Component ^a
FWRA	Soil	ISCO
	Groundwater	TI waiver with natural attenuation (NA)
MW-109	Soil	ISCO On-site biotreatment
	Groundwater	TI waiver with NA
WRA	Soil	Soil vapor extraction (SVE) Surfactant flushing In-situ thermal desorption (ISTD) In-situ chemical oxidation (ISCO)
	Groundwater	In-situ bioremediation (ISB) with extraction Containment (slurry wall) TI waiver zone with NA
MWA	Soil	SVE ISTD On-site biotreatment
	Groundwater	ISB with extraction TI waiver with NA
OTA	Soil	SVE Bioventing ISTD On-site biotreatment
	Groundwater	ISB with extraction TI waiver with NA
OTA Subareas B-53 and MW-45	Soil	SVE
	Groundwater	ISB with extraction TI waiver with NA
OTA Subarea MW-10 Area	Soil	No action
	Groundwater	ISB with extraction TI waiver with NA
EA-North	Soil	SVE ISTD On-site biotreatment
	Groundwater	ISB with extraction TI waiver with NA
EA-South	Soil	SVE ISTD
	Groundwater	ISB with extraction

Source Area	Media	Remedial Action Component ^a
		TI waiver with NA
BDA	Soil	No action
	Groundwater	No action
<i>Notes:</i>		
a. Decision documents offered a number of possible remedial options for soil and groundwater. To promote clarity, the remedial components actually used are presented from the Site's 2010 Preliminary Close-Out Report.		

The OU2 soil and groundwater protection standards, as defined by the 1991 ROD, 1998 and 2006 ARODs, and 2012 ESDs are summarized in Table 3 and Table 4, respectively.

Table 3: Summary of OU2 Non-residential Soil Cleanup Levels

COC	Depth Interval (feet)	Cleanup Goal (mg/kg) ^a	Basis
Benzene	NA	36	TCEQ Tier 1 Commercial Industrial Protective Concentration Limit (PCL)
Lead	NA	800	EPA non-residential value
Naphthalene	NA	190	TCEQ Tier 1 Commercial Industrial PCL
Vinyl chloride	NA	10	TCEQ Tier 1 Commercial Industrial PCL
<i>Notes:</i>			
a. From Table 20 of the 2006 AROD, applies to the CR126 right-of-way. mg/kg = milligrams per kilogram NA = not applicable to non-residential areas			

Table 4: Summary of OU2 Groundwater Protection Standards

COC	Standard ^a (µg/L)	Basis
1,1,2-trichloroethane	5	Federal maximum contaminant level (MCL)
1,1-dichloroethane	4,900 ^b	TCEQ Texas Risk Reduction Program, Tier One Groundwater Protective Concentration Limits (TRRP Tier One PCL)
1,1-dichloroethylene	7	Federal MCL
1,2-dichloroethane	5	Federal MCL
1,2-dichloropropane	5	Federal MCL
Acetone	22,000	TCEQ TRRP Tier One PCL
Benzene	5	Federal MCL
Cis-1,2-dichloroethylene	70	Federal MCL
Ethylbenzene	700	Federal MCL
Lead	15	Federal MCL
Naphthalene	327	1991 ROD health-based value
Styrene	100	Federal MCL
TBA	2,200	TCEQ TRRP Tier One PCL
Toluene	1,000	Federal MCL
Trans-1,2-dichloroethylene	100	Federal MCL
Trichloroethylene	5	Federal MCL
Vinyl chloride	2	Federal MCL
Xylene	10,000	Federal MCL
<i>Notes:</i>		
a. Values from Table 17 of 2006 AROD.		
b. Value updated in the 2012 ESDs for EPEC and Lyondell Trust properties; Table 2 in both ESDs.		
TRRP Tier One PCL = Texas Risk Reduction Program, Tier One Groundwater Protective Concentration Limit		
MCL = maximum contaminant level		
µg/L = micrograms per liter		

Status of Implementation

OU1

EPA and TCEQ completed the remedial design between June 1987 and October 1987. The remedial action started in January 1988. EPA excavated contaminated soils from 1 to 5 feet below ground surface along 1,800 feet of CR126; excavated materials were placed in a temporary, aboveground RCRA storage facility (TRSF) on site in the MWA. EPA then backfilled the excavated area with clean soil. The entire length of the road was paved, which prevents direct contact with less-contaminated soils. EPA completed the remedy for OU1 in August 1988. In 2009, EPA entered into an interagency agreement with the U.S. Army Corps of Engineers (USACE) to re-surface CR126 to meet Liberty County Road Specifications. The Liberty County Commissioner's Court approved the CR126 road resurfacing design in June 2010; road resurfacing finished in September 2010. In October 2010, the Court agreed to accept the road as a county road. A Memorandum of Agreement (MOA) dated January 21, 2011, is in place between EPA and Liberty County for the County to operate and maintain CR126. USACE obtained the necessary signatures on an easement agreement from all property owners next to CR126 and submitted the documents to the County in August 2013. Liberty County has assumed responsibility for the ongoing and continued maintenance, improvement and upkeep of the road in accordance with the MOA.

OU2-EPEC Properties

In August 2007, EPA entered into a Consent Decree with EPEC requiring them to address contamination in the Site's FWRA and BDA. EPEC began the In-situ Chemical Oxidation (ISCO) remedial action construction work in the FWRA in March 2008 and completed the remedial action in September 2008. EPEC collected confirmatory samples in October 2008; they confirmed that soil cleanup criteria were met. EPEC conducted a statistical evaluation of soil data in the BDA in February 2007 that indicated that the non-residential soil cleanup criteria had been met. Hence, no excavation was required for the affected soil. Groundwater also met cleanup criteria in the BDA. Therefore, EPEC also plugged and abandoned three monitoring wells in the area in March 2008 and completed installation of a security fence around the BDA in July 2008. EPA's decision to establish a TI waiver zone for the residual groundwater contamination at FWRA is documented in another August 2012 ESD specifically for the EPEC properties. Long-term monitoring is currently taking place to monitor whether contaminant plumes remain within the TI Zone and comply with ARARs within the Compliance Zone (an area beyond the TI Zone).

OU2-MW-109

The ISCO remedy at the MW-109 Area was implemented in 2010. After two rounds of chemical injections and several rounds of injections in the western quadrant of the MW-109 Area, soil remediation goals were not met. In March 2011, an alternative remedy identified in the 1998 AROD – soil excavation with ex-situ biotreatment – was implemented to meet residential and industrial right-of-way cleanup goals. In addition, in 2011, three additional groundwater monitoring wells were installed in the MW-109 area. Eight rounds of quarterly sampling followed. The results indicate that further delineation of the plume is necessary. In May 2016, EPA completed the delineation of the plume and installed four monitoring wells. Sampling of these wells is expected to begin in the summer of 2016.

OU2-Lyondell Trust Properties

In December 1993, EPA issued a Unilateral Administrative Order (UAO) to Lyondell Chemical Company and ARCO to work with EPA and the Texas Natural Resource Conservation Commission (TNRCC) to complete the OU2 remedial design for the WRA, MWA, OTA, EA and BDA. The OU2 remedial design began in September 1992 and finished in May 1998. In December 1998, EPA entered into a Consent Decree with Lyondell and ARCO that superseded the provisions of the 1993 UAO. It required that EPA and TCEQ address contamination in the BDA while Lyondell addressed the WRA, MWA, OTA and EA. However, in 2000, EPA determined that the BDA and Far West Road Area were EPEC's responsibility as part of its settlement with EPEC.

Lyondell completed the remedial action using a variety of soil and groundwater remedial technologies at the four areas between January 1996 and September 2010 pursuant to the Consent Decree (Table 2). Based on more than seven years of active remediation, EPA determined that attaining the Site's groundwater cleanup goals was technically impracticable. Lyondell purchased the affected areas to preclude access and residential exposure. Lyondell filed for bankruptcy in 2010. The Lyondell Trust was established to complete the remediation of the former Lyondell areas of the Site. EPA issued the Preliminary Close-Out Report for OU2 construction completion in September 2010.

EPA and TCEQ have been working with the Lyondell Trust on the OU2 actions. EPA approved a TI waiver zone for residual groundwater contamination at the Lyondell Trust properties in an August 2012 ESD. Lyondell Trust contractors completed an Operations and Maintenance Plan (O&M Plan) for the West Road Slurry Wall in February 2016 and made revisions to the Long-Term Groundwater Monitoring Plan in January 2016 to ensure contaminants remain within the TI Zone and comply with ARARs in the Compliance Zone.

Institutional Control (IC) Summary Table

EPA and Liberty County signed an MOA on January 21, 2011, for the County to operate and maintain CR126. Since CR-126 serves as a cap for remaining soils with concentrations of less than 100 mg/kg of PNAs or VOCs, the MOA requires that the County notify EPA any time extensive road repairs are warranted or when there is a need to dig through CR126. The County is required to submit roadwork repair and dig plans to EPA for review and approval to make sure activities do not expose residual contamination.

The 1991 ROD, 2006 AROD and 2010 ESD required soil and groundwater institutional controls at OU2. EPEC has purchased several properties and has institutional controls in place at other properties. These controls grant EPEC groundwater rights across those properties and/or restrict land use for those properties.

A summary of the institutional controls planned and implemented at EPEC-owned properties or properties where EPEC owns the groundwater rights is presented in Table 5. Maps showing the institutional controls implemented at the EPEC-owned properties is presented in Appendix B.

Table 5: Summary of Planned and/or Implemented ICs for the EPEC OU2 Properties

Media, Engineered Controls, and Areas that do not Support UU/UE Based on Current Conditions	ICs Needed	ICs Called for in the Decision Documents	Impacted Parcel(s)	IC Objective	Title of IC Instrument Implemented and Date Filed (or planned)
BDA					
Groundwater	Yes	Yes	Lot 5 of Parcel 10473 Lot 8 of Parcel 19470	Restrict installation of groundwater wells and groundwater use.	General Warranty Deed for Groundwater Easement and Restrictive Covenants, June 13, 2009
Soil and Groundwater	Yes	Yes	Lot 15 and 36 of Parcel 19502 Lot 37 of Parcel 19503	Prohibit use of groundwater and any kind of residential use or unrestricted recreational use of property.	Special Warranty Deed with Restrictive Covenants July 11, 2012

Media, Engineered Controls, and Areas that do not Support UU/UE Based on Current Conditions	ICs Needed	ICs Called for in the Decision Documents	Impacted Parcel(s)	IC Objective	Title of IC Instrument Implemented and Date Filed (or planned)
Groundwater	Yes	Yes	Lots 7, 11, 38 and 39 of Parcel 19475	Restrict groundwater use and any kind of residential use or unrestricted recreational use of property.	Recording of restrictive covenant is pending
FWRA					
Groundwater	Yes	Yes	Lot 57 of Parcel 128433 (Includes MW-109 Area)	Restrict the use of groundwater in the S1 and S2 water-bearing zones within a 1,000-foot radius of the source area.	General Warranty Deed for Groundwater Easement and Restrictive Covenants, May 7, 2012
			Lot 101 of Parcel 120240		General Warranty Deed for Groundwater Easement and Restrictive Covenants, June 27, 2008
			Lots 78 and 86 of Parcel 19456		General Warranty Deed for Groundwater Easement and Restrictive Covenants, May 1, 2009
			Lots 47, 83, 87 and 90 of Parcel 19453		Special Warranty Deed, December 17, 2009
			Lots 91 and 95 of Parcel 19467		General Warranty Deed for Groundwater Easement and Restrictive Covenants, April 10, 2008
Soil and Groundwater	Yes	Yes	Lot 81 of Parcel 19365	Restrict soil excavation and groundwater use.	Declaration of Covenants, Conditions and Restrictions, August 23, 2002
Groundwater	Yes	Yes	Lots 16, 32, 34, 40 ^a , 63, 81, 94, 107, 112 and 113 of Parcel 19365	Restrict groundwater use.	EPEC owns these parcels and ICs have not yet been implemented. However the parcels will be restricted as part of the sale of the property as deed restrictions, or as a separate restrictive covenant prior to the sale of the property.
Groundwater	Yes	Yes	Lot 31 ^b of Parcel 19364	Restrict groundwater use.	EPEC has been in discussions with the owners of Lot 31 regarding the placement of groundwater restrictions on a portion of that property.
<p><i>Notes:</i></p> <p>a. This lot located within the 1,000-foot radius for which EPEC is in the process of restricting the use of groundwater between the land surface and a depth of 175 feet. The only institutional control required is the restriction of groundwater use between the land surface and a depth of 175 feet. No excavation or construction restrictions are required.</p> <p>b. EPEC does not own this lot. It is, however, located within the 1,000-foot radius for which EPEC will restrict the use of groundwater between the land surface and a depth of 175 feet. EPEC has been working with the owner of this parcel since 2007 to establish a restriction on the water use for the portion of the property that lies within the 1,000-foot radius. An agreement between EPEC and the property owner(s) may be reached in the near future.</p>					

As of February 2005, Lyondell acquired all contaminated properties in the WRA, MWA, OTA and EA. It restricted access to these areas such that residential use does not occur. Since acquiring these properties, Lyondell's bankruptcy was finalized, and the Lyondell Trust was established in March 2010. EPA and TCEQ approved the TI Zones for the Lyondell Trust properties in 2012 following the 2-year monitoring period. Except for the MW-109 area, access to the OU2 disposal areas is controlled by a combination of fences, gates, signs, cable guards and natural barriers. Signs are posted at access locations, which indicate that there may be chemicals on the property and that digging and drilling are restricted to protect human health and the environment. Soil has been remediated to residential standards at the MW-109 area. However, residual contamination remains in groundwater. Eight rounds of quarterly sampling followed. The results indicate that further delineation of the plume is necessary. In May 2016, EPA completed the delineation of the groundwater plume and installed four additional monitoring wells. Sampling of these wells is expected to begin in summer 2016. As of March 2016, institutional controls have not yet been placed on the properties, including restrictions on land and use and drilling of wells. However, the implementation of institutional controls is anticipated to occur second quarter of 2016. Table 6 summarizes the institutional controls planned at the Lyondell trust-owned properties.

Table 6: Summary of Planned and/or Implemented ICs for the OU2 Lyondell Trust Owned Properties

Media, Engineered Controls, and Areas that do not Support UU/UE based on Current Conditions	ICs Needed	ICs Called for in the Decision Documents	Impacted Parcel(s)	IC Objective	Title of IC Instrument Implemented and Date (or planned)
WRA					
Groundwater and Soil	Yes	Yes	Parcels 19350 and 19352	Restrict groundwater and land use. Restrict excavation and construction. Restrict site access.	Property conveyance restriction and property use restriction proposed.
MWA and OTA (includes B-53, MW-45 and MW-10 subareas)					
Groundwater and Soil	Yes	Yes	Parcels 19343, 19348, 19350, 19352, 19366, 19432, 19433, 19468, 19480, 19488, 145649 and 147914	Restrict groundwater and land use Restrict excavation and construction. Restrict site access.	Property conveyance restriction and property use restriction proposed.
Groundwater	Yes	Yes	Parcels 19282, 19368 and 19489	Restrict groundwater use.	Property conveyance restriction proposed.
EA					
Groundwater and Soil	Yes	Yes	Parcels 19509, 19471, 19500, 19434 and 19281	Restrict groundwater and land use. Restrict excavation and construction. Restrict site access.	Property conveyance restriction and property use restriction proposed.
Groundwater	Yes	Yes	Parcels 19469, 19490, 19491 and	Restrict groundwater use.	Property conveyance restriction proposed.

Media, Engineered Controls, and Areas that do not Support UU/UE based on Current Conditions	ICs Needed	ICs Called for in the Decision Documents	Impacted Parcel(s)	IC Objective	Title of IC Instrument Implemented and Date (or planned)
			19510		

The 2010 ESD specifies that EPA will work with the landowner to place a deed restriction on the property in the MW-109 Area. EPEC has implemented the ICs for the residential property (Lot 57 of parcel 128433) as summarized in Table 5. EPA is continuing to delineate the groundwater contamination to support the development of a TI waiver for the MW-109 area.

Systems Operations/Operation & Maintenance

OUI

On October 26, 2010, the Liberty County Commissioners Court accepted the as-built condition of CR126 as a County Road and assumed responsibility for its operations and maintenance. EPA and Liberty County signed a MOA on January 21, 2011, for the County to operate and maintain the road. Maintenance may include ditch clearing, crack repair, culvert maintenance and other maintenance. Costs were not available from the County.

OU2 – Lyondell Trust Properties

Lyondell completed active remediation in the WRA, MWA, OTA, and EA in July 2005. Non-residential soil cleanup criteria have been met for these areas. However, groundwater cleanup criteria were not met in any of these areas despite remedial activities. Since the end of remedial operations in 2005, operations at the WRA, MWA, OTA, and EA have included groundwater monitoring, fence installation and maintenance, mowing, vegetation control, and other O&M activities. Contractors for the Lyondell Trust monitor groundwater to assess natural attenuation and to ensure compliance with the TI waiver zone established in August 2012.

The Lyondell Trust conducts O&M activities according to the 2016 Long-Term Maintenance Plan to evaluate the condition of the trust properties and ensure contamination remains within the final TI and Compliance Zone boundaries. These activities include site maintenance once per quarter that includes mowing, fence repair, and removal of downed trees, as needed to maintain the physical access restrictions at the Site and to keep interior portions of the Site accessible for periodic monitoring. In addition, the Trustee contractors conduct site inspections once per quarter and complete groundwater monitoring semi-annually. The Lyondell Trust also conducts additional O&M activities that pertain to the WRA slurry wall but has not yet finalized the O&M Plan for the TRSF. A summary of the O&M costs implemented at the Lyondell Trust properties is provided in **Table 7**.

Table 7: Lyondell Annual O&M Costs

Year	Total Cost (rounded to the nearest \$1,000)
2010	\$574,000
2011	\$806,000
2012	\$1,010,000
2013	\$591,000
2014	\$369,000
2015	\$507,000

OU2 – EPEC Properties

EPEC completed active remediation at the Site in October 2008. The only O&M still required on the EPEC properties is long-term groundwater monitoring and periodic inspections that include maintenance of security fences, mowing and repairs to wells, as necessary. EPEC conducts site inspections twice each year, usually in June and December, and include a site walk to check the status of each monitoring well (to ensure they are closed and locked) and the integrity of fences, storage garage, gates and locks. Any deficiencies are noted, photographed and addressed by the appropriate party. Since the TI Zone was established in August 2012 for the FWRA (the BDA did not require a TI waiver), EPEC has conducted groundwater monitoring for the S1 and S2 water bearing zones every 18 months for three years (two total sampling events) to document stability of dissolved COCs in groundwater. Sampling includes interior and exterior monitoring wells for both water-bearing zones. The first post TI waiver zone sampling events occurred in December 2011, June 2013 and December 2014. The fourth event is planned for June 2016. The O&M activities are described in the Sampling and Analysis Plan (SAP), the Long-Term Monitoring Plan, and the IC Plan (Appendices N, O and P, respectively), of the 2012 Remedial Design Report. Based on the 2006 AROD, EPEC has completed the requisite 2-year monitoring to demonstrate that NA is occurring. On November 5, 2015, EPA approved a modification to the Long-Term Groundwater Monitoring Plan that eliminated sampling requirements for natural attenuation parameters and lead. A summary of the O&M costs for the FYR are presented in Table 8. The costs were higher in 2010 to 2012 because the TI zone was established during this time.

Table 8: EPEC Annual O&M Costs

Year	Total Cost (rounded to the nearest \$1,000)
2010	\$231,000
2011	\$143,000
2012	\$200,000
2013	\$59,000
2014	\$10,000
2015	\$32,000

MW-109 Area

EPA completed the delineation of the groundwater plume and installed four additional monitoring wells in May 2016 in the MW-109 area. Sampling of these wells is expected to begin in summer 2016.

III. PROGRESS SINCE THE LAST REVIEW

This section includes the protectiveness determinations and statements from the last FYR (Table 9) as well as the recommendations from the last FYR and the current status of those recommendations (Table 10).

Table 9: Protectiveness Determinations/Statements from the 2011 FYR

OU #	Protectiveness Determination	Protectiveness Statement
1	Protective	The remedy at OU1 is protective of human health and environment.
2	Short-term Protective	The remedy at OU2 (the rest of the Site) is protective in the short term. The remedy will be protective in the long term provided that the action items identified in this Third Five-Year Review are addressed.

Table 10: Status of Recommendations from the 2011 OU2 FYR

Issue	Recommendation ^a	Current Status	Current Implementation Status Description	Completion Date (if applicable)
OU1				
	14 – Liberty County should perform year-round maintenance of the vegetation along roadway, particularly the curves, that can restrict visibility.	Completed	Liberty County Commissioner’s Court met on October 26, 2010, to accept the road as a County Road.	8/21/2013
OU2				
Define boundaries for groundwater subject to the TI waiver.	1 – Evaluate two years of groundwater monitoring data in the MW-109 Area.	Completed	EPA completed a Data Evaluation Report.	4/1/2013
	2 – Establish TI waiver zones in the FWRA, MWA, WRA, OTA and EA after the EPA and TCEQ have reviewed documents establishing the TI waiver zones.	Completed	TI waiver zone document for the FWRA finalized and the ESD signed.	8/17/2012
	3 – Perform trend analyses as more groundwater data becomes available, to establish trends in horizontal and vertical COC migration.		TI waiver zone for Lyondell Trust properties finalized and ESD signed.	8/22/2012
	4 – The groundwater monitoring program for Lyondell Trust properties should be updated and implemented. The locations where increasing concentrations of contaminants were found will be investigated and addressed further, although additional characterization after the FYR period sufficiently characterized the groundwater plumes for the properties and a TI Boundaries Plan was submitted to EPA and TCEQ for review.	Completed	Lyondell Trust completed a Long-Term Monitoring Plan in 2012. The plan is currently under revision based on monitoring since the TI boundaries were established.	10/1/2012
O&M plans have not been established for all areas	5 – Develop O&M plans for the MW-109 Area.	Considered But Not Implemented	O&M has not begun because the remedial action is still ongoing. Additional investigation is ongoing to establish a TI waiver zone.	NA
	6 – Finalize O&M plans for the FWRA and BDA.	Completed	The Long-Term Monitoring Plan was revised as part of the Remedial Design Report.	6/1/2012
	7 – The Lyondell Trust should remove all remaining drums, infrastructure and construction debris (e.g., well casings, wastewater treatment plant debris), and remove or properly abandon remaining stickups and any associated underground piping, particularly from the MWA and OTA. Consideration may need to be given to whether any sampling needs to be	Completed	Drums/Investigation Derived Waste (IDW) have been removed. The only remaining drums are drums currently used to stage IDW; they are waiting for disposal. Also, about 150 wells have been abandoned according to the September 2015 Work Plan.	Drums removed 2/18/2016 Wells abandoned 12/1/2015-12/4/2015

Issue	Recommendation ^a	Current Status	Current Implementation Status Description	Completion Date (if applicable)
	conducted in associated with proper completion.			
	8 – The Lyondell Trust should remove leachate water from sumps at the MWA TRSF and include monitoring of the sump and leachate removal in future O&M plans.	Ongoing	The Lyondell Trust submitted an O&M Plan for the TRSF to EPA in October 2013. Based on EPA’s review, the O&M Plan requires significant revision and is expected to be resubmitted by the end of fourth quarter of 2016.	NA
	9 – The Lyondell Trust should update their contact information on posted signs at the Site.	Completed	Contact information updated.	5/16/2012
	10 – O&M for the WRA slurry wall must be reviewed and actions taken accordingly.	Completed	Action completed. EPA approved the O&M Plan.	2/25/2016
	11 – O&M of the TRSF at the MWA must be reviewed and action taken accordingly.	Ongoing	The Lyondell Trust submitted an O&M Plan for the TRSF to EPA in October 2013. Based on EPA’s review, the O&M Plan requires significant revision and is expected to be resubmitted to EPA by the end of fourth quarter of 2016	NA
	12 –Broken latch on gate at southeast side of the WRA should be repaired.	Completed	Repairs completed.	11/23/2011
	13 –The telephone utility company, or Liberty County, should repair the utility access pit near the MW-109 Area, which was open during the site inspection on May 5, 2011.	Completed	Completed by the utility company as confirmed by EPA inspection.	9/6/2012
	15 – Evaluate the location of inhabitable structures relative to the location of VOC-contaminated soil and/or groundwater sources, to determine if a vapor intrusion exposure pathway evaluation should be performed. This exposure pathway evaluation should be performed if inhabitable structures are or will be closer than 100 feet from VOC sources. Changes in institutional controls might be necessary.	Completed	EPA sampled a residential property near the MW-109 area for vapor intrusion in March 2016. The sample results were evaluated and it was determined that there is no exposure pathway at the residential property from MW-109 area.	5/24/2016
ICs have not been established and implemented	16 – Groundwater rights have been purchased for BDA parcels 5 and 8 by EPEC as a precautionary measure to prevent groundwater drawdown from the BDA. Parcels 5 and 8 are not within the BDA and hence no	Completed	As a precautionary measure, EPEC worked with the owner of the parcels Lot 5 and 8 to record a restriction of groundwater use on the	5/25/2008

Issue	Recommendation ^a	Current Status	Current Implementation Status Description	Completion Date (if applicable)
in all of the areas	additional restrictions are needed on the deeds for these properties prohibiting excavation and construction at this time (2011 FYR Addendum).		properties even though not required by the ROD.	
	17 – No documentation describing the groundwater, excavation and construction restrictions on the EPEC-owned parcels within the BDA was available for review (parcel numbers 7, 38, 39 and 11). It is recommended that EPEC place restrictions on the deeds for the properties it currently owns that preclude groundwater extraction, excavation and construction so that these restrictions run with the land.	Ongoing	EPEC purchased the BDA parcels and is in the process of placing a restrictive covenant on the properties.	NA
	18 – No documentation describing the groundwater, excavation, and construction restrictions on the EPEC-owned parcels within the FWRA was available for review (parcel numbers 94, 63, 107, 81, 16, 80, 34 and 32). It is recommended that EPEC place restrictions on the deeds for the properties it currently owns that preclude groundwater extraction, excavation and construction so that these restrictions run with the land. (This item has been updated in this addendum to reflect correct parcel numbers to which this recommendation applies). (2011 FYR Addendum).	Ongoing	EPEC purchased most of the FWRA parcels and is in the process of filing restrictive covenants on these parcels, recording the restrictions required by the 2006 AROD and the Institutional Controls Plan. For properties that EPEC could not purchase, EPEC has purchased the groundwater rights, which have been filed and recorded by the Liberty County property records.	NA
	19-Groundwater rights have been purchased for FWRA parcels 47, 87, 90, 83, 78, 86, 95, 91, and 101 in accordance with the 2006 AROD and the Institutional Control Plan (ICP) within a 1,000-foot radius. No additional restrictions prohibiting excavation and construction are needed for these parcels at this time. (2011 FYR addendum).	Completed	EPEC filed groundwater restrictions with Liberty County property records.	Tracts 47, 83,84,87,90 12/17/09 Tracts 78,86 7/16/12 Tract 91,95 4/10/08 Tract 101 6/27/08
	20 – There is very little specificity regarding the precise nature of the required institutional controls for the WRA, MWA, OTA and EA. The ROD and ARODs only provide general information. It is recommended that Lyondell provide an ICP that lays out more specific information about the nature, maintenance and parcel location of	Ongoing	The ICP is expected to be submitted by the end of fourth quarter of 2016.	NA

Issue	Recommendation ^a	Current Status	Current Implementation Status Description	Completion Date (if applicable)
	use restrictions and other institutional controls.			
	21 – Evidence that deed restrictions have been recorded in the land records of Liberty County for the Lyondell Trust properties (WRA, MWA, OTA and EA) could not be identified during this FYR. Therefore, it is uncertain if the institutional control requirements of the remedies for these areas are being met. Lyondell Trust should record the required use restrictions, as specified in an ICP, on the deeds for the required parcels.	Ongoing	The ICP is expected to be submitted by the end of fourth quarter of 2016.	NA

IV. FIVE-YEAR REVIEW PROCESS

Community Notification, Involvement & Site Interviews

A public notice was made available by a press notice published in the *Liberty Vindicator* on 11/19/2015, stating that there was a draft FYR and inviting the public to submit any comments to EPA (Appendix F). The results of the review and the report will be made available at the Site’s information repositories, located at the Liberty Municipal Library in Liberty, Texas, TCEQ’s office in Houston, Texas, and EPA Region 6’s office in Dallas, Texas.

During the FYR process, interviews were conducted to document any perceived problems or successes with the remedy that has been implemented to date. The results of these interviews are summarized below. Appendix K provides the complete interviews.

TCEQ staff indicated that, overall, the site remedy is functioning as intended. TI waiver zone boundaries may require some adjusting as more data is collected. In addition, TCEQ staff stated that many of the issues and recommendations from the prior FYR have been addressed, except for the filing of all institutional controls. EPEC’s contractors continue to conduct long-term monitoring of site disposal areas, with several areas requiring institutional controls. The contractors for Lyondell Trust properties have completed active remediation at the Trust’s disposal areas and continue to conduct long-term monitoring of these areas. Lyondell Trust contractors also indicated that the remedy is performing as intended and with the planned establishment of land use institutional controls, the remedy should be protective of human health and the environment. Local residents stated that they have been kept informed of environmental issues at the Site and are pleased with the remediation, with the exception of concern about some localized flooding that may have been caused by backfilled areas. One resident indicated that hunters occasionally trespass on the fenced properties where remediation had occurred however, there is no soil exposure since the area is capped and the PRPs maintain and repair the fencing on a routine basis if fencing becomes damaged.

Data Review

Historical groundwater monitoring and mass removal data have shown that active remediation has reached its technological limits. As a result, EPA issued ESDs for both EPEC and the Lyondell Trust remediation areas in 2012 that established TI waiver zones (TI Zones) for the various disposal areas. The TI zones require long-term groundwater monitoring to demonstrate that the contaminant plumes are stable or declining in concentrations. The following sections summarize the 2011 to 2015 semi-annual and annual monitoring reports available for the

EPEC properties and the Lyondell Trust properties. Since only two to three years of data have been collected since the TI Zones were established, the data evaluation focused on general observations of COC concentrations in relation to the TI and Compliance Zone boundaries.

EPEC Areas

FWRA

The scope of work for the Long-Term Monitoring Plan consists of groundwater monitoring of interior and exterior monitoring wells in both the S1 and S2 Sands (Table 11). The TI waiver zone is applicable to COCs in each water-bearing unit that exceed groundwater cleanup standards in the 2006 Amended ROD and companion products to these COCs. Figure I-1 shows the approximate extent of groundwater contamination in the S1 zone and S2 zone based on the data collected from October 2008 to June 2010 that were used to establish the TI Zone.

Since the TI Zone was established, additional monitoring of these wells occurred in December 2011, June 2013 and December 2014. The concentrations of COCs in many wells exhibiting variable concentrations with an overall generalized slight decline or remain relatively the same in both the S1 and S2 zones. There are a few exceptions, with monitoring well AW-61R showing a slight increase in benzene over time. However, any contamination detected above cleanup goals occurs in the interior wells, with exterior wells remaining below cleanup goals or below detection. These data indicate that the contaminant plumes are remaining within the TI Zone. However, continued monitoring is warranted to ensure that the contaminant plumes are not expanding or migrating toward the Compliance Zone. Appendix I shows the location of the interior and exterior wells and TI and compliance zones (Figure I-1) and includes summary of the analytical data for the S1 and S2 wells exceeding criteria (Table I-1 and Table I-2, respectively).

Table 11: Summary of S1 and S2 Wells and COCs Monitoring the FWRA TI Waiver Zone

Zone	COCs	Interior Wells	Exterior Wells
S1	1,1-Dichloroethane 1,1-Dichloroethene 1,2-Dichloroethane 1,2-Dichloropropane Benzene cis-1,2-Dichloroethylene, trans-1,2-Dichloroethylene TBA Vinyl chloride	AW-61R AW-64R MW-31 MW-126 MW-175 MW-177 MW-178 MW-179 MW-180 MW-181 MW-191-S1 TMW-23R	AW-41 MW-176 MW-188-S1 MW-189-S2 MW-190-S1 MW-193-S1
S2	1,2-Dichloroethane Benzene TBA Vinyl chloride	MP-01R S/D MP-02R S/D MP-04R S/D MW-122 MW-123R S/D MW-127 MW-172 MW-173 MW-182 S/D MW-183 S/D MW-184 S/D MW-185 S/D MW-186 S/D	MW-188-S2 MW-189-S2 MW-190-S2 MW-191-S2 MW-192-S2 MW-193-S2

Notes:

Source: June 2012 Long-Term Monitoring Plan, prepared by the URS Corporation.

Bold = Concentrations of one or more COCs exceeded the cleanup goal in 2010 through 2015, with concentrations remaining stable or declining over time in most wells but several wells still exhibiting variation over time.

BDA

For the BDA, the soil and groundwater met cleanup standards, although institutional controls for soil are still required since soil was remediated to non-residential standards. Thus, there are no natural attenuation monitoring requirements and no monitoring wells, and therefore groundwater data in this area are not discussed.

Lyondell Trust Areas

WRA

Lyondell installed a slurry wall in 2002 due to persistent concentrations of benzene and TBA concentrations remaining in soil and groundwater after various in-situ remedial treatments. The slurry wall extends downward to the bottom of the S1 layer. The Lyondell Trust monitors the performance of the slurry wall by comparing the benzene and TBA concentration in M1/S1 paired wells inside and outside of the slurry wall boundary. AW-010/AW-10R, EW-001 and MW-034, located within the slurry wall, are paired with AW-038 and AW-012R, which are located outside the slurry wall. The concentrations of benzene and TBA in the monitoring wells inside the slurry wall at AW-010/AW-010R are typically above their respective groundwater cleanup standards (Appendix I; Table I-3); benzene concentrations show an increase from 250 µg/L in AW-010 to 160,000 µg/L in AW-010R between 2011 and 2014, while TBA concentrations increased from 2,700 µg/L in 2011 to 66,000 µg/L in 2014. However, the concentrations at inside slurry wall wells EW-001 and MW-034 have been below detection or below cleanup levels over the last five years. The concentrations of benzene and TBA at well locations outside the slurry wall (AW-038 and AW-012R) have been below detection from 2011 through December 2014. Wells AS-002, AW-003, MW-078 exhibit benzene concentrations consistently well above cleanup goal of 5 µg/L east and outside the slurry wall (Appendix I, Table I-4) with concentrations remaining above 20,000 µg/L in AS-002 and MW-078 over the last five years. A similar observation occurs in MW-152, where TBA consistently exceeds the cleanup goal of 2,200 µg/L; this well is located outside and side gradient of the slurry wall to the west where TBA fluctuated between 3,500 to 8,000 µg/L over the past five years. The contaminant plumes are being captured by long-term monitoring of the TI and Compliance Zone boundaries for the WRA.

The Lyondell Trust designed TI and Compliance Zone boundaries in 2012 for the WRA based on remaining concentrations of two COCs: benzene and TBA. The monitoring well network for the WRA consists of 26 monitoring wells, including 14 M1/S1 wells, nine S1 wells and three S2 wells. Based on data collected to date, the contaminant plumes at the WRA are present only in the M1/S1 and S1 wells. These are illustrated in Figure I-2 relative to the TI and Compliance Zone boundaries. Figure I-2 shows that the contaminant plumes remain within the TI boundary for the S1 zone. There are no plumes within the S2 zone.

MWA, OTA and Associated Subareas B-53/MW-45 and MW-10

Due to proximity of the MWA, OTA, and OB-53/MW-45 and MW-10 subareas, the plumes in these areas cross the area boundaries. As a result, the Lyondell Trust evaluates the TI and compliance zone boundaries for these four areas together. As shown on Figure I-3, the Trust has defined one TI waiver zone for the MWA, OTA and B-53/MW-45 areas. The wells monitor the M1/S1, S1, and S2 zones. Because there was enough separation between the plumes in the MW-10 Area and the adjacent OTA, the Lyondell Trust defined a separate TI Zone for the MW-10 Area. A single Compliance Zone was established for all four areas.

The contaminant plumes for the MWA, OTA and B-53/MW-45 subareas are primarily located in the M1/S1 and S1 zones and within the TI waiver boundary, as shown in Figure I-3, except for some elevated concentrations of TBA and additional COCs in EMW-44 and EMW-45, which are located beyond the TI waiver zone. In addition, there is a small vinyl chloride plume in the vicinity of wells EMW-059 and MW-036. The plumes in the vicinity of EMW-44, EMW-45, EMW-059 and MW-036 are still within the Compliance Zone. There is a small plume of 1,2-dichloroethane near MW-035, downgradient of the Compliance Zone. These results indicate that the TI and Compliance Zones may have to be expanded for the S1 zone at the MWA/OTA/B-53/MW-45 subareas.

There are small, isolated plumes of benzene and TBA in the S2 zone near well MW-141 in the OTA (Figure I-4). However, both plumes are located within the established TI Zones.

The monitoring well network for the MW-10 subarea consists of 24 wells, including 13 M1/S1 wells, nine S1 wells, and two S2 wells. Figure I-5 shows that the contaminant plumes remain within the TI Zone boundary for the M1/S1 and S1 zone. There are no plumes within the S2 zone. TBA exceeds the cleanup goal in MW-161 a S1 well in the MW-10 subarea with a concentration of 12,000 µg/L in December 2014. This well has shown a stable trend over the last five years. There do not appear to be any wells south of the MW-161 to monitor the TBA plume in the MW-10 subarea.

EA

The monitoring well network for the EA consists of 37 monitoring wells, including 19 M1/S1 wells, 15 S1 wells, and three S2 wells. Based on data collected to date, the contaminant plumes at the EA are present only in the M1/S1 and S1 wells and are illustrated in Figure I-6 relative to the TI and Compliance Zone boundaries. Figure I-6 shows that the contaminant plumes remain within the TI boundary for the S1 zone. There are no plumes within the S2 zone.

EPA – MW-109

EPA completed remediation of soil to residential and industrial right-of-way standards in 2011. EPA installed three additional monitoring wells in 2011 and after eight rounds of quarterly groundwater sampling, the results indicated additional delineation was warranted. In May 2016, EPA completed delineation of the groundwater plume and installed four additional monitoring wells. Sampling is expected to be begin in the summer of 2016.

Site Inspection

The site inspection took place on 1/12/2016 in two phases. The first phase began in the morning to inspect the remedies at the two parcels owned by EPEC (the BDA and FWRA) and the MW-109 Area overseen by EPA. Site inspection participants included Rajalakshmi Josiam (EPA Region 6 RPM), Audrey Kirtley (TCEQ), Joseph Wiley (Kinder-Morgan, EPEC contractor), and Eric Marsh and Claire Marcussen (Skeo Solutions). The purpose of the inspection was to assess the protectiveness of the remedy. The second phase began in the afternoon to inspect the remedies at the parcels owned by the Lyondell Trust (WRA, MWA, OTA, and EA). Site inspection participants included the same representatives from EPA, TCEQ and Skeo Solutions as well as Angela DeDolph and David Heidlauf (contractors for the Lyondell Trustee).

The morning inspection began at the FWRA, located at the most western extent of the Site. CR126 was paved as part of the OU1 remedy and appeared to be in good condition. Participants met with Mr. Wiley, who provided an overview of the remedies for the EPEC polymers-contaminated areas as well as the current status of the institutional controls for soil and groundwater. The cover of the FWRA was well maintained, all monitoring wells were in good condition, and locked and secured. Participants observed that the soil mixing area was also well vegetated. The area is secured by a fenced, locked gate, with “no trespassing signs” clearly posted. After the FWRA, site participants next visited the BDA next to Turtle Bayou. The area was fenced, secured with a locked gate, and posted with “no trespassing” signs. However, there was evidence that trespassing occurs; torn areas of the fence were repaired. Trespassing is not expected to involve excavation activities and soils met non-residential standards; thus, trespasser exposure to soil is not expected to pose a health concern. Mr. Wiley said that trespassing is primarily by hunters and BDA O&M activities involve repairing fences and removing deer stands constructed by hunters. The BDA is well maintained, with a peripheral grass cover. It is heavily forested in the former dumping area. Participants observed Turtle Bayou, where recent flooding had left large tree limbs on CR126. Routine county maintenance of the road will address the limbs. Drainage appeared to be unobstructed along the side of the road.

Site participants then visited the MW-109 Area and met the property owner living there. The area where groundwater injections took place was covered with vegetation. Wells were secured and locked. Participants also viewed the field behind the home where bioremediation took place. The field appeared to be well vegetated.

The second phase of the inspection began at the WRA, which was enclosed by a tall chain-link fence next to CR126. Site inspection participants observed two locations where wells had been abandoned. The surface was heavily vegetated with grass. All wells were labeled and secured with locks. Site participants then visited the MWA. It included the TRSF, which contains contaminated soils from disposal areas along CR126 and a drum staging area for investigation-derived waste. The vault included two large sumps that are not operational; the wastewater treatment plant has been dismantled. However, the sumps continue to contain leachate, which will be addressed by an upcoming O&M Plan for this area. Participants next visited the OTA and associated subareas, the MW-10 Area and the MW-45 areas. All three areas were enclosed by locked and secured fencing. All monitoring wells were labeled and secured with locks. Participants observed tanks that contain well purge water. Off-site disposal of the water is planned in 2016. Fencing requires routine repairs at all Lyondell Trust parcels due to trespassing from hunters. The participants concluded the inspection at the EA, which was also enclosed by a locked and secured fence. All wells were locked and secured. The area was covered by dense forest.

After the site inspection, Skeo Solutions staff visited the Site's local information repository, Liberty Municipal Library, located at 1710 Sam Houston Avenue in Liberty, Texas. Administrative record documents appeared to be in place, including the Administrative Record for the 2010 and 2012 ESDs on CDs. However, the FYR reports were not identified in the repository.

On January 13, 2016, Skeo Solutions staff reviewed site property records at the Liberty County Clerk Public Records Office, located at 1923 Sam Houston Avenue in Liberty, Texas. The records were reviewed to determine if the groundwater rights have been filed for several of the EPEC-owned properties. Skeo Solutions staff located both warranty deeds and groundwater rights documents.

Appendix E includes a completed Site Inspection Checklist. Appendix G includes photographs of the Site prior to remediation taking place as well as photos taken during the site inspection.

V. TECHNICAL ASSESSMENT

QUESTION A: Is the remedy functioning as intended by the decision documents?

Question A Summary:

The soil and groundwater remedies are functioning as intended. EPA, EPEC and Lyondell Trust have excavated or treated soils to achieve cleanup goals and groundwater remediation has reached its technological limits such that EPA has established TI Zones for those areas where groundwater cleanup levels have not yet been achieved. TI Zones have been established for the MWA, EA and OTA, and associated subareas for the Lyondell Trust properties as well as EPEC's FWRA.

Based on groundwater monitoring since establishment of the TI Zones in 2012, the groundwater plumes at most areas are present in the M1/S1 or S1 zone. Only one area exhibited a small plume of benzene and TBA in the S2 zone in the OTA. However, both plumes are located within the established TI Zone for this area. The plumes within the S1 zone remain within TI Zone boundaries, with two exceptions. TBA was detected above cleanup goals in EMW-44 and EMW-45, which are located beyond the TI Zone boundary southwest of the OTA but still remains within the Compliance Zone. A similar observation was made for vinyl chloride in EMW-059 and MW-036, which represents a localized plume outside of the TI Zone boundary but within the Compliance Zone. In addition, there is a small plume of 1,2-dichloroethane in the vicinity of MW-035 that is further downgradient of EMW-44 and EMW-045 and outside of the Compliance Zone. These results indicate that the TI and Compliance Zones may have to be expanded for the S1 zone at the MWA/OTA/B-53/MW-45 areas. TBA exceeds the cleanup goal in MW-161 in the MW-10 subarea. This well has shown a stable trend over the last five years. There do not appear to be any wells south of the MW-161 to monitor the TBA plume in the MW-10 subarea. The monitoring well network should be evaluated to determine whether additional monitoring wells are needed in this area. Although ICs are not yet in place for this area, there is no soil exposure and there are no residents living downgradient of this area therefore there is no exposure to groundwater.

EPA concluded in the Site's 2006 AROD that no additional groundwater monitoring was required for the BDA because cleanup goals were met. Thus, a TI Zone was not established and groundwater quality monitoring activities are not warranted for this area. EPA installed additional wells to delineate groundwater contamination at the MW-109 Area downgradient of the residential structure; sampling is expected to begin in the summer of 2016 to determine if NA is occurring and to establish a TI Zone. EPA recently completed sampling at a residential area near the MW-109 area to support a vapor intrusion evaluation. The vapor intrusion evaluation indicated that there is no exposure pathway at the residential property from the MW-109 area. The area has not yet entered into an O&M program.

O&M activities are ongoing at the Site, with a primary focus on long-term groundwater monitoring for areas with established TI Zones and ensuring the different disposal areas remain secured. No unexpected issues have arisen with respect to ongoing O&M activities.

Since the last FYR, a number of institutional controls have been implemented or are in the process of being implemented. As of December 2005, Lyondell acquired all contaminated properties in the WRA, MWA, OTA, and EA, and access to these areas has been restricted such that residential use on these properties does not occur. Groundwater restrictions have not yet been filed with Liberty County property records. The Lyondell Trust plans to submit the Institutional Controls Plan to EPA by the end of the second quarter of 2016. The plan will summarize the nature, maintenance and parcel location of use restrictions and other institutional controls. Once EPA approves the Institutional Controls Plan, the Lyondell Trust will begin filing the restrictions with Liberty County property records.

EPEC is currently filing restrictive covenants on its parcels, as required by the 2006 AROD and the Institutional Controls Plan. EPEC has completed the filing of groundwater restrictions on most of the properties it does not own that are potentially impacted by groundwater contamination. EPEC is in the process of filing groundwater use restrictions on one additional parcel. EPEC continues to work with the owner of another parcel to establish a restriction on water use.

EPA and Liberty County signed an MOA in 2011 for the County to operate and maintain CR126. Since CR126 serves as a cap over any remaining residual soil contamination, the County must notify EPA any time extensive road repairs are warranted or when there is a need to dig through CR126. The County must submit roadwork repair and dig plans to the EPA for review and approval to make sure activities do not make residual contamination available for exposure.

QUESTION B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selection still valid?

Question B Summary:

Changes in Standards and To-be-Considered Values (TBCs)

Since the last FYR, the 2012 ESDs were published for both the EPEC- and Lyondell Trust-owned areas to include updates to the groundwater cleanup levels. Maximum contaminant levels (MCLs) were selected as the cleanup levels for the groundwater COCs. However, in the absence of MCLs, health-based values were identified. The MCLs for site COCs have not changed since the 2012 ESDs were issued for the EPEC- and Lyondell Trust-owned areas (Appendix H). To determine if any toxicity values may have changed that could impact cleanup goals for the COCs without MCLs, health-based cleanup goals are evaluated in the next section.

Changes in Toxicity and Other Contaminant Characteristics

MCLs were not established for four groundwater COCs (1,1-dichloroethane, acetone, naphthalene and TBA). Therefore, EPA and TCEQ selected the Texas Risk Reduction Program (TRRP) Tier 1 protective concentration limits (PCLs) as the health-based cleanup goals for groundwater in the 2012 ESDs. To determine if the cleanup goals for these four COCs remain valid, the cleanup goals were compared to EPA's 2016 tapwater regional screening levels, or RSLs (Appendix J). Based on a screening-level risk evaluation, the cancer risk associated

with the 2012 ESD cleanup goals for 1,1-dichloroethane and naphthalene exceeds the upper bound of EPA's cancer risk management range of 1×10^{-6} to 1×10^{-4} . The cleanup goals for 1,1-dichloroethane, acetone and naphthalene exceed EPA's target noncancer threshold of 1. EPA has not established toxicity criteria for TBA. The cleanup goal established by TCEQ as the Tier 1 PCL was compared to the most current PCL; the value has not changed. These results indicate that the cleanup goals for 1,1-dichloroethane, acetone, and naphthalene may not be stringent enough for monitoring of the Compliance Zones. EPA has established toxicity values for acetone. Thus, the cleanup goal should be evaluated. In addition, EPA's RSLs for 1,1-dichloroethane and naphthalene rely on provisional toxicity values obtained from the California Environmental Protection Agency (CalEPA) as EPA has not finalized toxicity values for these two COCs. Based on these results, the cleanup goals for 1,1-dichloroethane, acetone and naphthalene should be evaluated to determine if the cleanup goals remain protective.

Changes in Risk Assessment Methods

Historically, the vapor intrusion pathway has not been quantitatively evaluated in EPA risk assessments. EPA finalized vapor intrusion guidance in 2015. It requires evaluation of multiple lines of evidence to confirm the relative significance of this pathway and whether any response action is warranted. Per the guidance, if it can be shown that VOC-contaminated soil and/or groundwater sources are or will come within 100 feet of inhabited structures, screening this exposure pathway is generally warranted. Most residences at the Site are upgradient of contaminated zones and there are no residences within 100 feet of the groundwater plumes. The closest residence to the MW-109 Area is about 200 feet upgradient of the localized impacted area, suggesting that vapor intrusion is unlikely to pose a concern. The well closest to the residence, MW-191, contained only trace levels of phenol and bis(2-ethylhexyl)phthalate; these compounds are not considered by EPA to be volatile enough to pose a vapor intrusion concern. To confirm this conclusion, EPA recently completed sampling at a residential area near the MW-109 area to support a vapor intrusion evaluation. The vapor intrusion evaluation indicated that there is no exposure pathway at the residential property from the MW-109 area.

Changes in Exposure Pathways

There have been no changes in site conditions that would suggest the presence of new exposure pathways.

Expected Progress toward Meeting RAOs

EPA approved the TI Zones for groundwater plumes in 2012. Therefore, long-term monitoring will be reviewed over the next FYR period to determine if the remedy progressing as expected toward meeting RAOs.

QUESTION C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has come to light that could call into question the protectiveness of the remedy.

VI. ISSUES/RECOMMENDATIONS

Issues/Recommendations	
OU(s) without Issues/Recommendations Identified in the Five-Year Review:	
OU1	

Issues and Recommendations Identified in the Five-Year Review:
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OU(s): OU2	Issue Category: Remedy Performance			
	Issue: The groundwater protection standards for 1,1-dichloroethane, acetone and naphthalene may not be stringent enough for monitoring the TI and Compliance Zones.			
	Recommendation: Evaluate whether groundwater protection standards should be revised for 1,1-dichloroethane, acetone and naphthalene to reflect current toxicity values. If so, determine if the TI and Compliance Zones need to be revised.			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
No	Yes	EPA	EPA/State	6/11/2017

OU(s): OU2	Issue Category: Remedy Performance			
	Issue: Contamination has been detected above cleanup goals outside of the Compliance Zone southwest of the Main Waste Area (MWA) and Office Trailer Area (OTA) in well MW-035.			
	Recommendation: Evaluate whether the TI and Compliance Zones requires expansion in the vicinity of well MW-035.			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
No	Yes	PRP	EPA/State	6/11/2017

OU(s): OU2	Issue Category: Remedy Performance			
	Issue: TBA concentrations appear stable but remain well above the cleanup goal of 2,200 µg/L in MW-161 in the MW-10 subarea. However, there are no wells south of this well to monitor whether this contaminant remains below the cleanup goal in the Compliance Zone.			
	Recommendation: Install a well south of MW-161 to evaluate whether TBA in the MW-10 subarea remains below the cleanup goal within the Compliance Zone.			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
No	Yes	PRP	EPA/State	6/11/2017

OU(s): OU2	Issue Category: Institutional Controls			
	Issue: Not all institutional controls have been implemented by the potentially responsible parties (PRPs) and Trustee as outlined in site decision documents.			
	Recommendation: Complete implementation of remaining institutional controls at all parcels impacted by the Site.			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
No	Yes	PRP	EPA/State	6/11/2017

OU(s): OU2	Issue Category: Monitoring			
	Issue: A technical impracticability waiver for the MW-109 Area needs to be established based on the delineated groundwater plume.			
	Recommendation: Establish a TI waiver once the groundwater contamination delineation is completed.			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
No	Yes	EPA	EPA	12/1/2016

OTHER FINDINGS

These recommendations, identified during the FYR, do not affect current and/or future protectiveness:

- Evaluate Site groundwater data relative to the depths of residential wells and determine if any residential wells require resampling.
- Include a copy of the 2011 and 2016 FYRs in the Site's local information repository.
- Consider documenting the change of the soil and groundwater remedy for the BDA in a decision document.

VII. PROTECTIVNESS STATEMENT

Protectivness Statements	
<i>Operable Unit:</i> OU1	<i>Protectivness Determination:</i> Protective
<i>Protectivness Statement:</i> The OU1 remedy is protective of human health and the environment. The most contaminated soils have been removed and contained within a TRSF. Institutional controls are in place to prevent exposure to any residual contaminated soils remaining under CR126.	

<i>Operable Unit:</i> OU2	<i>Protectivness Determination:</i> Short-term Protective
<i>Protectivness Statement:</i> The remedy at OU2 currently protects human health and the environment. Soil has been remediated, groundwater has been treated, and groundwater is being monitored at the FWRA, BDA, WRA, EA, MWA and OTA (including the OTA subareas). For the remedy to be protective over the long term, the following actions need to be taken at the MW-109 area: establish the TI waiver. In addition, evaluate whether the TI and Compliance Zones need to be revised southwest of the MWA and OTA and complete the implementation of remaining institutional controls at all parcels impacted by the Site.	

Sitewide Protectivness Statement	
<i>Protectivness Determination:</i> Short-term Protective	
<i>Protectivness Statement:</i> The OU1 remedy is protective of human health and the environment. The most contaminated soils have been removed and contained within a temporary RCRA storage facility and institutional controls are in place to prevent exposure to any residual contaminated soils remaining under CR126. The OU2 remedy currently protects human health and the environment because soil has been remediated, groundwater has been treated, and groundwater is being monitored at the FWRA, BDA, WRA, EA, MWA and OTA (including the OTA subareas). For the remedy to be protective over the long term, the following actions need to be taken at the MW-109 area: establish the TI waiver. In addition, evaluate whether the TI and Compliance Zones need to be revised southwest of the MWA and OTA and complete the implementation of remaining institutional controls at all parcels impacted by the Site.	

VII. NEXT REVIEW

The next FYR Report for the Petro-Chemical Systems, Inc. (Turtle Bayou) Superfund site is required five years from the completion date of this review.

APPENDIX A – REFERENCE LIST

Amended Record of Decision: Petro-Chemical Systems, Inc. (Turtle Bayou) Superfund Site, Liberty County, Texas. United States Environmental Protection Agency Region 6. April 30, 1998.

Amended Record of Decision: Petro-Chemical Systems Inc. (Turtle Bayou) Superfund Site, Liberty County, Texas. United States Environmental Protection Agency Region 6. September 22, 2006.

Explanation of Significant Differences, Petro-Chemical Systems, Inc. (Turtle Bayou) Superfund Site. September 23, 2010.

Explanation of Significant Differences, Petro-Chemical Systems, Inc. (Turtle Bayou) Superfund Site: EPEC Polymers Inc. Property (CR-126 West Area). August 17, 2012.

Explanation of Significant Differences, Petro-Chemical Systems, Inc. (Turtle Bayou) Superfund Site: Lyondell Environmental Custodial Trust Properties. August 22, 2012.

First Five-Year Review Report for Petro-Chemical Systems Inc. (Turtle Bayou) Site, Liberty County. October 23, 2000.

Institutional Controls Plan for CR 126 West Area and Bayou Disposal Area Turtle Bayou Superfund Site. Prepared by ERM. February 2007.

Long-term Monitoring Plan for the CR 126 West Area and Bayou Disposal Area. Prepared by URS. June 2012.

Long-term Monitoring Plan for the Lyondell Environmental Custodial Trust Properties. Prepared by Ramboll/Environ. January 2016.

O&M Plan for the West Road Area Slurry Wall. Lyondell Environmental Custodial Trust Properties. Prepared by Ramboll/Environ. February 2016.

NPL Site Narrative for Petro-Chemical Systems, (Turtle Bayou). Federal Register Notice, June 10, 1986

NPL Fact Sheet, Petro-Chemical Systems, Inc. (Turtle Bayou) Texas. Last update July 2015.

Preliminary Close Out Report, Petro-Chemical Systems Inc. (Turtle Bayou) Superfund Site, Liberty County, Texas. September 2010.

Record of Decision, Petro-Chemical Systems, Inc. (Turtle Bayou) Superfund Site, Liberty County, Texas. United States Environmental Protection Agency Region 6. March 27, 1987.

Record of Decision: Petro-Chemical Systems Inc. (Turtle Bayou) Superfund Site, Liberty County, Texas. United States Environmental Protection Agency Region 6. September 6, 1991.

Second Five-Year Review Report for Petro-Chemical Systems Inc. (Turtle Bayou) Site, Liberty County, Liberty, Texas. September 22, 2006.

Superfund Site Progress Profile, Petro-Chemical Systems, Inc. (Turtle Bayou). Available online at: <http://cumulis.epa.gov/supercpad/cursites/csinfo.cfm?id=0602957&msspp=medL>. Last update on October 1, 2015.

Third Five-Year Review Report for Petro-Chemical Systems Inc. (Turtle Bayou) Site, Liberty County, Liberty, Texas. September 16, 2011.

APPENDIX B – INSTITUTIONAL CONTROL FIGURES

Figure B-1: Institutional Controls Map for EPEC-FWRA Properties

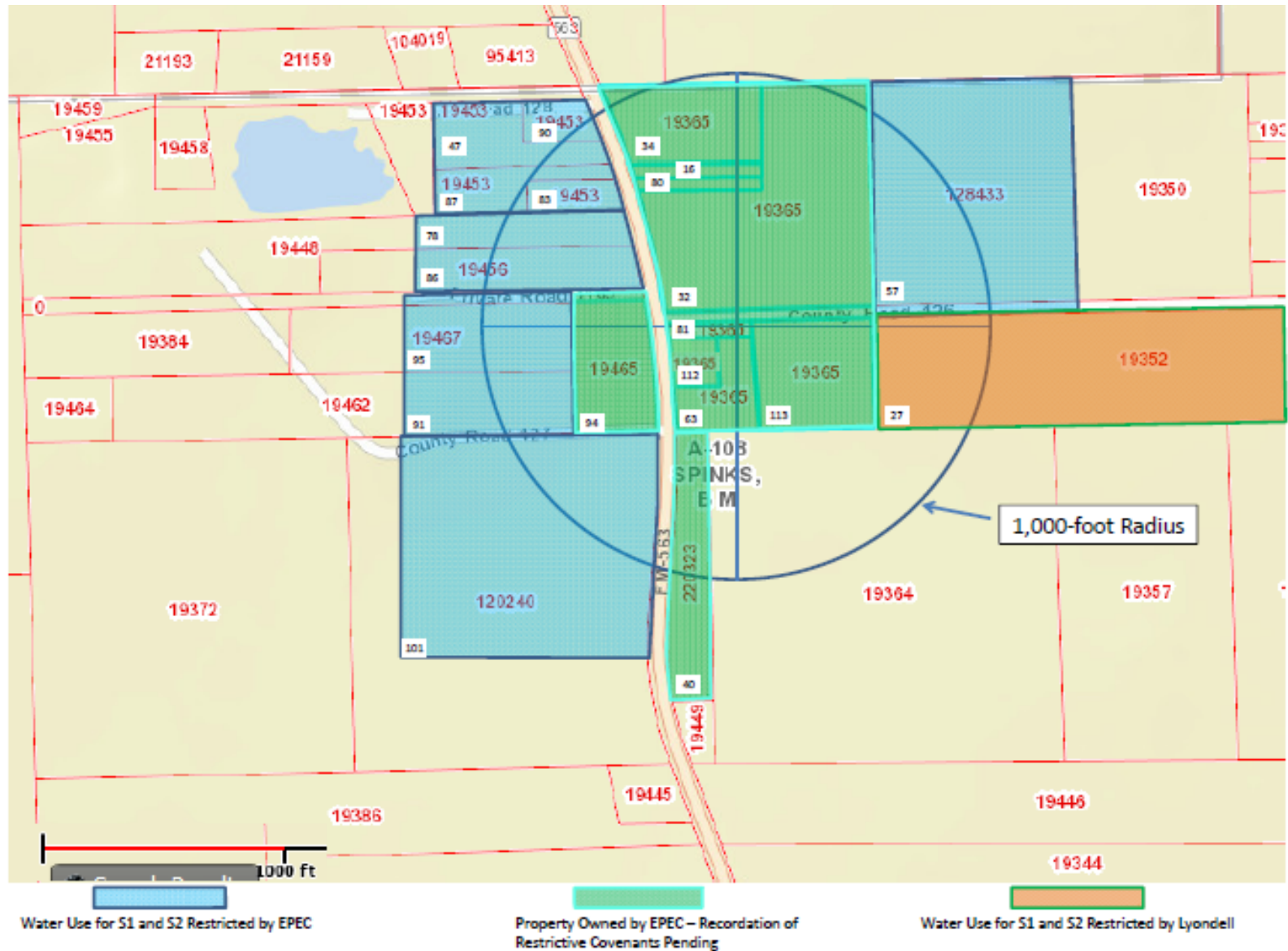
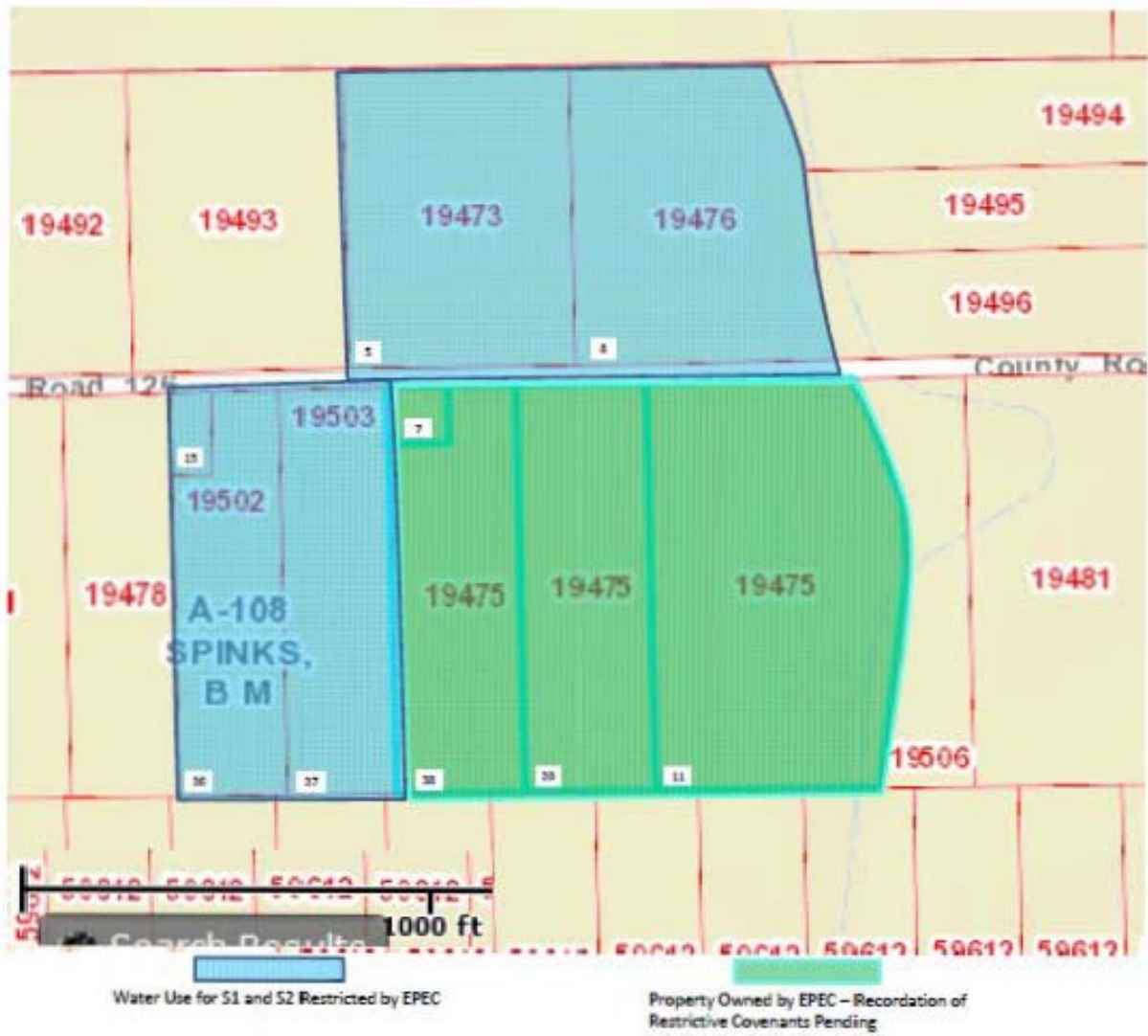


Figure B-2: Institutional Controls Map for EPEC-BDA Properties



APPENDIX C – SITE BACKGROUND

C-1. Physical Characteristics

The 500-acre area is located in rural Liberty County, 15 miles southeast of Liberty, Texas. The Site is 6 miles north of Interstate 10 along Farm to Market Road 563 (FM 563), which borders the Site to the west. County Road 126 (CR126 – previously identified as Frontier Park Road) provides access to the Site from FM 563. CR126 traverses the middle of the Site, spanning a total length of 2.5 miles heading east from FM 563, and extends 0.5 miles beyond Turtle Bayou (Figure 1). Turtle Bayou is a tributary to Lake Anahuac. It forms the eastern boundary of the Site. The eastern end of the Site falls within the 100-year floodplain along the Turtle Bayou tributary.

Although the Site is mostly flat, local surface water drains across the Site from northwest to southeast, and eventually into Turtle Bayou. Two water-bearing zones are located in the upper 100 feet of the subsurface.

The Site's subsurface conditions create challenges for remediation of contaminated soil and groundwater. There are five different zones. The uppermost clay unit is designated C1 and overlies a silt unit, the M1 and a sand zone (S1 zone). The M1 silt and S1 zones are about 12 and 29 feet below grade under the entire site. The second clay layer (C2) lies at the base of the S1 zone and varies from 2 to more than 10 feet thick isolating the first sand layer zone (S1) sand from the second sand layer zone (S2 zone) in which local supply wells have typically been installed. The overall clayey and silty nature of the S1 sand across the Site poses challenges to removing or in-situ treatment of contaminants because the presence of clays restricts contaminant movement and contaminants tend to adsorb to clay and trap non-aqueous phase waste liquids (NAPLs).

There are residences and drinking water wells within a 1-mile radius of the Site along FM 563 and CR126. However, drinking water wells currently used on site are screened in the deeper non-contaminated aquifer at depths of approximately 180 feet or more.

C-2. Land and Resource Use

Land uses in the surrounding area include cropland, pasture, range, forest and small rural communities. In 1971, the site owner filed an application for a commercial industrial waste disposal permit with the State of Texas. However, the permit application was withdrawn due to legal action in 1974. After 1974, the owner subdivided the Site into 5-acre and 15-acre plots and sold them for residential development. Residential use of the Site has been continuous since 1974, except when remedial activities required temporary relocation of residents. No residents live on any of the identified disposal areas. However, seven families live next to waste disposal areas (the FWRA, EA and BDA). Shallow water supply wells in the vicinity of remediation areas have been plugged and abandoned.

The shallow aquifer is not currently in use as a source of drinking water on site. However, the shallow aquifer could be used as a source of drinking water in the future and is considered a class 2-B aquifer by the State of Texas. A class 2-B aquifer has water quality such that it is a usable aquifer but that for other reasons (e.g., low water yield capacity) is not currently used.

C-3. History of Contamination

Unpermitted waste disposal may have started as early as the late 1960s. The Texas Water Quality Board has documented records of waste disposal as early as 1971; records indicate waste oils from nearby petroleum refining activities were disposed of into unlined pits and on Frontier Park Road (CR126) for dust suppression. Since the Site was never an authorized waste disposal facility, the exact nature of disposal activities at the Site is uncertain. However, it appears that the waste was simply dumped from trucks at numerous locations. In some areas, it appears that the wastes were tilled into the soil. Disposal activities resulted in the release of liquid wastes that contaminated soil and groundwater with VOCs and SVOCs.

C-4. Initial Response

Following the State's revocation of the industrial waste disposal permit in 1974, EPA and TCEQ conducted preliminary sampling and found several PAHs in the former disposal pits along CR126. In May 1984, TCEQ requested the inclusion of the Site on EPA's National Priorities List (NPL). EPA proposed the Site for inclusion on the NPL on October 15, 1984, and listed the Site on the NPL on May 20, 1986. EPA completed a removal action, which included posting warning signs and installing a fence around the Site's MWA, between May 12 and 16, 1986.

APPENDIX D – SITE CHRONOLOGY AND REMEDY HISTORY

Table D-1: Site Chronology

Date	Event
Unpermitted waste disposal may have begun at the Site	1960s
Texas Water Quality Board documents waste disposal at the Site; PRP filed for a commercial waste disposal permit	1971
PRP withdrew the waste disposal permit application, subdivided the Site into residential parcels and sold the parcels for redevelopment.	1974
TCEQ requested the Site's inclusion on the NPL	May 1984
EPA proposed the Site for listing on the NPL	October 15, 1984
EPA conducted a removal action at the MWA	May 16, 1986
EPA listed the Site on the NPL	May 20, 1986
The Texas Water Commission (TWC) and EPA completed the RI/FS for the Frontier Road Area (also known as the CR126 Area or OU1)	September 1986
EPA issued the OU1 ROD	March 27, 1987
EPA and TWC began the OU1 remedial design	June 5, 1987
EPA and TWC completed the OU1 remedial design	October 30, 1987
EPA and TWC began the remedial action for OU1	January 25, 1988
EPA and TWC completed the remedial for OU1	March 1, 1989
EPA and TWC completed the OU2 RI	November 1990
EPA and TWC completed the FS for OU2; EPA issued an Administrative Order on Consent for the PRP to conduct a supplemental RI/FS at OU2	March 1991
The PRP completed the supplemental RI/FS for OU2	August 1991
EPA issued the ROD for OU2 to address five areas – the WRA, MWA, OTA, EA and BDA	September 6, 1991
PRP began OU2 remedial design	September 25, 1992
EPA issued a UAO for site PRPs – the Lyondell Chemical Company and Atlantic Richfield Company – to complete the remedial design for OU2 at the Lyondell properties (the WRA, MWA, OTA and EA)	December 22, 1993
PRP begins OU2 remedial action	January 18, 1996
EPA issued OU2 AROD for addressing cleanup criteria for benzene in soils and enhancing remedy components for soil and groundwater	April 30, 1998
PRP completed OU2 remedial design	May 22, 1998
EPA entered into a Consent Decree with site PRPs; superseded the 1993 UAO and required PRPs to address contamination in the WRA, MWA, OTA and EA; EPEC to address contamination in the FWRA and BDA.	December 8, 1998
EPA and TCEQ identified contamination at the FWRA	August 1999
EPA signed Site's first FYR.	September 8, 2000
PRPs complete active remedial action and start two-year monitoring period for OU2	July 27, 2005
EPA signed Site's second FYR and issued second OU2 AROD to include remediation at MW-109 area and documenting the TI determination for portions of shallow groundwater, amending soil and groundwater cleanup levels, and describing contingency remedies	September 22, 2006
PRP completes remedial design for CR126 West Area and OU2 BDA	February 28, 2007
EPA enters into a Consent Decree with EPEC to conduct remedial design and remedial action at the CR126 West Area and OU2 BDA	August 21, 2007
PRP completes remedial action for the CR126 West Area	September 2008
EPA entered into interagency agreement with USACE to conduct the remedial design and remedial action for the MW-109 Area	2009
USACE completes supplemental RI/FS at MW-109 Area	February 25, 2010
USACE began soil remedial action at MW-109 Area	2010
Lyondell Environmental Custodial Trust formed	May 3, 2010
EPA issued ESD for OU2 to include remedial action for the MW-109 Area	September 23, 2010
EPA issued Preliminary Close-out Report for construction completion at the Site	September 30, 2010

Date	Event
USACE completed soil remedial action for the MW-109 Area	March 9, 2011
EPA signed Site's third FYR	September 16, 2011
EPA finalized TI waiver zone document for EPEC's CR126 West Area after a two-year transitional monitoring period and signed the ESD	August 17, 2012
EPA finalized TI waiver zone documents for Lyondell Trust sites (the WRA, MWA, OTA and EA) after a two-year transitional monitoring period and signed the ESD	August 22, 2012

Table D-2: Summary of OU2 Decision Documents, Remedial Components, and RAOs

Source Area	Decision Document	Remedial Components	RAOs
<u>Lyondell</u> • WRA • OTA • MWA • EA <u>EPEC</u> • BDA	ROD 09/06/1991	<ul style="list-style-type: none"> • Dismantle RCRA landfill/vault • Soil: SVE/engineered cap/site restoration • Groundwater: air injection/slurry wall/monitoring • Stormwater controls 	<ul style="list-style-type: none"> • Prevent current or future exposure to contamination in soil. • Eliminate the potential for soils to act as a continuing source of groundwater contamination. • Restore shallow groundwater to its beneficial use as a potential source of drinking water.
<u>Lyondell</u> • WRA • OTA • MWA • EA <u>EPEC</u> • BDA	AROD 04/30/1998	<ul style="list-style-type: none"> • Modified benzene cleanup goal • Soil hot spots: added thermal desorption/excavation and on-site biotreatment and off-site disposal/treatment • Soil: added a living cap, bioventing, aqueous phase bioremediation • Groundwater: added in-situ bioremediation and MNA • Soil and groundwater institutional controls 	
<u>Lyondell</u> • WRA • OTA • MWA • EA <u>EPEC</u> • BDA • FWRA	AROD 09/22/2006	<ul style="list-style-type: none"> • Identified FWRA requiring soil and groundwater remediation using ISCO • Groundwater: added TI waivers for the WRA, MWA, OTA (including the Central B-53 Area and MW-45 Area within OTA), EA (North and South), as well as in the FWRA • Presented MW-109 Area information • Amended groundwater and soil cleanup criteria • Amended remedy for BDA for limited excavation and off-site disposal of soil • Amended TRSF remedy to engineering controls and groundwater monitoring • Contingency remedies if TI waiver zones violated • Soil and groundwater institutional controls 	<ul style="list-style-type: none"> • Maintain stable or declining contaminated groundwater plumes and prevent exposure to contaminants exceeding soil and groundwater cleanup criteria for areas designated as TI waiver zones. • Protect the groundwater from degradation from site contaminants, thereby maintaining its beneficial use as a potential future source of drinking water in areas outside the TI waiver zones. • Prevent direct contact to soil in the MWA and WRA. • Prevent contaminant migration from soil to groundwater. • Reduce soil contaminant concentrations based on current land uses.
MW-109 Area	ESD 09/23/2010	<ul style="list-style-type: none"> • Soil: ISCO • Groundwater: monitoring • Soil and groundwater institutional controls 	<ul style="list-style-type: none"> • Restore shallow groundwater to its beneficial use as a potential source of drinking water.
<u>Lyondell</u> • WRA	ESD 08/22/2012	<ul style="list-style-type: none"> • Establish the final boundaries of the TI waiver zones for shallow groundwater 	<ul style="list-style-type: none"> • Maintain stable or declining contaminated groundwater plumes

Source Area	Decision Document	Remedial Components	RAOs
<ul style="list-style-type: none"> • MWA • OTA • EA 			<p>and prevent exposure to contaminants exceeding soil and groundwater cleanup criteria for areas designated as TI waiver zones.</p>
<p><u>EPEC</u></p> <ul style="list-style-type: none"> • FRWA 	<p>ESD 08/22/2012</p>	<ul style="list-style-type: none"> • Establish the final boundaries of the TI waiver zones for shallow groundwater 	<ul style="list-style-type: none"> • Protect the groundwater from degradation from site contaminants, thereby maintaining its beneficial use as a potential future source of drinking water in areas outside the TI waiver zones.

APPENDIX E – SITE INSPECTION CHECKLIST

FIVE-YEAR REVIEW SITE INSPECTION CHECKLIST			
I. SITE INFORMATION			
Site Name: Petro-Chemical Systems, Inc. (Turtle Bayou)	Date of Inspection: 01/12/2016		
Location and Region: Liberty County, Texas – EPA Region 6	EPA ID: TXD980873350		
Agency, Office or Company Leading the Five-Year Review: EPA	Weather/Temperature: Sunny/40 degrees Fahrenheit		
Remedy Includes: (Check all that apply)			
<input checked="" type="checkbox"/> Landfill cover/containment	<input checked="" type="checkbox"/> Monitored natural attenuation		
<input checked="" type="checkbox"/> Access controls	<input checked="" type="checkbox"/> Groundwater containment		
<input checked="" type="checkbox"/> Institutional controls	<input type="checkbox"/> Vertical barrier walls		
<input checked="" type="checkbox"/> Groundwater pump and treatment			
<input type="checkbox"/> Surface water collection and treatment			
<input checked="" type="checkbox"/> Other: <u>Geosynthetic caps over removal areas at the former tar area and dredged sediment area in the Calcasieu River.</u>			
Attachments: <input checked="" type="checkbox"/> Inspection team roster attached <input type="checkbox"/> Site map attached			
II. INTERVIEWS (check all that apply)			
1. O&M Site Manager	<u>Joseph Wiley</u> Name	<u>Project Manager (Kinder Morgan Inc. parent company of EPEC)</u> Title	<u>mm</u> Date
Interviewed <input type="checkbox"/> at site <input type="checkbox"/> at office <input checked="" type="checkbox"/> by email Phone: _____			
Problems, suggestions <input type="checkbox"/> Report attached: <u>Interview question responses are summarized in Section 6.6.</u>			
2. O&M Staff	<u>Angela DeDolph</u> Name	_____ Title	_____ Date
Interviewed <input type="checkbox"/> at site <input type="checkbox"/> at office <input type="checkbox"/> by phone Phone: _____			
Problems/suggestions <input type="checkbox"/> Report attached: _____			

3. **Local Regulatory Authorities and Response Agencies** (i.e., state and tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices). Fill in all that apply.

Agency TCEQ
 Contact _____ LDEQ Site Manager _____
 Name Title Date Phone No.

Problems/suggestions Report attached: _____

Agency _____
 Contact _____
 Name Title Date Phone No.

Problems/suggestions Report attached: _____

Agency _____
 Contact _____
 Name Title Date Phone No.

Problems/suggestions Report attached: _____

Agency _____
 Contact _____
 Name Title Date Phone No.

Problems/suggestions Report attached: _____

Agency _____
 Contact _____
 Name Title Date Phone No.

Problems/suggestions Report attached: _____

4. **Other Interviews** (optional) Report attached: Interview question responses are summarized in Section 6.6.

III. ON-SITE DOCUMENTS AND RECORDS VERIFIED (check all that apply)

1. **O&M Documents**

- O&M manual Readily available Up to date N/A
- As-built drawings Readily available Up to date N/A
- Maintenance logs Readily available Up to date N/A

Remarks: _____

- 2. **Site-Specific Health and Safety Plan** Readily available Up to date N/A
- Contingency plan/emergency response plan Readily available Up to date N/A

Remarks: Located at Kinder Morgan and Ramboll Environ offices.

- 3. **O&M and OSHA Training Records** Readily available Up to date N/A

Remarks: Not verified.

4. Permits and Service Agreements			
<input type="checkbox"/> Air discharge permit	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
<input type="checkbox"/> Effluent discharge	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
<input type="checkbox"/> Waste disposal, POTW	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
<input type="checkbox"/> Other permits: _____	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
Remarks: _____			
5. Gas Generation Records			
	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
Remarks: _____			
6. Settlement Monument Records			
	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
Remarks: _____			
7. Groundwater Monitoring Records			
	<input checked="" type="checkbox"/> Readily available	<input checked="" type="checkbox"/> Up to date	<input type="checkbox"/> N/A
Remarks: _____			
8. Leachate Extraction Records			
	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
Remarks: _____			
9. Discharge Compliance Records			
<input type="checkbox"/> Air	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
<input type="checkbox"/> Water (effluent)	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
Remarks: _____			
10. Daily Access/Security Logs			
	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
Remarks: <u>All site guests are required to sign in at the main Entergy office. Daily access logs are not required; locked fences and gates prohibit access to all waste areas except for the MW-109 Area where soils have been remediated. Groundwater remains contaminated and is located near a residence.</u>			
IV. O&M COSTS			
1. O&M Organization			
<input type="checkbox"/> State in-house	<input type="checkbox"/> Contractor for state		
<input checked="" type="checkbox"/> PRP in-house	<input checked="" type="checkbox"/> Contractor for PRP		
<input type="checkbox"/> Federal facility in-house	<input type="checkbox"/> Contractor for Federal facility		
<input checked="" type="checkbox"/> Other			

2. O&M Cost Records

Readily available Up to date

Funding mechanism/agreement in place Unavailable

Original O&M cost estimate: _____ Breakdown attached

Total annual cost by year for review period if available

From: _____	To: _____	_____	<input type="checkbox"/> Breakdown attached
Date	Date	Total cost	
From: _____	To: _____	_____	<input type="checkbox"/> Breakdown attached
Date	Date	Total cost	
From: _____	To: _____	_____	<input type="checkbox"/> Breakdown attached
Date	Date	Total cost	
From: _____	To: _____	_____	<input type="checkbox"/> Breakdown attached
Date	Date	Total cost	
From: _____	To: _____	_____	<input type="checkbox"/> Breakdown attached
Date	Date	Total cost	

3. Unanticipated or Unusually High O&M Costs during Review Period

Describe costs and reasons:

V. ACCESS AND INSTITUTIONAL CONTROLS Applicable N/A

A. Fencing

1. **Fencing Damaged** Location shown on site map Gates secured N/A

Remarks: All fencing appears to be in good condition.

B. Other Access Restrictions

1. **Signs and Other Security Measures** Location shown on site map N/A

Remarks: Fencing and locking gates restrict site access.

C. Institutional Controls (ICs)

1. Implementation and Enforcement			
Site conditions imply ICs not properly implemented	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> N/A
Site conditions imply ICs not being fully enforced	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> N/A
Type of monitoring (e.g., self-reporting, drive by): _____			
Frequency:			
Responsible party/agency: _____			
Contact _____	_____	_____	_____
Name	Title	Date	Phone no.
Reporting is up to date	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
Reports are verified by the lead agency	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
Specific requirements in deed or decision documents have been met	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
Violations have been reported	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
Other problems or suggestions: <input checked="" type="checkbox"/> Report attached			
2. Adequacy <input type="checkbox"/> ICs are adequate <input checked="" type="checkbox"/> ICs are inadequate <input type="checkbox"/> N/A			
Remarks: <u>Not all institutional controls have been filed with the Liberty County Clerk Public Records Office. See Section 3.3 for more detail.</u>			
D. General			
1. Vandalism/Trespassing <input type="checkbox"/> Location shown on site map <input type="checkbox"/> No vandalism evident			
Remarks: _____			
2. Land Use Changes On Site <input checked="" type="checkbox"/> N/A			
Remarks: <u>Since 2010, residential development has expanded northwest of the Site.</u>			
3. Land Use Changes Off Site <input checked="" type="checkbox"/> N/A			
Remarks: <u>Since 2010, residential development has expanded northwest of the Site.</u>			
VI. GENERAL SITE CONDITIONS			
A. Roads <input checked="" type="checkbox"/> Applicable <input type="checkbox"/> N/A			
1. Roads Damaged <input type="checkbox"/> Location shown on site map <input checked="" type="checkbox"/> Roads adequate <input type="checkbox"/> N/A			
Remarks: _____			
B. Other Site Conditions			
Remarks: _____			
VII. LANDFILL COVERS <input checked="" type="checkbox"/> Applicable <input type="checkbox"/> N/A			
A. Landfill Surface			
1. Settlement (low spots) <input type="checkbox"/> Location shown on site map <input checked="" type="checkbox"/> Settlement not evident			
Aerial extent: _____		Depth: _____	
Remarks: _____			

2.	Cracks	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> Cracking not evident
	Lengths: _____	Widths: _____	Depths: _____
	Remarks: _____		
3.	Erosion	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> Erosion not evident
	Arial extent: _____		Depth: _____
	Remarks: _____		
4.	Holes	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> Holes not evident
	Arial extent: _____		Depth: _____
	Remarks: _____		
5.	Vegetative Cover	<input type="checkbox"/> Grass	<input checked="" type="checkbox"/> Cover properly established
	<input type="checkbox"/> No signs of stress	<input type="checkbox"/> Trees/shrubs (indicate size and locations on a diagram)	
	Remarks: _____		
6.	Alternative Cover (e.g., armored rock, concrete)		<input checked="" type="checkbox"/> N/A
	Remarks: _____		
7.	Bulges	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> Bulges not evident
	Arial extent: _____		Height: _____
	Remarks: _____		
8.	Wet Areas/Water Damage	<input checked="" type="checkbox"/> Wet areas/water damage not evident	
	<input checked="" type="checkbox"/> Wet areas	<input type="checkbox"/> Location shown on site map	Arial extent: _____
	<input type="checkbox"/> Ponding	<input type="checkbox"/> Location shown on site map	Arial extent: _____
	<input type="checkbox"/> Seeps	<input type="checkbox"/> Location shown on site map	Arial extent: _____
	<input type="checkbox"/> Soft subgrade	<input type="checkbox"/> Location shown on site map	Arial extent: _____
	Remarks: <u>Wet area at the bottom edge of the landfill were evident due to heavy rains in the area, however, no erosion evident.</u>		
9.	Slope Instability	<input type="checkbox"/> Slides	<input type="checkbox"/> Location shown on site map
	<input checked="" type="checkbox"/> No evidence of slope instability		
	Arial extent: _____		
	Remarks: _____		
B. Benches	<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A	
	(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)		
1.	Flows Bypass Bench	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> N/A or okay
	Remarks: _____		
2.	Bench Breached	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> N/A or okay
	Remarks: _____		

3.	Bench Overtopped	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> N/A or okay
Remarks: _____			
C. Letdown Channels <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A			
1.	Settlement (Low spots)	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> No evidence of settlement
Aerial extent: _____		Depth: _____	
Remarks: _____			
2.	Material Degradation	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> No evidence of degradation
Material type: _____		Aerial extent: _____	
Remarks: _____			
3.	Erosion	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> No evidence of erosion
Aerial extent: _____		Depth: _____	
Remarks: _____			
4.	Undercutting	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> No evidence of undercutting
Aerial extent: _____		Depth: _____	
Remarks: _____			
5.	Obstructions	Type: _____	<input type="checkbox"/> No obstructions
<input type="checkbox"/> Location shown on site map		Aerial extent: _____	
Size: _____			
Remarks: _____			
6.	Excessive Vegetative Growth	Type: _____	
<input type="checkbox"/> No evidence of excessive growth			
<input type="checkbox"/> Vegetation in channels does not obstruct flow			
<input type="checkbox"/> Location shown on site map		Aerial extent: _____	
Remarks: _____			
D. Cover Penetrations <input checked="" type="checkbox"/> Applicable <input type="checkbox"/> N/A			
1.	Gas Vents	<input type="checkbox"/> Active	<input type="checkbox"/> Passive
<input type="checkbox"/> Properly secured/locked		<input type="checkbox"/> Functioning	<input type="checkbox"/> Routinely sampled
<input type="checkbox"/> Evidence of leakage at penetration		<input type="checkbox"/> Needs maintenance	<input type="checkbox"/> Good condition
			<input checked="" type="checkbox"/> N/A
Remarks: _____			
2.	Gas Monitoring Probes	<input type="checkbox"/> Active	<input type="checkbox"/> Passive
<input type="checkbox"/> Properly secured/locked		<input type="checkbox"/> Functioning	<input type="checkbox"/> Routinely sampled
<input type="checkbox"/> Evidence of leakage at penetration		<input type="checkbox"/> Needs maintenance	<input type="checkbox"/> Good condition
			<input checked="" type="checkbox"/> N/A
Remarks: _____			

3. Monitoring Wells (within surface area of landfill)			
<input type="checkbox"/> Properly secured/locked	<input type="checkbox"/> Functioning	<input type="checkbox"/> Routinely sampled	<input type="checkbox"/> Good condition
<input type="checkbox"/> Evidence of leakage at penetration		<input type="checkbox"/> Needs maintenance	<input checked="" type="checkbox"/> N/A
Remarks: _____			
4. Extraction Wells Leachate			
<input type="checkbox"/> Properly secured/locked	<input type="checkbox"/> Functioning	<input type="checkbox"/> Routinely sampled	<input type="checkbox"/> Good condition
<input type="checkbox"/> Evidence of leakage at penetration		<input type="checkbox"/> Needs maintenance	<input checked="" type="checkbox"/> N/A
Remarks: <u>Two sumps remaining on the landfill surface collect leachate, which is pumped out as part of the O&M activities for this area.</u>			
5. Settlement Monuments			
<input type="checkbox"/> Located	<input type="checkbox"/> Routinely surveyed	<input checked="" type="checkbox"/> N/A	
Remarks: _____			
E. Gas Collection and Treatment			
<input type="checkbox"/> Applicable		<input checked="" type="checkbox"/> N/A	
1. Gas Treatment Facilities			
<input type="checkbox"/> Flaring	<input type="checkbox"/> Thermal destruction	<input type="checkbox"/> Collection for reuse	
<input type="checkbox"/> Good condition	<input type="checkbox"/> Needs maintenance		
Remarks: _____			
2. Gas Collection Wells, Manifolds and Piping			
<input type="checkbox"/> Good condition	<input type="checkbox"/> Needs maintenance		
Remarks: _____			
3. Gas Monitoring Facilities (e.g., gas monitoring of adjacent homes or buildings)			
<input type="checkbox"/> Good condition	<input type="checkbox"/> Needs maintenance	<input type="checkbox"/> N/A	
Remarks: _____			
F. Cover Drainage Layer			
<input type="checkbox"/> Applicable		<input checked="" type="checkbox"/> N/A	
1. Outlet Pipes Inspected			
<input type="checkbox"/> Functioning	<input type="checkbox"/> N/A		
Remarks: _____			
2. Outlet Rock Inspected			
<input type="checkbox"/> Functioning	<input type="checkbox"/> N/A		
Remarks: _____			
G. Detention/Sedimentation Ponds			
<input type="checkbox"/> Applicable		<input checked="" type="checkbox"/> N/A	
1. Siltation Area extent: _____ Depth: _____ <input type="checkbox"/> N/A			
<input type="checkbox"/> Siltation not evident			
Remarks: _____			
2. Erosion Area extent: _____ Depth: _____			
<input type="checkbox"/> Erosion not evident			
Remarks: _____			
3. Outlet Works			
<input type="checkbox"/> Functioning	<input type="checkbox"/> N/A		
Remarks: _____			

4. Dam	<input type="checkbox"/> Functioning	<input type="checkbox"/> N/A
Remarks: _____		
H. Retaining Walls		
	<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A
1. Deformations	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> Deformation not evident
Horizontal displacement: _____		Vertical displacement: _____
Rotational displacement: _____		
Remarks: _____		
2. Degradation	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> Degradation not evident
Remarks: _____		
I. Perimeter Ditches/Off-Site Discharge		
	<input checked="" type="checkbox"/> Applicable	<input type="checkbox"/> N/A
1. Siltation	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> Siltation not evident
Area extent: _____		Depth: _____
Remarks: _____		
2. Vegetative Growth	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> N/A
<input checked="" type="checkbox"/> Vegetation does not impede flow		
Area extent: _____		Type: _____
Remarks: _____		
3. Erosion	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> Erosion not evident
Area extent: _____		Depth: _____
Remarks: _____		
4. Discharge Structure	<input type="checkbox"/> Functioning	<input checked="" type="checkbox"/> N/A
Remarks: _____		
VIII. VERTICAL BARRIER WALLS		
	<input checked="" type="checkbox"/> Applicable	<input type="checkbox"/> N/A
1. Settlement	<input checked="" type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> Settlement not evident
Area extent: _____		Depth: _____
Remarks: _____		
2. Performance Monitoring	Type of monitoring: <u>Performance</u>	
<input type="checkbox"/> Performance not monitored		
Frequency: _____		<input type="checkbox"/> Evidence of breaching
Head differential: _____		
Remarks: _____		
IX. GROUNDWATER/SURFACE WATER REMEDIES		
	<input checked="" type="checkbox"/> Applicable	<input type="checkbox"/> N/A
A. Groundwater Extraction Wells, Pumps and Pipelines		
	<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A

<p>1. Pumps, Wellhead Plumbing and Electrical</p> <p><input type="checkbox"/> Good condition <input type="checkbox"/> All required wells properly operating <input type="checkbox"/> Needs maintenance <input type="checkbox"/> N/A</p> <p>Remarks: _____</p>
<p>2. Extraction System Pipelines, Valves, Valve Boxes and Other Appurtenances</p> <p><input type="checkbox"/> Good condition <input type="checkbox"/> Needs maintenance</p> <p>Remarks: _____</p>
<p>3. Spare Parts and Equipment</p> <p><input type="checkbox"/> Readily available <input type="checkbox"/> Good condition <input type="checkbox"/> Requires upgrade <input type="checkbox"/> Needs to be provided</p> <p>Remarks: _____</p>
<p>B. Surface Water Collection Structures, Pumps and Pipelines <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A</p>
<p>1. Collection Structures, Pumps and Electrical</p> <p><input type="checkbox"/> Good condition <input type="checkbox"/> Needs maintenance</p> <p>Remarks: _____</p>
<p>2. Surface Water Collection System Pipelines, Valves, Valve Boxes and Other Appurtenances</p> <p><input type="checkbox"/> Good condition <input type="checkbox"/> Needs maintenance</p> <p>Remarks: _____</p>
<p>3. Spare Parts and Equipment</p> <p><input type="checkbox"/> Readily available <input type="checkbox"/> Good condition <input type="checkbox"/> Requires upgrade <input type="checkbox"/> Needs to be provided</p> <p>Remarks: _____</p>
<p>C. Treatment System <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A</p>
<p>1. Treatment Train (check components that apply)</p> <p><input type="checkbox"/> Metals removal <input type="checkbox"/> Oil/water separation <input type="checkbox"/> Bioremediation</p> <p><input type="checkbox"/> Air stripping <input type="checkbox"/> Carbon adsorbers</p> <p><input type="checkbox"/> Filters: _____</p> <p><input type="checkbox"/> Additive (e.g., chelation agent, flocculent): _____</p> <p><input type="checkbox"/> Others: _____</p> <p><input type="checkbox"/> Good condition <input type="checkbox"/> Needs maintenance</p> <p><input type="checkbox"/> Sampling ports properly marked and functional</p> <p><input type="checkbox"/> Sampling/maintenance log displayed and up to date</p> <p><input type="checkbox"/> Equipment properly identified</p> <p><input type="checkbox"/> Quantity of groundwater treated annually: _____</p> <p><input type="checkbox"/> Quantity of surface water treated annually: _____</p> <p>Remarks: <u>Groundwater remedy included in-situ bioremediation and extraction. The remedial actions are completed and the remedy is now in long-term monitoring.</u></p>

<p>2. Electrical Enclosures and Panels (properly rated and functional)</p> <p><input type="checkbox"/> N/A <input type="checkbox"/> Good condition <input type="checkbox"/> Needs maintenance</p> <p>Remarks: _____</p>
<p>3. Tanks, Vaults, Storage Vessels</p> <p><input type="checkbox"/> N/A <input type="checkbox"/> Good condition <input type="checkbox"/> Proper secondary containment <input type="checkbox"/> Needs maintenance</p> <p>Remarks: _____</p>
<p>4. Discharge Structure and Appurtenances</p> <p><input type="checkbox"/> N/A <input type="checkbox"/> Good condition <input type="checkbox"/> Needs maintenance</p> <p>Remarks: _____</p>
<p>5. Treatment Building(s)</p> <p><input type="checkbox"/> N/A <input type="checkbox"/> Good condition (esp. roof and doorways) <input type="checkbox"/> Needs repair</p> <p><input type="checkbox"/> Chemicals and equipment properly stored</p> <p>Remarks: _____</p>
<p>6. Monitoring Wells (pump and treatment remedy)</p> <p><input type="checkbox"/> Properly secured/locked <input type="checkbox"/> Functioning <input type="checkbox"/> Routinely sampled <input type="checkbox"/> Good condition</p> <p><input type="checkbox"/> All required wells located <input type="checkbox"/> Needs maintenance <input type="checkbox"/> N/A</p> <p>Remarks: _____</p>
<p>D. Monitoring Data</p>
<p>1. Monitoring Data</p> <p><input checked="" type="checkbox"/> Is routinely submitted on time <input checked="" type="checkbox"/> Is of acceptable quality</p>
<p>2. Monitoring Data Suggests:</p> <p><input checked="" type="checkbox"/> Groundwater plume is effectively contained <input type="checkbox"/> Contaminant concentrations are declining</p>
<p>E. Monitored Natural Attenuation</p>
<p>1. Monitoring Wells (natural attenuation remedy)</p> <p><input checked="" type="checkbox"/> Properly secured/locked <input type="checkbox"/> Functioning <input checked="" type="checkbox"/> Routinely sampled <input checked="" type="checkbox"/> Good condition</p> <p><input type="checkbox"/> All required wells located <input type="checkbox"/> Needs maintenance <input type="checkbox"/> N/A</p> <p>Remarks: _____</p>
<p align="center">X. OTHER REMEDIES</p> <p>If there are remedies applied at the site and not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.</p>
<p align="center">XI. OVERALL OBSERVATIONS</p>
<p>A. Implementation of the Remedy</p> <p>Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is designed to accomplish (e.g., to contain contaminant plume, minimize infiltration and gas emissions).</p> <p>_____</p>
<p>B. Adequacy of O&M</p> <p>Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.</p> <p><u>O&M activities appear to be sufficient – the landfill cover is functioning as intended, fencing is secure, and fields are kept mowed and maintained. Purged monitoring well water is properly disposed of on site within a secured fenced area.</u></p>

C. Early Indicators of Potential Remedy Problems
Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future. <u>None observed during the site inspection. EPA will begin additional characterization of groundwater contamination downgradient of MW-109 Area to establish a TI waiver zone for this area.</u>
D. Opportunities for Optimization
Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. <u>None observed during the site inspection.</u>

APPENDIX F – PRESS NOTICE



Petro-Chemical Systems, Inc. (Turtle Bayou) Superfund Site Public Notice U. S. Environmental Protection Agency, Region 6

November 2015

The U.S. Environmental Protection Agency Region 6 (EPA) will be conducting the fourth five-year review of the remedy implementation and performance at the Petro-Chemical Systems, Inc. (Turtle Bayou) Superfund Site (Site) located in Liberty County, Texas. The EPA divided the Site into two operable units (OUs) to manage site cleanup. The OU1 remedy consists of excavation of impacted soil on County Road 126 and placement in a temporary aboveground landfill at OU2. The OU2 remedy for impacted soil at several areas adjacent to County Road 126 consists of treatment, on-site consolidation, capping and surface restoration, and stormwater controls; the remedy for impacted groundwater consists of treatment, containment and long-term maintenance and monitoring. The five-year review will determine if the remedies are still protective of human health and the environment following completion of remedy construction in 2010.

The five-year review is schedule for completion in July 2016, and the report will be made available to the public at the following local information repository:

Liberty Municipal Library
1710 Sam Houston Avenue
Liberty, Texas 77575
(936) 336-8901

Site status updates are available on the Internet at:

<http://www.epa.gov/superfund/petro-chemical-systems>

All media inquiries should be directed to the EPA Press Office at (214) 665-2200

For more information about the site, contact:

Raji Josiam/Remedial Project Manager
(214) 665-8529
or 1-800-533-3508 (toll-free)
or by e-mail at Josiam.raji@epa.gov

Stephen Harper/Community Involvement Coordinator
(214) 665-2727
or 1-800-533-3508 (toll-free)
or by e-mail at Harper.stephen@epa.gov

APPENDIX G – REMOVAL ACTION AND/OR REMEDIAL ACTION AND SITE INSPECTION PHOTOS

Historical Site Photos and Photos of 2009-2010 CR126 Resurfacing and FWRA Remedial Action



Cutting of subgrade and ditch along CR126 (2009)



Adding aggregate to subgrade along CR126 (2009)



Asphalt paving of CR126 (2010)



CR126 Ditch prior to improvements (2010)



Construction of new ditches along CR126 (2010)



Installation of new ditch culverts (2010)



Mixing of treated soil with lime (2009)



FWRA soil treatment area graded and hydroseeded (2009)



Wastewater treatment plant at the MWA (2005)



Office Trailer Area (2005)

Site Inspection Photos: January 12, 2016



CR126, looking east



Locked and secured well TMW-23R in the FWRA



Looking south at a shed on the FWRA where sampling purge water is stored



Culvert running parallel to CR126 discharging to Turtle Bayou (far right)



Bridge over Turtle Bayou (easternmost extent of the Site)



Turtle Bayou, looking northeast



Turtle Bayou, looking south of the bridge



Field north of MW-109 where bioremediation took place



Former soil borrow area for MW-109 bioremediation remedy



MW-109A, adjacent to CR126



Gated and locked entrance to the WRA, looking south



The WRA, facing east (showing well AW32)



View from top of the TRSF, looking west



Sumps on top of the TRSF



Well EMW11, within the B53 subarea of the OTA



Well MW-010, within the MW-10 subarea of the OTA



Secured entrance into the utility easement areas (the EA)



EA well south of CR126

APPENDIX H – DETAILED ARARs REVIEW

CERCLA Section 121(d)(1) requires that Superfund remedial actions attain “a degree of cleanup of hazardous substance, pollutants, and contaminants released into the environment and of control of further release at a minimum which assures protection of human health and the environment.” The remedial action must achieve a level of cleanup that at least attains those requirements that are legally applicable or relevant and appropriate. In performing the FYR for compliance with ARARs, only those ARARs that address the protectiveness of the remedy are reviewed.

Groundwater ARARs

The 2006 AROD and 2012 ESDs identified chemical-specific ARARs for the Site’s groundwater COCs as the MCLs specified under the Safe Drinking Water Act. In the absence of an MCL, the AROD and ESDs listed the Tier 1 protective concentration limits established under TCEQ’s Texas Risk Reduction Program (TCEQ TRRP Tier 1 PCLs). The PCLs are health-based guidance levels and not enforceable standards. The 2006 AROD required two years of transitional monitoring to further characterize hydrogeologic conditions and the lateral and vertical extent of COCs that exceed cleanup standards. Based on the transitional monitoring results, EPA and TCEQ granted a TI waiver for groundwater ARARs in the areas where complete restoration of groundwater was demonstrated to be technically impracticable. EPA issued TI waivers in the two 2012 ESDs for Lyondell Trust- and EPEC-owned properties. They established TI waiver zones where ARARs for groundwater restoration are waived for specific COCs for each area (Table H-1 and Table H-2, respectively). In addition, EPA established a compliance zone boundary outside of the TI waiver zone boundary to verify compliance with ARARs and to verify that the plume has not migrated to the compliance zone wells. The compliance zone also serves as a buffer to allow time, if contingency measures are needed, before the plume migrates to the compliance zone wells.

This review compared current federal MCLs to those used in the 2006 AROD and ESDs for the groundwater COCs. None of the MCLs have changed since the last FYR (Table H-3).

Table H-1: Summary of COCs Requiring ARAR Waivers at EPEC’s FWRA^a

COC	Groundwater Zone Where ARAR Waiver Applies
1,1,2-Trichloroethane	--
1,1-Dichloroethane	S1
1,1-Dichloroethylene	S1
1,2-Dichloroethane	S1 and S2
1,2-Dichloropropane	S1
Acetone	--
Benzene	S1 and S2
Cis-1,2-dichloroethylene	S1
Ethylbenzene	--
Lead	--
Naphthalene	--
Styrene	--
TBA ^b	S1 and S2
Toluene	--
Trans-1,2-dichloroethylene	S1
Trichloroethylene	--
Vinyl chloride	S1 and S2

COC	Groundwater Zone Where ARAR Waiver Applies
Xylene	--
<i>Notes:</i> a. Information obtained from Table 3 in the 2012 ESD. b. ARAR not established. The TCEQ TRRP Tier 1 PCL is waived for this COC. -- = ARAR waiver not required for this COC S1 = shallow sandy zone S2 = intermediate sandy zone	

Table H-2: Summary of COCs Requiring ARAR Waivers at Lyondell Trust Properties^a

COC	Groundwater Zone Where ARAR Waiver Applies					
	West Road Area	Main Waste Area	B-53/MW-45 Area	Office Trailer Area	MW-10 Area	Easement Area
1,1,2-Trichloroethane	--	S1	S1	--	--	S1
1,1-Dichloroethane	--	--	--	--	--	S1
1,1-Dichloroethylene	--	--	S1	--	--	S1
1,2-Dichloroethane	--	S1	S1	--	S1	S1
1,2-Dichloropropane	--	--	S1	--	--	S1
Acetone	--	--	--	--	--	--
Benzene	S1, S2	S1	S1, S2	S1	S1	S1
Cis-1,2-dichloroethylene	--	--	S1	--	--	S1
Ethylbenzene	S1	--	--	--	S1	S1
Lead	--	--	S2	--	--	--
Naphthalene	S1	S1	S1	--	S1	S1
Styrene	--	--	--	--	--	S1
TBA	S1	S1	S1, S2	S1	S1	S1
Toluene	--	--	S1	--	S1	S1
Trans-1,2-dichloroethylene	--	--	S1	--	--	S1
Trichloroethylene	--	--	S1	--	--	S1
Vinyl chloride	--	S1	S1, S2	--	S1	S1
Xylene	--	--	S1 ^c	--	--	S1 ^c
<i>Notes:</i> a. Information from Table 3 in the 2012 ESD. b. ARAR not established. The TCEQ TRRP Tier 1 PCL is waived for this COC. c. The 2012 ESD indicates that ARAR waivers for xylene apply to meta- and para-xylene. -- = ARAR waiver not required for this COC S1 = shallow sandy zone S2 = intermediate sandy zone						

Table H-3: Previous and Current ARARs for Groundwater COCs

COC	2006 AROD ARAR ^a (µg/L)	Current Federal MCL (µg/L)	ARAR Change
1,1,2-Trichloroethane	5	5	none
1,1-Dichloroethane	NA	NA	none
1,1-Dichloroethylene	7	7	none
1,2-Dichloroethane	5	5	none
1,2-Dichloropropane	5	5	none
Acetone	NA	NA	none

COC	2006 AROD ARAR ^a (µg/L)	Current Federal MCL (µg/L)	ARAR Change
Benzene	5	5	none
Cis-1,2-dichloroethylene	70	70	none
Ethylbenzene	700	700	none
Lead	15	15	none
Naphthalene	NA	NA	none
Styrene	100	100	none
TBA	NA	NA	none
Toluene	1,000	1,000	none
Trans-1,2-dichloroethylene	100	100	none
Trichloroethylene	5	5	none
Vinyl chloride	2	2	none
Xylene	10,000	10,000	none

Notes:

a. COCs as identified in the Site's 2006 AROD.

b. The source for the National Primary Drinking Water MCLs is <http://water.epa.gov/drink/contaminants/index.cfm> (accessed on 11/18/2015).

NA = not applicable; MCLs have not been established for these COCs. The 2006 AROD established TCEQ TRRP Tier 1 PCLs.

APPENDIX I – ADDITIONAL FIGURES AND TABLES TO SUPPORT DETAILED DATA ANALYSIS

Figure I-1: Monitoring Well Locations at EPEC's FWRA

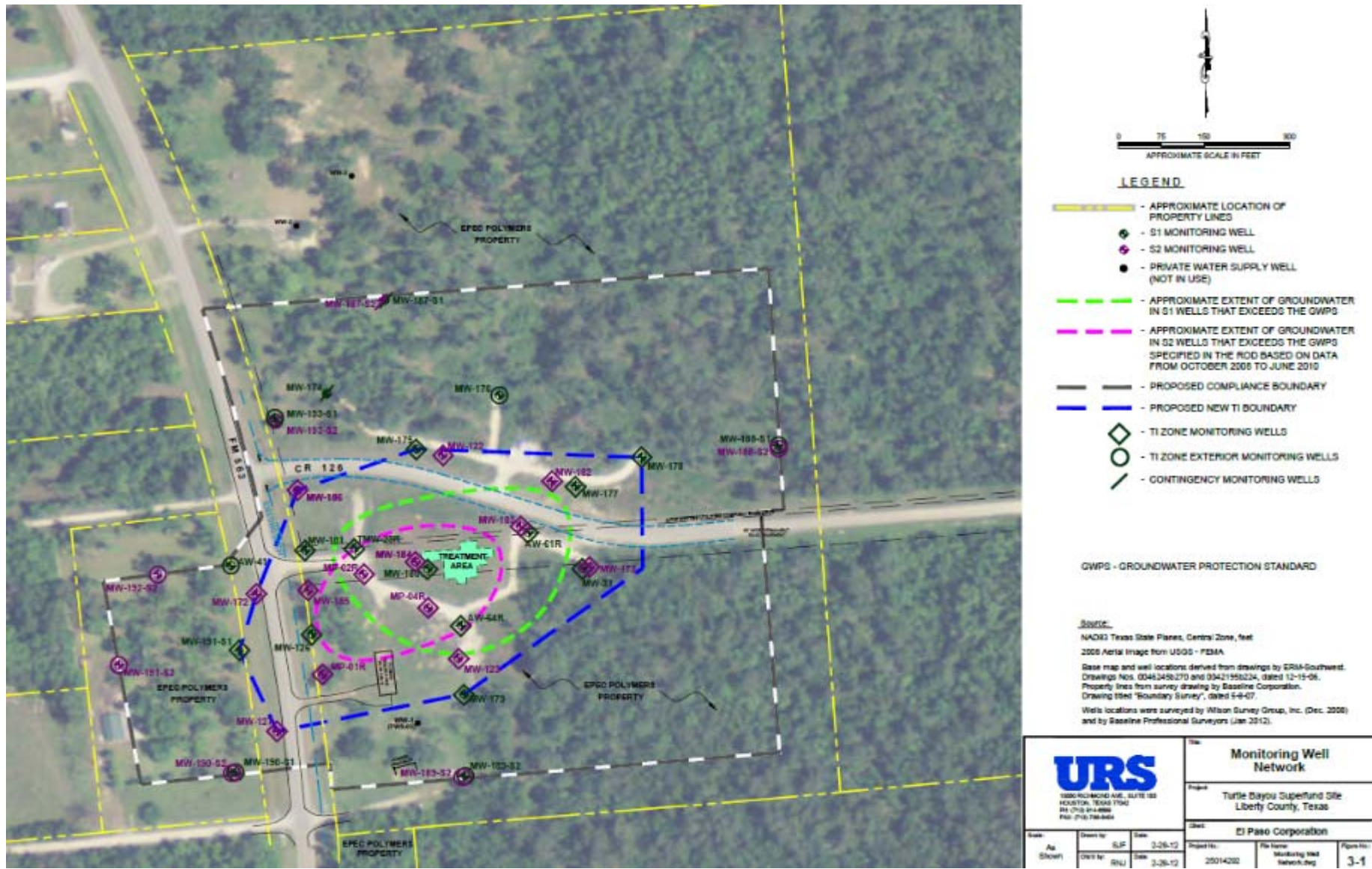


Table I-1: Summary of Analytical Data for S-1 Wells Exceeding Cleanup Goals at EPEC's FWRA (2010 to 2014)

Analyte	Cleanup Standard	NW 01R														NW 02R														NW 03R													
		10/20/2003	10/20/2004	10/20/2005	5/15/2006	1/15/2009	1/6/2010	3/24/2013	6/26/2013	12/27/2013	6/25/2013	10/6/2006	10/20/2006	4/9/2008	4/20/2009 (D)	3/10/2009	3/10/2009	11/10/2009	5/5/2010	3/26/2010	2/25/2010	1/27/2011	6/25/2013																				
Acetone	25	-6.50E UJ	-2.47E	-4.50E UJ	-2.50E	-2.50E	-3.50E U	-2.50E U	-5.00E U	-2.50	-0.23	-0.01E D	-0.01E R	-0.10	-0.10	-0.10E	-0.10E	-0.10E	-0.10E	-0.10E	-0.10E	-0.10E	-0.10E	-0.10E																			
Hexane	3.00E	0.20E	0.24E	0.15E	0.20E	0.30E	0.30E	0.20E	0.20E	0.20E	0.20E	0.20E	0.20E	0.20E	0.20E	0.20E	0.20E	0.20E	0.20E	0.20E	0.20E	0.20E	0.20E																				
1,1-Dichloroethane	4.0	0.80E	0.80E	0.80E	0.80E	0.80E	0.80E	0.80E	0.80E	0.80E	0.80E	0.80E	0.80E	0.80E	0.80E	0.80E	0.80E	0.80E	0.80E	0.80E	0.80E	0.80E	0.80E																				
1,1-Dichloroethene	3.00E	-0.20E	0.40E	0.40E	-0.20E	-0.20E	-0.20E	-0.20E	-0.20E	-0.20E	-0.20E	-0.20E	-0.20E	-0.20E	-0.20E	-0.20E	-0.20E	-0.20E	-0.20E	-0.20E	-0.20E	-0.20E	-0.20E																				
1,2-Dichloroethane	3.00E	-0.20E	0.40E	0.40E	-0.20E	-0.20E	-0.20E	-0.20E	-0.20E	-0.20E	-0.20E	-0.20E	-0.20E	-0.20E	-0.20E	-0.20E	-0.20E	-0.20E	-0.20E	-0.20E	-0.20E	-0.20E	-0.20E																				
1,2-Dichloroethene	0.07	-0.01E	0.02E	0.02E	-0.01E	-0.01E	-0.01E	-0.01E	-0.01E	-0.01E	-0.01E	-0.01E	-0.01E	-0.01E	-0.01E	-0.01E	-0.01E	-0.01E	-0.01E	-0.01E	-0.01E	-0.01E	-0.01E																				
trans 1,2-Dichloroethene	0.1	-0.02E	0.02E	0.02E	-0.02E	-0.02E	-0.02E	-0.02E	-0.02E	-0.02E	-0.02E	-0.02E	-0.02E	-0.02E	-0.02E	-0.02E	-0.02E	-0.02E	-0.02E	-0.02E	-0.02E	-0.02E	-0.02E																				
Chlorobenzene	0.7	-0.02E	-0.02E	-0.02E	-0.02E	-0.02E	-0.02E	-0.02E	-0.02E	-0.02E	-0.02E	-0.02E	-0.02E	-0.02E	-0.02E	-0.02E	-0.02E	-0.02E	-0.02E	-0.02E	-0.02E	-0.02E	-0.02E																				
Heptachlor	3.30E	-0.30E	-0.30E	-0.30E	-0.30E	-0.30E	-0.30E	-0.30E	-0.30E	-0.30E	-0.30E	-0.30E	-0.30E	-0.30E	-0.30E	-0.30E	-0.30E	-0.30E	-0.30E	-0.30E	-0.30E	-0.30E	-0.30E																				
Styrene (Total)	0.1	-0.01E	-0.01E	-0.01E	-0.01E	-0.01E	-0.01E	-0.01E	-0.01E	-0.01E	-0.01E	-0.01E	-0.01E	-0.01E	-0.01E	-0.01E	-0.01E	-0.01E	-0.01E	-0.01E	-0.01E	-0.01E	-0.01E																				
n-Butyl alcohol	2.2	0.70E	0.70E	0.70E	0.70E	0.70E	0.70E	0.70E	0.70E	0.70E	0.70E	0.70E	0.70E	0.70E	0.70E	0.70E	0.70E	0.70E	0.70E	0.70E	0.70E	0.70E	0.70E																				
1,1,2-Trichloroethane	3.00E	-0.10E	-0.10E	-0.10E	-0.10E	-0.10E	-0.10E	-0.10E	-0.10E	-0.10E	-0.10E	-0.10E	-0.10E	-0.10E	-0.10E	-0.10E	-0.10E	-0.10E	-0.10E	-0.10E	-0.10E	-0.10E	-0.10E																				
Toluene	1	-0.01E	0.02E	0.02E	-0.01E	-0.01E	-0.01E	0.02E	0.02E	0.02E	0.02E	0.02E	0.02E	0.02E	0.02E	0.02E	0.02E	0.02E	0.02E	0.02E	0.02E	0.02E	0.02E																				
Trichloroethane	3.00E	-0.10E	0.02E	-0.02E	-0.10E	-0.10E	0.02E	-0.02E	-0.02E	-0.02E	-0.02E	-0.02E	-0.02E	-0.02E	-0.02E	-0.02E	-0.02E	-0.02E	-0.02E	-0.02E	-0.02E	-0.02E	-0.02E																				
Methyl Chloride	2.00E	0.50E	0.50E	0.50E	0.50E	0.50E	0.50E	0.50E	0.50E	0.50E	0.50E	0.50E	0.50E	0.50E	0.50E	0.50E	0.50E	0.50E	0.50E	0.50E	0.50E	0.50E	0.50E																				
Hydro (Total)	15	-0.15E	-0.15E	-0.15E	-0.15E	-0.15E	-0.15E	-0.15E	-0.15E	-0.15E	-0.15E	-0.15E	-0.15E	-0.15E	-0.15E	-0.15E	-0.15E	-0.15E	-0.15E	-0.15E	-0.15E	-0.15E	-0.15E																				
Lead (Arrowhead)	0.31E	-0.002E UJ	-0.01E	-0.002E	-0.002E	-0.002E	-0.002E	-0.002E	-0.002E	-0.002E	-0.002E	-0.002E	-0.002E	-0.002E	-0.002E	-0.002E	-0.002E	-0.002E	-0.002E	-0.002E	-0.002E	-0.002E	-0.002E																				
Lead (TWR)	0.31E	-0.002E UJ	-0.002E	-0.002E	-0.002E	-0.002E	-0.002E	-0.002E	-0.002E	-0.002E	-0.002E	-0.002E	-0.002E	-0.002E	-0.002E	-0.002E	-0.002E	-0.002E	-0.002E	-0.002E	-0.002E	-0.002E	-0.002E																				

Analyte	Cleanup Standard	NW 01R														NW 02R													
		10/20/2003	10/20/2004	10/20/2005	5/15/2006	1/15/2006	1/15/2006 (D)	1/6/2010	3/24/2013	6/26/2013	12/27/2013	6/25/2013	10/6/2006	10/20/2006	4/9/2008	4/20/2009 (D)	3/10/2009	3/10/2009	11/10/2009	5/5/2010	3/26/2010	2/25/2010	1/27/2011	6/25/2013					
Acetone	25	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ						
Hexane	3.00E	0.01E	0.01E	0.01E	0.01E	0.01E	0.01E	0.01E	0.01E	0.01E	0.01E	0.01E	0.01E	0.01E	0.01E	0.01E	0.01E	0.01E	0.01E	0.01E	0.01E	0.01E	0.01E						
1,1-Dichloroethane	4.0	0.4 UJ	0.4 UJ	0.4 UJ	0.4 UJ	0.4 UJ	0.4 UJ	0.4 UJ	0.4 UJ	0.4 UJ	0.4 UJ	0.4 UJ	0.4 UJ	0.4 UJ	0.4 UJ	0.4 UJ	0.4 UJ	0.4 UJ	0.4 UJ	0.4 UJ	0.4 UJ	0.4 UJ	0.4 UJ						
1,1-Dichloroethene	3.00E	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ						
1,2-Dichloroethane	3.00E	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ						
1,2-Dichloroethene	0.07	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ						
trans 1,2-Dichloroethene	0.1	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ						
Chlorobenzene	0.7	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ						
Styrene (Total)	0.1	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ						
n-Butyl alcohol	2.2	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ						
1,1,2-Trichloroethane	3.00E	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ						
Toluene	1	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ	-0.01 UJ						
Trichloroethane	3.00E	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ						
Methyl Chloride	2.00E	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ						
Hydro (Total)	15	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ	-0.10 UJ						
Lead (Arrowhead)	0.31E	-0.002E UJ	-0.002E UJ	-0.002E UJ	-0.002E UJ	-0.002E UJ	-0.002E UJ	-0.002E UJ	-0.002E UJ	-0.002E UJ	-0.002E UJ	-0.002E UJ	-0.002E UJ	-0.002E UJ	-0.002E UJ	-0.002E UJ	-0.002E UJ	-0.002E UJ	-0.002E UJ	-0.002E UJ	-0.002E UJ	-0.002E UJ	-0.002E UJ						
Lead (TWR)	0.31E	-0.002E UJ	-0.002E UJ	-0.002E UJ	-0.002E UJ	-0.002E UJ	-0.002E UJ	-0.002E UJ	-0.002E UJ	-0.002E UJ	-0.002E UJ	-0.002E UJ	-0.002E UJ	-0.002E UJ	-0.002E UJ	-0.002E UJ	-0.002E UJ	-0.002E UJ	-0.002E UJ	-0.002E UJ	-0.002E UJ	-0.002E UJ	-0.002E UJ						

NOTES:
 (D) - Value is flag
 (U) - Cleanances are highlighted, and detections are shown in bold
 (J) - Field Duplicate Sample
 (L) - Value exceeds calibration range
 (V) - Correlation detected below the method quantitative limit
 (U) - Not Detected and estimated because detection limits may be higher than reported
 (W) - Reported sample
 (U) - Qualified but not checked due to detection limit blank anomaly

Table I-3: Summary of Groundwater Data Inside and Outside the WRA Slurry Wall

Well Location Screened Zone¹ Analyte Groundwater Cleanup Standard	AW-10/AW-10R² Inside Slurry Wall M1 / S1 Benzene 5	AW-038 Outside Slurry Wall M1 / S1 Benzene 5	EW-001/ MW-034 Inside Slurry Wall M1 / S1 Benzene 5	AW-012 Outside Slurry Wall M1 / S1 Benzene 5	AW-10/AW-10R² Inside Slurry Wall M1 / S1 TBA 2,200	AW-038 Outside Slurry Wall M1 / S1 TBA 2,200	EW-001/ MW-034 Inside Slurry Wall M1 / S1 TBA 2,200	AW-012 Outside Slurry Wall M1 / S1 TBA 2,200
December 2005	5,940	5.0 U	5.0 U	5.0 U	18,100	1,160	50 U	50 U
March 2006	1,000	5.0 U	5.0 U	5.0 U	1,990	90	50 U	50 U
May 2006	667	5.0 U	5.0 U	5.0 U	1,290	99	50 U	50 U
October 2006	810	5.0 U	5.0 U	5.0 U	4,150	477	50 U	50 U
December 2006	243	5.0 U	5.0 U	5.0 U	2,820	315	50 U	50 U
March 2007	130	5.0 U	5.0 U	5.0 U	749	50 U	50 U	55
June 2007	206	5.0 U	5.0 U	5.0 U	890	50 U	50 U	50 U
September 2007	470	5.0 U	5.0 U	5.0 U	1,160	50 U	50 U	50 U
April 2008	390	489	5.0 U	5.0 U	2,130	2,040	50 U	50 U
November 2008	500	5.0 U	5.0 U	5.0 U	2,270	50 U	50 U	50 U
November 2009	150	5.0 U	5.0 U	5.0 U	2,430	50 U	50 U	50 U
December 2010	330	0.10 U	0.10 U	0.10 U	5,200	36	3.0 U	3.0 U
December 2011	250	0.30 U	--	0.30 U	2,700	4.0 U	--	4.0 U
November 2012	AW-010R Installed				AW-010R Installed			
December 2012	58,000	0.20 U	0.20 U	0.20 U	64,000	10 U	10 U	10 U
November 2013	84,000	0.20 U	0.20 U	0.20 U	140,000	10 U	57	10 U
December 2014	160,000	0.20 U	--	--	66,000	10 U	--	--

Notes:

All concentrations in micrograms per liter.

Green Highlighting = Concentration above the Groundwater Cleanup Standard

-- = not sampled

TBA = tert butyl alcohol

U = not detected above the listed detection limit.

¹ Monitoring wells are screened across four different lithologic layers M1- upper silty clay layer, S1 - upper sand layer, C2 - lower clay layer, and S2 - lower sand layer. The M1 and S1 layers comprise the upper water bearing zone and the S2 layer comprises the lower water bearing zone. Refer to Section 1.3 of the Long Term Monitoring Plan for a further discussion of the interpreted monitoring well classifications.

² AW-010 was noted as damaged beyond repair and was replaced with AW-010R in November 2012. A concentration increase for benzene and TBA was noted in December 2012 and November 2013 for the replacement monitoring well, AW-010R. The replacement well was installed with the same construction as the original monitoring well. One possible explanation for this increase is that the damage to monitoring well AW-010 was allowing surface water to infiltrate into the well, causing dilution of the benzene and TBA. Another possible explanation for this increase is that the water quality at the replacement well location is simply different than the original monitoring well location.

Table I-4: Summary of Groundwater Data Side Gradient and Outside the WRA Slurry Wall

Well Screened Interval ¹ Analyte Groundwater Cleanup Standard	AS-002 M1 Benzene 5	AW-003 M1 / S1 Benzene 5	MW-078 M1 / S1 Benzene 5	MW-152 S1 Benzene 5	AS-002 M1 TBA 2,200	AW-003 M1 / S1 TBA 2,200	MW-078 M1 / S1 TBA 2,200	MW-152 S1 TBA 2,200
August 2005	--	--	--	5 U	--	--	--	584
November 2005	--	--	26,400	--	--	--	2,000 U	--
December 2005	57,100	1,630	26,400	5 U	2,000 U	500 U	2,000 U	675
March 2006	58,200	1,760	17,700	5 U	20,000 U	500 U	6,250 U	50 U
May 2006	35,000	1,670	5,960	5 U	5,000 U	500 U	1,250 U	930
October 2006	37,600	1,900	18,000	5 U	10,000 U	500 U	1,250 U	436
December 2006	42,600	2,600	23,800	5 U	10,000 U	705	5,000 U	1,150
March 2007	40,400	1,740	19,000	5 U	10,000 U	500 U	5,000 U	563
June 2007	34,300	1,530	3,430	5 U	2,000 U	500 U	1,000 U	78
September 2007	38,200	1,070	6,850	5 U	10,000 U	250 U	1,000 U	434
April 2008 ²	32,500	728	2,520	455	10,000 U	371	1,330	1,910
November 2008	50,700	1,690	10,800	5.0 U	10,000 U	250 U	4,000 U	1,600
November 2009	26,100	240	10,300	5.0 U	10,000 U	50 U	2,500 U	2,640
December 2010	52,000	3,600	21,000	0.10 U	300 U	110	6,900	6,200
December 2011	38,000	1,100	21,000	0.30 U	400 UJ	250 JL	2,800 JL	8,000
December 2012 ³	28,000	3	30,000	0.20 U	1,000	14	1,700	3,700
November 2013	44,000	340	22,000	0.20 U	2,400	10 U	940	7,900
December 2014	--	--	17,000	0.20 U	--	--	650	3,500

Notes:

All concentrations in micrograms per liter.

Green Highlighting = Concentration above the Groundwater Cleanup Standard

-- = not sampled

TBA = tert butyl alcohol

U = not detected above the method detection limit.

J = datum estimated

JL = datum estimated; low bias

¹ Monitoring wells are screened across four different lithologic layers M1- upper silty clay layer, S1 - upper sand layer, C2 - lower clay layer, and S2 - lower sand layer. The M1 and S1 layers comprise the upper water bearing zone and the S2 layer comprises the lower water bearing zone. Refer to Section 1.3 of the Long Term Monitoring Plan for a further discussion of the interpreted monitoring well classifications.

² The benzene concentration reported for monitoring well MW-152 in April 2008 appears to be anomalously high.

³ The benzene concentration reported for monitoring well AW-003 in December 2012 appears to be anomalously low.

Figure I-2: Groundwater Contaminant Plumes in the S1 and S2 Zones at the WRA

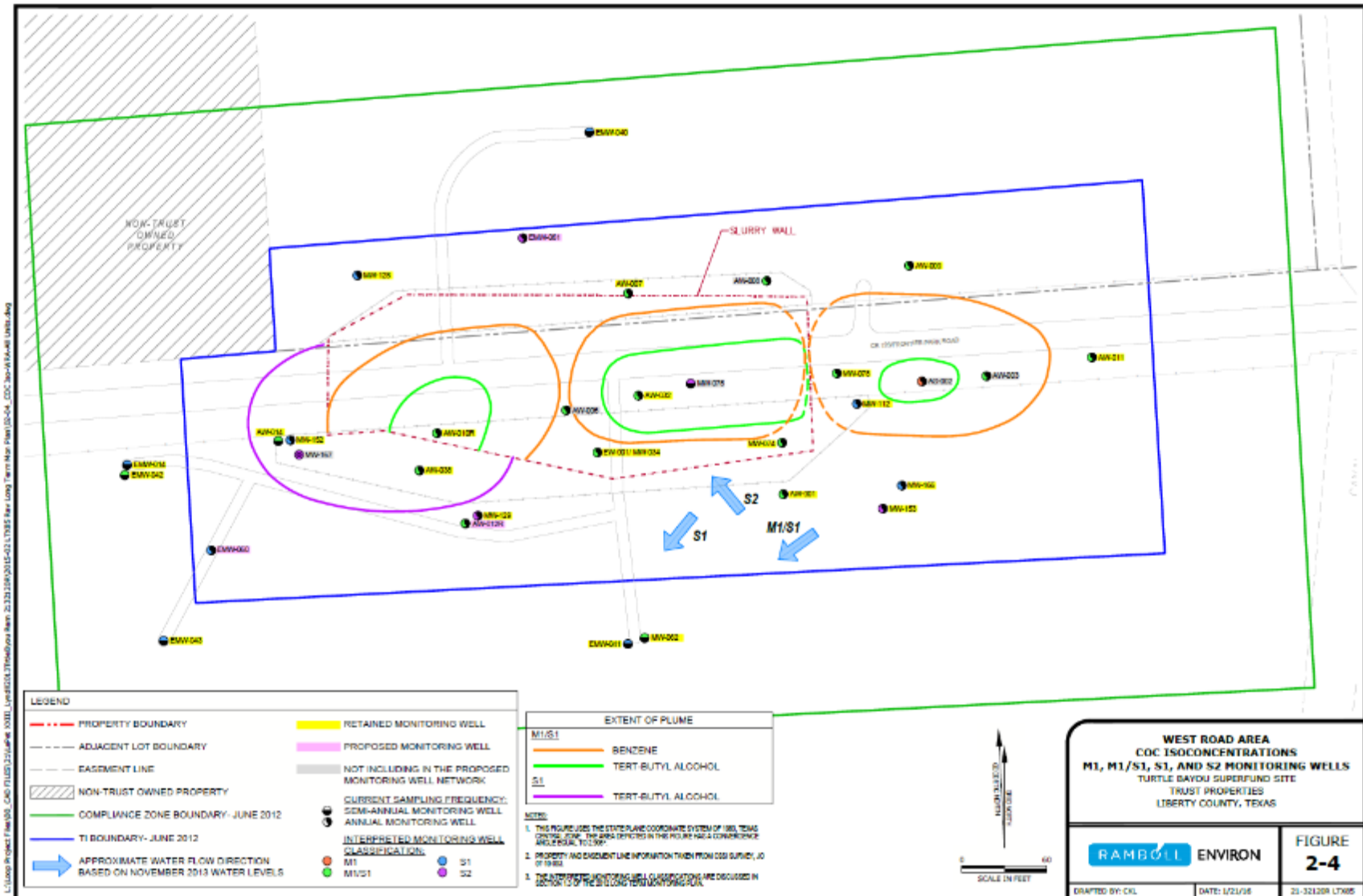


Figure I-3: Groundwater Contaminant Plumes in the M1/S1, S1 and S2 Zones at the MWA, OTA and B-52/MW-45 Subareas

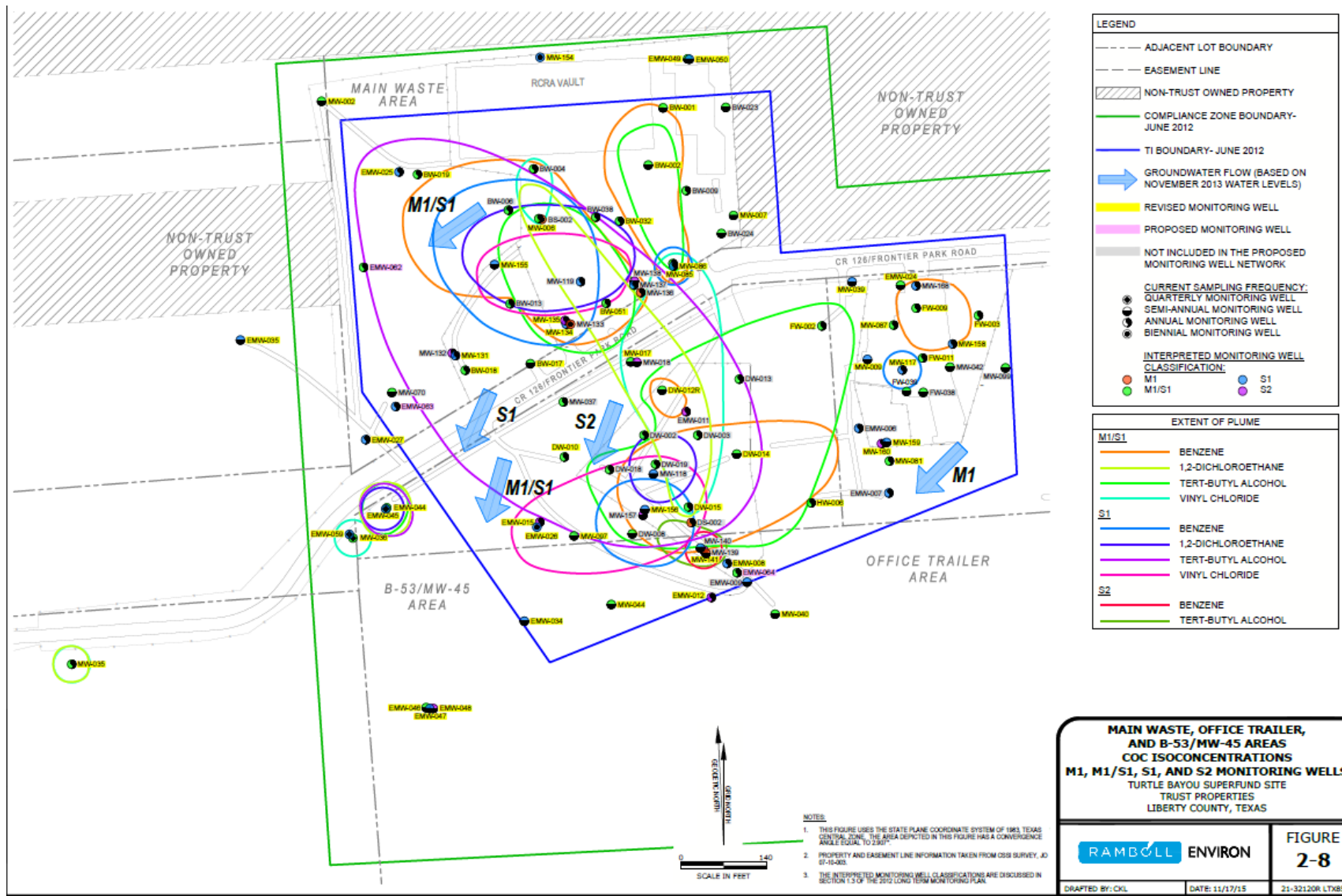


Figure I-4: S2 Contaminant Plumes in the S2 Zone at the MWA, OTA and B-52/MW-45 Subareas

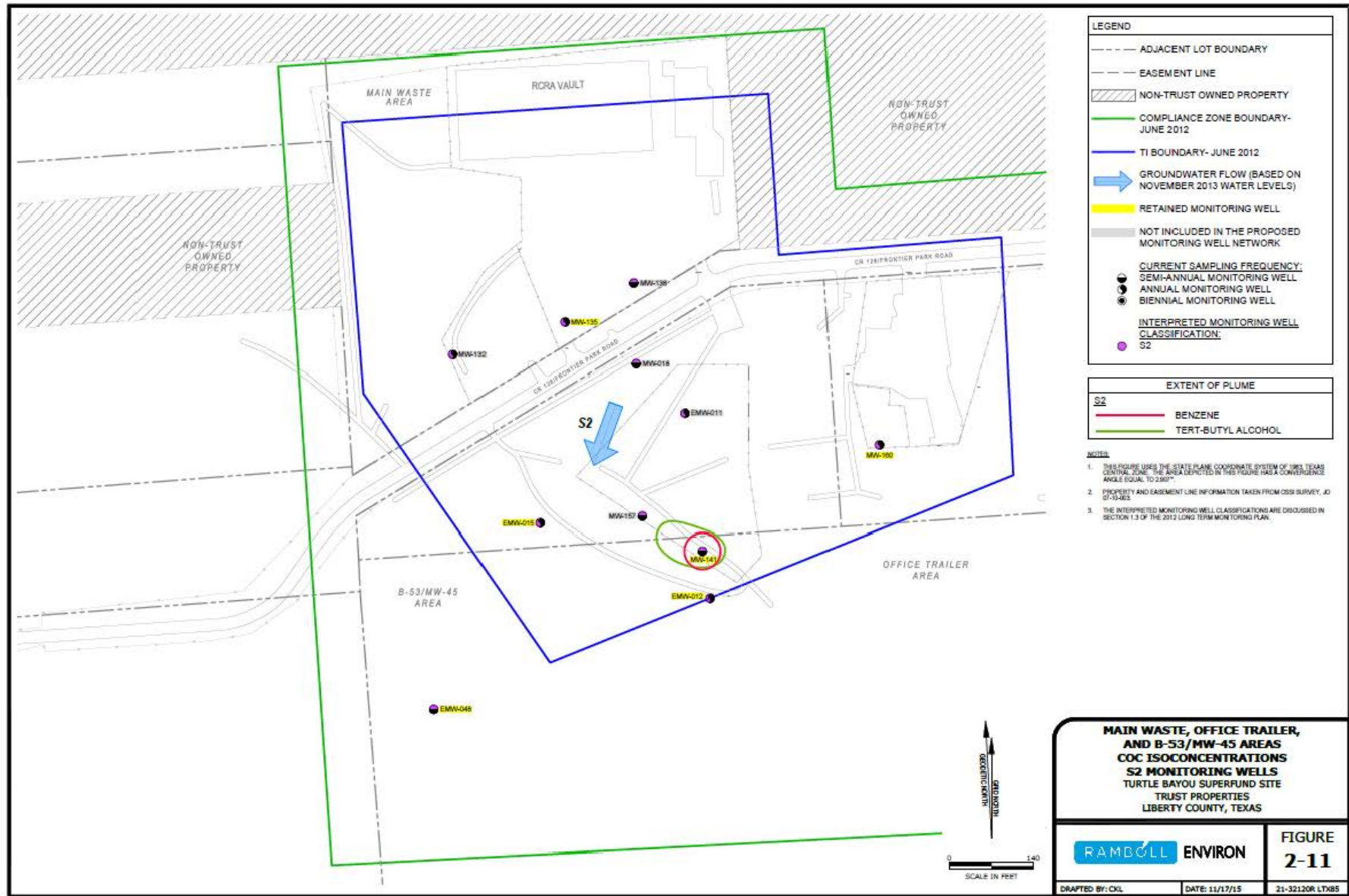


Figure I-5: Groundwater Contaminant Plumes in the S1 and S2 Zones at the OTA MW-10 Subarea

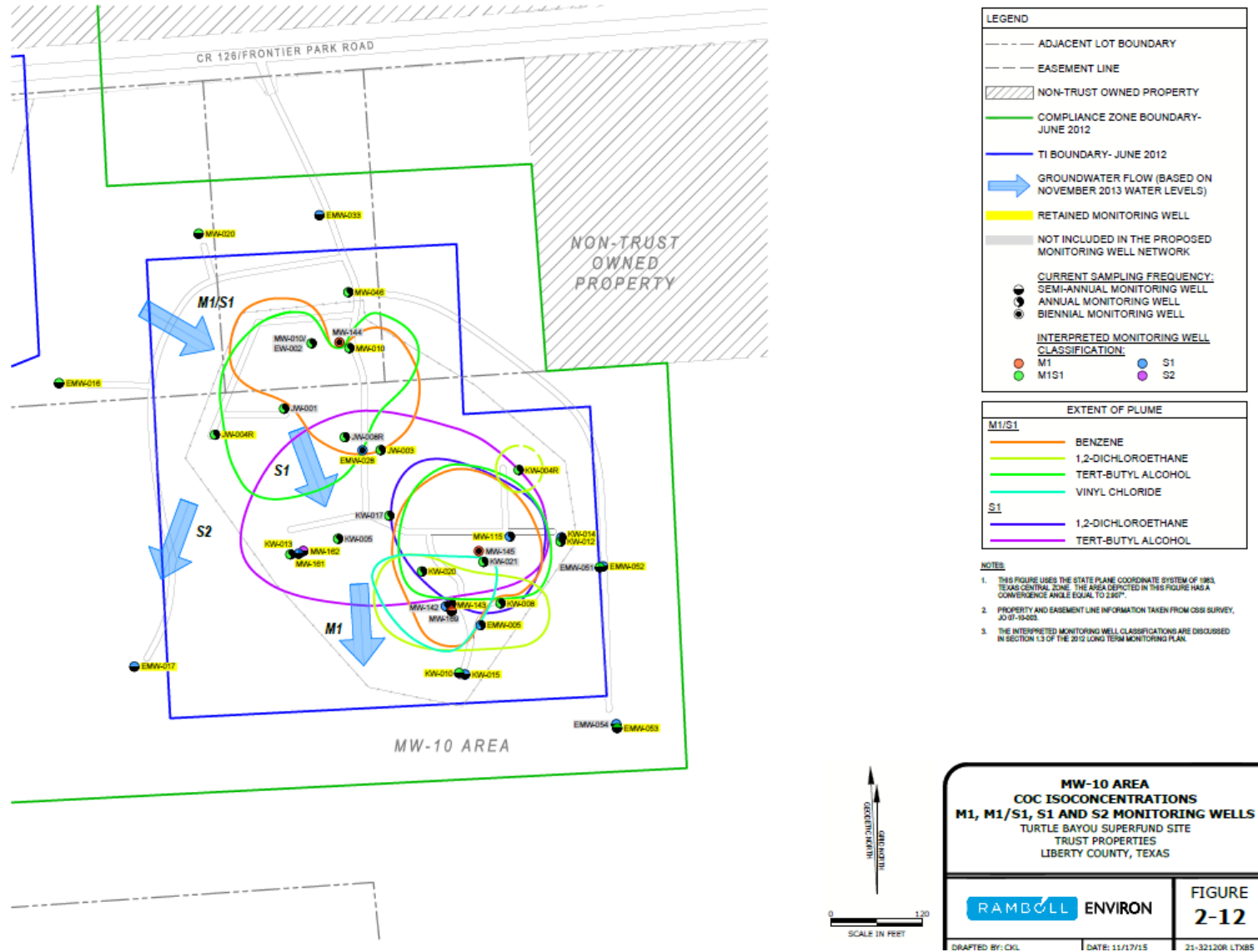
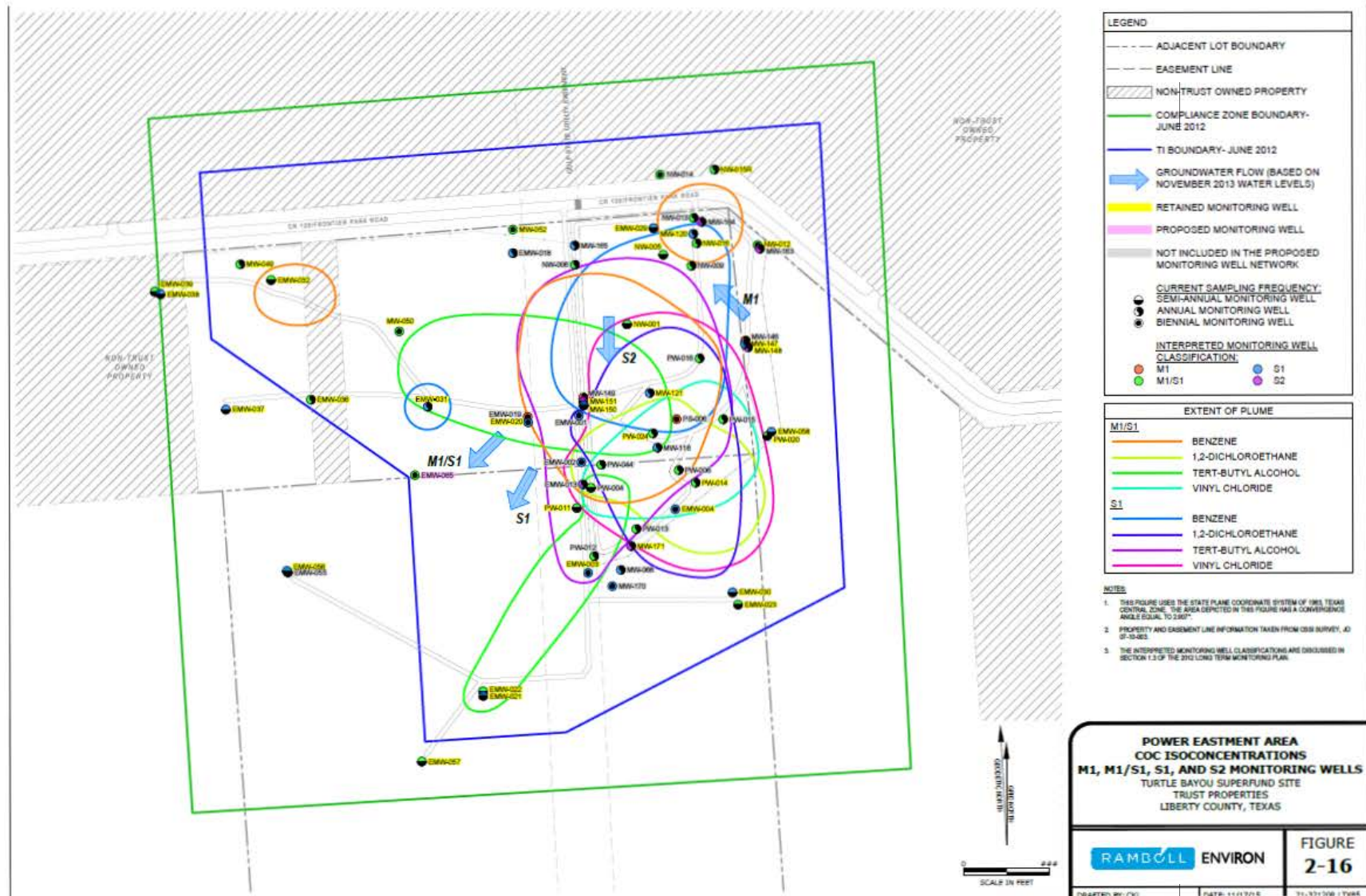


Figure I-6: Groundwater Contaminant Plumes in the S1 and S2 Zones at the EA



APPENDIX J – DETAILED TOXICITY REVIEW

Table J-1: Health Evaluation of OU2 Groundwater Protection Standards

COC	2012 ESD Standard (µg/L)	Tap Water RSL ^a (µg/L)		Cancer Risk ^b	Noncancer HQ ^c
		1 x 10 ⁻⁶ Risk	HQ=1.0		
1,1-Dichloroethane	4,900	2.8 ^d	3,800 ^d	2 x 10⁻³	1.3
Acetone	22,000	NA	14,000	--	1.6
Naphthalene	327	0.17 ^e	6.1	2 x 10⁻³	54
TBA	2,200 ^f	NA	NA	NA	NA

Notes:

a. Current EPA RSLs, dated November 2015, are available at <http://www2.epa.gov/risk/risk-based-screening-table-generic-tables> (accessed 2/26/2016).

b. The cancer risks were calculated using the following equation, based on the fact that RSLs are derived based on 1 x 10⁻⁶ risk:
Cancer risk = (Cleanup goal ÷ Cancer-based RSL) × 10⁻⁶

c. The noncancer hazard quotient (HQ) was calculated using the following equation:
HQ = cleanup goal ÷ noncancer based RSL

d. EPA has not established cancer and noncancer toxicity criteria for this chemical. However, EPA has adopted toxicity values developed by the California Environmental Protection Agency (CalEPA) for use in screening level evaluations.

e. EPA has not established cancer toxicity criteria for this chemical. However, EPA has adopted the cancer toxicity values developed by CalEPA for use in screening level evaluations.

f. Current Tier 1 PCL obtained at <http://www.tceq.texas.gov/remediation/trrp/trrppcls.html> (Accessed 3/4/2016).

NA = toxicity values not established by EPA
-- = cancer risk could not be calculated because the contaminant has not been classified as a carcinogen
Bold = cancer risk exceeds 1 x 10⁻⁴ or noncancer HQ exceeds 1.0

Table J-2: Health Evaluation of OU2 Soil Cleanup Levels

COC	Depth Interval (feet)	Cleanup Goal ^a (mg/kg)	Industrial RSL ^b (mg/kg)		Cancer Risk ^c	Noncancer HQ ^d
			1 x 10 ⁻⁶ Risk	HQ=1.0		
Benzene	NA	36	5.1	420	7.1 x 10 ⁻⁶	0.086
Lead	NA	800	800 ^e			
Naphthalene	NA	190	17	590	1.1 x 10 ⁻⁵	0.32
Vinyl chloride	NA	10	1.7	370	5.9 x 10 ⁻⁶	0.027

Notes:

a. From Page 69 of the 2006 AROD.

b. Current EPA RSLs, dated November 2015, are available at <http://www2.epa.gov/risk/risk-based-screening-table-generic-tables> (accessed 2/26/2016).

c. Cancer risks calculated using the following equation, based on the fact that RSLs are derived based on 1 x 10⁻⁶ risk: cancer risk = (cleanup goal ÷ cancer-based RSL) × 10⁻⁶

d. Noncancer HQ calculated using the following equation: HQ = cleanup goal ÷ noncancer-based RSL

e. Noncancer and carcinogenic toxicity criteria have not been developed for lead; EPA evaluates lead exposure using blood-lead modeling.
HQ = hazard quotient

APPENDIX K – INTERVIEW FORMS

Petro-Chemical Systems, Inc. (Turtle Bayou) Superfund Site

FYR Interview Form

Site Name: Petro-Chemical Systems, Inc. (Turtle Bayou) EPA ID No.: TXD980873350
Interviewer Name: N/A Affiliation: Skeo Solutions
Subject Name: Resident 1 Affiliation:
Subject Contact Information:
Time: 11:30 A.M. Date: 01/12/16
Interview Location: MW-109 Area
Interview Format (circle one): In Person Phone Mail Other:

Interview Category: Residents

1. Are you aware of the environmental issues at the Site and what cleanup activities have occurred?
Yes.
2. What is your general impression of the work conducted at the Site during the past five years?
Overall good, except the remediation activities may have created mounding near my septic tank so my septic tank backs up into my house during heavy rains.
3. What effect has the Site had on the surrounding community, if any?
None.
4. Are you aware of any community concerns regarding the Site or its operation and administration? If so, please provide details.
No.
5. Have there been any problems with unusual or unexpected activities at the Site, such as emergency response, vandalism or trespassing?
Occasionally, there are hunters that trespass and dump trash.
6. Do you feel well informed about the site's activities and progress?
Yes, except I have not received a copy of the 2006 Residential Well Monitoring Report.
7. Are you aware of any contamination or additional dumping that has not been addressed?
No.
8. Do you have a private well and if so, for what purposes is your private well used and what depth is this well?
Yes, but I do not use the water for drinking.
9. Do you have any comments, suggestions or recommendations regarding any aspects of the project?
No.

Petro-Chemical Systems, Inc. (Turtle Bayou) Superfund Site

FYR Interview Form

Site Name: Petro-Chemical Systems, Inc. (Turtle Bayou) EPA ID No.: TXD980873350
Interviewer Name: Claire Marcussen Affiliation: Skeo Solutions
Subject Name: Resident 2 Affiliation:
Subject Contact Information:
Time: 5:00 P.M. Date: 01/12/16
Interview Location: BDA area
Interview Format (circle one): In Person Phone Mail Other:

Interview Category: Residents

1. Are you aware of the environmental issues at the Site and what cleanup activities have occurred?
Yes.
2. What is your general impression of the work conducted at the Site during the past five years?
Seems ok. We are happy with the new road.
3. What effect has the Site had on the surrounding community, if any?
None.
4. Are you aware of any community concerns regarding the Site or its operation and administration? If so, please provide details.
No.
5. Have there been any problems with unusual or unexpected activities at the Site, such as emergency response, vandalism or trespassing?
Yes, hunters trespassing and poaching and leaving dead animals behind.
6. Do you feel well informed about the Site's activities and progress?
Yes.
7. Are you aware of any contamination or additional dumping that has not been addressed?
No.
8. Do you have a private well? If so, for what purposes is your private well used and what depth is this well?
Yes, but we don't use it except for watering the animals.

Do you have any comments, suggestions or recommendations regarding any aspects of the project?
No.

Petro-Chemical Systems, Inc. (Turtle Bayou) Superfund Site

Five-Year Review Interview Form

Site Name: Petro-Chemical Systems, Inc. (Turtle Bayou)

EPA ID No.: TXD980873350

Interviewer Name:

Affiliation: Skeo Solutions

Subject Name: Resident 3

Affiliation:

Subject Contact Information:

Time:

Date: 01/23/16

Interview Location:

Interview Format (circle one): **In Person** **Phone** **Mail** **Other:**

Interview Category: **Residents**

1. Are you aware of the environmental issues at the Site and what cleanup activities have occurred?
Yes.
2. What is your general impression of the work conducted at the Site during the past five years?
The maintenance is performed very efficiently, quietly and with little disruption to the residences along CR126.
3. What effect has the Site had on the surrounding community, if any?
Unsure.
4. Are you aware of any community concerns regarding the Site or its operation and administration? If so, please provide details.
No.
5. Have there been any problems with unusual or unexpected activities at the Site, such as emergency response, vandalism or trespassing?
No.
6. Do you feel well informed about the Site's activities and progress?
Yes.
7. Are you aware of any contamination or additional dumping that has not been addressed?
No.
8. Do you have any comments, suggestions or recommendations regarding any aspects of the project?
No.

Petro-Chemical Systems, Inc. (Turtle Bayou) Five-Year Review Interview Form Superfund Site

Site Name: Petro-Chemical Systems, Inc. (Turtle Bayou) EPA ID No.: TXD980873350

Interviewer Name: _____ Affiliation: Skeo Solutions
 Subject Name: Joseph Wiley Affiliation: Kinder Morgan, Inc.

Subject Contact Information: joe_wiley@kindermorgan.com

Time: _____ Date: 02/02/16

Interview Location: _____

Interview Format (circle one): In Person Phone Mail Other: Email

Interview Category: O&M Contractor

- What is your overall impression of the remedial activities at the Site?
Remedial activities for the site are completed. Long-term groundwater monitoring and periodic site inspections are the only remaining routine site activities, along with maintenance of fences, mowing, repairs to wells, etc., as necessary.
- What is your assessment of the current performance of the remedy in place at the Site?
The in-situ chemical oxidation portion of the remedy appears to have satisfactorily addressed soil impacts in the Far West Road Area, and the remaining groundwater plume is very stable. The remedy appears to be accomplishing what was intended.
- What are the findings from the monitoring data? What are the key trends in contaminant levels that are being documented over time at the Site?
The key findings of the monitoring data are that the groundwater plume is stable. Contaminant concentrations are stable or declining.
- Is there a continuous on-site O&M presence? If so, please describe staff responsibilities and activities. Alternatively, please describe staff responsibilities and the frequency of site inspections and activities if there is not a continuous on-site O&M presence.
There is no continuous on-site presence at the Site. Inspections are conducted twice each year, usually in June and December. The EPEC Polymers project manager meets with personnel from our consulting company (presently AECOM – Houston Office) and a site walk is conducted to check the status of each monitoring well (closed and locked), the fences, storage garage, gates, locks, etc. Any deficiencies are noted, photographed and subsequently addressed by the appropriate resource.
- Have there been any significant changes in site O&M requirements, maintenance schedules or sampling routines in the last five years and have these changes been included in an update O&M Plan? If so, do they affect the protectiveness or effectiveness of the remedy? Please describe changes and impacts and date of latest O&M plan(s).
On November 5, 2015, EPA approved a modification to the Long-Term Groundwater Monitoring Plan, which eliminated sampling requirements for natural attenuation parameters and lead. This change will not affect the protectiveness of the remedy.
- Please provide general summary of costs in table below:

Annual O&M Costs

Date Range	Total Cost (rounded to the nearest \$1,000)
2010	\$231,000

2011	\$143,000
2012	\$200,000
2013	\$59,000
2014	\$10,000
2015	\$32,000

7. Have there been unexpected O&M difficulties, challenges or costs at the Site in the last five years? If so, please provide details.
There have been no O&M issues in the past five years.
8. Since that 2011 FYR, not all institutional controls (ICs) have been addressed as summarized below. Please describe the restrictions and dates when ICs have been filed with the county. If ICs remain outstanding, clarify what ICs are needed and when they will be filed.
- a. BDA: When did EPEC record a restriction of groundwater on Lots 5 and 8?
The groundwater restrictions for Lots 5 and 8 were recorded in Liberty County records on May 28, 2008.
 - b. BDA: EPEC owns parcels 7, 11, 38 and 39. Have groundwater and land use restrictions been recorded? If so, when?
 - c. FWRA: EPEC owns lot 40. Have groundwater restrictions been recorded and if so when?
Groundwater restrictions have not yet been placed on Lot 40. However, that parcel will be restricted as part of the sale of the property as deed restrictions, or as a separate restrictive covenant prior to the sale of the property.
 - d. FWRA: EPEC does not own Lot 31. However, groundwater restrictions are warranted. Have groundwater restrictions been recorded? If so, when?
Groundwater restrictions have not been placed on Lot 31. EPEC has been in discussions with the owners of Lot 31 regarding the placement of groundwater restrictions on a portion of that property.
 - e. FWRA: EPEC purchased parcels 32, 34, 63, 81, 94, 107 and a portion of parcel 27. Have land use restrictions been recorded? If so, when?
Land and groundwater use restrictions have not yet been placed on the referenced parcels. Upon receipt from EPA of approval of the proposed revision to the previously accepted format, those restrictions will be placed, in the form of a restrictive covenant.
 - f. FWRA: EPEC purchased the groundwater rights for parcels 47, 78, 83, 86, 87, 90, 91, 95 and 101. Have restrictions on excavation and construction been recorded? If so, when?
There is no requirement for restriction of excavation or construction on any parcel that is not part of the Far West Road Area. There is only a requirement to restrict the use of groundwater in the S1 and S2 water-bearing zones within a 1,000-foot radius of the source area, which has been accomplished for these parcels by the purchase of water rights.
9. Do you have any additional comments, suggestions or recommendations regarding O&M activities and schedules at the Site?
No other comments.

Petro-Chemical Systems, Inc. (Turtle Bayou) Superfund Site

Five-Year Review Interview Form

Site Name: Petro-Chemical Systems, Inc. (Turtle Bayou) EPA ID No.: TXD980873350

Interviewer Name: _____ Affiliation: Skeo Solutions

Subject Name: Audrey Kirtley Affiliation: TCEQ

Subject Contact audrey.kirtley@tceq.texas.gov

Information:

Time: _____ Date: 01/22/16

Interview Location: _____

Interview Format (circle one): In Person Phone Mail Other: Email

Interview Category: State Agency

1. What is your overall impression of the project, including cleanup, maintenance and reuse activities (as appropriate)?

The Site appears to be well maintained. The residents in the area seem well informed about the Site. There are posted signs in place with contact information. The fences appear to be secure overall but there are indications of trespassing on the Site.

2. What is your assessment of the current performance of the remedy in place at the Site?

The TI boundaries in place are suitable. There may be some areas in which the TI boundaries need to be extended further. There is a large network of groundwater monitoring wells delineating the contaminated groundwater in each affected groundwater bearing unit. Additional assessment in the MW-109 Area will be necessary.

3. Are you aware of any complaints or inquiries regarding site-related environmental issues or remedial activities from residents in the past five years?

A resident called TCEQ in January 2015 because she was trying to sell her property located next to the Site. She claimed the potential purchaser was unable to gain access to her land because the Lyondell gates were locked. She was upset that the potential purchaser cancelled their sale after seeing hazardous waste warning signs on the adjacent property. TCEQ staff referred her to EPA to discuss further.

4. Has your office conducted any site-related activities or communications in the past five years apart from standard communications? If so, please describe the purpose and results of these activities.

TCEQ provided technical reviews of documents submitted by the PRP and Trustee. TCEQ participated in meetings with EPA's remedial project manager and site PRP and Trustee..

5. Are you aware of any changes to state laws that might affect the protectiveness of the Site's remedy?

No.

6. Do you feel that the recommendations from the 2011 FYR have been sufficiently addressed?

Besides the completion of filing of institutional controls at the Site, many of the 2011 recommendations have been addressed.

7. Are you comfortable with the status of the institutional controls at the Site? If not, what are the associated outstanding issues?

TCEQ has not received the Institutional Controls Plan yet to evaluate the status of the institutional controls at the site. TCEQ would like to receive a projected timeline for completion of filing the necessary institutional controls. TCEQ would also like information regarding which off-site properties need institutional controls in place.

8. Are you aware of any changes in projected land use(s) at the Site?

No.

9. Do you have any additional comments, suggestions or recommendations regarding the management or operation of the Site's remedy?

No.

Petro-Chemical Systems, Inc. Superfund Site Five-Year Review Interview Form

Site Name: Petro-Chemical Systems, Inc. **EPA ID No.:** TXD980873350
Interviewer Name: N/A **Affiliation:** Skeo Solutions
Subject Name: Angela E. DeDolph **Affiliation:** Ramboll Environ
Subject Contact Information: adedolph@ramboll.com
Time: N/A **Date:** 2/24/2016
Interview Location: N/A

Interview Format (circle one): **In Person** **Phone** **Mail** **Other: Email**

Interview Category: **O&M Contractor**

1. What is your overall impression of the remedial activities at the Site?
Active remedial activities were completed before Ramboll Environ began working at the site, so the comments provided below are focused on the current activities, which include long-term monitoring and maintenance in support of a Technical Impracticability waiver granted to the Site. The remedy is performing as intended and with the planned establishment of land use restriction institutional controls, the remedy should be protective of human health and the environment.

2. What is your assessment of the current performance of the remedy in place at the Site?
The remedy in place at the Site is performing as anticipated. The existing groundwater contamination has been delineated and the impacted areas do not appear to be expanding. The soil has been remediated to the extent that it does not pose a direct contact risk.

3. What are the findings from the monitoring data? What are the key trends in contaminant levels that are being documented over time at the Site?
The monitoring data demonstrate that existing groundwater contamination has been delineated and the impacted areas do not appear to be expanding.

4. Is there a continuous on-site O&M presence? If so, please describe staff responsibilities and activities. Alternatively, please describe staff responsibilities and the frequency of site inspections and activities if there is not a continuous on-site O&M presence.
There is not a continuous on-site O&M presence. The on-Site activities include the following:
 - *Once per quarter, there is a maintenance event at the site that generally takes one week. The maintenance activities include mowing, fence repair, and removal of downed trees, as needed to maintain the physical access restrictions at the Site and to keep interior portions of the Site accessible for periodic monitoring.*
 - *Site inspections are performed once per quarter and generally take one day to complete. They are documented in a quarterly site inspection report.*
 - *Groundwater monitoring is performed semi-annually. The length of sampling events varies from one to ten days depending on the number of wells for the respective sampling event.*

5. Have there been any significant changes in site O&M requirements, maintenance schedules or sampling routines in the last five years and have these changes been included in an update O&M Plan? If so, do they affect the protectiveness or effectiveness of the remedy? Please describe changes and impacts and date of latest O&M plan(s).
An updated plan for monitoring of the site has been prepared and is documented in the 2016 Long Term Monitoring Plan prepared by Ramboll Environ, dated January 2016. A West Road Slurry Wall Operations and Maintenance Plan dated February 2016 was prepared by Ramboll Environ. A draft Temporary RCRA Storage Facility Operations and Maintenance Plan has been prepared and is currently under revision. A revised version is expected to be completed in 2016.

6. Please provide general summary of costs in table below:

Annual O&M Costs

Date Range	Total Cost (rounded to the nearest \$1,000)
May to December 2010	\$574,000
2011	\$806,000
2012	\$1,010,000
2013	\$591,000
2014	\$369,000
2015	\$507,000

7. Have there been unexpected O&M difficulties, challenges or costs at the Site in the last five years? If so, please provide details.

There have not been unexpected O&M difficulties.

8. What is the status of the well abandonment program and removal of leachate from the sumps at the MWA landfill?

The well abandonment program was completed in December 2015 with the exception of once well (MW-063) located in the Main Waste Area that was not accessible due to wet conditions at the Site and three wells (MW-011, MW-048, and MW-054) that are not located on Trust owned property for which access agreements have not been obtained. A draft plan for pilot testing the removal of leachate from the sumps at the MWA landfill has been prepared and will be implemented when the plan and budget have been approved, which expected to occur in 2016.

9. What additional institutional controls (ICs) been established since the 2011 FYR? Please include actions and dates.

No institutional controls have been established since the 2011 FYR.

10. What are the outstanding issues that need to be addressed to ensure all ICs are in place at the WRA, MWA, OTA and EA (Please describe actions completed with dates)?

The land use restrictions need to be established for the various areas of the Site. Establishment of land use restrictions are scheduled to be implemented this year in accordance with an Institutional Controls Plan, which is in the process of being drafted.

11. Do you feel that the recommendations from the 2011 Five Year Review have been sufficiently addressed?

A majority of the recommendations have been sufficiently addressed. The exceptions are the establishment of institutional controls and the finalization of the O&M Plan for the Temporary RCRA Storage Facility (including appropriate management of leachate).

12. Do you have any additional comments, suggestions or recommendations regarding O&M activities and schedules at the Site?

No additional comments.