RCRA PART B APPLICATION
COMPLIANCE PLAN ATTACHMENT XI.D – VOL I

RESPONSE ACTION PLAN – Revision No. 2

UNION PACIFIC RAILROAD
HOUSTON WOOD PRESERVING WORKS
HOUSTON, TEXAS

JULY 15, 2016

Prepared for:

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PBW Project No. 1358

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
Response Action Plan

Cover Page

Regulatory ID number (Solid waste registration number, VCP ID number, etc) SWR No. 31547
check one: ___ Initial submittal for this on-site property X Subsequent submittal for this on-site property
Report date: July 15, 2016 – Rev 2 TCEQ Region No.: 12

TCEQ Program (check one)

X	Corrective Action (Mail Code 127)		Superfund PRP Lead (Mail Code 143)
	Voluntary Cleanup Program (Mail Code 221)		Municipal Solid Waste Permits (Mail Code 124)
	RPR Section (Mail Code 137)		

On-Site Property Information

On-Site Property Name: Union Pacific Railroad Houston Wood Preserving Works Site
Street no. 4910 Pre dir: ___ Street name Liberty Street type: Road Post dir: ___
City: Houston County: Harris County Code: 101 Zip: 77007
Nearest street intersection or location description: Site is located south of Liberty Rd. between Kashmere St. and Lockwood St, and north of Lee St.

Latitude: Decimal Degrees (circle one) North 29.787413
Longitude: Decimal Degrees (circle one) West 95.321062

Off-Site Affected Property Information

Off-Site Affected Property Name: See Appendix 5 for Off-Site Affected Property information
Physical Address: NA
Street no. ___ Pre dir: ___ Street name ___ Street type: ___ Post dir: ___
City: ___ County: ___ County Code: ___ Zip: ___

☐ Check if no off-site properties affected

Contact Person Information and Acknowledgement

Person (or company) Name: Union Pacific Railroad
Contact Person: Geoffrey Reeder Title: Manager, Site Remediation
Mailing Address: 24125 Aldine Westfield
City: Spring State: TX Zip: 77373 E-mail address gbreeder@up.com
Phone: 281-350-7197 Fax: 402-233-2351

By my signature below, I acknowledge the requirement of §350.2(a) that no person shall submit information to the executive director or to parties who are required to be provided information under this chapter which they know or reasonably should have known to be false or intentionally misleading, or fail to submit available information which is critical to the understanding of the matter at hand or to the basis of critical decisions which reasonably would have been influenced by that information. Violation of this rule may subject a person to the imposition of civil, criminal, or administrative penalties.

Signature of Person ___ Name, print: ___ Date: ___

RAP Executive Summary	ID No.: SWR No. 31547
	Report Date: December 7, 2015 - Rev 1

Use this worksheet to summarize the report. Be sure to complete and submit the Checklist for Report Completeness. **Attach a chronology of activities associated with the affected property.**

Briefly describe the affected property and PCLE zones, the conclusions from the assessment activities, identify any affected or threatened receptors, and describe any other major considerations taken into account when developing this response action plan. If any portion of the response action is necessitated due to an aesthetic or nuisance condition, identify the nature of that condition and identify that portion of the response action proposed to address it. If any media that contains a PCLE zone is not addressed in this RAP, provide justification.

Property Location, Land Use, and Operations

The Union Pacific Railroad (UPRR) Houston Wood Preserving Works (HWPW) Facility at 4910 Liberty Road, Houston, Harris County, Texas (the Site) is located within unoccupied industrial land and also includes the Englewood Intermodal Yard, which is to the south of the former HWPW facilities. The Englewood Intermodal Yard is used for the transfer of box containers from rail cars to truck trailers and vice-versa. UPRR mainline rail and siding rails lie between the former HWPW and the Englewood Intermodal Yard. The Site will remain commercial/industrial for the foreseeable future. The Site was first developed for creosoting operations in 1899, and operated various creosoting operations until 1984 when operations ceased. The facility was dismantled in the early 1990s. Details of the history and previous operations at the Site have been discussed in detail in the previously submitted Affected Property Assessment Report (APAR) (ERM, 2000) and Revised APAR (ERM, 2004), as well as the RCRA Facility Assessment (RFA) Report (PRC, 1993).

The surrounding properties within a 500-foot radius of the Site, including the Englewood Intermodal Yard, consist of residential to the northwest, north, southeast, and south. The UPRR Englewood Classification Yard, commercial/industrial property, is located to the east of the Site. An area of undeveloped land and abandoned houses are located west of the Site. The 500-foot radius field survey demonstrated no current potential groundwater receptors within the residential neighborhood. No water wells, water tanks, cisterns, or windmills, or surface water bodies were encountered. The nearest surface water body is Buffalo Bayou, located approximately 1.6 miles southwest of the Site. The potential for lateral migration of groundwater from the Site to the southwest approximately 8,500 feet to Buffalo Bayou is not likely.

Assessment Results

The initial APAR prepared for the Site was submitted to the TCEQ dated June10, 2000 (ERM, 2000). A revised APAR was submitted to the TCEQ dated June 10, 2004. Pastor, Behling & Wheeler, LLC (PBW) prepared the APAR Addendum dated July 2009 (PBW, 2009). Following comments from the TCEQ, PBW submitted the Updated APAR Addendum dated October 2010, with response to comments dated March 29, 2011. The TCEQ approved the APAR in a letter dated April 13, 2011.

As detailed in the APARs and subsequent submittal, the Affected Property consists of surface soils, subsurface soils, and groundwater affected by chemical of concern (COC) at the Site: The soil and groundwater exposure pathways were evaluated as part of the Site assessments are considered to be complete and/or anticipated to be complete.

Site stratigraphy from the ground surface to a depth of approximately 135 feet is separated into the following units: Fill Material (0 to5 feet thick), A-Cohesive Zone (A-CZ) (8 to 15 feet thick); A-Transmissive Zone (A-TZ) (4 to 21 feet thick); B-Cohesive Zone (B-CZ) (6 to 19 feet thick); B-Transmissive Zone (B-TZ) (discontinuous, where present, 3 to 10 feet thick); C-Cohesive Zone (C-CZ)

(8 to 20 feet thick); C-Transmissive Zone (C-TZ) (10 to 13 feet thick); D-Cohesive Zone (D-CZ) (17 to 36 feet thick); and D-Transmissive Zone (D-TZ).

As detailed in the Updated APAR Addendum (PBW, 2010), target COCs in soil and groundwater media were evaluated using the March 2010 TCEQ TRRP Residential PCLs, or Residential Assessment Levels (RALs) to establish the Affected Property. Surface and subsurface soil data collected from 1997 through June 2010, with subsequent sampling in 2013 and 2014, were evaluated to assess the Affected Property and Protective Concentration Level (PCL) Exceedance (PCLE) Zone in surface and subsurface soils. Groundwater data from the most recent sampling event (July/August 2014) were evaluated to assess COC exceedances in groundwater.

PCLE Zones

Soils

The soil critical PCLs were established for the Site by using the lower commercial/industrial PCLs for on-site soils and residential PCLs for off-site soils for the following pathways:

- $^{Tot}Soil_{Comb}$ (Tier 1);
- $^{Air}Soil_{Inh\text{-}V}$ (Tier 1); and
- $^{GW}Soil_{Ing}$ (Tier 1 or 2).

Although the former wood preserving works portion of the Site is partially covered with crushed gravel and soil, the $^{Tot}Soil_{Comb}$ pathway was evaluated as potentially complete since potential future construction activities could occur at the Site. Most of the Englewood Intermodal Yard has a concrete pavement cover, and the rail area between the HWPW and the Englewood Intermodal Yard is covered with railroad ballast, which both prevents exposure to surface and subsurface soils in the area.

Comparing the surface and subsurface soil analytical data to the appropriate critical PCLs, concentrations of 15 COCs exceeded their respective critical PCLs:

Surface Soils

- 1,2-Diphenylhydrazine
- 2,4-Dinitrotoluene
- 2-Methylnaphthalene
- Benzene
- Benzo(a)anthracene
- Benzo(a)pyrene
- Dibenzofuran
- Naphthalene
- Pentachlorophenol
- Arsenic
- Lead

Subsurface Soils

- 2-Methylnaphthalene
- Benzene
- Naphthalene
- Pentachlorophenol

The surface soil PCLE zone extends across the Original Process Area (SWMU 5) and Recent Process Area (SWMU 4), down the South Drainage Ditch (SDD) (SWMU 2), and across the Former Inactive Wastewater Lagoon (AOC 6). The PCLE zone was primarily defined by the concentrations of benzo(a)anthracene, benzo(a)pyrene, naphthalene, and pentachlorophenol in surface soils. Additional soil sampling conducted in 2013 indicates that the surface soil PCLE Zone extends into the Englewood Intermodal Yard. Additional soil sampling in 2014 indicated that the surface soil PCLE Zone

(benzo(a)pyrene and pentachlorophenol) extended north beyond the fence to the edge of Liberty Road, but was delineated along the northeast side of the Site. Arsenic and lead were detected at concentrations greater than cPCLs in surface soil in the Englewood Intermodal Yard.

For subsurface soils, the PCLE zones for 2-methylnaphthalene, naphthalene (more mobile COCs in soils), and pentachlorophenol were extrapolated using available subsurface soil data and applying the surface PCLE zone for those two COCs to the subsurface. By using the surface PCLE zone, this assumes the PCLE zone extends from the surface to the top of the uppermost GWBU (i.e. A-TZ). However for pentachlorophenol, none of the groundwater samples from A-TZ wells collected during the July/August 2014 groundwater monitoring event had detected pentachlorophenol concentrations above the RAL, suggesting the concentrations in surface and subsurface soils are protective of groundwater. The subsurface PCLE zone is confined to the area around the Original and Recent Process Areas (SWMUs 4 and 5), with a small area of naphthalene subsoil PCLE Zone in the Englewood Intermodal Yard area.

Groundwater

A total of 106 groundwater monitoring wells have been installed on and off-site in the GWBUs A-TZ, B-CZ/B-TZ, C-TZ, and D-TZ. Groundwater in A-TZ and B-TZ generally flows across the Site to the east; groundwater flow in the C-TZ flows from northeast to southwest, and groundwater flow in the D-TZ appears to flow to the northwest.

Based on the maximum groundwater analytical data from the July/August 2014 groundwater sampling event, concentrations of the following 23 target COCs exceeded their respective RALs where detected or had a SDL greater than the cPCL (>SDL) for COCs with no detections:

<u>VOCs</u>

- Benzene (A-TZ, B-TZ, C-TZ)
- Ethylbenzene (B-CZ only)
- Methylene Chloride (A-TZ, B-TZ/B-CZ, & C-TZ)
- Toluene (B-CZ only)
- Vinyl Chloride (A-TZ and B-TZ)

<u>SVOCs</u>

- 2,4-Dimethylphenol (A-TZ, B-TZ, C-TZ)
- 2,6-Dinitrotoluene (B-TZ & C-TZ)
- 2-Methylnaphthalene (A-TZ, B-CZ/B-TZ, & C-TZ)
- Acenaphthene (C-TZ only, one well*)
- Anthracene (C-TZ only, one well*)
- Benzo(a)anthracene (A-TZ, B-CZ, & C-TZ)
- Benzo(a)pyrene (A-TZ, C-TZ, and D-TZ)
- Bis(2-chloroethoxy)methane (A-TZ & C-TZ*)
- Chlorobenzene (A-TZ only, one well)
- Chrysene (C-TZ only, one well*)
- Dibenzofuran (A-TZ, B-CZ/B-TZ, & C-TZ)
- Fluoranthene (C-TZ only, one well*)
- Fluorene (C-TZ only, one well*)
- Naphthalene (A-TZ, B-CZ/B-TZ, & C-TZ)
- Pentachlorophenol (C-TZ)
- Phenanthrene (C-TZ only, one well*)
- Phenol (A-TZ, B-CZ, & C-TZ)
- Pyrene (C-TZ only, one well*)

* - COC only detected in wells with DNAPL present

As noted above, SVOCs acenaphthalene, anthracene, chrysene, fluoranthene, fluorene, phenanthrene, and pyrene were detected above cPCLs in only one well, MW-23C, which contained dense nonaqueous phase liquids (DNAPL) during the sampling event. These concentrations may overestimate the dissolved fraction in the groundwater; however, these COCs were included in the PCLE COC list.

The location and extent of the groundwater PCLE zones were determined by COCs present in groundwater at concentrations that exceed the critical PCL ($^{GW}GW_{ing}$) using the most recent groundwater data. Groundwater PCLE Zones were mapped for the three upper GWBUs: A-TZ, B-CZ/B-TZ, and C-TZ. One COC benzo(a)pyrene has been detected in the D-TZ GWBU during the most recent groundwater sampling event. A resample from the well confirmed the initial result. UPRR will evaluate further investigation of the D-TZ following the next sampling event.

No affected or threatened receptors are associated with the groundwater PCLE zone. Groundwater supply wells are not located in the affected area and drinking water in the area is provided by a municipal water supply (City of Houston).

Creosote DNAPL has been detected in the GWBUs A-TZ, B-CZ, B-TZ, and C-TZ as noted in soil borings and monitoring wells. The sources of DNAPL observed at the Site are likely from spills and drippings at the Site over the 80+ years of wood treating operations, with most of the releases likely occurring prior to 1984. The wood treating facility was shut down and dismantled in the early 1990s; thus, the DNAPL sources were removed over 20 years ago. UPRR completed a DNAPL Recovery Pilot Study for 24 months ending January 2015 to evaluate the effectiveness of DNAPL recovery through monthly DNAPL pumping events for 24 months. The results of the pilot test indicated that monthly DNAPL recovery activities are effective with DNAPL recovery and with overall DNAPL thicknesses either decreasing or becoming stable in the wells.

Response Action Plan

The objective of this RAP is to develop responses to protect current and future pathways from exposure to the PCLE Zones in surface soil, subsurface soil, and groundwater. The following response actions are proposed at the Site to achieve this objective:

- Surface/subsurface soil – The surface/subsurface soil PCLE Zones at the Site will be addressed as follows:
    1) Former HWPW Area: Remedy Standard B closure through consolidating impacted soils within the Area of Contamination (AOC) and implementing Physical Control through an engineered soil cap and asphalt roadway. Periodic inspections and maintenance of the cap and roadway will be implemented;
    2) Englewood Intermodal Yard: Remedy Standard B closure by implementing Physical Control using the existing concrete pavement as a cap. Periodic inspections and maintenance of the cap will be implemented;
    3) Railroad mainlines and siding tracks: The response action for the operational area between the Former HWPW area and the Englewood Intermodal Yard will be Remedy Standard B closure using the existing railroad ballast as a protective barrier.
    4) City of Houston ROW along Liberty Road: Remedy Standard B closure through limited excavation of surface soils, consolidating impacted soils within the AOC, and implementing Physical Control through an engineered concrete sidewalk. Periodic inspections and maintenance of the cap and roadway will be implemented.

- Groundwater – Remedy Standard B closure using a Plume Management Zone (PMZ) with monitored natural attenuation (MNA) for control as the response action for the groundwater

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PCLE Zones within the Affected Property. For the purposes of this RAP submittal, there will be four PMZ areas:

1) On-Site PMZ (Main) - The on-site PMZ (Main) will include the cumulative groundwater PCLE Zone within the UPRR-owned property from the center to the east portion of the Site.
2) On-Site PMZ (West) - The on-site PMZ (West) will include the B-CZ/B-TZ PCLE Zone on the west side of the Site within the UPRR-owned property.
3) Off-Site PMZ - The off-site PMZ includes the cumulative groundwater PCLE Zone that extends off-site to the north of the Site, but not including City of Houston ROW. The proposed off-site PMZ will require institutional controls for up to 88 individual properties.
4) Off-Site PMZ City of Houston ROW - The off-site PMZ includes the cumulative groundwater PCLE Zone that extends off-site to the north of the Site within the City of Houston ROW.

In addition, areas where DNAPL was noted will be proposed for control under a Technical Impracticability (TI) Demonstration per 30 TAC §350.33(f). Groundwater monitoring is proposed to be performed as part of the PMZ to confirm that the lateral extent of COC concentrations greater than their respective cPCLs continue to remain within the boundaries of the PMZ. Groundwater monitoring will be initiated for both the On-Site PMZs and Off-Site PMZs following approval of the RAP. During the acquisition of landowner consent for the off-site PMZ, groundwater monitoring will be conducted concurrently with the on-site PMZ monitoring requirements. DNAPL will be recovered from wells on a periodic basis through pumping to recover the readily recoverable NAPL for the GWBUs to satisfy requirements of the "no growth" PMZ and TI Zone.

What is the selected remedy standard for this affected property? ___ A **X** B

List all media that contains a PCLE zone and specify the proposed response action for each media. Indicate the type of removal, decontamination, physical control and/or institutional control action that is proposed.

Media	COCs[1]	Removal	Decontamination	Control			
				Physical Control	Modified Groundwater Response Objective[2]		
					PMZ	WCU	TI
Surface Soil	**Benzene, SVOCs, metals**			**X**			
Subsurface Soil	**SVOCs**			**X**			
Groundwater	**Benzene, SVOCs**				**X**		**X**

Is there a media that contains a PCLE zone that is not addressed in this RAP? ___ yes **X** no

[1] Specify either a specific COC or, if the response action is the same for all COCs in one type, specify the type of COC (for example, VOCs, SVOCs, metals).
[2] If a modified groundwater response objective is proposed, check the type(s) of proposed modifications.

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If yes, provide justification for not addressing the PCLE zone in this RAP.

On-site land use:	[ ]	Residential	[X]	Commercial/Industrial
Off-site land use:	[X]	Residential	[X]	Commercial/Industrial (check all that apply)

Is this a re-submittal or revision of a previous RAP? **X** Yes ___ No

If yes, explain why the RAP is being revised or resubmitted.

This RAP is being submitted with revisions based on the TCEQ 2nd Technical Notice of Deficiencies (NOD) dated June 2, 2016 on the UPRR Houston Wood Preserving Works Permit Renewal/Compliance Plan with Major Amendment, Permit/Compliance Number 50343, ISWR 31547.

Were all the appropriate notifications made in accordance with §350.55? **X** Yes ___ No

If no, explain why notifications were not made:

CHRONOLOGY

Below is a summary of the site investigation and regulatory chronology at the UPRR Former Houston Wood Preserving Works facility (listed in reverse order).

Date	Description
May 2016	UPRR completes the response actions authorized under the Area of Contamination to address the surface and subsurface soil Protective Concentration Level Exceedance (PCLE) Zones as detailed in the updated Response Action Plan (RAP) dated December 7, 2015.
February 2016	TCEQ approves the request to extend the termination date for the Area of Contamination from February 15, 2016 to March 7, 2016 in a letter dated February 22, 2016
January 2016	Begin response actions (excavation/placement and cap constriction) activities to address surface soil PCLE Zones. PBW conducts 2016 first semi-annual groundwater monitoring event for the Solid Waste Management Unit (SWMU) 1. PBW submits on behalf of UPRR a request to extend the termination date from February 15, 2015 to March 7, 2016 for the Area of Contamination set by the TCEQ.
December 2015	Union Pacific Railroad (UPRR) submits the RCRA Part A and B Permit Renewal Application (Revision No. 2) with Response Action Plan (RAP) (Revision No. 1) to the TCEQ dated December 7, 2015. Remediation contractor begins site preparation for response actions under the Area of Contamination.
November 2015	Union Pacific Railroad (UPRR) receives the Texas Commission on Environmental Quality (TCEQ) letter dated November 5, 2015 detailing the agency's review of the September 18, 2015 submittal titled Additional Information for Clean Closure Equivalence Demonstration. The TCEQ Industrial and Hazardous Waste (I&HW) Permits Section was unable to accept the request for discontinuing post-closure care of the former surface impoundment, Solid Waste Management Unit (SWMU) 1.
November 2015	Meeting with UPRR, Pastor, Behling & Wheeler (PBW), and the TCEQ on November 4, 2015 discussing the October 23, 2015 technical comment letter from the TCEQ.
October 2015	UPRR receives additional technical comments from the TCEQ in a letter dated October 23, 2015 on the Response Action Plan (RAP) regarding the Plume Management Zones and Technical Impracticability Demonstration provided in the Response Action Plan.
September 2015	PBW submits to the TCEQ the Additional Information for Clean Closure Equivalence Demonstration dated September 18, 2015 that included historical data and letters from 1983, 1984, and 1991 to demonstrate clean closure of the soils under the former surface impoundment (SWMU 1). The letter also included a request to cease the post-closure care for SWMU 1.

Date	Description
August 2015	UPRR receives Technical Notice of Deficiency (NOD) Letter dated August 5, 2015 on the RCRA Part A and B Permit Renewal Application and Response Action Plan from the TCEQ.
July 2015	PBW submits to the TCEQ the Corrective Action Monitoring Report: 2015 First Semi-Annual Event dated July 16, 2015; PBW conducts 2015 second semi-annual groundwater monitoring event for the SWMU No. 1.
April 2015	PBW submits to the TCEQ newspaper tear sheets and affidavits that public notice was published in English and Spanish in the *Houston Chronicle* on April 2 and *La Subasta* on March 31, respectively as required once the RCRA Permit Renewal/Compliance Plan with Major Amendment was administratively complete.
March 2015	TCEQ issues a letter dated March 13, 2015 declaring the RCRA Permit Renewal/Compliance Plan with Major Amendment was administratively complete on March 13, 2015.
February 2015	PBW submits a response letter to the TCEQ dated February 13, 2015 for the TCEQ Administrative NOD on the RCRA Part A and B Permit Renewal Application.
January 2015	PBW submits to the TCEQ the Corrective Action Monitoring Report: 2014 Second Semi-Annual Event dated January 15, 2015; PBW conducts 2015 first semi-annual groundwater monitoring event for the SWMU No. 1.
December 2014	UPRR submits the RCRA Part A and B Permit Renewal Application with Response Action Plan (RAP) to the TCEQ dated December 10, 2014. UPRR receives the TCEQ Administrative NOD Letter dated December 17, 2014.
November 2014	RCRA Permit Pre-Application Meeting with UPRR, PBW, and TCEQ dated November 6, 2014.
September 2014	UPRR holds public meeting with residents near the Site to detail institutional controls for off-site groundwater Plume Management Zone (PMZ).
July/August 2014	PBW conducts site-wide groundwater sampling event.
May 2014	PBW oversees installation of seven new monitoring wells (MW-51C, MW-76C, MW-77A, MW-78A, MW-79A, MW-80B, and MW-81B) in the Englewood Intermodal Yard to evaluate DNAPL extent and extent of chemicals of concern (COCs) in the B-CZ unit to the southeast, and one replacement well MW-34CR to replace MW-34C. Soil samples also collected from City of Houston right of way (ROW) along north perimeter of the Site.
January 2014	PBW conducts site-wide groundwater sampling event.
July 2013	PBW conducts site-wide groundwater sampling event.

Date	Description
February/March 2013	PBW conducts cone penetrometer testing (CPT)/rapid optical screening tool (ROST) and soil investigation at the Englewood Intermodal Yard adjacent to the UPRR Houston Wood Preserving Works (HWPW) site.
January/February 2013	PBW conducts site-wide groundwater sampling event (95 wells). PBW submits Proposed DNAPL Recovery Pilot Test letter to TCEQ dated February 5, 2013, and initiates monthly DNAPL recovery from on-site and off-site wells (10-12 wells) (planned for 24 months).
November 2012	Meet with TCEQ regarding proposed CPT/ROST investigation of Englewood Intermodal Yard based on DNAPL detected from the December 2011 investigation.
July 2012	PBW conducts site-wide groundwater sampling event.
January 2012	PBW conducts site-wide groundwater sampling event.
July 2012	PBW conducts site-wide groundwater sampling event.
December 2011	PBW installs additional monitoring wells in the cohesive zone B-CZ to evaluate extent of DNAPL in the B-CZ.
July 2011	PBW conducts site-wide groundwater sampling event.
April 2011	TCEQ approves the Affected Property Assessment Report (APAR) (including updates and addendums).
March 2011	PBW submits the Revised Updated APAR Addendum to the TCEQ. UPRR repairs fence around site.
January 2011	PBW conducts site-wide groundwater sampling event.
December 2010/ January 2011	UPRR/PBW submits Off-Site Notification Letters to off-site properties indicating Notice of Information Availability for the site, as required with the submittal of the Updated APAR Addendum (Oct 2012) .
October 22, 2010	PBW submits the Updated APAR Addendum to the TCEQ.
June/July 2010	PBW conducts additional soil (along northeast portion of Site) and groundwater investigation (A-TZ, B-CZ, C-TZ and D-TZ wells); including site-wide groundwater monitoring event.
February 16, 2010	UPRR Response to TCEQ Comment Letter dated November 18, 2009.
January 2010	PBW conducts site-wide groundwater sampling event; selected wells are analyzed for Volatile Organic Compounds (VOCs) by EPA Method 8620.

Date	Description
November 18, 2009	TCEQ Comment Letter on Revised APAR.
July 2009	PBW submits APAR Addendum to TCEQ.
January 2009	PBW conducts additional soil and groundwater investigation.
July 2008	PBW conducts additional CPT-ROST and groundwater investigation
January 2007	PBW conducts additional soil and groundwater investigation
August 2006	ERM-Southwest, Inc. (ERM) conducted additional soil and groundwater investigation
April 2006	ERM conducted additional soil and groundwater investigation
September 6, 2005	UPRR Response to TCEQ Response Letter dated August 1, 2005
August 2005	TCEQ Response to UPRR Response Letter dated June 9, 2005
June 9, 2005	UPRR Response to TCEQ Letter dated April 15, 2005
April 15, 2005	TCEQ Response to UPRR Response Letter dated November 19, 2004
November 19, 2004	UPRR Response to October 8, 2004 TCEQ Letter
October 8, 2004	TCEQ Comment Letter on Revised APAR
June 10, 2004	Revised APAR submitted to the TCEQ by ERM, Inc. on behalf of UPRR
November 7, 2001	Texas Natural Resources Conservation Commission (TNRCC) provides comments to July 5, 2001 response letter.
July 5, 2001	Follow-up response to November 6, 2000 TNRCC comment letter on the On-Site APAR submitted to TNRCC on behalf of UPRR.
January 9, 2001	Initial response to November 6, 2000 TNRCC comments.
November 6, 2000	TNRCC provides comments to On-Site APAR.
July 10, 2000	Affected Property Assessment Report for On-Site Property (On-Site APAR) submitted to TNRCC on behalf of UPRR by ERM.
February 20, 2000	Letter submitted to the TNRCC regarding proposed Phase 2-C investigation for further delineation of off-site areas
September 10, 1999	Phase 2-B RFI/EOC Investigation Report submitted to TNRCC on behalf of UPRR by ERM

Date	Description
April 27, 1998	Interim Stabilization Measures Report – Southern Drainage Ditch, submitted to TNRCC on behalf of UPRR by ERM.
February 13, 1998	Phase 2-A RFI/EOC Investigation Report submitted to TNRCC on behalf of UPRR by ERM.
January 13, 1997	RFI portion of the Phase 1 RFI/EOC Investigation Report approved by TNRCC
November 26, 1996	EOC portion of the Phase 1 RFI/EOC Investigation Report approved by TNRCC
May 23, 1996	Phase 1 RFI/EOC Report submitted on behalf of Southern Pacific Transportation Company (SPTCo) by Terranext
October 16, 1995	RFI Work Plan approved by TNRCC
September 29, 1995	EOC Work Plan approved by TNRCC
January 10, 1995	Operation and Maintenance Plan approved by TNRCC
November 3, 1994	Revised Compliance Schedule approved by TNRCC
October 14, 1994	RCRA Facility Investigation (RFI) Work Plan submitted on behalf of SPTCo
September 16, 1994	Extent of Contamination (EOC) Work Plan submitted on behalf of SPTCo
September 7, 1994	Revised Compliance Schedule submitted on behalf of SPTCo
August 19, 1994	Operation and Maintenance Plan and Compliance Schedule submitted on behalf of SPTCo
June 20, 1994	Permit No. HW-50343-000 and Compliance Plan CP-50343-000 issued by TNRCC.
October 1993	RCRA Facility Assessment completed on behalf of U.S. EPA by PRC Environmental Management, Inc.
May 13, 1991	RCRA Permit Application submitted by SPTCo

Note: Not all groundwater sampling events are listed in the chronology

Checklist for Report Completeness	ID No.: SWR ID 31547
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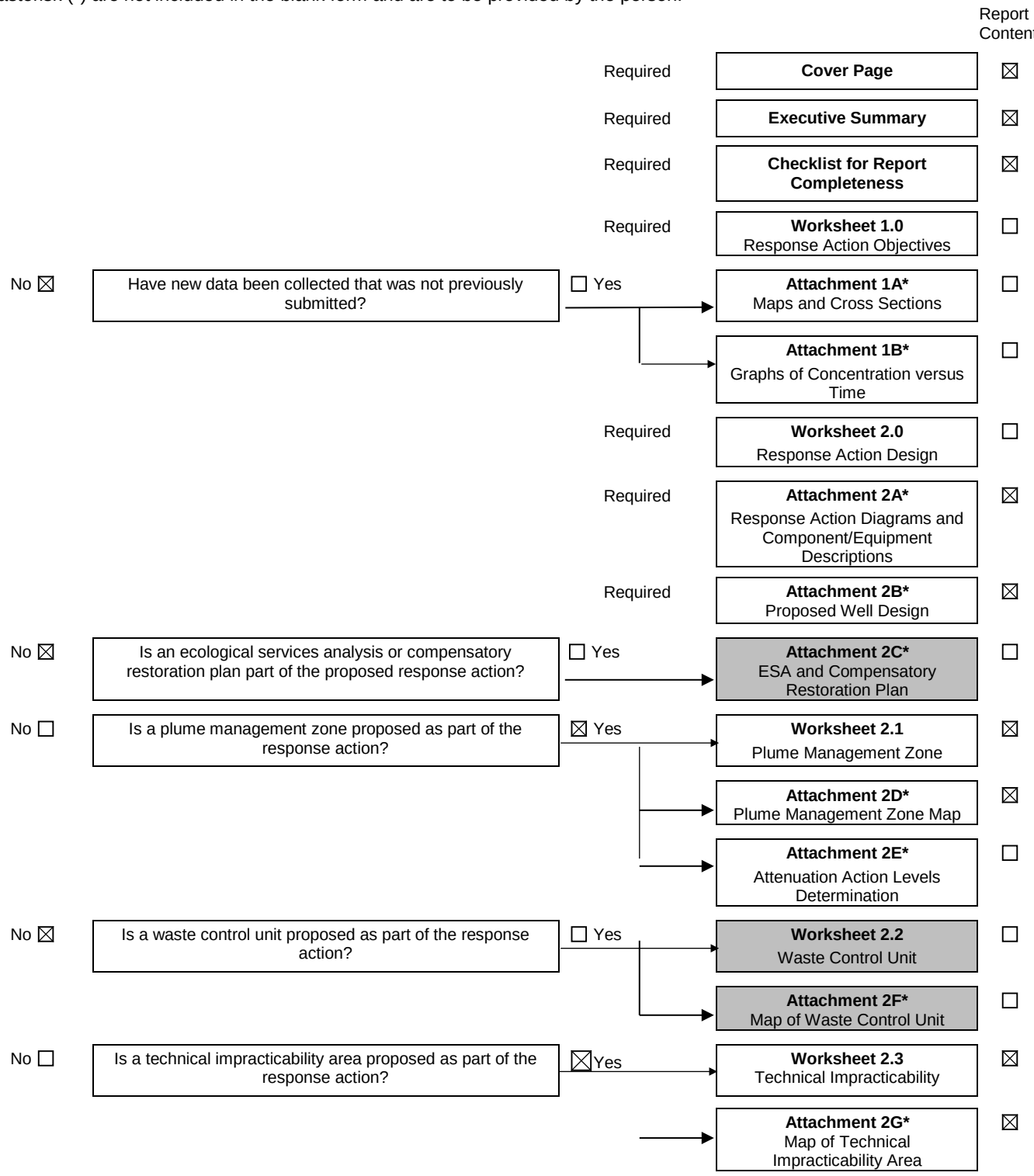
Use this checklist to determine the portions of the form that must be submitted for this report. Answer all questions by checking Yes or No. If the answer is Yes include that portion of the report. If the answer is No, do not complete or submit that portion of the report. All form contents that are marked "Required" must be submitted. Form contents marked with an asterisk (*) are not included in the blank form and are to be provided by the person.



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				Report Contents
No ☐	Is the response action a remedy standard B?	☒ Yes →	**Worksheet 2.4** Institutional Controls	☒
		Required	**Worksheet 3.0** Performance Measures and Potential Problems	☐
		Required	**Worksheet 3.1** Monitoring and Sampling	☒
		Required	**Attachment 3A*** Map of Monitoring and Sampling Points	☒
		Required	**Worksheet 3.2** Operation and Maintenance	☐
		Required	**Worksheet 4.0** Confirmation Sampling Plan	☐
		Required	**Attachment 4A*** Map of Confirmation Sampling Points	☐
No ☐	Is the response action a Remedy Standard B?	☒ Yes →	**Worksheet 5.0** Post Response Action Care	☐
		→	**Attachment 5A*** Map of PRAC Monitoring and Sampling Points	☒
		→	**Attachment 5B*** PRAC Costs	☐
No ☒	Does the person, who is a small business, desire to modify the financial assurance requirement?	☐ Yes →	**Attachment 5C*** Small Business Affidavit	☐
		Required	**Worksheet 6.0** Implementation Schedule	☐
		Required	**Appendix 1*** References	☐
No ☐	Was any data collected that was not previously reported?	☐ Yes →	**Appendix 2*** Data Tables and Boring Logs	☐
No ☐	Were any studies or tests conducted?	☐ Yes →	**Appendix 3*** Studies and Tests Documentation	☐
No ☐	Is the response action a Remedy Standard B?	☒ Yes →	**Appendix 4*** Proposed Institutional Controls	☒
No ☐	Are any institutional controls proposed/required on property not owned by the person?	☒ Yes →	**Appendix 5*** Landowner Concurrence	☒
No ☐	Are any of the sample collection or handling procedures different from those reporting in the APAR or other previously submitted report?	☐ Yes →	**Appendix 6*** Sampling Procedures	☐
No ☐	Are statistics or geostatistics proposed to be used as part of the response action?	☐ Yes →	**Appendix 7*** Statistical Methodology	☐
No ☒	Was approval received from the TCEQ regarding the use of different rules to address a media?	☐ Yes →	**Appendix 8*** Split Media Approval	☐

Form contents marked with an asterisk (*) are not included in the blank form.

ATTACHMENT 2A

RESPONSE ACTION DIAGRAMS AND COMPONENT/EQUIPMENT DESCRIPTIONS

ATTACHMENT 2A-1a RESPONSE ACTION DESIGN – SOILS
ATTACHMENT 2A-1B RESPONSE ACTION DESIGN – SOILS (AOC6)
ATTACHMENT 2A-2 RESPONSE ACTION DESIGN – GROUNDWATER - UPDATED
ATTACHMENT 2A-3 HOUSTON WOOD PRESERVING WORKS SOIL CAP AND ROADWAY IMPROVEMENTS ENGINEERING DRAWINGS

EXPLANATION

- UPRR Property Boundary
- Property Boundary (GIMS)
- A-TZ Monitoring Well Location
- B-CZ/B-TZ Monitoring Well Location
- C-TZ Monitoring Well Location
- D-TZ Monitoring Well Location
- Corrective Action System Well (DNAPL Recovery)
- Plugged and Abandoned
- Groundwater PCLE Zones (A-TZ, B-CZ/B-TZ and C-TZ)
- MW-26A — Alternate Groundwater Point of Exposure (POE)
- MW-18A — Attenuation Monitoring Point (AMP)
- MW-26A — RCRA Unit No. 1 Point of Compliance (POC) Well
- Proposed Monitoring Well

Proposed Cumulative PMZ (A-TZ, B-CZ/B-TZ, and C-TZ)

- On-Site PMZ
- Off-Site PMZ
- Off-Site PMZ City of Houston ROW

Notes:
1. Vertical datum based on City of Houston Vertical Datum (HVD).
2. DNAPL = Dense non-aqueous phase liquids detected in monitoring well (July 2014).
3. ** - Corrective Action observation well.
4. (B) - Background Well.

N

Approx. Scale in Feet

0 200 400

Source:
Parcel Boundaries: City of Houston Geographic Information & Management Systems (GIMS).
Aerial: Houston-Galveston Area Council (HGAC) 2012 Aerial.

OFF-SITE PMZ

ON-SITE PMZ (WEST)

HWPW

ON-SITE PMZ (MAIN)

Englewood Intermodal Yard

MW-27A MW-27C MW-67B PMW-84B PMW-87B MW-65D** MW-28C PMW-28B MW-28A PMW-83B PMW-83C MW-63B MW-68C MW-26A MW-36B MW-36D** MW-45C MW-54C MW-66D** MW-68B MW-33BR MW-36A MW-44A (DNAPL) MW-46C (DNAPL) PMW-82B** MW-35B** MW-33A MW-25C MW-25A MW-35A MW-32AR (DNAPL) MW-70B (DNAPL) MW-71B MW-34CR MW-44C (DNAPL) MW-32B MW-57A MW-58A MW-57B** MW-72B MW-18C** MW-18A MW-13 MW-15C MW-17 MW-60A MW-14 MW-15A MW-15B MW-17C MW-23C (DNAPL) PMW-47B MW-47C MW-20A MW-31A MW-19C MW-55B MW-74B **MW-49B MW-48C MW-38A MW-39B MW-12A MW-12C MW-40B MW-79A MW-49A MW-61A MW-38B MW-12B (DNAPL) MW-42B TW-41B MW-41B (DNAPL) MW-62B MW-59A MW-59B MW-59D** PMW-88C P-11 MW-69A MW-75B (DNAPL) MW-02 MW-01A MW-03 MW-78A (DNAPL) MW-10A MW-08 (B) P-12 (B) MW-80B MW-22A** MW-10B MW-09 MW-22B** MW-11B MW-11A MW-04 P-10 MW-07 MW-21C MW-05 PMW-85C MW-77A MW-64A MW-76C** MW-50A MW-81B PMW-86C** MW-51A MW-51C

UNION PACIFIC RAILROAD CO.

HOUSTON WOOD PRESERVING WORKS

Attachment 2A-2

RESPONSE ACTION DESIGN GROUNDWATER

PROJECT: 1358	BY: ADJ	REVISIONS
DATE: JULY, 2016	CHECKED: ECM	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

ATTACHMENT 2B

PROPOSED WELL DESIGN

ATTACHMENT 2B – 1 PROPOSED MONITORING WELL NETWORK - UPDATED
ATTACHMENT 2B – 2 TYPICAL MONITORING WELL CONSTRUCTION

ATTACHMENT 2B

PROPOSED WELL DESIGN

Introduction

As detailed in RAP Worksheet 2.1, the following wells are proposed to be installed:

1. Point of Exposure Wells:
    a. B-TZ/B-CZ: PMW-28B, PMW-47B, PMW-83B, PMW-84B, and PMW-87B
    b. C-TZ: PMW-83C, PMW-85C, and PMW-88C
2. Corrective Action Observation Wells:
    a. PMW-82B and PMW-86C
3. Replacement Wells:
    a. A-TZ: MW-18AR and MW-22AR
    b. B-TZ: MW-22BR

The proposed new wells and replacement wells are shown on Attachment 2B-1. Monitoring wells MW-22AR and 22BR are to be installed to replace damaged wells MW-22A and MW-22B, respectively. Details of the well installation are discussed below.

Permanent Monitoring Well Installation

Soil borings for monitoring wells will be advanced using hollow stem auger, mud rotary, or sonic drilling methods. Soil samples will be collected continuously from each boring and will be logged in the field for lithology and sedimentary structure. Soil headspace samples will be collected every two feet and screened in the field for total organic vapor concentrations. In addition, soil core samples will be visually inspected for contamination and non-aqueous phase liquid (NAPL) presence.

Soil borings that will be used for monitoring well installation will be advanced as necessary to identify the top and base of the targeted groundwater bearing-unit (GWBU) (i.e., A-TZ, B-TZ, C-TZ). Based on the boring logs for previous monitoring wells drilled at the Site, it is anticipated that these borings will be advanced to the following maximum depths (subject to field conditions):

- A-TZ: approximately 30 feet below ground surface (bgs)
- B-TZ/B-CZ: approximately 36 feet to 40 feet bgs
- C-TZ: approximately 70 feet bgs.

Although the proposed borings for wells below the A-TZ will be located away from areas where NAPL has been identified, surface or isolation casing (permanent isolation casing or temporary isolation casing using sonic drilling techniques) may be installed prior to penetration of any low permeability confining unit.

Permanent monitoring wells will be constructed after the total depth of the borehole is reached. Monitoring wells will be constructed using 2-inch or larger diameter, flush-joint-threaded Schedule 40 PVC casing and 0.010-inch slotted PVC screen. Other well casing and screen materials (i.e., stainless steel) may be used instead of PVC depending on the potential for exposure to NAPL. The specific well design will be determined in the field based on the observed lithology with the goal of screening the well at the base of the targeted GWBU. It is anticipated that each well screen will be approximately 10 feet in length, but shorter screen intervals may be installed for the B-CZ wells. After the boring is completed to the total depth, the casing and screen will be lowered into the borehole through the augers or sonic isolation casing.

Once the casing and screen are in place, the remaining well materials (filter sand, bentonite pellets, and cement/bentonite grout) will be added to the hole as the augers/sonic casings are slowly removed. Depths

to the top of the annular materials will be measured with a weighted, calibrated tape and recorded on the Well Completion Log. A bentonite seal layer will be installed on top of the filter sand and will be a minimum of 2 feet in thickness. The remainder of the borehole annulus will be filled with a Portland/bentonite grout (or bentonite pellets). Each well will be completed with either a flush-grade surface completion with a 2-foot by 2-foot pad or above grade within a protective casing on a 4-foot-by-4-foot concrete pad. If an above grade completion is constructed, bollards or bumper guards should be installed around the surface completion. Typical monitoring well completion details are shown on Attachment 2B-2. After construction, the position and elevation of each monitoring well will be surveyed by a licensed, professional surveyor relative to Texas State Plane Coordinates and mean sea level.

Monitoring Well Development

A minimum of 24 hours shall elapse after well construction and before well development to allow for bentonite hydration and grout set. Development will consist initially of surging and bailing or pumping; however, the specific development method will ultimately be decided by the field personnel based on the specific conditions encountered. Temperature, pH, specific conductivity, and turbidity will be monitored during purging. Development will continue until the well produces water with stable field parameter readings (i.e., temperature, pH, conductivity) and turbidity is below 10 NTU. At least five casing volumes of water will be removed from the well during development unless the well pumps dry. If the turbidity is not below 10 NTU after 10 casing volumes of water are removed from the well, then the final turbidity will be recorded and more aggressive development procedures such as air lifting may be considered.

Monitoring Well Documentation

Documentation of well installation and development will include field boring logs, monitoring well installation forms, well development forms, and any photographs. For wells installed within the City of Houston right of way (ROW), city permits will be required prior to installing the wells. Investigation-derived wastes (IDW), such as soil cuttings, decontamination fluids, or development water, generated from the drilling activities will be stored and disposed of in accordance with state and federal requirements. Documentation of the wastes disposed of as part of the well installation will be maintained.

Following installation, a certification report will be submitted to the Texas Commission on Environmental Quality (TCEQ) detailing the well installation and related documentation.

FIGURES

EXPLANATION

- UPRR Property Boundary
- A-TZ Monitoring Well Location
- B-CZ/B-TZ Monitoring Well Location
- C-TZ Monitoring Well Location
- D-TZ Monitoring Well Location
- Corrective Action System Well (DNAPL Recovery)
- MW-26A — Alternate Groundwater Point of Exposure (POE)
- MW-18A — Attenuation Monitoring Point (AMP)
- MW-26A — RCRA Unit No. 1 Point of Compliance (POC) Well
- Proposed Monitoring Well

Proposed Cumulative PMZ (A-TZ, B-CZ/B-TZ, and C-TZ)

- On-Site PMZ
- Off-Site PMZ
- Off-Site PMZ City of Houston ROW

Notes:
1. Vertical datum based on City of Houston Vertical Datum (HVD).
2. DNAPL = Dense non-aqueous phase liquids detected in monitoring well (July 2014).
3. **- Corrective Action observation well.
4. (B) - Background Well.

N

Approx. Scale in Feet

0 200 400

Source:
Parcel Boundaries: City of Houston Geographic Information & Management Systems (GIMS).
Aerial: Houston-Galveston Area Council (HGAC) 2012 Aerial.

OFF-SITE PMZ
ON-SITE PMZ (WEST)
ON-SITE PMZ (MAIN)
HWPW
Englewood Intermodal Yard

MW-67B, PMW-84B, PMW-87B, MW-28C, PMW-28B, MW-28A, MW-65D**, PMW-83B, PMW-83C, MW-63B, MW-68C, MW-26A, MW-33BR, MW-36B, MW-36D**, MW-44A, MW-45C, MW-54C, MW-46C (DNAPL), MW-25A, MW-66D**, MW-36A, MW-34CR, MW-44C (DNAPL), PMW-82B**, MW-35B**, MW-35A, MW-32B, MW-70B (DNAPL), MW-57A (DNAPL), MW-57B**, MW-18C**, MW-18A, MW-60A, MW-15C, MW-15A, MW-15B, MW-17C, MW-23C (DNAPL), MW-19C, PMW-47B, MW-47C, MW-39B, MW-38B, MW-12B (DNAPL), MW-42B, MW-62B, MW-41B (DNAPL), P-11, MW-02, MW-01A, MW-08 (B), P-12 (B), MW-22A**, MW-10A, MW-10B, MW-22B**, MW-11B, MW-11A, MW-07, PMW-88C, **MW-49B, MW-48C, MW-61A, MW-69A, MW-59A, MW-59B, MW-59D**, MW-75B (DNAPL), MW-78A (DNAPL), MW-80B, PMW-85C, MW-77A, MW-76C**, MW-50A, MW-81B, PMW-86C**

UNION PACIFIC RAILROAD CO.

HOUSTON WOOD PRESERVING WORKS

Attachment 2B-1

PROPOSED MONITORING WELL LOCATION MAP

PROJECT: 1358	BY: ADJ	REVISIONS
DATE: JULY, 2016	CHECKED: ECM	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

Plume Management Zone	RAP Worksheet 2.1 Page 1 of 19	
Associated Information: Attachments 2D, 2E	ID No.: 31547	Report Date: July 15, 2016 – Rev 2

Complete this worksheet when a PMZ is proposed as part of the response action. Include in Attachment 2D a map of the proposed PMZ with alternate POE(s) and attenuation monitoring points identified and the current groundwater PCLE zone. If a PMZ is not proposed, do not submit this worksheet.

Groundwater-bearing unit **A-TZ**

Repeat this worksheet for each groundwater-bearing unit for which a PMZ is proposed.

Groundwater classification **X** 2 ____ 3

Provide justification as to why the PMZ is appropriate in accordance with §350.33(f)(4)(A). Include supporting documentation in Attachment 2E.

The on-site and off-site PMZs proposed as a response action for the A-TZ PCLE zone (Attachment 2D-1) ensures that COCs will not pose a potential unacceptable risk to human health or the environment as long as the AALs are not exceeded at the respective AMPs, and COC concentrations less than cPCLs at the proposed Alternate POE wells. PMZs are appropriate for this PCLE zone based on a relatively low groundwater velocity, overall stable/declining COC concentrations, the proposed institutional controls (deed recordation (on-site PMZs) and restrictive covenants (off-site PMZs)) on use of groundwater within the PCLE Zone, and the absence of any existing water supply wells within ½-mile of the Site. In addition, there are no surface water bodies at the Site or near the proposed PMZ; therefore, there is no potential for contaminating surface waters that would be hydraulically connected to groundwater. The City of Houston provides municipal water services for all properties within the Affected Property, so there is no human health complete pathway associated with this GWBU. The Site is also within the jurisdiction of the Harris-Galveston Subsidence District (HGSD), which restricts groundwater use in the area and requires a permit application prior to drilling a groundwater well. There are permitting exemptions, but only in areas that do not have an alternative water supply. The HGSD rules are not a complete prohibition on the use of groundwater in the area, but rather the fees associated with the rules are "intended to operate as an economic disincentive to groundwater withdrawal" (HGSD, 2013).

The on-site and off-site PMZs proposed for the A-TZ PCLE zones consists of two components: 1) filing of institutional controls including deed recordation (UPRR-Owned properties) and restrictive covenants (off-site properties, City of Houston ROW) prohibiting the use of groundwater within the PMZs; and 2) performance of ongoing groundwater monitoring at the proposed AMPs and POE wells. The proposed deed recordation and restrictive covenant language, to be filed in the Harris County deed records, is included in Appendix 4.

As detailed in Attachment 1A, the PMZs for A-TZ were established using the July/August 2014 groundwater analytical data collected from the Site, in conjunction with trend analysis for groundwater analytical data from 2010 through 2014 (10 semi-annual sampling events). Comparing the maximum groundwater analytical data from the July/August 2014 groundwater sampling event to cPCLs, concentrations of 23 target COCs exceeded their respective cPCLs in at least one of the four GWBUs. For the A-TZ, the following 12 COCs were detected above cPCLs:

VOCs

- Benzene
- Methylene Chloride
- Vinyl Chloride

SVOCs

- 2,4-Dimethylphenol
- 2-Methylnaphthalene
- Benzo(a)anthracene
- Benzo(a)pyrene
- Bis(2-chloroethoxy)methane

- Chlorobenzene (A-TZ only, one well)
- Dibenzofuran
- Naphthalene
- Phenol

Of those COCs, benzene, 2,4-dimethylphenol, 2-methylnaphthalene, dibenzofuran, and naphthalene are the most prominent COCs where the cPCL exceedances for these COCs define the PCLE Zone in the A-TZ. Therefore, the trend analyses and attenuation action levels were calculated for these five COCs (Attachment 2E). None of the COCs listed above were detected in the A-TZ at concentrations that exceeded the $^{Air}GW_{Inh\text{-}V}$ PCL.

The overall groundwater flow across the Site in the A-TZ is to east, until the Lockwood Street Bridge area on the far east side of the Site. As discussed in the APAR Addendum (PBW, 2009), there is a City of Houston 60-inch sanitary sewer line that cuts across the east end of the Site (Attachment 1A, Figure 5A-1) that flows north to south just west of the Lockwood Street Bridge. Based on a review of the City of Houston engineering drawing files for the sanitary sewer line, the sewer line potentially intersects the saturated A-TZ unit, and may be affecting the groundwater potentiometric surface elevation of the A-TZ (Attachment 1A, Figure 4C-1).

PBW installed a small diameter piezometer MW-69A in June 2010 in the City of Houston ROW along the west side of the sanitary sewer line south of MW-49A (Attachment 1A, Figure 1A) to evaluate the potential for site-specific COCs affecting the sanitary sewer. The location of the piezometer was chosen to evaluate if COCs in groundwater are travelling along the west side of the sanitary sewer line. Groundwater data from monitoring well MW-59A indicates that the COCs were not detected above PCLs east of the sanitary sewer line. In addition, PBW collected grab samples of fluid from the sanitary sewer line upgradient, within the Site, and downgradient of the Site to evaluate potential discharge of site-specific COCs detected in the A-TZ into the wastewater line (PBW, 2010). Samples from the sanitary sewer were collected from three manholes using a peristaltic pump and tubing inserted through the manhole covers.

Based on the analytical results from July 2010 through July/August 2014, none of the site-specific COCs have been detected above TRRP PCLs in the groundwater samples collected from MW-69A. Also, sanitary sewer water analytical results from the three sanitary sewer samples were also compared to TRRP Tier 1 PCLs for groundwater, even though the fluid in the line is not considered groundwater. Of the three samples collected in 2010, the only sample with concentrations greater than PCLs was the upgradient sample SSW1 that had a detection of bis(2-ethylhexl)phthalate (0.0092 mg/L) above the $^{GW}GW_{ing}$ PCL of 0.006 mg/L; however, bis(2-ethylhexyl)phthalate is a common laboratory contaminant (as cited in 30 TAC§350.71(k)(2)(B)). The sanitary sewer sample analytical results suggest that there is not a significant mass loading of COCs from groundwater into the sanitary sewer.

As discussed in Worksheet 2.3, a TI Zone will also be established for areas where DNAPL has been detected in monitoring wells or observed in the soil boring log for the GWBUs on site and off site. Details of the TI Zone are provided in Attachment 2G.

In accordance with §350.33(f)(4)(A), both PMZs for the A-TZ Unit will be actively monitored (semi-annually). MNA will be used as a control response for the Site.

Is the alternate POE proposed to be beyond the current limits of the PCLE zone? **X** Yes ___ No
If yes, how far? Approximately 400 feet (§350.37(l) or (m) as applicable)
Is it to be off-site? **X** Yes ___ No
On an off-site property that currently does not contain a residential-based groundwater PCLE zone?
X Yes ___ No -

If yes and this is a Class 2 groundwater, provide the basis for concluding that this groundwater does not have a reasonably anticipated future beneficial use (§350.37(l)(3)).

The residential-based PCLE zone extends onto the off-site properties (to the north and to the east in the residential area), and on to the City of Houston ROW. The proposed PMZs extend to the closest monitoring wells where COC concentrations in groundwater are less than the cPCL based on the groundwater data collected in July/August 2014. As previously discussed, the City of Houston provides municipal water services for all properties within the Affected Property, so there is no current beneficial use for the GWBU. The Site is also within the jurisdiction of the HGSD, which restricts groundwater use in the area and requires a permit application prior to drilling a groundwater well. There are permitting exemptions for small domestic wells, but only in areas that do not have an alternative water supply. The HGSD rules are not a complete prohibition on the use of groundwater in the area, but rather the fees associated with the rules are "intended to operate as an economic disincentive to groundwater withdrawal" (HGSD, 2013).

Therefore, with the City of Houston providing water for the area, and financial disincentives placed on shallow groundwater use by the HGSD (which the Texas Supreme Court ruled in favor of the HGSD in 1977 to protect public welfare by limiting harmful pumping, which was causing ground subsidence of the land resulting in flooding (*Beckendorff v. Harris-Galveston Coastal Subsidence District (1977)*), the shallow groundwater does not have a reasonably anticipated future beneficial use in the area.

Is NAPL present? **X** Yes ___ No
If so, describe how the response action will achieve the performance criteria in §350.33(f)(4)(E).

§350.33(f)(4)(E) The person is required to reduce NAPLs which contain COCs in excess of PCLs within a plume management zone to the extent practicable. In the determination of adequate NAPL reduction, the executive director may consider conformance with the following criteria and other relevant factors:

(i) readily recoverable NAPLs have been recovered;

(ii) the NAPLs will not generate explosive conditions as defined in §350.31(c) of this title (relating to General Requirements for Remedy Standards);

(iii) the NAPLs will not discharge to the ground surface, to surface waters, to structures, or to other groundwater-bearing units;

(iv) the vertical and lateral extent of NAPLs will not increase under natural conditions, or sufficient NAPLs have been recovered such that an active recovery system can be demonstrated to effectively control or contain migration of NAPLs (i.e., no increased NAPL extent); and

(v) the NAPLs will not result in the critical groundwater PCLs being exceeded at the downgradient boundary of the plume management zone or in the critical PCLs for other environmental media being exceeded at the applicable POE.

To address the NAPL in the TI Zones for the A-TZ, the NAPL response action objectives and endpoints using TCEQ Guidance TRRP-32 (Risk-Based NAPL Management) will be achieved through control via TI based on the occurrence of DNAPL in wells completed in the A-TZ. For areas where either creosote NAPL was noted in the soil boring log in the saturated zone or is detected in monitoring wells (i.e., MW-57A and MW-78A), the TI demonstration details the difficulty of achieving groundwater PCLs in these

areas because of complex hydrogeology and physical nature of creosote (discussed in Worksheet 2.3). The control endpoint will be to control the soluble NAPL fraction sufficient to create stable or shrinking PCLE zones. Methods to control the creosote DNAPL will include recovery (recover readily recoverable creosote DNAPL from wells with DNAPL present) at the NAPL source zone so that the dissolved-phase groundwater PCLE zone is stable (or shrinking) and the PCLE performance objectives for the TI-based "no growth" PMZs can be met, including no cPCL exceedances at the alternate POE wells.

Therefore, since the wells with DNAPL lie within the proposed TI Zones (On-site and Off-Site), the current response objective per the TCEQ Guidance is to ensure compliance of NAPL in the TI Zone through control. Readily recoverable NAPL will be recovered from wells on a monthly basis in order to control potential migration from the TI Zone. In addition, institutional controls on groundwater use will be implemented to protect exposure to residual NAPL in the GWBUs.

DNAPL recovered as part of the corrective action will be stored on-site in DOT approved drums within the CSA (Unit 4), and then disposed of in accordance with all applicable laws and regulations within the applicable timeframes.

If this is a Class 2 groundwater, explain how the response action will ensure that leachate from the surface soil and subsurface soil PCLE zones will not increase concentration of COCs greater than the current measured concentrations (at time of RAP submittal). (§350.33(a)(2))

Groundwater monitoring has been on-going at the Site since 1997. Current and historical groundwater data from the A-TZ source areas (SWMU 4, 5, 8) (Attachment 1B), especially wells with data going back to 1997, suggest that the COC concentrations in the A-TZ groundwater plume were historically higher compared to present day data. Overall the primary COC concentrations are stable or decreasing. The few wells with increasing concentrations either contain DNAPL or had DNAPL noted in the GWBU on the soil boring log. Therefore, the COCs in the vadose zone (surface and subsurface soil) have reached a point where the mass loading to the A-TZ has reached a state of equilibrium and continued leachate migration to groundwater from surface or subsurface soil will not cause expansion of the groundwater PCLE Zone for the A-TZ. In addition, with the proposed PMZ for the Site, groundwater monitoring as part of the PMZ will be used to confirm that any potential leachate in the surface and subsurface soils will not cause an increase in COC concentrations in groundwater at the POE in excess of the groundwater PCL.

As part of the response action for the surface and subsurface soils in the former HWPW area, the proposed response will be to construct a capped area over the surface soil PCLE Zone. Even though the cap is not designed for hydraulic control, the cap will be constructed with compacted clay and vegetation and sloped to drain storm water. The design of the cap (sloped and vegetated) will minimize infiltration across the surface soil PCLE Zone and reduce leachate migration from the vadose zone to the A-TZ.

Provide the basis that the COCs will not migrate beyond the downgradient boundary of the PMZ at concentrations above the critical PCL. Include supporting documentation in Attachment 2E.

Since the Site was first developed for creosoting operations in 1899, various releases over time likely occurred until the Site operations ceased in 1984. The facility was dismantled in the early 1990s. There have been no other operations at the former HWPW Site in over 30 years. Given the long period of time since releases have occurred at the Site, impacts to surface soils that have migrated to the A-TZ

groundwater have likely reached a state of equilibrium, as discussed above. This is supported with the A-TZ groundwater analytical data that indicate the distribution of COCs dissolved in Site groundwater is relatively stable in the source areas. The concentration vs time graphs presented in Attachment 1B-1 through 1B-15 indicate that most of the groundwater COC concentrations are remaining relatively stable. This is confirmed for most of the wells with the Mann-Kendall statistical analysis included in Attachment 2E, except for the following wells:

- For wells MW-12A and MW-18A in the source areas, the Mann-Kendall trend analysis for 2-methylnaphthalene (MW-18A) and dibenzofuran (MW-12A and MW-18A) show increasing trends from 2010 to 2014. However, for both MW-12A and MW-18A, both 2-methylnaphthalene (Attachment 1B-3) and dibenzofuran (Attachment 1B-4) concentrations were greater in 2001 to 2002 compared to recent concentrations.
- An increasing trend for naphthalene in MW-15A was noted, but similar to MW-12A and MW-18A, the highest concentrations in this well were detected in 2001 to 2003 sampling events. None of the COCs were detected above cPCLs during the most recent sampling event.
- Increasing trends for 2-methylnaphthalene, dibenzofuran, and naphthalene were calculated for off-site well MW-33A (with probably increasing trends for benzene and 2,4-dimehtylphenol); however, the most recent groundwater data indicate COC concentrations less than cPCLs.
- Increasing trends for benzene and 2-methylnaphthalene were calculated for off-site well MW-44A; however, the most recent groundwater data indicate COC concentrations less than cPCLs.

Therefore, the increasing trends calculated may be due to fluctuations over time rather than indicative of additional release causing the apparent increase. As shown on Attachment 1A, Figure 5B-20, the groundwater PCLE Zone for the A-TZ has remained stable over the past four years.

The downgradient boundary of the on-site and off-site A-TZ PMZ is located at monitoring wells MW-25A, MW-26A, MW-28A, MW-36A, MW-59A, MW-60A, MW-61A, and MW-69A (alternate points of exposure) (Attachment 2D-1). As previously discussed, there appears to be a groundwater divide near MW-44A on the north end and MW-49A/MW-59A on the south end just east of MW-18A (Attachment 1A, Figure 5A-1), which lines up with the 60-inch sanitary sewer line that runs north-south. Wells MW-25A, MW-59A, MW-60A, and MW-61A appear to be east of the groundwater divide. This is supported with by the low concentrations of COCs in these wells (Attachment 1A, Figure 5B-1). Fluid samples collected from the sanitary sewer line in 2010 did not indicate a significant loading of COC concentrations into the sewer line; however, the sewer line appears to serve as the downgradient groundwater control for the PMZ. Therefore, it is not anticipated that the on-site and off-site A-TZ groundwater PCLE zone will migrate beyond the proposed A-TZ PMZ boundary.

Attenuation Action Levels (AALs) have been established for Attenuation Monitoring Points (AMPs) within the centerline of the A-TZ plume in order to ensure groundwater COC concentrations do not exceed the cPCLs at the alternate point of exposure (POE) wells. Details on AAL development are provided in Attachment 2E. However, given the complex hydrogeology in the A-TZ, the primary monitoring points for the on-site and off-site PMZs will be at the proposed alternate POE wells. The proposed POE wells are shown on Attachment 2D-1.

Details of the monitoring plan for the A-TZ PMZ are provided in Worksheet 3.1 and Appendix 6.

Describe the methods used to determine that there are no artificial penetrations which can allow COCs to migrate from the groundwater PCLE zone to currently unaffected groundwater-bearing units. Include supporting documentation in Attachment 2E.

An on-site field survey and water-well data search was conducted, indicating no potential vertical artificial penetrations that would act as a conduit for migration of shallow groundwater into the underlying groundwater formation. However, as discussed in the APAR Addendum (PBW, 2009), two sets of fiber optic lines, Level 3 Communications and Qwest, run along the north side of the rail main lines across the entire length of the Site (Attachment 1A, Figure 5A-1). Based on conversations with both Level 3 Communications and Qwest representatives, the fiber lines run underneath SWMUs 2, 5, 4, 8, and 10/11. The fiber lines run directly underneath the drainage ditch southwest of the Site and under the SDD about 3 to 5 feet bgs. The Level 3 Communications line reportedly was directionally bored to a depth of 40 to 45 feet bgs underneath the Original and Recent Process Areas (SWMU Nos. 5 and 4, respectively) and under the AST Area (SWMU No. 8). The Qwest fiber line reportedly runs 10 to 15 feet northwest and parallel of the main rail line, and is about 5 to 10 feet bgs through the Site. Just east of SWMU No. 8, both fiber lines return to approximately 4 to 6 feet below grade an continue running northeast parallel to the rail main line. The Level 3 Communications line may act as an artificial penetration since the reported depths of the line go through both the A-TZ and into the B-CZ immediately below the primary source areas. Given the depth of the fiber optic line is below the A-TZ and likely below the B-TZ (or carbonate seams within the B-CZ), monitoring well MW-19C will continue to be monitored to evaluate if the directional bored fiber optic lines are creating a preferential pathway for COCs to migrate to the C-TZ GWBU.

In addition to the fiber lines, three City of Houston utilities were identified in the previous APAR (PBW, 2009) that cut across the Site oriented north-south just west of the Lockwood Street Bridge: 1) 60-in wastewater line, 2) 84-in water line, and 3) a 42-in storm sewer line (PBW, 2009). Through a review of the utility drawing files obtained from the City of Houston Public Works Survey Department, two of the underground utility lines (the 60-in sanitary sewer line and the 84-in water line) appear to be at depths that potentially intersect the uppermost GWBU A-TZ. The estimated depths of the utilities based on the city drawings are shown on the Geologic Cross Sections A-A', B-B', and C-C' (Attachment 1A, Figure 4C-1). The estimated base depth of the 60-in wastewater line and the 84-in water line where Cross Section B-B' crosses the utility lines is approximately 23 feet bgs (approximate elevation of 26 feet HVD). It is highly unlikely that A-TZ groundwater is seeping into the 84-in water line, given the line is under pressure (flow is south to north), constructed with welded steel pipe, and is relatively new (constructed in 2000). Sampling of the 60-in sanitary sewer line was conducted in 2010, as previously discussed.

List the attenuation action level determined for each attenuation monitoring point. Illustrate the proposed attenuation monitoring points and the groundwater PCLE zone on the map in Attachment 2D. Include all calculations and other methods of determining the attenuation action levels in Attachment 2E.

COC	Attenuation Monitoring Point (well number)	Attenuation Action Level (mg/L)	Attenuation Action Level limited by $^{Air}GW_{Inh\text{-}V}$ or existing COC concentration? Y/N
Benzene	MW-18A	1.5	N
	MW-44A	0.0132	N
	MW-25A	0.005 (cPCL)	N
2,4-Dimethylphenol	MW-18A	24	NA
	MW-44A	1.251	NA
	MW-25A	0.49 (cPCL)	NA
2 Methylnaphthalene	MW-18A	1.5	NA
	MW-44A	0.189	NA
	MW-25A	0.098 (cPCL)	NA
Dibenzofuran	MW-18A	0.52	NA
	MW-44A	0.147	NA
	MW-25A	0.098 (cPCL)	NA
Naphthalene	MW-18A	26.16	N
	MW-44A	1.424	N
	MW-25A	0.49 (cPCL)	N

Note: Attenuation Action Levels were not developed for other COCs since the primary COCs listed above define the PCLE Zone.

Groundwater-bearing unit **B-CZ/B-TZ**

Repeat this worksheet for each groundwater-bearing unit for which a PMZ is proposed.

Groundwater classification **X** 2 ____ 3

Provide justification as to why the PMZ is appropriate in accordance with §350.33(f)(4)(A). Include supporting documentation in Attachment 2E.

The two On-site PMZs (On-Site PMZ (Main) and On-Site PMZ (West)) and Off-Site PMZs proposed (Attachment 2D-2) as a response action for the B-CZ/B-TZ PCLE zone ensures that COCs will not pose a potential unacceptable risk to human health or the environment as long as the AALs are not exceeded at the respective AMPs and exceedances of cPCLs at the proposed alternate POE wells. Both the on-site and off-site PMZs are appropriate for this PCLE zone based on a low groundwater velocity (hydraulic conductivities are indicative of saturated soils in the B-CZ (see Attachment 1A)), overall stable/declining COC concentrations, the proposed institutional controls (deed recordation and restrictive covenants) on use of groundwater within the PCLE Zone, and the absence of any existing water supply wells within ½-mile of the Site. In addition, there are no surface water bodies at the Site or near the proposed PMZs; therefore, there is no potential for contaminating surface waters that would be hydraulically connected to groundwater. The City of Houston provides municipal water services for all properties within the Affected Property, so there is no complete human health pathway associated with this GWBU. The Site is also within the jurisdiction of the HGSD, which restricts groundwater use in the area and requires a permit application prior to drilling a groundwater well. There are permitting exemptions, but only in areas that do not have an alternative water supply. The HGSD rules are not a complete prohibition on the use of groundwater in the area, but rather the fees associated with the rules are "intended to operate as an economic disincentive to groundwater withdrawal" (HGSD, 2013).

The PMZs proposed for the B-CZ/B-TZ PCLE zones consists of two components: 1) filing of institutional controls including deed recordation (UPRR-Owned properties – on-site PMZ)) and restrictive covenants (off-site properties – off-site PMZ)) prohibiting the use of groundwater within the PMZs; and 2) performance of ongoing groundwater monitoring. The proposed deed recordation and restrictive covenant language, to be filed in the Harris County deed records, is included in Appendix 4.

As detailed in Attachment 1A, the B-CZ/B-TZ on-site and off-site PMZs were established using the July/August 2014 groundwater analytical data collected from the Site, in conjunction with trend analysis for groundwater analytical data from 2010 through 2014 (10 semi-annual sampling events, Attachment 2E) and development of attenuation action levels from groundwater data collected from 2006 through 2014. Comparing the maximum groundwater analytical data from the July/August 2014 groundwater sampling event to cPCLs, concentrations of 23 target COCs exceeded their respective cPCLs in at least one of the four GWBUs. For the B-CZ/B-TZ, the following 14 COCs were detected above cPCLs (using Class 2 groundwater PCLs for both the B-TZ and B-CZ (see Attachment 1A for discussion on B-CZ as a saturated soil):

VOCs

- Benzene
- Ethylbenzene (B-CZ only)
- Methylene Chloride
- Toluene (B-CZ only)
- Vinyl Chloride

SVOCs

- 2,4-Dimethylphenol
- 2,6-Dinitrotoluene
- 2-Methylnaphthalene
- Benzo(a)anthracene
- Benzo(a)pyrene
- Bis(2-chloroethoxy)methane
- Dibenzofuran

- Naphthalene
- Phenol

Similar to the A-TZ PCLE Zone, benzene, 2,4-dimethylphenol, 2-methylnaphthalene, dibenzofuran, and naphthalene are the most prominent COCs where the cPCL exceedances for these COCs define the PCLE Zone in the B-CZ/B-TZ. Therefore, the trend analyses were conducted for these five COCs (Attachment 2E).

Since there are two distinct groundwater PCLE Zones further than 500 feet apart within the B-CZ and B-TZ, two separate on-site PMZs were established (Attachment 2D-2):

1. On-Site PMZ (Main)
2. On-Site PMZ (West)

As discussed in Worksheet 2.3, a TI Zone will also be established for areas where DNAPL has been detected in monitoring wells or observed in the soil boring log for the GWBUs on site and off site. Details of the TI Zone are provided in Attachment 2G.

In accordance with §350.33(f)(4)(A), the on-site and off-site PMZs for the B-CZ and B-TZ Unit will be actively monitored (semi-annually). MNA will be used as a control response for this unit.

Is the alternate POE proposed to be beyond the current limits of the PCLE zone? X Yes ___ No
If yes, how far? Approximately 150 feet downgradient (§350.37(l) or (m) as applicable)
Is it to be off-site? **X** Yes ____ No
On an off-site property that currently does not contain a residential-based groundwater PCLE zone?
X Yes ___ No

If yes and this is a Class 2 groundwater, provide the basis for concluding that this groundwater does not have a reasonably anticipated future beneficial use (§350.37(l)(3)).

The residential-based PCLE zone extends onto the off-site properties (to the north and to the east in the residential area), and on to the City of Houston ROW. The proposed PMZs extend to the closest monitoring wells where COC concentrations in groundwater are less than the cPCL based on the groundwater data collected in July/August 2014. As previously discussed, the City of Houston provides municipal water services for all properties within the Affected Property, so there is no current beneficial use for the GWBU. The Site is also within the jurisdiction of the HGSD, which restricts groundwater use in the area and requires a permit application prior to drilling a groundwater well. There are permitting exemptions for small domestic wells, but only in areas that do not have an alternative water supply. The HGSD rules are not a complete prohibition on the use of groundwater in the area, but rather the fees associated with the rules are "intended to operate as an economic disincentive to groundwater withdrawal" (HGSD, 2013).

Therefore, with the City of Houston providing water for the area, and financial disincentives placed on shallow groundwater use by the HGSD (which the Texas Supreme Court ruled in favor of the HGSD in 1977 to protect public welfare by limiting harmful pumping, which was causing ground subsidence of the land resulting in flooding (*Beckendorff v. Harris-Galveston Coastal Subsidence District (1977)*), the shallow groundwater does not have a reasonably anticipated future beneficial use in the area.

Is NAPL present? X Yes _____ No

If so, describe how the response action will achieve the performance criteria in §350.33(f)(4)(E).

To address the NAPL in the TI Zone for the B-CZ/B-TZ, the NAPL response action objectives and endpoints using TCEQ Guidance TRRP-32 (Risk-Based NAPL Management) will be achieved through control via TI based on the occurrence of DNAPL in wells completed in the B-CZ/B-TZ. For areas where either creosote NAPL was noted in the soil boring log in the saturated zone or is detected in monitoring wells (i.e., MW-12B, MW-32B, MW-41B, MW-70B, MW-75B and MW-78A, and observed DNAPL in soil borings (Attachment 1A, Figure 5A-6)), the TI demonstration details the difficulty of achieving groundwater PCLs in these areas because of complex hydrogeology (B-CZ consists of thin carbonate seams with average hydraulic conductivity of approximately 2×10^{-7} cm/sec (Attachment 1A)) and physical nature of creosote (discussed in Worksheet 2.3). The control endpoint will be to control the soluble NAPL fraction sufficient to create stable or shrinking PCLE zones. Methods to control the creosote DNAPL will include recovery (recover readily recoverable creosote DNAPL from wells with DNAPL present) at the NAPL source zone so that the dissolved-phase groundwater PCLE zone is stable (or shrinking) and the PCLE performance objectives for the overall TI-based "no-growth" PMZ (includes on-site and off-site PMZs) can be met, including no cPCL exceedances at the alternate POE wells.

Therefore, since the wells with DNAPL present lie within the proposed TI Zones (On-site and Off-Site), the current response objective per the TCEQ Guidance is to ensure compliance of NAPL zone in the TI Zone through control. Readily recoverable NAPL will be recovered from wells on a monthly basis in order to control potential migration from the TI Zone. In addition, institutional controls on groundwater use will be implemented to protect exposure to residual NAPL in the GWBUs.

DNAPL recovered as part of the corrective action will be stored on-site in DOT approved drums within the CSA (Unit 4), and then disposed of in accordance with all applicable laws and regulations within the applicable timeframes.

If this is a Class 2 groundwater, explain how the response action will ensure that leachate from the surface soil and subsurface soil PCLE zones will not increase concentration of COCs greater than the current measured concentrations (at time of RAP submittal). (§350.33(a)(2))

With the B-CZ/B-TZ underlying the A-TZ, see response to this question for the A-TZ unit.

Provide the basis that the COCs will not migrate beyond the downgradient boundary of the PMZ at concentrations above the critical PCL. Include supporting documentation in Attachment 2E.

As discussed for the A-TZ PMZs, wood treating operations began at the Site over 115 years ago and continued until about 30 years ago. Given the long period of time since releases have occurred at the Site, creosote DNAPL and related COCs has migrated from the vadose zone (surface and subsurface soils) to the A-TZ groundwater, then to the B-CZ/B-TZ. There are two main areas within the B-CZ/B-TZ where the DNAPL has migrated and resulted in a PCLE Zone:

1. On-Site PMZ (Main)/Off-Site PMZs - Centered in the northeast part of the Site near SWMUs 4, 5, and 8, onto the eastern portion of the Englewood Intermodal Yard, and extending off-site (Off-Site PMZs) to the north of the Site; and
2. On-Site (West) - On the west side of the Site near MW-12B and MW-41B.

<u>On-Site PMZ (Main)/Off-Site PMZs (including City of Houston ROW):</u>

For the area centered over the northeast portion of the Site, predominately off-site, DNAPL has been either observed in the monitoring well soil borings (i.e., MW-35B, MW-63B, MW-68B, and others) or has been detected in the wells (i.e., MW-32B, MW-70B, MW-75B) that fall within the B-CZ/B-TZ groundwater PCLE Zone (Attachment 1A, Figure 5A-6). The fact that the PCLE Zone in the B-CZ is closely tied to where NAPL was observed suggests that there is both not a high rate of dissolved constituent migration beyond the DNAPL areas either on-site or off-site. Also groundwater velocities through the B-CZ are very low given the low hydraulic conductivity of the carbonate gravel seams within the clay unit. Proposed POE wells MW-15B, MW-36B, MW-59B, MW-67B, MW-80B and MW-81B show either no detections of the COCs or relatively stable COC concentrations well below the RALs (Attachment 1B-11 through 1B-15). This is supported with the B-CZ/B-TZ groundwater analytical data that indicate the distribution of COCs dissolved in Site groundwater is relatively stable in the source areas.

For wells with concentrations near or above cPCLs, the concentration vs time graphs presented in Attachment 1B indicate that groundwater concentrations are remaining relatively stable, which is confirmed with the Mann-Kendall statistical analysis (Attachment 2E), except for MW-49B, MW-70B and MW-74B. Mann-Kendall trend analyses of the groundwater data from MW-49B indicate increasing trends for 2,4-dimethylphenol, 2-methylnaphthalene, and naphthalene; and probably increasing trends for benzene and dibenzofuran using data from 2010 through 2014. Benzene concentrations in well MW-70B indicate a Mann-Kendall increasing trend; however, DNAPL is present in the well. An increasing trend was noted for 2-methylnaphthalene in MW-74B. There have been only five sampling events from MW-74B; therefore, the trends may be indicative of seasonal variation rather than a true increase that will be confirmed with additional sampling. Both MW-70B and MW-74B are located within the central portion of the plume. As shown on Attachment 1A-Figure 5B-21, the overall groundwater PCLE Zone for the B-CZ/B-TZ has remained stable over the past four years.

In addition, migration of either DNAPL or dissolved-phase COCs in the B-CZ is not likely to extend beyond the current impacted areas based on the very low hydraulic conductivity of the wells north of the Site (consistently less than 1×10^{-5} cm/sec as discussed in Attachment 1A).

<u>On-Site PMZ (West)</u>:
On the west side of the Site, the B-TZ groundwater PCLE zone appears to be confined to three wells: MW-12B, MW-40B, and MW-41B. Historically, wells MW-12B and MW-41B have had DNAPL in-well thicknesses as thick as 15 feet (MW-12B) and 22.8 feet (MW-41B). Both wells are part of the on-going DNAPL recovery activities. In 2009, monitoring well (test well) TW-41B was installed about 40 feet north of MW-41B between MW-41B and MW-12B to serve as a possible DNAPL recovery well. The well was constructed to the same general elevations and screened intervals as MW-41B (Attachment 1A, Figure 4C-3). However, no DNAPL has been detected in TW-41B, and groundwater samples from the well have been less than RALs.

The boundary of the B-TZ PMZ on the west side is located at monitoring wells MW-38B, MW-39B, MW-42B, MW-62B, P-12, and P-11 (alternate POE wells) (Attachment 2D-2). Groundwater analytical data from these west perimeter wells indicate COC concentrations less than cPCLs, and most show either no trend or decreasing trends (Attachment 1B-16 through 1B-20). Monitoring well MW-38B is located approximately 50 feet west of MW-12B. The viscosity of the DNAPL from MW-12B was tested in 2007 with a reading of 192 centipoises, indicating a relatively viscous liquid. With groundwater data less than cPCLs in the wells in close proximity of the wells with DNAPL, this supports the limited dissolved COC migration in the area. Therefore, it is not anticipated that the B-TZ groundwater PCLE zone will migrate beyond the proposed B-CZ/B-TZ PMZ boundary.

For the B-CZ groundwater PCLE Zone on the northeast side of the Site, AALs were established for sampling points leading from MW-70B (off-site, and contains DNAPL) to MW-67B (Attachment 2E-6 through 2E-10 for benzene, 2,4-dimethylphenol, 2-methylnaphthalene, dibenzofuran, and naphthalene, respectively) in order to ensure groundwater COC concentrations do not exceed the cPCLs at the point of exposure (MW-67B). Details on AAL development are provided in Attachment 2E. POE wells for the north and east sides of the B-CZ PMZ are shown on Attachment 2D-2. Four additional B-TZ/B-CZ wells (PMW-83B, PMW-84B, PMW-87B, and PMW-28B ("P" indicates proposed and will be removed from the well identification once installed)) are proposed to be installed north of the Site and one additional well (PMW-47B) will be installed on the east side of the PMZ to serve as alternate POE wells and monitor the PMZ (Attachment 2D-2). An additional corrective action observation well (PMW-82B) will be installed to the west of MW-35B. Details of the well installation are provided in Attachment 2B.

Describe the methods used to determine that there are no artificial penetrations which can allow COCs to migrate from the groundwater PCLE zone to currently unaffected groundwater-bearing units. Include supporting documentation in Attachment 2E.

The site-related contaminants and DNAPL have been detected in the B-CZ/B-TZ, and underlying C-TZ. PMZs are also proposed for the other GWBUs at the Site. Groundwater wells were installed in the underlying D-TZ, and until the July/August 2014 groundwater sampling event, Site-related COC concentrations have been below RALs in those wells.

An on-site field survey and water-well data search was conducted, indicating no potential artificial vertical penetrations that would act as a conduit for migration of shallow groundwater into the underlying groundwater formation. A discussion on underground utilities for A-TZ and possible communication with the B-CZ and deeper C-TZ is provided under the A-TZ summary (see RAP Worksheet 2.1, Page 13).

List the attenuation action level determined for each attenuation monitoring point. Illustrate the proposed attenuation monitoring points and the groundwater PCLE zone on the map in Attachment 2D. Include all calculations and other methods of determining the attenuation action levels in Attachment 2E.

COC	Attenuation Monitoring Point (well number)	Attenuation Action Level (mg/L)	Attenuation Action Level limited by $^{Air}GW_{Inh\text{-}V}$ or existing COC concentration? Y/N
Benzene	MW-70B	38.45	Y -23 mg/L (Res, 30-ac Source)
	MW-33BR	3.259	N
	MW-63B	0.210	N
	MW-67B	0.005 (cPCL)	N
2,4-Dimethylphenol	MW-70B	72	NA
	MW-33BR	18.18	NA
	MW-63B	3.94	NA
	MW-67B	0.49 (cPCL)	NA
2 Methylnaphthalene	MW-70B	2.399	NA
	MW-33BR	0.993	NA
	MW-63B	0.3727	NA
	MW-67B	0.098 (cPCL)	NA
Dibenzofuran	MW-70B	0.6483	NA
	MW-33BR	0.3850	NA
	MW-63B	0.2158	NA
	MW-67B	0.098 (cPCL)	NA
Naphthalene	MW-70B	87.86	Y – 41 mg/L (>S) (Res, 30-ac Source)
	MW-33BR	21	N
	MW-63B	4.281	N
	MW-67B	0.49 (cPCL)	N

Note: Attenuation Action Levels were not developed for other COCs since the primary COCs listed above define the PCLE Zone.

The proposed PMZ and AMPs for the B-CZ/B-TZ are shown on Attachment 2D-2.

Groundwater-bearing unit **C-TZ**

Repeat this worksheet for each groundwater-bearing unit for which a PMZ is proposed.

Groundwater classification X 2 ____ 3

Provide justification as to why the PMZ is appropriate in accordance with §350.33(f)(4)(A). Include supporting documentation in Attachment 2E.

The on-site and off-site PMZs proposed (Attachment 2D-3) as a response action for the C-TZ PCLE zone ensures that COCs will not pose a potential unacceptable risk to human health or the environment as long as the AALs are not exceeded at the respective AMPs or exceeds the cPCL at the alternate POE wells. The PMZs are appropriate for this PCLE zone based on a low groundwater velocity, stable/declining COC concentrations, the proposed institutional controls (deed recordation and restrictive covenants) on use of groundwater within the PCLE Zone, and the absence of any existing water supply wells within ½-mile of the Site. In addition, there are no surface water bodies at the Site or near the proposed PMZs; therefore, there is no potential for contaminating surface waters that would be hydraulically connected to groundwater. The City of Houston provides municipal water services for all properties within the Affected Property, so there is no complete human health pathway associated with this GWBU. The Site is also within the jurisdiction of the HGSD, which restricts groundwater use in the area and requires a permit application prior to drilling a groundwater well. There are permitting exemptions, but only in areas that do not have an alternative water supply. The HGSD rules are not a complete prohibition on the use of groundwater in the area, but rather the fees associated with the rules are "intended to operate as an economic disincentive to groundwater withdrawal" (HGSD, 2013).

The PMZs proposed for the C-TZ PCLE zones consists of two components: 1) filing of institutional controls including deed recordation (UPRR-Owned properties – on-site PMZ)) and restrictive covenants (off-site properties – Off-Site PMZ and Off-Site PMZ City of Houston ROW)) prohibiting the use of groundwater within the PMZs; and 2) performance of ongoing groundwater monitoring at the AMP and POE wells. The proposed deed recordation and restrictive covenant language, to be filed in the Harris County deed records, is included in Appendix 4.

The on-site and off-site PMZs for C-TZ were established using the July/August 2014 groundwater analytical data collected from the Site (Attachment 1A), in conjunction with trend analysis for groundwater analytical data from 2010 through 2014 (10 semi-annual sampling events) and development of attenuation action levels from groundwater data collected from 1997 through 2014. Comparing the maximum groundwater analytical data from the July/August 2014 groundwater sampling event to cPCLs, concentrations of 23 target COCs exceeded their respective cPCLs in at least one of the four GWBUs. For the C-TZ, the following 19 COCs were detected above cPCLs:

VOCs

- Benzene
- Methylene Chloride

SVOCs

- 2,4-Dimethylphenol
- 2,6-Dinitrotoluene
- 2-Methylnaphthalene
- Acenaphthene (one well*)
- Anthracene (one well*)
- Benzo(a)anthracene
- Benzo(a)pyrene
- Bis(2-chloroethoxy)methane (one well*)
- Chrysene (one well*)

SVOCs (cont)

- Dibenzofuran
- Fluoranthene (one well*)
- Fluorene (one well*)
- Naphthalene
- Pentachlorophenol
- Phenanthrene (one well*)
- Phenol
- Pyrene (one well*)

* - COC only detected in wells with DNAPL present

Similar to the A-TZ PCLE Zone, benzene, 2,4-dimethylphenol, 2-methylnaphthalene, dibenzofuran, and naphthalene are the most prominent COCs where the cPCL exceedances for these COCs define the PCLE Zone in the C-TZ. Therefore, the trend analyses were conducted for these five COCs (Attachment 2E).

As discussed in Worksheet 2.3, a TI Zone will also be established for areas where DNAPL has been detected in monitoring wells or observed in the soil boring log for the GWBU (Attachment 2G).

In accordance with §350.33(f)(4)(A), the PMZ for the C-TZ Unit will be actively monitored (semi-annually). MNA will be used as a control response for this unit.

Is the alternate POE proposed to be beyond the current limits of the PCLE zone? X Yes ___ No
If yes, how far? Approximately 100 feet (§350.37(l) or (m) as applicable)
Is it to be off-site? X Yes ___ No
On an off-site property that currently does not contain a residential-based groundwater PCLE zone?
X Yes ___ No - The residential-based PCLE zone extends onto the off-site property (to the north and to the east).

If yes and this is a Class 2 groundwater, provide the basis for concluding that this groundwater does not have a reasonably anticipated future beneficial use (§350.37(l)(3)).

The residential-based PCLE zone extends onto the off-site properties (to the north and to the east in the residential area), and on to the City of Houston ROW. The proposed PMZs extend to the closest monitoring wells where COC concentrations in groundwater are less than the cPCL based on the groundwater data collected in July/August 2014. As previously discussed, the City of Houston provides municipal water services for all properties within the Affected Property, so there is no current beneficial use for the GWBU. The Site is also within the jurisdiction of the HGSD, which restricts groundwater use in the area and requires a permit application prior to drilling a groundwater well. There are permitting exemptions for small domestic wells, but only in areas that do not have an alternative water supply. The HGSD rules are not a complete prohibition on the use of groundwater in the area, but rather the fees associated with the rules are "intended to operate as an economic disincentive to groundwater withdrawal" (HGSD, 2013).

Therefore, with the City of Houston providing water for the area, and financial disincentives placed on shallow groundwater use by the HGSD (which the Texas Supreme Court ruled in favor of the HGSD in 1977 to protect public welfare by limiting harmful pumping, which was causing ground subsidence of the land resulting in flooding (*Beckendorff v. Harris-Galveston Coastal Subsidence District (1977)*), the shallow groundwater does not have a reasonably anticipated future beneficial use in the area.

Is NAPL present? **X** Yes _____ No

If so, describe how the response action will achieve the performance criteria in §350.33(f)(4)(E).

To address the NAPL in the TI Zone for the C-TZ, the NAPL response action objectives and endpoints using TCEQ Guidance TRRP-32 (Risk-Based NAPL Management) will be achieved through control via TI based on the occurrence of DNAPL in wells completed in the C-TZ. For areas where either creosote NAPL was noted in the soil boring log in the saturated zone or is detected in monitoring wells (i.e., MW-17C, MW-18C, MW-23C, MW-25C, MW-34CR, MW-44C, MW-45C, MW-46C, MW-47C, MW-48C, and MW-68C, and observed DNAPL in soil borings (Attachment 1A, Figure 5A-7)), the TI demonstration details the difficulty of achieving groundwater PCLs in these areas because of complex hydrogeology (Attachment 1A) and physical nature of creosote (discussed in Worksheet 2.3). The control endpoint will be to control the soluble NAPL fraction sufficient to create stable or shrinking PCLE zones. Methods to control the creosote DNAPL will include recovery (recover readily recoverable creosote DNAPL from wells with DNAPL present) at the NAPL source zone so that the dissolved-phase groundwater PCLE zone is stable (or shrinking) and the PCLE performance objectives for the overall TI-based "no-growth" PMZ (includes on-site and off-site PMZs) can be met, including no cPCL exceedances at the alternate POE wells.

Therefore, since the wells with DNAPL present lie within the proposed TI Zones (On-site and Off-Site), the current response objective per the TCEQ Guidance is to ensure compliance of NAPL zone in the TI Zone through control. Readily recoverable NAPL will be recovered from wells on a monthly basis in order to control potential migration from the TI Zone. In addition, institutional controls on groundwater use will be implemented to protect exposure to residual NAPL in the GWBUs.

DNAPL recovered as part of the corrective action will be stored on-site in DOT approved drums within the CSA (Unit 4), and then disposed of in accordance with all applicable laws and regulations within the applicable timeframes.

If this is a Class 2 groundwater, explain how the response action will ensure that leachate from the surface soil and subsurface soil PCLE zones will not increase concentration of COCs greater than the current measured concentrations (at time of RAP submittal). (§350.33(a)(2))

With the C-TZ underlying the A-TZ and the B-CZ/B-TZ, please see response to this question for the A-TZ unit (RAP Worksheet 2.1, page 11).

Provide the basis that the COCs will not migrate beyond the downgradient boundary of the PMZ at concentrations above the critical PCL. Include supporting documentation in Attachment 2E.

Wood treating operations began at the Site over 115 years ago and continued until about 30 years ago. Given the long period of time since releases have occurred at the Site, creosote DNAPL and related COCs has migrated from the vadose zone (surface and subsurface soils) to the A-TZ groundwater, to the B-CZ/B-TZ, and to the C-TZ. The PCLE Zone for the C-TZ groundwater appears to correlate well with where DNAPL was observed in the C-TZ sand in the soil borings or where DNAPL has been detected in the monitoring wells. The center of the groundwater PCLE Zone appears to be in the vicinity of MW-23C (near SWMU 4 and 6), and extends off-site to the northeast near the Lockwood Street Bridge

overpass (DNAPL present in wells MW-25C, MW-44C, MW-45C, and MW-46C). Unlike the A-TZ and B-CZ/B-TZ units, groundwater flow in the C-TZ is generally to the southwest across the area.

For the off-site area northeast of the Site, DNAPL has been detected in the wells (i.e., MW-25C, MW-44C, MW-45C, and MW-46C) that fall within the C-TZ groundwater PCLE Zone (Attachment 1A, Figure 5A-7). Similar to the B-CZ/B-TZ, the PCLE Zone in the C-TZ is closely tied to where NAPL was observed. This suggests that there is not a high rate of dissolved constituent migration beyond the DNAPL areas. This is supported with the C-TZ groundwater analytical data that indicate the distribution of COCs dissolved in Site groundwater is relatively stable in the source areas, with the exception of MW-18C. The Mann-Kendall trend analysis for MW-18C groundwater data from 2010 through 2014 indicate increasing trends of 2-methylnaphthalene, dibenzofuran, and naphthalene. Well MW-18C is upgradient of MW-23C, which has higher concentrations of these COCs relative to MW-18C and also has DNAPL present in the well. MW-19C dibenzofuran concentrations from 2010 to 2014 indicate a Mann-Kendall probably increasing trend; however, concentrations in MW-19C (0.000554 mg/L) are well below the cPCL (0.29 mg/L (on-site)).

Along the edges of the PCLE Zone, concentration vs time graphs presented in Attachment 1B (1B-31 through 1B-40) indicate that groundwater concentrations are remaining relatively stable, which is confirmed with the Mann-Kendall statistical analysis included in Attachment 2E, except for MW-68C. As shown on Attachment 1A-Figure 5B-22, the groundwater PCLE Zone for the C-TZ has remained relatively stable over the past four years, with slight changes along the northeast and cross gradient side during the July 2012 and July/August 2014 events because of benzene cPCL exceedances in MW-68C. Benzene and naphthalene concentrations have been sporadic in MW-68C, where benzene concentrations exceeded the cPCL in January and July 2012, decreased below the cPCL in January 2013, then exceeded the cPCL in July/August 2014, and then decreased below the cPCL during the resampling event in September 2014 (discussed in Attachment 1A). For the purposes of this RAP, the PMZ will include MW-68C to account for the occasional benzene PCLE at that well. Newly installed well MW-76C (installed in May 2014) had a detection of pentachlorophenol (0.00272 mg/L) above the cPCL (0.002 mg/L) during the July/August 2014 sampling event. The well was resampled in September 2014, and pentachlorophenol concentrations were not detected (SDL<cPCL), but benzo(a)pyrene concentrations were detected at 0.000278 mg/L, just above the cPCL of 0.0002 mg/L. Benzo(a)pyrene concentrations were less than the cPCL during the initial sampling event. However, based on conversations with the TCEQ regarding the PMZ for the C-TZ, the On-Site PMZ (Main) in the C-TZ will not include this well, but rather will be extended to a proposed wells (PMW-85C and PMW-88C) upgradient of MW-76C. MW-76C will be included as a Corrective Action Observation Well, along with another C-TZ monitoring well downgradient of MW-76C (Attachment 2D-3).

Proposed point of exposure wells MW-15C, MW-28C, MW-47C, MW-48C, and MW-54C show either predominantly no detections of the COCs or relatively stable COC concentrations well below the RALs (Attachment 1B-26 through 1B-30). Mann-Kendall trend analysis shows an increasing concentration for dibenzofuran from 2010 to 2014 in MW-54C (Attachment 2E); however, concentrations have been decreasing since July 2013 (Attachment 1B-39). With groundwater data less than cPCLs in the wells (MW-19C and MW-54C) in close proximity of the wells with DNAPL, this supports the limited dissolved COC migration in the area. Therefore, it is not anticipated that the C-TZ groundwater PCLE zone will migrate beyond the proposed C-TZ on-site and off-site PMZ boundary.

For the C-TZ groundwater PCLE Zone, AALs were established for sampling points leading from MW-23C (contains DNAPL) to MW-76C (Attachment 2D-3) in order to ensure groundwater COC concentrations do not exceed the cPCLs at the POE (at the proposed well PMW-85C). Once PMW-85C

is installed, the well will be evaluated as the downgradient alternate POE well for the C-TZ. Details on AAL development are provided in Attachment 2E. POE wells for the C-TZ PMZ are also shown on Attachment 2D-3. With the low detections of benzene in MW-68C, one additional C-TZ well (PMW-83C) is proposed to be installed to serve as a POE well and monitor the PMZ cross gradient to the north of the Site and MW-68C (Attachment 2D-3). Details of the well installation are provided in Attachment 2B.

Describe the methods used to determine that there are no artificial penetrations which can allow COCs to migrate from the groundwater PCLE zone to currently unaffected groundwater-bearing units. Include supporting documentation in Attachment 2E.

An on-site field survey and water-well data search was conducted, indicating no potential artificial penetrations that would act as a conduit for migration of shallow groundwater into the underlying groundwater formation.

A discussion on underground utilities for A-TZ and possible communication with the C-TZ was provided under the A-TZ summary. Given the depths of the fiber optic line (reportedly as deep as 45 feet bgs) to just above the C-TZ unit, monitoring well MW-19C will be monitored as a Alternate POE Well to evaluate if the directional bored fiber optic lines are creating a preferential pathway for COCs to migrate to the deep GWBUs.

List the attenuation action level determined for each attenuation monitoring point. Illustrate the proposed attenuation monitoring points and the groundwater PCLE zone on the map in Attachment 2D. Include all calculations and other methods of determining the attenuation action levels in Attachment 2E.

COC	Attenuation Monitoring Point (well number)	Attenuation Action Level (mg/L)	Attenuation Action Level limited by $^{Air}GW_{Inh-V}$ or existing COC concentration? Y/N
Benzene	MW-23C	0.131	N
	MW-17	0.093	N
	MW-76C**	0.007	N
	PMW-85C**	0.005	N
2,4-Dimethylphenol	MW-23C	9.74	N
	MW-17	7.09	N
	MW-76C**	0.629	N
	PMW-85C**	0.49	N
2 Methylnaphthalene	MW-23C	28	N
	MW-17	18.22	N
	MW-76C**	0.688	N
	PMW-85C**	0.49	N
Dibenzofuran	MW-23C	46	N
	MW-17	23.94	N
	MW-76C**	0.164	N
	PMW-85C**	0.098	N
Naphthalene	MW-23C	83	***NA – 41 mg/L (>S) (Res, 30-ac Source)
	MW-17	48.13	***NA – 41 mg/L (>S) (Res, 30-ac Source)
	MW-76C**	0.753	N
	PMW-85C**	0.49	N

Note:
** - Proposed well PMW-85C (and PMW-88C) will be evaluated as the downgradient alternate POE well following installation, replacing MW-76C as the downgradient POE well.
*** - $^{Air}GW_{Inh-V}$ PCL for naphthalene not applicable since solubility for naphthalene (31.4 mg/L) is less than $^{Air}GW_{Inh-V}$. In addition, the C-TZ GWBU underlies other GWBUs, where upward vapor migration is not possible.

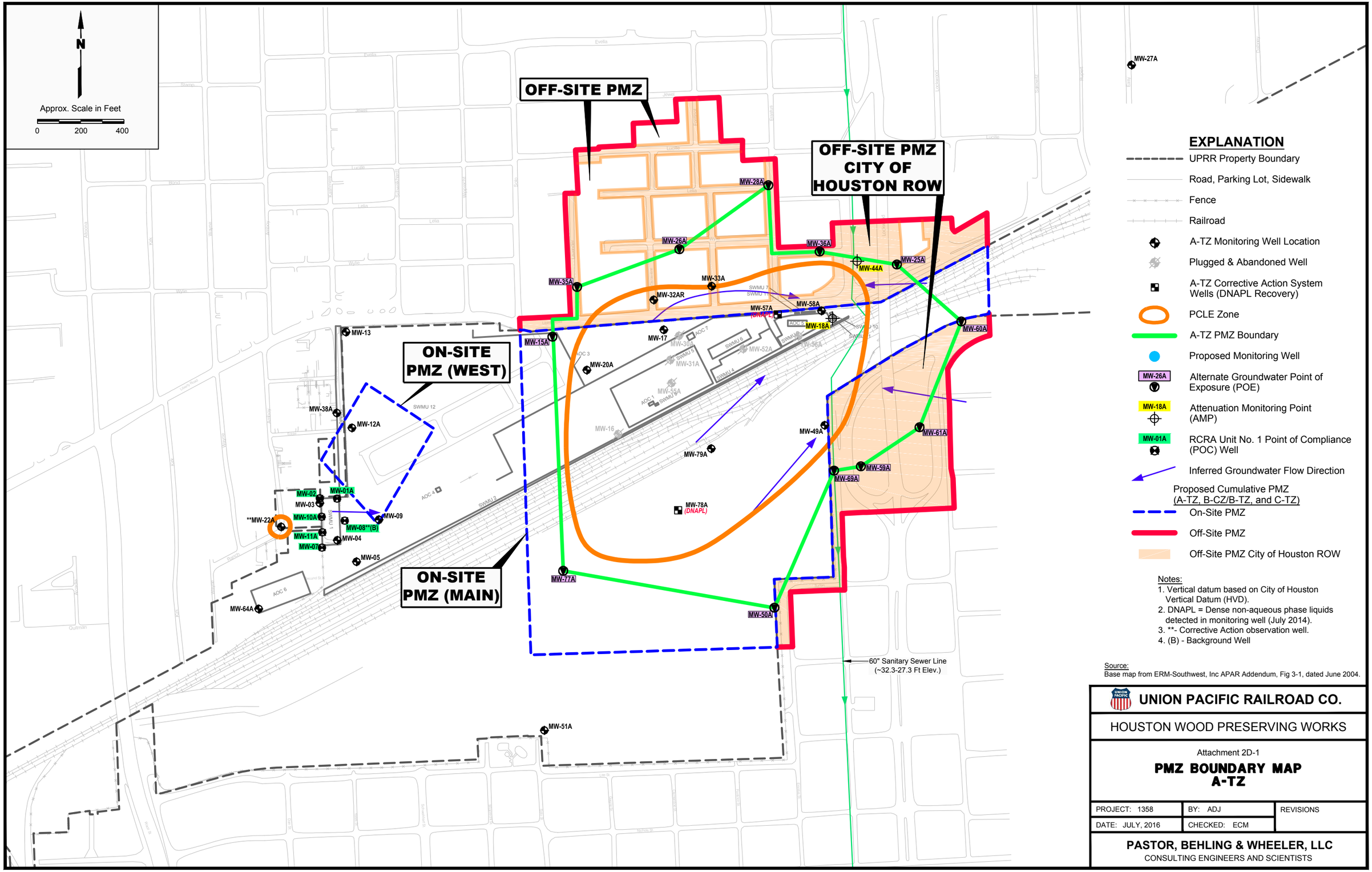
Attenuation Action Levels were not developed for other COCs since the primary COCs listed above define the PCLE Zone.

The proposed PMZ and AMPs for the C-TZ are shown on Attachment 2D-3.

ATTACHMENT 2D

PLUME MANAGEMENT ZONE MAP

ATTACHMENT 2D – 1 PMZ BOUNDARY MAP – A-TZ - UPDATED
ATTACHMENT 2D – 2 PMZ BOUNDARY MAP – B-CZ/B-TZ - UPDATED
ATTACHMENT 2D – 3 PMZ BOUNDARY MAP – C-TZ - UPDATED



Notes:
1. Vertical datum based on City of Houston Vertical Datum (HVD).
2. DNAPL = Dense non-aqueous phase liquids detected in monitoring well (July 2014).
3. **- Corrective Action observation well.
4. (B) - Background Well

Source:
Base map from ERM-Southwest, Inc APAR Addendum, Fig 3-1, dated June 2004.

UNION PACIFIC RAILROAD CO.

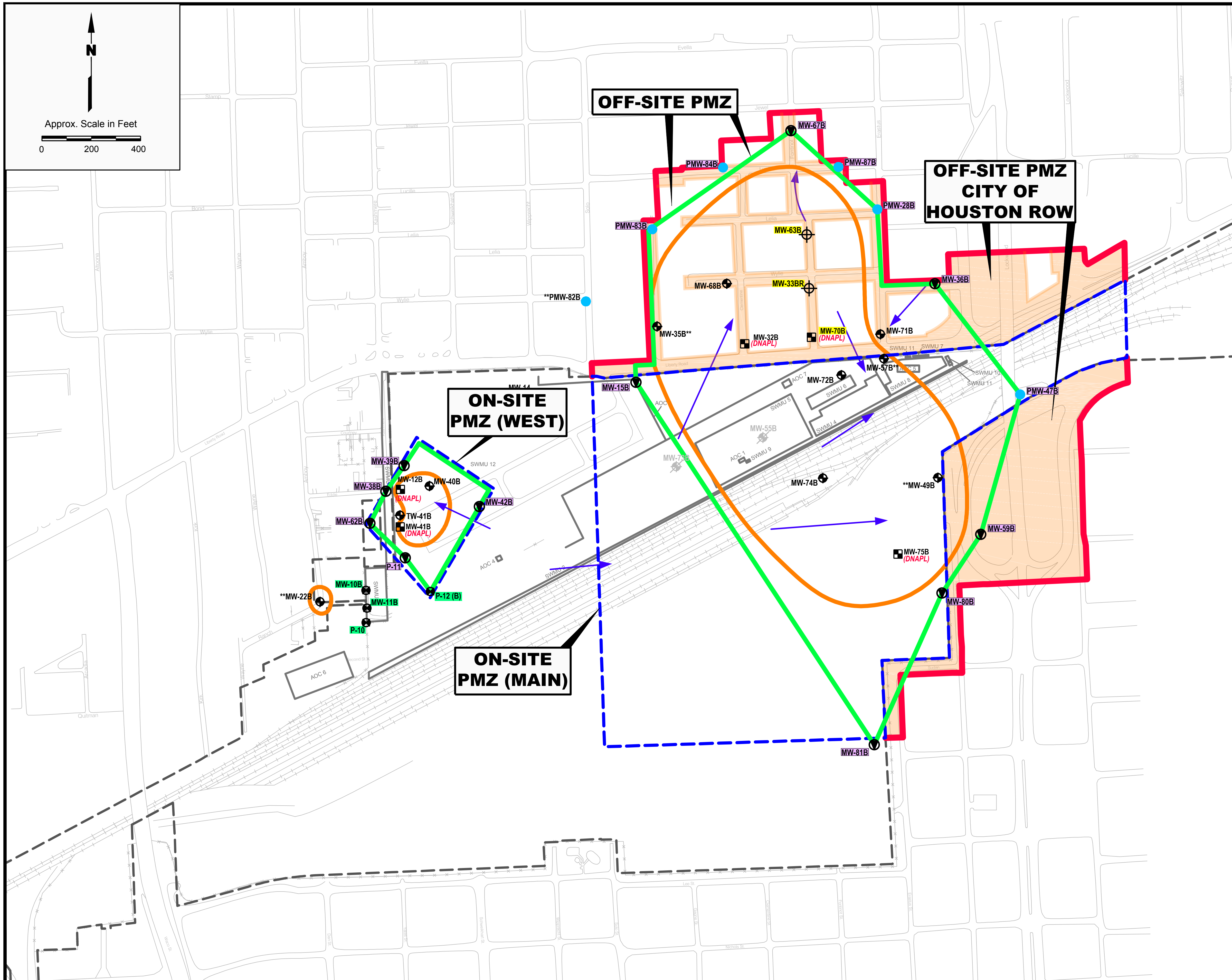
HOUSTON WOOD PRESERVING WORKS

Attachment 2D-1

PMZ BOUNDARY MAP A-TZ

PROJECT: 1358	BY: ADJ	REVISIONS
DATE: JULY, 2016	CHECKED: ECM	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS



EXPLANATION

- UPRR Property Boundary
- Road, Parking Lot, Sidewalk
- Fence
- Railroad
- B-TZ Monitoring Well Location
- Plugged & Abandoned Well
- B-TZ Corrective Action System Wells (DNAPL Recovery)
- PCLE Zone
- B-TZ PMZ Boundary
- Proposed Monitoring Well
- MW-59B Alternate Groundwater Point of Exposure (POE)
- MW-70B Attenuation Monitoring Point (AMP)
- MW-11B RCRA Unit No. 1 Point of Compliance (POC) Well
- Inferred Groundwater Flow Direction

Proposed Cumulative PMZ (A-TZ, B-CZ/B-TZ, and C-TZ)

- On-Site PMZ
- Off-Site PMZ
- Off-Site PMZ City of Houston ROW

Notes:
1. Vertical datum based on City of Houston Vertical Datum (HVD).
2. DNAPL = Dense non-aqueous phase liquids detected in monitoring well (July 2014).
3. **- Corrective Action observation well.
4. (B) - Background Well

Source:
Base map from ERM-Southwest, Inc APAR Addendum, Fig 3-1, dated June 2004.

UNION PACIFIC RAILROAD CO.

HOUSTON WOOD PRESERVING WORKS

Attachment 2D-2

PMZ BOUNDARY MAP B-CZ/B-TZ

PROJECT: 1358	BY: ADJ	REVISIONS
DATE: JULY, 2016	CHECKED: ECM	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

N

Approx. Scale in Feet

0 200 400

OFF-SITE PMZ

OFF-SITE PMZ CITY OF HOUSTON ROW

ON-SITE PMZ (WEST)

ON-SITE PMZ (MAIN)

MW-27C
PMW-83C
MW-28C
MW-68C
MW-54C
MW-45C (DNAPL)
MW-25C
MW-46C (DNAPL)
MW-44C (DNAPL)
MW-34CR
MW-18C**
MW-15C
MW-17C
MW-23C (DNAPL)
MW-47C
MW-19C
MW-48C
MW-12C
PMW-88C
MW-21C
PMW-85C
MW-76C**
PMW-86C**
MW-51C

AOC 1
AOC 3
AOC 4
AOC 5
AOC 6
AOC 7
SWMU 1
SWMU 2
SWMU 5
SWMU 7
SWMU 8
SWMU 9
SWMU 10
SWMU 12

EXPLANATION

- UPRR Property Boundary
- Road, Parking Lot, Sidewalk
- Fence
- Railroad
- C-TZ Monitoring Well Location
- C-TZ Corrective Action System Wells (DNAPL Recovery)
- PCLE Zone
- C-TZ PMZ Boundary
- Proposed Monitoring Well
- MW-48C — Alternate Groundwater Point of Exposure (POE)
- MW-17C — Attenuation Monitoring Point (AMP)
- Inferred Groundwater Flow Direction

Proposed Cumulative PMZ (A-TZ, B-CZ/B-TZ, and C-TZ)

- On-Site PMZ
- Off-Site PMZ
- Off-Site PMZ City of Houston ROW

Notes:
1. Vertical datum based on City of Houston Vertical Datum (HVD).
2. DNAPL = Dense non-aqueous phase liquids detected in monitoring well (July 2014).
3. **- Corrective Action observation well.

Source:
Base map from ERM-Southwest, Inc APAR Addendum, Fig 3-1, dated June 2004.

UNION PACIFIC RAILROAD CO.

HOUSTON WOOD PRESERVING WORKS

Attachment 2D-3

PMZ BOUNDARY MAP C-TZ

PROJECT: 1358	BY: ADJ	REVISIONS
DATE: JULY, 2016	CHECKED: ECM	

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CONSULTING ENGINEERS AND SCIENTISTS

ATTACHMENT 2G

RESPONSE TO TCEQ COMMENT ID T42(2)
TECHNICAL IMPRACTICABILITY DEMONSTRATION - UPDATED

ATTACHMENT 2G – 1 TI FACTORS
ATTACHMENT 2G – 2 PROPOSED TI ZONE
ATTACHMENT 2G – 3 CONCEPTUAL SITE MODEL SW-NE
ATTACHMENT 2G – 4 CONCEPTUAL SITE MODEL S-N
ATTACHMENT 2G – APPENDIX 1 – GROUNDWATER FLOW MODEL RESULTS

PBW

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TECHNICAL MEMORANDUM

DATE: July 15, 2016

RE: Response to Texas Commission on Environmental Quality 2nd Technical Notice of Deficiency Letter Dated June 2, 2016 – Comment ID T42(2)
Response Action Plan (RAP), Attachment 2G – Technical Impracticability Demonstration

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As stated in the 2nd Technical NOD letter dated June 2, 2016, the TCEQ issued additional comments regarding the Technical Impracticability (TI) RAP Worksheet 2.3 and Attachment 2G included with the IHW Permit renewal application for the Union Pacific Railroad (UPRR) Houston Wood Preserving Works. Below are responses to the TCEQ comments under Comment ID T42(2) in a comment-response format:

- **RAP Worksheet 2.1, several places, and Attachment 2.G, Section 4.3 regarding receptors. In order for the proposed PMZs to extend onto properties that do not already contain the PCLE zone, UPRR must show that the Class 2 groundwater has no foreseeable future beneficial use. The TRRP rule at 350.37(l) (3) (A) –(C) specifies under what conditions this can be allowed, with subparagraph C describing example information needed for such a demonstration. UPRR cites lack of groundwater use due to availability of superior supplies and a zoning or governmental ordinance in lieu of the otherwise required Institutional Controls, specifically the Harris Galveston Subsidence District's limitations on water wells. I recommend having Legal evaluate the HGSD's regulations for equivalency to the zoning or governmental ordinance option as described in TRRP-16 and TRRP-21 since the HGSD regulations pre-dated the TRRP rule and don't address COCs in the groundwater. If the HGSD's regulations do not meet criteria for equivalency to the normally required ICs, UPRR will need restrictive covenants on all off-site properties designated for inclusion in a PMZ.**

Response:

Pending the TCEQ review of the Harris and Galveston Subsidence District (HGSD) Rules as an equivalent ordinance, PBW prepared the following evaluation for future beneficial use of the shallow groundwater within the proposed Plume Management Zone (PMZ). As allowed under the PMZ approach, multiple groundwater Protective Concentration Level Exceedance (PCLE) Zones that overlie each other can be covered under a single, combined PMZ (350.37(l)(1)(B) extending over the full depth of the affected GWBUs. Following that approach, the RAP details the individual groundwater PCLE

Zones (A-TZ, B-TZ/B-CZ, and C-TZ) and proposed PMZs for each of those GWBUs with the overall, cumulative groundwater PMZ encompassing all three individual PMZs, both for on-site and off-site properties. For most of the off-site properties, the groundwater PCLE Zone for the B-CZ/B-TZ has the largest lateral extent. Therefore, to address the question of extending the proposed PMZ to property that do not already contain a PCLE Zone, the focus of the response regarding foreseeable future beneficial use will be on the B-CZ/B-TZ PCLE Zone relative to the proposed overall PMZ.

As discussed in 350.37(l)(3)(C), the determination of future beneficial use shall be based upon:

1. the existing quality of groundwater, considering nonpoint sources of COCs and their cumulative impact on the groundwater quality,
2. the lack of use of the groundwater based on the presence of superior water supplies, proximity and withdrawal rates of groundwater users, or
3. the property is subject to a zoning or governmental ordinance which is equivalent to the deed notice, VCP certificate of completion or restrictive covenant that otherwise would have been required. The executive director may require the collection of groundwater samples to document the presence of the COCs originating from nonpoint sources.

Lack of Use of the Groundwater Based on the Presence of Superior Water Supplies

To address the presence of superior water supplies, the City of Houston provides municipal water services for the properties within the proposed PMZ area. The water services provided by the City are superior water supplies both in terms of water quality and quantity. City of Houston utility drawings for the area suggest that the area has received municipal-supplied water since the 1950s.

Proximity and Withdrawal Rates of Groundwater Users

In addition, there are two lines of evidence that suggest the shallow groundwater has no current or future beneficial use: 1) lack of groundwater wells completed in the shallow GWBUs, and 2) estimated well yields or withdrawal rates of groundwater for monitoring wells completed in the shallow groundwater within the proposed PMZ boundary.

As detailed in the Affected Property Assessment Report (APAR), five industrial water wells were identified within a one-half mile radius of the Site through a review of the available water well records (APAR Addendum, PBW, 2009). However, the wells, which records indicated were at least 850 feet or deeper, were either abandoned or are no longer in use. A 500-foot radius field survey was also conducted and demonstrated that no current potential receptors were identified within the residential neighborhood. No water wells, water tanks, cisterns, or windmills, or surface water bodies were encountered.

UPRR has conducted an extensive assessment of groundwater yield within the B-CZ at the Site. Groundwater yield and aquifer tests conducted within the proposed B-CZ/B-TZ PMZ footprint indicates the unit will not sustain a groundwater yield that would be considered a usable resource for potential groundwater users in the area. Aquifer testing results as part of the groundwater resource classification

were detailed in the initial Response Action Plan (RAP) (Attachment 1A) submittal dated December 2014 (PBW, 2014). The results indicated the following:

> *Using the geometric mean approach, the average hydraulic conductivity value for the B-CZ water-bearing unit was calculated to be 1.1 x 10^{-7} cm/sec. Conductivity values in the unit ranged from 1.1 x 10^{-6} cm/sec to 8.0 x 10^{-9} cm/sec.*

Well yield tests (cyclic bailing) conducted on monitoring well MW-67B, which is located on the north portion of the Off-Site PMZ between the groundwater PCLE Zone and downgradient edge of the PMZ, indicated that the B-CZ would not yield more than 10 gallons per day (RAP - PBW, 2014). Therefore, based on the aquifer testing conducted, the quantity of B-CZ groundwater within the proposed PMZ would not likely sustain needed withdrawal rates for groundwater users in the area and would not be considered having future beneficial use. Aquifer testing conducted for the A-TZ and C-TZ indicates these GWBUs can produce greater than 150 gallons per day. However, it is unlikely these individual units would be targeted for groundwater users in the area given historical water supply wells were over 500 feet deeper.

Based on the lack of a usable source of drinking water and city-provided water system, the shallow groundwater within the overall proposed PMZ does not have any foreseeable future beneficial use and thereby satisfies 350.37(l)(3)(C).

Property is Subject to a Zoning or Governmental Ordinance

The Site is also within the jurisdiction of the Harris-Galveston County Subsidence District (HGSD), which restricts groundwater use in the area and requires a permit application prior to drilling a groundwater well. There are permitting exemptions for small domestic wells, but only in areas that do not have an alternative water supply (i.e., not currently supplied water by a municipality). The HGSD rules are not a complete prohibition on the use of groundwater in the area, but rather the fees associated with the rules are "intended to operate as an economic disincentive to groundwater withdrawal" (HGSD, 2013). Therefore, the HGSD rules may not be equivalent to the required restrictive covenant as required under TRRP. However, as discussed in the TCEQ Guidance (TRRP-21 page 31, March 2009) "*In the circumstance where zoning or a governmental ordinance cannot be demonstrated to be equivalent to a deed notice, VCP certificate of completion, or restrictive covenant, the zoning or ordinance can still influence the groundwater response decisions at an affected property.*" The objective of the HGSD Rules are to regulate groundwater withdrawal throughout Harris and Galveston counties for the purpose of preventing land subsidence, which leads to increased flooding. The HGSD rules therefore serve as deterrent for developing groundwater resources within the area for the betterment of the overall community, including within the proposed off-site PMZ, and bolster the case that there is no anticipated future beneficial use for the shallow groundwater.

- **Att. 2-G, Section 5.1, Source Control. The discussion of source control on page 12 needs clarification. For example, the general inability to recover DNAPL is one of the cornerstones for the TI waiver yet recovery of DNAPL is proposed in this section as the means by which the DNAPL source will be controlled. This action may satisfy 350.33(f) (3) (D) regarding the requirement to remove readily recoverable NAPL from a PMZ. The section goes on to assert that this DNAPL control via recovery will also enable achievement of critical PCLs at the alternate POEs of the PMZ through MNA, thereby meeting requirements for 350.33(f)(3)(B) and (C). Not addressed is how UPRR will achieve 350.33(f) (3) (E) regarding prevention of COCs that exceed the critical groundwater PCLs from migrating beyond the existing boundary of the groundwater PCLE zones.**

Response:

To clarify the proposed DNAPL recovery in the context of the TI, even though DNAPL recovery is proposed to aid in controlling potential migration of the DNAPL, it is not feasible or technically practicable to remove all the creosote DNAPL in the subsurface to the point of achieving groundwater cleanup criteria within a reasonable timeframe.

In regards to 350.33(f)(3)(E) that states *"the person must … prevent COCs at concentrations above the critical groundwater PCLs from spreading beyond the existing boundary of the groundwater PCLE zone"*, PBW conducted an evaluation of the groundwater plume stability for each of the groundwater bearing zones, as summarized in the RAP, Attachment 1A (December 2014). Below are excerpts from the evaluation for each impacted GWBU:

> A-TZ: *For the A-TZ groundwater Affected Property, the configuration of the groundwater plume based on the data collected from 2011 through 2014 has been stable or shrinking (concentrations in MW-12A decreasing below cPCLs) as shown on Figure 5B-20. Using primary lines of evidence (PLOE), groundwater data from the A-TZ wells suggests the plume is not migrating and COC concentrations are predominantly limited to the on-site property except for areas near wells MW-32AR and MW-33A and along the east portion of the Site at wells MW-18A and MW-49A.*
>
> B-CZ/B-TZ: *The groundwater Affected Property in the B-TZ and the B-CZ appears to be stable based on the groundwater data collected from 2011 through 2014. The groundwater PCLE Zone in the B-TZ on the west side of the Site is stable and limited in extent laterally (Figure 5B-21). UPRR will continue to evaluate the naphthalene concentrations at MW-22B. For the B-CZ, the PLOE indicates that the PCLE Zone appears to be stable with some minor fluctuations over time.*
>
> C-TZ: *VOCs and SVOCs detected in the C-TZ wells appear to be stable with some benzene fluctuations on the north cross gradient side of the PCLE Zone at MW-68C (Figure 5B-22). There does not appear to be any expansion of the C-TZ groundwater Affected Property (Figure 5B-3); however, the low levels of COC concentrations in MW-76C will continue to be evaluated.*

The PLOE suggest the PCLE Zone for the C-TZ is stable, but will need to be monitored at MW-68C to ensure the PCLE does not expand in that area.

In addition, PBW conducted trend analyses for the COCs in each GWBU as detailed in the RAP (December 2015) Worksheet 2.1. The trend analyses discussed in the RAP indicate that groundwater COC concentrations at the edges of the PCLE Zones are relatively stable, with a few increasing trends. These increasing trends may be due to fluctuations over time rather than indicative of plume migration causing the apparent increase and increasing trends for some wells but with concentrations less than historical highs in those wells (RAP, 2015).

Natural attenuation of the COCs in the GWBUs outside of the areas with NAPL appears to be controlling groundwater with COC concentrations above critical PCLs (cPCLs) from migrating beyond the current groundwater PCLE Zones as well as preventing migration beyond the proposed PMZ boundaries. Since the Site operations ceased over 30 years ago (and that NAPL sources have been removed for some time),and with the on-going DNAPL recovery efforts, we anticipate stable or decreasing trends will continue, with occasional fluctuations as a result of temporal changes (i.e. significant wet or dry periods). Therefore, groundwater with COC concentrations exceeding the cPCL will not likely migrate beyond the existing boundary of the groundwater PCLE Zone as a result of natural attenuation and thereby satisfying 30 TAC§350.33(f)(3)(E). The anticipated continuation of these decreasing trends will be monitored throughout the post-closure care period for the Site.

Attachment 2-G, Section 5.1 has been updated to include details of monitored natural attenuation to control possible migration of groundwater containing COCs above the cPCL beyond the groundwater PCLE Zones.

- **Att. 2-G, Section 5.3 Restoration Timeframe Analysis. The expanded discussion on the restoration timeframe analysis used a model similar to that used on the North Cavalcade Superfund site. Only the C-TZ unit was modeled because of its relatively consistent groundwater flow direction and gradient. UPRR should explain why the A-TZ and B TZ/CZ units were not modeled. For example, the B-TZ/CZ Unit PCLE zone extends farthest off-site to the north and has a notable north-south configuration in contrast to the C-TZ Unit.**

Response:

As detailed in the Attachment 2G Technical Impracticability, the C-TZ unit was selected to evaluate the restoration timeframe using groundwater modelling based on the occurrence of creosote DNAPL in the unit, extensive groundwater data available for the unit, relatively consistent groundwater flow direction and gradient, and the C-TZ has the greatest potential to achieve groundwater clean-up standards compared to the other GWBUs.

The other GWBUs were not modelled based on the following factors:

- A-TZ: *Residual DNAPL in Aquifer Matrix* - The occurrence of mobile DNAPL in the A-TZ is relatively limited where only two wells completed in the A-TZ have had measurable amount of the DNAPL present (MW-57A and MW-78A). However, evidence of DNAPL has been noted in numerous soil boring across the Site where the majority of DNAPL noted in the A-TZ boring logs appears to be residual within the aquifer matrix, with little mobile NAPL noted entering into the A-TZ monitoring wells (see Section 4.2 in Attachment 2G, RAP, 2015). Based on current groundwater remediation technologies, effective removal of the more viscous, residual DNAPL in the aquifer matrix is not feasible. As detailed in Attachment 2G, one of the assumptions for the transient model was to hypothetically reduce naphthalene concentrations within the area where DNAPL has been observed by half every five years until groundwater PCLs are achieved. Given the thicker, non-flowing residual NAPL noted in A-TZ borings, any removal of NAPL to reduce the naphthalene concentrations from the A-TZ would likely take longer relative to NAPL recovery in the C-TZ. Therefore, modelling of the C-TZ was selected over the A-TZ as a better case scenario to evaluate restoration timeframes.

- B-CZ/B-TZ: *Low hydraulic conductivity and variable flow conditions* - The B-CZ was not included in the modelling evaluation primarily because of the low hydraulic conductivity of the B-CZ. As previously discussed, groundwater yield and aquifer tests conducted within the B-CZ/B-TZ indicated an average hydraulic conductivity value at 1.1×10^{-7} cm/sec with values ranging from 1.1×10^{-6} cm/sec to 8.0×10^{-9} cm/sec. When establishing the steady-state groundwater flow model within MODFLOW, it is difficult to calibrate groundwater flow conditions with low hydraulic conductivities. In addition, modelling the transient phase with the low hydraulic conductivity for the GWBU would show minimal reduction in concentrations in the model cells adjacent to the cells with active naphthalene reduction. Also, the groundwater flow conditions in the B-CZ have been relatively variable. Groundwater flow directions change over time, and the changes have not been consistent or predictable. With these characteristics, calibrating the flow model for the B-CZ to Site conditions based on historical observations would be difficult. In contrast, the groundwater flow conditions in the C-TZ have been relatively consistent over time with flow from northeast to southwest (RAP, Attachment 1A, 2014). This allows for better calibration of the groundwater flow model to site conditions.

- **Att. 2-G, Appendix A, page 3. The text in the last paragraph on Input Parameters and Calibration refers to two tables (Tables 1 and 2) containing information used in the model. The tables do not appear to be included with the report and need to be submitted.**

Response:

Tables 1 and 2 are included with Attachment 2G.

- **Att. 2-G, Appendix A, page 4. The TRRP rule at 350.33(f) (3) (E) requires preventing COCs at concentrations above the critical groundwater PCLs from spreading beyond the existing PCLE zone boundaries. One of the model scenarios (current conditions with constant DNAPL source throughout the time period) predicted some amount of naphthalene migration, approximately 250 feet after 100 years. Another scenario modeled source reduction by assuming naphthalene decay rate at one-half every five years. That model also showed some migration although the naphthalene concentrations within the PCLE zone were greatly reduced. The TRRP rule at 350.75(g), regarding differences between natural attenuation factor modeling outputs and monitoring data, calls for placing more weight on the monitoring data. Whereas the predicted response is slight expansion of the naphthalene PCLE zone, the actual conformance with 350.33(f) (3) (C) and (E) will need to be verified with monitoring results. UPRR proposes a monitoring program in RAP Worksheet 2.1. UPRR should also provide supporting monitoring data as part of the evaluation to supplement the model prediction, and demonstrate the proposed monitoring program has sufficient to demonstrate conformance with the two provisions. Based on review of the proposed monitoring program the TCEQ believes there are an insufficient number of APOE wells and observation wells designated to adequately monitor and demonstrate conformance with the two provisions.**

Response:

The purpose of the groundwater model provided in Appendix A as part of the Technical Impracticability demonstration was to primarily evaluate the potential for achieving groundwater PCLs in a reasonable timeframe. The groundwater PCLE Zones consist of several COCs, not just naphthalene, which was the only COC modeled in the groundwater model. Therefore, even though the model outputs indicate some growth of the naphthalene PCL Zone, the overall PCLE Zone based on historical groundwater data is not anticipated to migrate from the general current position. This will be confirmed through the post-response action care period where groundwater monitoring will be conducted.

To address the comment that the TCEQ believes there are insufficient number of APOE wells and observation wells designated to monitor the groundwater PCLE Zone, additional APOE wells (existing or proposed monitoring wells) are proposed for the A-TZ, B-CZ/B-TZ and C-TZ as detailed in the RAP Worksheet 2.1 (July 2016 Revision 2).

ATTACHMENT 2G

TECHNICAL IMPRACTICABILITY DEMONSTRATION

UNION PACIFIC RAILROAD
HOUSTON WOOD PRESERVING WORKS
HOUSTON, TEXAS

DECEMBER 7, 2015 – REVISION 1
JULY 20, 2016 – REVISION 2

Prepared for:

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PBW Project No. 1358

DNAPL noted in the two nearby wells. The well was constructed to the same general elevations and screen interval as MW-41B (Attachment 1A, Figure 4C-3). However, no DNAPL has been detected in TW-41B, and groundwater samples from the well have been less than RALs.

At monitoring wells where DNAPL does flow into the wells, UPRR is conducting a DNAPL recoverability pilot study (discussed below). At these wells, DNAPL recovery will be evaluated for long-term source control of the creosote DNAPL in the three GWBUs.

To address the NAPL source control within the TI Zone for each of the GWBUs, the NAPL response action objectives and endpoints using TCEQ Guidance TRRP-32 (Risk-Based NAPL Management) will be addressed through control via TI based on the occurrence of DNAPL in wells at the Site. The control endpoint will be to control the source (i.e., soluble NAPL fraction) sufficient to create stable or shrinking PCLE zones. Methods to control the creosote DNAPL will include recovery (recover readily recoverable creosote DNAPL from wells with DNAPL present) at the NAPL source zone so that the dissolved-phase groundwater PCLE zone is stable (or shrinking) and the PCLE performance objectives for the TI-based PMZ can be met.

As previously discussed, the creosote DNAPL does not create large, extensive dissolved-phase plumes outside of where the creosote is found to be present in the subsurface. Studies have shown that the dissolved COC plumes from creosote sources tend to have concentrations three to 50 times lower about 150 feet downgradient of the source compared to source concentrations (Kiilerich, 1996). This is supported at the Site by the limited migration distance of the dissolved-phase plume from the source areas, indicating a primary line of evidence (PLOE) that natural attenuation is occurring and controlling expansion of groundwater with COCs above cPCLs from migrating beyond the current PCLE Zones. Furthermore, as detailed in RAP Worksheet 2.1, groundwater analytical data from the three upper GWBUs indicate the distribution of COCs dissolved in Site groundwater is relatively stable in the source areas, with a few exceptions (i.e., a few increasing trends but less than historical high concentrations). Therefore, as long as the DNAPL does not migrate outside of the TI Area, which will be controlled through recovery, groundwater concentrations will achieve critical PCLs at the alternate point of exposure (APOE) wells within the PMZ through decontamination techniques (i.e., natural attenuation) satisfying 30 TAC§350.33(f)(3)(B) and (C), and COC concentrations above cPCLs will not likely migrate beyond the existing groundwater PCLE zone satisfying 30 TAC§350.33(f)(3)(E).

APPENDIX A
GROUNDWATER FLOW AND TRANSPORT MODEL
(TABLES 1 AND 2)

TABLE 1

PHYSICAL PARAMETERS USED IN TRANSPORT MODEL
UPRR HOUSTON WOOD PRESERVING WORKS, HOUSTON, TEXAS

Property	Units	C-TZ
Hydraulic Conductivity		
Horizontal	cm/sec	1.0E-03
Vertical	cm/sec	1.0E-04
Effective Porosity	fractional	0.15
Bulk Density	g/cm^3	170

TABLE 2

CHEMICAL PARAMETERS AND OTHER VARIABLES
USED IN C-TZ TRANSIENT MODEL
UPRR HOUSTON WOOD PRESERVING WORKS, HOUSTON, TEXAS

Timeframe		No. of Years	Upgradient Boundary Head Elevation , ft AMSL	Downgradient Boundary Head Elevation , ft AMSL	Source Concentration, mg/L	Koc*	foc*	Kd (L/mg)	First-Order decay (λ) (1/day)*
Start	End								
1960	2015	55	30	25	19.0	1.30E+03	1.22E-04	1.59E-07	2.00E-05
2015	2115	100							

Notes:

* Values taken from North Cavalcade Superfund Site, Houston, Texas (INL, 2006)

Monitoring and Sampling	RAP Worksheet 3.1 Page 1 of 2	
Associated Information: Attachment 3A	ID No.: SWR ID 31547	Report Date: July 15, 2016 – Rev 2

List the monitoring and sampling of COC concentrations or other parameters that will be conducted during the response action. Illustrate the monitoring or sampling locations in Attachment 3A. If statistics or geostatistics will be used, provide details in Appendix 7. If monitoring or observation wells will be constructed for the response action, provide well construction details in Attachment 2B if not previously provided.

Monitored Media	COC[1]	Other parameter (specify)	Sampling Method[2]	Sampling points or locations[3]	Depth/Height[4] (ft.)	Analytical or Field Screening Method	Sampling or Monitoring Frequency[5]
Surface Soil	Site Specific SVOCs: Benzo(a)anthracene Benzo(a)pyrene Dibenzofuran 1,2-Diphenylhydrazine 2,4-Dinitrotoluene Fluoranthene Phenanthrene		Bulk sampling	PCLE zone excavation; and perimeter of proposed soil cap area to confirm soil PCLE zone for cap	Sidewalls and base of excavation; and near the soil cap from 0-5 feet bgs.	US EPA 8260	One time
Subsurface Soil	None						
Groundwater	Site-Specific VOCs		Same as APAR (low-flow sampling)	See Attachment 3A for list of wells	Middle of screened interval of monitoring well	US EPA 8260	Semi-Annual
	Site-Specific SVOCs		Same as APAR (low-flow sampling)	See Attachment 3A for list of wells	Middle of screened interval of monitoring well	US EPA 8270	Semi-Annual
	Arsenic, lead		Same as APAR (low-flow sampling)	See Attachment 3A for list of wells	Middle of screened interval of monitoring well	US EPA 6010/6020	One-time to evaluate metals in groundwater.

Explain the reasons for the above-listed monitoring and sampling plan.

The monitoring and sampling plan for the groundwater PCLE zone was developed in accordance with PMZ monitoring procedures provided in §350.33(f)(4)(D). As specified therein, AMPs were established at a hydraulically upgradient location within the PCLE zone for each unit (A-TZ,

[1] Specify the COCs to be monitored in this media. List either type of COC (such as VOCs, metals) if all the COCs of that type will be monitored the same way.
[2] Describe the sampling or monitoring methods and QC procedures in Appendix 1 unless the proposed sampling or monitoring procedure is the same as the sampling or monitoring procedure described in the APAR.
[3] Specify the sampling or monitoring point, such as the specific monitor well or general sampling or monitoring location.
[4] Specify the depth or height of the sampling or monitoring points.
[5] Specify the frequency at which this monitoring or sampling will occur.

B-CZ/B-TZ, and C-TZ) and at locations continuing down the approximate central flow path to the downgradient extent of the on-site and off-site PMZ. These are the AMPs for which AALs were developed as detailed in Attachment 2E. Selected monitoring wells (i.e., corrective action observation wells) not located along the approximate central flow path will continue to be monitored to evaluate potential migration of the PCLE Zone at the upgradient, cross-gradient, and downgradient POEs. The four D-TZ monitoring wells will also be sampled to evaluate the potential for vertical migration of COCs to the underlying water-bearing zone. Semi-annual monitoring of the wells is proposed based on the stability of the PCLE zone and absence of potential receptors in the area. With the main source area proposed to be capped, most of the monitoring wells within the capped area will be plugged and abandoned. Selected monitoring wells will be modified (surface completion) following the cap construction (MW-19C and MW-23C).

Additional POE wells are proposed to be installed in the B-CZ/B-TZ off-site (five wells (PMW-28B, PMW-47B PMW-83B, PMW-84B, and PMW87B) and in the C-TZ off-site (three well (PMW-83C, PMW-85C, and PMW-88C)). Details of the well construction are provided in Attachment 2B.

ATTACHMENT 3A

PROPOSED GROUNDWATER MONITORING NETWORK

ATTACHMENT 3A TABLE 1 – PROPOSED PLUME MANAGEMENT ZONE (PMZ) MONITORING WELL NETWORK - UPDATED

ATTACHMENT 3A TABLE 2 – CORRECTIVE ACTION OBSERVATION WELLS - UPDATED

ATTACHMENT 3A TABLE 3 – CORRECTIVE ACTION SYSTEM WELLS

ATTACHMENT 3A – PMZ GROUNDWATER MONITORING NETWORK - UPDATED

ATTACHMENT 3A - TABLE 1

PROPOSED PLUME MANAGMENT ZONE (PMZ) MONITORING WELL NETWORK
UPRR HOUSTON WOOD PRESERVING WORKS, HOUSTON, TEXAS

WELL NO.	AMP/POE Well	DATE INSTALLED	NORTHING	EASTING	TOP OF CASING ELEVATION (FT HVD)	TOTAL DEPTH (FT BGS)	Top Screen Interval (FT BGS)	Bottom Screen Interval (FT BGS)	Zone
A-TZ MONITORING WELLS									
MW-15A	POE	2/25/1997	728,755	3,166,931	50.41	30	12	26.1	A-TZ
MW-18A	AMP	2/26/1997	728,839	3,168,227	51.57	35	18	32.5	A-TZ
MW-25A	POE	3/7/2000	729,089	3,168,524	44.65	29	18.5	28.5	A-TZ
MW-26A	POE	3/7/2000	729,159	3,167,519	44.62	26	14.5	24.5	A-TZ
MW-28A	POE	3/26/2001	729,462	3,167,926	43.86	28	16	26	A-TZ
MW-35A	POE	2/21/2007	728,985	3,167,045	44.75	28	13	28	A-TZ
MW-36A	POE	2/22/2007	729,148	3,168,167	44.53	28	18	28	A-TZ
MW-44A	AMP	2/22/2007	729,021	3,168,349	45.11	28	18	28	A-TZ
MW-50A	POE	3/1/2007	727,501	3,167,958	46.96	25	15	25	A-TZ
MW-59A	POE	1/28/2009	728,155	3,168,358	44.18	21	11	21	A-TZ
MW-60A	POE	1/26/2009	728,825	3,168,823	46.79	28.5	18.5	28.5	A-TZ
MW-61A	POE	1/26/2009	728,336	3,168,630	44.67	22	12	22	A-TZ
MW-69A	POE	6/23/2010	728,136	3,168,234	45.71	18.5	8.5	18.5	A-TZ
MW-77A	POE	5/7/2014	727,672	3,166,981	49.05	25	13	23	A-TZ
B-CZ/B-TZ MONITORING WELLS									
MW-33BR	AMP	12/19/2011	729,142	3,167,662	44.86	40	28	38	B-CZ
MW-36B	POE	6/24/2010	729,161	3,168,172	44.07	43	38	43	B-CZ
MW-38B	POE	12/31/2003	728,319	3,165,945	45.51	37	25.5	35.5	B-TZ
MW-39B	POE	12/16/2003	728,424	3,166,019	49.58	40	29.5	39.5	B-TZ
MW-42B	POE	8/24/2006	728,257	3,166,324	50.52	42	30	40	B-TZ
MW-59B	POE	6/26/2010	728,145	3,168,358	44.36	33	28	33	B-CZ
MW-62B	POE	1/21/2009	728,190	3,165,880	48.16	35	25	35	B-TZ
MW-63B	AMP	1/28/2009	729,361	3,167,652	44.48	36	31	36	B-CZ
MW-67B	POE	6/26/2010	729,782	3,167,588	43.93	40	35	40	B-CZ
MW-70B	AMP	12/14/2011	728,944	3,167,671	45.02	40	25	35	B-CZ
MW-80B	POE	5/8/2014	727,907	3,168,201	47.107	35	29	34	B-TZ
MW-81B	POE	5/11/2014	727,292	3,167,926	46.766	40	29	34	B-TZ
P-12[1]	POE	3/27/1991	727,912	3,166,127	48.78	50	36.3	38.3	B-TZ
P-11	POE	3/25/1991	728,049	3,166,025	48.98	50	36.2	38.2	B-TZ
PMW-28B	POE	Proposed			TBD	~40	TBD	TBD	B-CZ
PMW-47B	POE	Proposed			TBD	~40	TBD	TBD	B-CZ
PMW-83B	POE	Proposed			TBD	~40	TBD	TBD	B-CZ
PMW-84B	POE	Proposed			TBD	~40	TBD	TBD	B-CZ
PMW-87B	POE	Proposed			TBD	~40	TBD	TBD	B-CZ
C-TZ MONITORING WELLS									
MW-15C	POE	4/25/1997	728,761	3,166,947	50.01	75	64	73.5	C-TZ
MW-17C	AMP	12/10/2003	728,779	3,167,446	50.17	70	59.5	69.5	C-TZ
MW-21C	POE	10/26/1998	727,730	3,165,884	49.05	72.5	62.5	72.5	C-TZ
MW-23C	AMP	10/14/1998	728,759	3,167,721	51.91	72.5	62.5	72.5	C-TZ
MW-28C	POE	4/12/2001	729,461	3,167,920	43.96	88	75	85	C-TZ
MW-34CR	AMP**	5/9/2014	728,982	3,168,227	46.47	70	60	70	C-TZ
MW-47C	POE	3/16/2007	728,725	3,168,535	45.61	71	61	71	C-TZ
MW-48C	POE	2/2/2004	728,417	3,168,241	44.68	72	60	70	C-TZ
MW-51C	POE	5/10/2014	726,935	3,166,894	47.48	80	62	72	C-TZ
MW-54C	POE	8/15/2006	729,218	3,168,766	44.99	72	60	70	C-TZ
MW-68C	AMP**	6/25/2010	729,164	3,167,346	44.8	70	60	70	C-TZ
PMW-83C	POE	Proposed			TBD	~70	TBD	TBD	C-TZ
PMW-85C	POE	Proposed			TBD	~70	TBD	TBD	C-TZ
PMW-88C	POE	Proposed			TBD	~70	TBD	TBD	C-TZ

Notes:
POE - Point of Exposure Wells
AMP - Attenuation Monitoring Points (AMPs)
Monitoring well MW-18A is within the proposed soil cap area, well will be replaced
BGS=Below Ground Surface
HVD = Elevations relative to Houston Vertical Datum, Houston Monument System
Northing/Easting = Coordinates based on NAD 1927 Texas State Plane, South Central Zone, US Survey Feet
1 - Well P-12 also serves as background well for SWMU 1 (Detection Monitoring)
** - AALs not calculated for these wells (upgradient and cross-gradient of primary source area), but will be monitored.

ATTACHMENT 3A - TABLE 2

CORRECTIVE ACTION OBSERVATION WELLS
UPRR HOUSTON WOOD PRESERVING WORKS, HOUSTON, TEXAS

WELL NO.	PURPOSE OF CORRECTIVE ACTION OBSERVATION WELL	DATE INSTALLED	NORTHING	EASTING	TOP OF CASING ELEVATION (FT HVD)	TOTAL DEPTH (FT BGS)	Top Screen Interval (FT BGS)	Bottom Screen Interval (FT BGS)	Zone
A-TZ MONITORING WELLS									
MW-22A	Off-site PCLE	10/1/1998	727,876	3,165,677	46.07	25	10	20	A-TZ
B-CZ/B-TZ MONITORING WELLS									
MW-22B	Off-site PCLE	10/27/1998	727,871	3,165,678	45.86	38	27.5	37.5	B-TZ
MW-35B	Off-Site PCLE	2/26/2007	728,988	3,167,045	44.83	42	32	42	B-CZ
MW-49B	On-Site PCLE	1/24/2009	728,375	3,168,184	46.43	35	30	35	B-CZ
MW-57B	On-Site PCLE	12/21/2011	728,857	3,167,965	47.93	40	34	39	B-TZ
PMW-82B	Off-site PCLE	Proposed			TBD	~40	TBD	TBD	B-TZ
C-TZ MONITORING WELLS									
MW-76C	On-Site PCLE	5/7/2014	727,485	3,166,628	47.84	70	60	70	C-TZ
PMW-85C	On-Site PCLE	Proposed			TBD	~70	TBD	TBD	C-TZ
D-TZ MONITORING WELLS									
MW-36D	Sentry monitoring	6/23/2010	729,162	3,168,180	44.33	110	100	110	D-TZ
MW-59D	Sentry monitoring	1/27/2009	728,114	3,168,365	44.22	118	108	118	D-TZ
MW-65D	Sentry monitoring	1/17/2009	729,512	3,168,331	44.55	110	100	110	D-TZ
MW-66D	Sentry monitoring	1/20/2009	729,137	3,169,381	46.51	103	93	103	D-TZ

Notes:

These monitroing wells are not part of the proposed monitoring network. Wells listed above are to evaluate PCLE Zones witihn and outside of the PMZs, and sentry wells forr the D-TZ.

BGS=Below Ground Surface

HVD = Elevations relative to Houston Vertical Datum, Houston Monument System

Northing/Easting = Coordinates based on NAD 1927 Texas State Plane, South Central Zone, US Survey Feet

ATTACHMENT 3A - TABLE 3

CORRECTIVE ACTION SYSTEM WELLS
UPRR HOUSTON WOOD PRESERVING WORKS, HOUSTON, TEXAS

WELL NO.	PURPOSE OF CORRECTIVE ACTION SYSTEM WELL	DATE INSTALLED	NORTHING	EASTING	TOP OF CASING ELEVATION (FT HVD)	TOTAL DEPTH (FT BGS)	Top Screen Interval (FT BGS)	Bottom Screen Interval (FT BGS)	Zone
A-TZ MONITORING WELLS									
MW-57A	DNAPL recovery	1/22/2009	728,858	3,167,974	47.72	27	12	27	A-TZ
MW-78A	DNAPL recovery	5/6/2014	727,953	3,167,512	48.68	30	15	25	A-TZ
B-CZ/B-TZ MONITORING WELLS									
MW-12B	DNAPL recovery	2/27/1997	728,328	3,166,004	50.02	45	32.5	42.5	B-TZ
MW-32B	DNAPL recovery	12/15/2011	728,918	3,167,400	44.73	40	26	36	B-TZ
MW-41B	DNAPL recovery	1/7/2003	728,176	3,166,003	49.37	40	29.5	39.5	B-TZ
MW-70B	DNAPL recovery	12/14/2011	728,944	3,167,671	45.02	40	25	35	B-CZ
MW-75B	DNAPL recovery	12/20/2011	728,066	3,168,022	47.18	40	32.2	37.2	B-TZ
C-TZ MONITORING WELLS									
MW-23C	DNAPL recovery	10/14/1998	728,759	3,167,721	51.91	72.5	62.5	72.5	C-TZ
MW-44C	DNAPL recovery	1/16/2004	729,021	3,168,349	45.03	70	57.5	67.5	C-TZ
MW-45C	DNAPL recovery	1/20/2004	729,155	3,168,512	44.73	70	58	68	C-TZ
MW-46C	DNAPL recovery	1/9/2004	729,121	3,168,576	44.94	72	60	70	C-TZ

Notes:

These monitroing wells are not part of the proposed monitoring network. Wells listed above are to evaluate DNAPL recovery.
BGS=Below Ground Surface
HVD = Elevations relative to Houston Vertical Datum, Houston Monument System
Northing/Easting = Coordinates based on NAD 1927 Texas State Plane, South Central Zone, US Survey Feet

EXPLANATION

- UPRR Property Boundary
- A-TZ Monitoring Well Location
- B-CZ/B-TZ Monitoring Well Location
- C-TZ Monitoring Well Location
- D-TZ Monitoring Well Location
- Corrective Action System Well (DNAPL Recovery)
- Groundwater PCLE Zones (A-TZ, B-CZ/B-TZ and C-TZ)
- MW-26A — Alternate Groundwater Point of Exposure (POE)
- MW-18A — Attenuation Monitoring Point (AMP)
- MW-26A — RCRA Unit No. 1 Point of Compliance (POC) Well
- Proposed Monitoring Well

Proposed Cumulative PMZ (A-TZ, B-CZ/B-TZ, and C-TZ)

- On-Site PMZ
- Off-Site PMZ
- Off-Site PMZ City of Houston ROW

Notes:
1. Vertical datum based on City of Houston Vertical Datum (HVD).
2. DNAPL = Dense non-aqueous phase liquids detected in monitoring well (July 2014).
3. **- Corrective Action observation well.
4. (B) - Background Well.

N

Approx. Scale in Feet

0 200 400

Source:
Parcel Boundaries: City of Houston Geographic Information & Management Systems (GIMS).
Aerial: Houston-Galveston Area Council (HGAC) 2012 Aerial.

OFF-SITE PMZ

ON-SITE PMZ (WEST)

HWPW

ON-SITE PMZ (MAIN)

Englewood Intermodal Yard

PMW-84B PMW-87B MW-67B MW-28C PMW-28B MW-28A MW-65D** PMW-83B PMW-83C MW-63B MW-68C MW-26A MW-33BR MW-36B MW-36D** MW-44A MW-36A MW-45C (DNAPL) MW-46C (DNAPL) MW-54C MW-66D** PMW-82B** MW-35B** MW-35A MW-32B (DNAPL) MW-70B (DNAPL) MW-34CR MW-44C (DNAPL) MW-25A MW-57B** MW-57A (DNAPL) MW-18C** MW-18A MW-60A MW-15C MW-15A MW-15B MW-17C MW-23C (DNAPL) PMW-47B MW-47C MW-19C MW-39B MW-38B MW-12B (DNAPL) MW-42B MW-41B (DNAPL) MW-62B P-11 MW-02 MW-01A MW-10A MW-10B MW-11B MW-08 (B) P-12 (B) MW-22A** MW-22B** MW-11A MW-07 PMW-88C **MW-49B MW-48C MW-61A MW-69A MW-59A MW-59B MW-59D** MW-75B (DNAPL) MW-78A (DNAPL) MW-80B PMW-85C MW-77A MW-76C** MW-50A MW-81B PMW-86C**

UNION PACIFIC RAILROAD CO.	
HOUSTON WOOD PRESERVING WORKS	
Attachment 3A **PMZ GROUNDWATER MONITORING NETWORK**	
PROJECT: 1358	BY: ADJ
DATE: JULY, 2016	CHECKED: ECM
REVISIONS	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

ATTACHMENT 5A

POST-RESPONSE ACTION CARE MONITORING MAP - UPDATED

EXPLANATION

- UPRR Property Boundary
- A-TZ Monitoring Well Location
- B-CZ/B-TZ Monitoring Well Location
- C-TZ Monitoring Well Location
- D-TZ Monitoring Well Location
- Corrective Action System Well (DNAPL Recovery)
- Soil Affected Property
- Groundwater PCLE Zones (A-TZ, B-CZ/B-TZ and C-TZ)
- MW-26A — Alternate Groundwater Point of Exposure (POE)
- MW-18A — Attenuation Monitoring Point (AMP)
- MW-26A — RCRA Unit No. 1 Point of Compliance (POC) Well
- Proposed Monitoring Well
- Surface Soils Excavated within AOC and Consolidated in Soil Cap Area
- Railroad Ballast Cap Area
- Asphalt Cap Area
- Soil Cap
- Concrete Cap Area

Proposed Cumulative PMZ (A-TZ, B-CZ/B-TZ, and C-TZ)

- On-Site PMZ
- Off-Site PMZ
- Off-Site PMZ City of Houston ROW

N

Approx. Scale in Feet

0 200 400

Source:
Parcel Boundaries: City of Houston Geographic Information & Management Systems (GIMS).
Aerial: Houston-Galveston Area Council (HGAC) 2012 Aerial.

Notes:
1. Vertical datum based on City of Houston Vertical Datum (HVD).
2. DNAPL = Dense non-aqueous phase liquids detected in monitoring well (July 2014).
3. **- Corrective Action observation well.
4. (B) - Background Well.

OFF-SITE PMZ

ON-SITE PMZ (WEST)

ON-SITE PMZ (MAIN)

HWPW

Englewood Intermodal Yard

AREA A (DNAPL)
AREA B
AREA C
AREA D
AREA E
AREA F
AREA G

MW-67B, PMW-84B, PMW-87B, MW-65D**, MW-28C, PMW-28B, MW-28A, PMW-83B, PMW-83C, MW-63B, MW-68C, MW-26A, MW-33BR, MW-36B, MW-36D**, MW-44A, MW-45C, MW-46C (DNAPL), MW-54C, MW-66D**, MW-36A, MW-34CR, MW-44C (DNAPL), MW-25A, PMW-82B**, MW-35B**, MW-35A, MW-32B, MW-70B (DNAPL), MW-57A (DNAPL), MW-57B**, MW-18C**, MW-18A, MW-15C, MW-15A, MW-15B, MW-17C, MW-23C (DNAPL), MW-19C, MW-60A, PMW-47B, MW-47C, MW-39B, MW-38B, MW-12B (DNAPL), MW-41B (DNAPL), MW-42B, MW-62B, P-11, MW-02, MW-01A, MW-10A, MW-08 (B), P-12 (B), MW-22A**, MW-10B, MW-22B**, MW-11B, MW-11A, MW-07, PMW-88C, **MW-49B, MW-48C, MW-61A, MW-69A, MW-59A, MW-59B, MW-59D**, MW-75B (DNAPL), MW-78A (DNAPL), MW-80B, PMW-85C, MW-77A, MW-76C**, MW-50A, MW-81B, PMW-86C**

UNION PACIFIC RAILROAD CO.	
HOUSTON WOOD PRESERVING WORKS	
Attachment 5A **POST-RESPONSE ACTION CARE MONITORING MAP**	
PROJECT: 1358	BY: ADJ
DATE: JULY, 2016	CHECKED: ECM
REVISIONS	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

LIST OF APPENDICES

APPENDIX 5B

LAND OWNER CONCURRENCE - INSTITUTIONAL CONTROLS NOT SIGNED/LANDOWNER CANNOT BE LOCATED

Affidavit of Paul Shanklin

THE STATE OF TEXAS §
§
COUNTY OF HARRIS §

BEFORE ME, the undersigned authority, personally appeared Paul Shanklin, who upon being sworn upon his oath did state as follows:

1. "My name is Paul Shanklin. I am over the age of 21 years, and I have never been convicted of any felony or of any misdemeanor involving moral turpitude. I have personal knowledge of everything stated in this affidavit unless otherwise expressly stated, and everything stated herein is true and correct."

2. "Prior to contacting landowners, Title Reports were prepared by Texas American Title Company from the real property records for the properties in the area of the Plume Management Zone (PMZ)."

3. "In late August 2014, on behalf of Union Pacific, outside counsel for Union Pacific (now "Baker Wotring") sent letters enclosing the restrictive covenant by regular and certified mail to landowners identified as having property in the PMZ. An example of the letter along with the restrictive covenant, as proscribed by 30 T.A.C. § 350.111(c), is attached to this affidavit as Exhibit A."

4. "After the letters were sent, I contacted the following Ministers and Pastors of the respective churches and congregations in the affected neighborhood to arrange a community meeting:

   a. Rev. Alix of Greater True Vine Baptist Church;

   b. Bishop Clark of Norton Memorial Temple COGIC Church;

   c. Rev. Ford of Greater Mt. Nebo Baptist Church;

   d. Rev. F.W. Mcilveen of Charity Baptist Church.

5. "I also contracted with local residents to distribute informational flyers on every piece of property located within the PMZ informing the property owners of a meeting to discuss the effect of contaminants found under their properties."

6. "I was in attendance at the community meeting at the Greater True Vine Baptist Church on September 11, 2014, and approximately 189 persons attended the meeting."

7. I was part of the group of UP attorneys, staff and outside counsel (collectively the

"Team") which explained to the residents that none of the properties in the area use the groundwater for drinking; rather, they are on city drinking water provided by the City of Houston."

8. "It was further explained at the meeting that in order to ensure that the shallow groundwater is not used in the future, the landowners in the affected area were being contacted to request that they execute a restrictive covenant which would prohibit use of the shallow groundwater on their property."

9. "The residents were informed that the restrictive covenant would be filed in the property records as part of planned work at the site to institute a Plume Management Zone."

10. Questions from local residents were answered by members of the Team well into the evening.

11. Maps identifying the affected properties that Union Pacific was asking to be subject to the restrictive covenants were displayed for the residents and title documents which indicated the rightful owners were also provided.

12. The names and addresses of people indicating that they owned affected properties were taken and arrangements were made to meet with each owner individually to provide further explanation regarding the need for the restrictive covenant and to make sure each person claiming ownership had the proper documentation to execute the covenant.

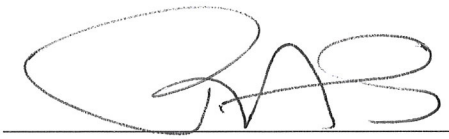
13. Since September 11, 2014, I have made visits to the community on over 70 occasions and spoken to over 200 people who have claimed ownership in properties within the PMZ. A high number of people have probate issues that must be addressed to determine proper ownership. Many have conflicts as to heirship and lacked documentation. Finally there are a number of residents who are simply squatters and may be able to claim ownership through the civil process but cannot afford to do so.

14. Of the numerous people I have met with, we have been able to confirm proper ownership documentation and have obtained notarized documents indicating their agreement with the deed recordation.

15. The chart attached as Exhibit B to this affidavit details the issues encountered with properties for which despite these efforts enumerated above, I was still unable to determine the location of the rightful owner of the properties.

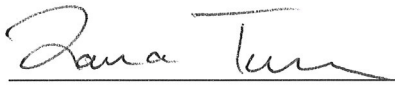
Further Affiant sayeth not.

SIGNED on July 26, 2016.



Paul Shanklin

SUBSCRIBED AND SWORN TO BEFORE ME, the undersigned authority, on this the 26th day of July, 2016.



Notary Public in and for the State of Texas
My Commission Expires:

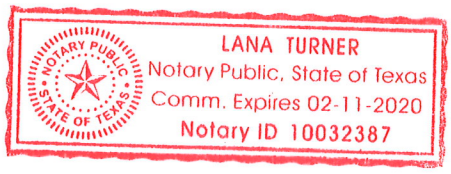


Exhibit A

Geoffrey Reeder, P.G.
Manager, Environmental Site Remediation

Union Pacific Railroad
24125 Aldine Westfield Rd., Spring, TX 77373
Ph. 281 350 7197 fax 402 233 2351
gbreeder@up.com

August 29, 2014

CERTIFIED MAIL
RETURN RECEIPT REQUESTED
AND REGULAR MAIL

Re: Request for Agreement for Restrictive Covenant on 2909 Lavender St for Union Pacific Railroad Company – Houston Wood Preserving Works Facility 4910 Liberty Road, Houston, TX, Post-Closure Care Permit No. HW-50343, TCEQ SWR No. 31547

Dear Sir or Madam:

As you may know, the Union Pacific Railroad Company ("UPRR") has been conducting on-going environmental investigations at the Former Houston Wood Preserving Works Facility ("HWPW") located at 4910 Liberty Road in Houston, Texas. UPRR has previously provided information to landowners that it could identify in the vicinity of the HWPW about the work being performed, including information regarding chemicals of concern ("COCs") identified in the groundwater under or near their properties.

It is important to note that no groundwater drinking wells have been identified in the area and ***none*** of the properties in the area use the groundwater for drinking or irrigation. All of the properties receive drinking water provided by the City of Houston from water supplies outside the area.

Laboratory analytical data of groundwater samples have revealed concentrations of COCs in the shallow groundwater under the Site, and other properties in the area, in excess of the Texas Commission on Environmental Quality ("TCEQ") Human Health Tier 1 Protective Concentration Levels ("PCLs") for Residential Land Use. Data from a groundwater monitoring well near the HWPW indicates that your property is one of the properties in the area. In order to ensure that the shallow groundwater is not used in the future, we are contacting you and other landowners in the area to request that you execute a document called a restrictive covenant which would prohibit use of the shallow groundwater on your property.

This restrictive covenant would be filed in the property records as part of planned work at the Site to institute a Plume Management Zone ("PMZ"). The purpose of the

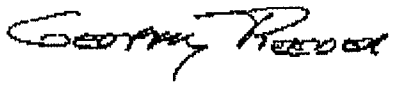
PMZ is to manage the COCs in the shallow groundwater (between 10 and 80 feet below the ground surface) to prevent human exposure and to protect other groundwater resources. In order to institute the PMZ, notice must be placed in the county deed records of a restriction from use of this shallow groundwater.

A copy of the restrictive covenant form is attached as Exhibit A to this letter. The purpose of this restrictive covenant is to give notice to anyone purchasing the property in the future of the restriction on the use of the shallow groundwater located beneath your property. As noted, your property currently receives water service from the City of Houston. This will not change. The groundwater beneath your property which will be restricted under this covenant is not currently being used, nor is there a likely use for it in the future. Therefore, the requested covenant will not affect the current or expected future use of the property.

In appreciation of your willingness to enter the restrictive covenant, UPPR intends to offer appropriate compensation for the agreement to file the restrictive covenant.

Someone from UPRR will be contacting you in the near future to discuss the proposed restrictive covenant and to answer any questions you may have about the procedure. A public meeting has also been scheduled for September 11, 2014 at 7 p.m. at the Greater True Vine Missionary Baptist Church at 3010 Fontinot Street to provide more information and to answer any questions you may have. In the meantime, any questions you have for UPRR should be directed to Mr. Geoffrey Reeder, UPRR Environmental Site Remediation Manager, 24125 Aldine Westfield Road, Spring, Texas 77373, (281) 350-7197. If you have any other questions regarding the request for a restrictive covenant, you may also contact the TCEQ Office of the Public Interest Counsel by phone at 512-239-6363, or facsimile 512-239-6377, or write to Office of Public Interest Counsel, MC 105, TCEQ, P.O. Box 13807, Austin, TX 78711-3087.

Sincerely,



Geoffrey Reeder, P.G.

Enclosure

Exhibit B

MAP ID[2]	HCAD ID[3]	PARCEL ADDRESS	PARCEL OWNER	OWNER MAILING ADDRESS	SIGNED RESTRICTIVE COVENANT	REASON FOR NO SIGNED RESTRICTIVE COVENANT
2	0402660100004	2910 Lavender St, Houston, TX 77026	Ray Carrington	4102 Waterstone St, Missouri City, TX 77459-1837	NO	This property is currently occupied by a squatter. Despite numerous letters and visits to titled owner's address we cannot locate the owner.
3	0141440000001	0 Wylie St, Houston, TX 77026	Greater Mt Nebo Baptist Church	5005 Liberty Rd, Houston, TX 77026-5217	YES	
4	0141440000002	5006 Wylie St, Houston, TX 77026	Greater Mt Nebo Baptist Church	2602 Caplin St, Houston, TX 77026-1104	YES	
5	0141440000003	5010 Wylie, Houston, TX 77026	Alberta Smith	5010 Wylie St, Houston, TX 77026-5226	YES	
6	0402660100003	2906 Lavender St, Houston, TX 77026	Eloise Beal	2906 Lavender St, Houston, TX 77026-5212	YES	
7	0402660100001	2904 Lavender St, Houston, TX 77026	Clark Investment Co	4901 Liberty Rd, Houston, TX 77026-5263	YES	
8	0141440000004	505 Liberty, Houston, TX 77026	Greater Mount Nebo Baptist Church	4511 Eddie St, Houston, TX 77026-7610	YES	
9	0141400000006	5119 Wylie St, Houston, TX 77026	Martha Gilliam	5119 Wylie St, Houston, TX 77026-5227	YES	
10	0141430000001	2820 Clementine St, Houston, TX 77026	Estate Of Tillie Potts Benson	2820 Clementine St, Houston, TX 77026-5202	YES	
11	0141430000004	2813 Fontinot St, Houston, TX 77026	Jose A & Reina I Coto	2819 Fontinot St, Houston, TX 77026-5205	YES	
12	0141430000010	5101 Liberty Rd, Houston, TX 77026	Janie & Wallace Longoria	1510 Beall St, Houston, TX 77008-3444	YES	
13	0141430000008	5105 Liberty Rd, Houston, TX 77026	Alejandro Gonzalez	4088 Pamela Way, Montgomery, TX 77316-2779	NO	Property is being leased. Visited titled owner at address in Montgomery, Texas and owner is unwilling to sign covenant.
14	0141430000007	5109 Liberty Rd, Houston, TX 77026	Joe H Martinez	5109 Liberty Rd, Houston, TX 77026-5218	YES	
15	0141430000011	5113 Liberty Rd, Houston, TX 77026	Harris County Cause No 2003-22512	PO Box 1525, Houston, TX 77251-1525	YES	
16	0141430000006	5117 Liberty Rd, Houston, TX 77026	Jorge D Rivera	5117 Liberty Rd, Houston, TX 77026-5218	YES	

Exhibit B

MAP ID[2]	HCAD ID[3]	PARCEL ADDRESS	PARCEL OWNER	OWNER MAILING ADDRESS	SIGNED RESTRICTIVE COVENANT	REASON FOR NO SIGNED RESTRICTIVE COVENANT
17	0141410000010	5201 Wylie St, Houston, TX 77026	Doris Jean Jefferson	PO Box 23611, Houston, TX 77228-3611	NO	Unresolved probate issues prevent determination of probable heirs and rightful owner, therefore there is no one currently authorized to execute the restrictive covenant.
18	0141420000001	5201 Wylie St, Houston, TX 77026	Charity Baptist Church	5217 Liberty Rd, Houston, TX 77026-5313	NO	Church pastor cannot get authority from his board, despite attempts to explain the nature of the restrictive covenant.
19	0141420000003	2809 Erastus St, Houston, TX 77026	Charity Baptist Church C/O Rev F W Mcilveen	2809 Erastus St, Houston, TX 77026-5303	NO	Church pastor cannot get authority from his board, despite attempts to explain the nature of the restrictive covenant.
20	0141420000009	5201 Liberty Rd, Houston, TX 77026	Full Gospel Christian Assn	5201 Liberty Rd, Houston, TX 77026-5313	NO	The property is currently vacant. There has been no response to letters sent to titled owner and we can not find any other information regarding the owner's current location.
21	0141420000008	5201 Liberty Rd, Houston, TX 77026	Full Gospel Christian Assn	5201 Liberty Rd, Houston, TX 77026-5313	NO	The property is currently vacant. There has been no response to letters sent to titled owner and we can not find any other information regarding the owner's current location.
22	0141420000006	2809 Erastus St, Houston, TX 77026	Charity Baptist Church C/O Rev F W Mcilveen	2809 Erastus St, Houston, TX 77026-5303	NO	Church pastor cannot get authority from his board, despite attempts to explain the nature of the restrictive covenant.
23	0140410000007	5301 Liberty Rd, Houston, TX 77026	Geneva Henry	7546 S Hall St, Houston, TX 77028-2410	YES	
24	0140410000002	5311 Liberty Rd, Houston, TX 77026	Elmer Preston Trust	3319 Liberty Rd , Houston, TX 77026-6238	NO	Trustee cannot get authority from beneficiaries to sign covenant.
25	0651290800937	3300 E Lockwood Dr, Houston, TX 77026	Robert Damian	3300 E Lockwood Dr, Houston, TX 77026-1811	NO	This property is currently occupied by a squatter. Despite numerous letters and visits to titled owner's address we cannot locate the owner.
26	0402600000019	3300 E Lockwood Dr, Houston, TX 77026	Robert Damian	7938 Capitol St, Houston, TX 77012-1649	NO	This property is currently occupied by a squatter. Despite numerous letters and visits to titled owner's address we cannot locate the owner.
28	0141400000004	5118 Lelia St, Houston, TX 77026	Greater True Vine Baptist Church	3010 Fontinot St, Houston, TX 77026-5210	YES	
29	0141400000010	2913 Fontinot St, Houston, TX 77026	Perez Paul M	2913 Fontinot S, Houston, TX 77026-5210	YES	
30	0141410000002	0 Lelia St, Houston, TX 77026	Greater True Vine Missionary Baptist Church	3010 Fontinot St, Houston, TX 77026-5210	YES	

Exhibit B

MAP ID[2]	HCAD ID[3]	PARCEL ADDRESS	PARCEL OWNER	OWNER MAILING ADDRESS	SIGNED RESTRICTIVE COVENANT	REASON FOR NO SIGNED RESTRICTIVE COVENANT
31	0141400000007	5111 Wylie St, Houston, TX 77026	Aquilina Perez	5111 Wylie St, Houston, TX 77026-5227	YES	
32	0141400000008	5107 Wylie St, Houston, TX 77026	Reginald & Leticia Tolbert	5107 Wylie St, Houston, TX 77026-5227	YES	
33	0141400000009	5105 Wylie St, Houston, TX 77026	Maryland Potts Estate	6308 Crane St, Houston, TX 77026-4318	YES	
34	0141390000005	2901 Clementine St, Houston, TX 77026	Mary Bass Ross	2901 Clementine St, Houston, TX 77026-5203	YES	
35	0141390000006	5011 Wylie St, Houston, TX 77026	Estate Of Carrie Mae Carr	5011 Wylie St, Houston, TX 77026-5225	YES	
36	0141390000007	5007 Wylie St, Houston, TX 77026	Andrew J Johnson	5007 Wylie St, Houston, TX 77026-5225	YES	
37	0141390000008	5005 Wylie St, Houston, TX 77026	Banda Monico Duque & Martha Z	5005 Wylie St, Houston, TX 77026-5225	YES	
38	0402660100018	2926 Lavender St, Houston, TX 77026	Clark Investment Co	4901 Liberty Rd, Houston, TX 77026-5263	NO	The Property has been sold for past dues taxes and title has not vested in the new owner, so there is no one currently authorized to execute the restrictive covenant.
39	0402660100022	2924 Lavender St, Houston, TX 77026	Clark Investment Co	2924 Lavender St, Houston, TX 77026-5212	YES	
40	0402660100005	2922 Lavender St, Houston, TX 77026	Greater Mt Nebo Baptist Church	2922 Lavender St, Houston, TX 77026-5212	YES	
41	0141410000001	5202 Lelia St, Houston, TX 77026	Greater True Vine Missionary Baptist Church	3010 Fontinot St, Houston, TX 77026-5210	YES	
42	0140410000006	2806 Erastus St, Houston, TX 77026	Margaret Roberts, et al.	3802 Lochmire Ln, Houston, TX 77039-2523	YES	
43	0140410000013	5304 Wylie St, Houston, TX 77026	Irene Perez Juarez	20726 I A Cote Cir Spring, Spring, TX 77388	YES	
44	0140410000005	5304-1/2 Wylie St, Houston, TX 77026	Susie I Delgado	5304 1/2 Wylie St, Houston, TX 77026-5322	YES	
45	0140330000001	3013 Fontinot St, Houston, TX 77026	Clifton Scott and Lenora Young	1111 Heath Ct, Houston, TX 77016	YES	

Exhibit B

MAP ID[2]	HCAD ID[3]	PARCEL ADDRESS	PARCEL OWNER	OWNER MAILING ADDRESS	SIGNED RESTRICTIVE COVENANT	REASON FOR NO SIGNED RESTRICTIVE COVENANT
46	0140330000003	705 Lucille, Houston, TX 77026	Taylor Crawford	5105 Lelia St, Houston, TX 77026-5215	YES	
47	0140400000002	3009 Erastus St, Houston, TX 77026	Mary Crowley	3009 Erastus St, Houston, TX 77026-5307	YES	
48	0140400000003	5212 Lucille St, Houston, TX 77026	Jose F & Yolanda Ruiz	5212 Lucille St, Houston, TX 77026-5316	YES	
49	0140400000004	5210 Lucille St, Houston, TX 77026	Alfred B & Freddie Randolph	8614 Shotwell St, Houston, TX 77016-5912	YES	
50	0140400000010	0 Lelia St, Houston, TX 77026	Percy Vital	304 Sandman Ave, Crosby, TX 77532-6244	NO	Unresolved probate issues prevent determination of probable heirs and rightful owner, therefore there is no one currently authorized to execute the restrictive covenant.
51	0140400000013	3005 Erastus St, Houston, TX 77026	Frank Thomas	3005 Erastus St, Houston, TX 77026-5307	NO	Unresolved probate issues prevent determination of probable heirs and rightful owner, therefore there is no one currently authorized to execute the restrictive covenant.
57	0141390000001	5008 Lelia St, Houston, TX 77026	Emitt Holmes	5002 Lelia St, Houston, TX 77026-5214	YES	
58	0141390000002	5010 Lelia St, Houston, TX 77026	Nicholas R Alvarado	3410 Chapman St, Houston, TX 77009-5812	NO	This Property is currently occupied by a lessor who has does not have a lease agreement. Despite numerous letters and visits to titled owner's address we cannot locate the owner.
59	0141390000003	5014 Leila, Houston, TX 77026	Guadalupe Rivera Jr and Flor Rivera	5014 Lelia St, Houston, TX 77026-5214	YES	
60	0141390000004	2421 Clementine, Houston, TX 77026	Rogelio R & Olivia Pineda	2921 Clementine St, Houston, TX 77026-5203	YES	
61	0141390000009	0 Lelia St, Houston, TX 77026	Guadalupe Rivera	3401 Erastus St, Houston, TX 77026-5335	YES	
62	0141400000001	2920 Clementine St, Houston, TX 77026	Jack Perkins	2920 Clementine St, Houston, TX 77026-5204	NO	Resident claims not to be the owner but pays the taxes. He refuses to cooperate in locating the owner to get the restrictive covenant signed and we have no further information regarding the owner's current location..
63	0141400000002	5116 Lelia St, Houston, TX 77026	Carter Thomas	5108 Lelia St, Houston, TX 77026-5216	YES	

Exhibit B

MAP ID[2]	HCAD ID[3]	PARCEL ADDRESS	PARCEL OWNER	OWNER MAILING ADDRESS	SIGNED RESTRICTIVE COVENANT	REASON FOR NO SIGNED RESTRICTIVE COVENANT
64	0141400000003	5112 Lelia St, Houston, TX 77026	Avie Potts	5112 Lelia St, Houston, TX 77026-5216	YES	
65	0141410000004	0 Lelia St, Houston, TX 77026	Mallie Pittman	6127 Westover St, Houston, TX 77033-1235	NO	The property is currently vacant. There has been no response to letters sent to titled owner and we can not find any other information regarding the owner's current location. Residents at titled owner's address claim not knowledge of subject property or owner.
66	0141410000006	5211 Wylie, Houston, TX 77026	Sterling Trust Company for the benefit of Charles Mock	5207 Jewel St, Houston, TX 77026-5345	YES	
67	0141410000007	0 Wylie, Houston, TX 77026	Sterling Trust Company for the benefit of Charles Mock	5207 Jewel St, Houston, TX 77026-5345	YES	
68	0141410000011	0 Lelia St, Houston, TX 77026	Leroy Mock	5207 Jewel St, Houston, TX 77026-5345	YES	
69	0141410000012	2925 Erastus St, Houston, TX 77026	Leroy Mock	5207 Jewel St, Houston, TX 77026-5345	YES	
71	0402660100008	2942 Lavender St, Houston, TX 77026	Sandra Rena Thompson	PO Box 671646, Houston, TX 77267-1646	YES	
76	0402660100019	2938 Lavender St, Houston, TX 77026	Essie Lee Hutchins	2938 Lavender St, Houston, TX 77026-5212	YES	
77	0402660100021	2934 Lavender St, Houston, TX 77026	Clark Investment Co	2934 Lavender St, Houston, TX 77026-5212	YES	
78	0522570000001	Leila St, Houston, TX 77026	Samuel J Schrinsky	152 W Wisconsin Ave, Milwaukee, WI 53203-2508	NO	The property is currently vacant. There has been no response to letters sent to titled owner and we can not find any other information regarding the owner's current location.
79	0522570000006	5009 Lelia St, Houston, TX 77026	Clara C Humphrey	5009 Lelia St, Houston, TX 77026-5213	NO	Unresolved probate issues prevent determination of probable heirs and rightful owner, therefore there is no one currently authorized to execute the restrictive covenant.
80	0522570000007	5007 Lelia St, Houston, TX 77026	Johnnie M York	9231 Oak Knoll Ln, Houston, TX 77078-4025	NO	Unresolved probate issues prevent determination of probable heirs and rightful owner, therefore there is no one currently authorized to execute the restrictive covenant.

Exhibit B

MAP ID[2]	HCAD ID[3]	PARCEL ADDRESS	PARCEL OWNER	OWNER MAILING ADDRESS	SIGNED RESTRICTIVE COVENANT	REASON FOR NO SIGNED RESTRICTIVE COVENANT
81	0522570000008	0 Lelia St, Houston, TX 77026	Herbert Hall	5014 Lucille St, Houston, TX 77026-5222	YES	
82	0522570000009	5015 Lelia St, Houston, TX 77026	Manuel Castillo	5015 Lelia St, Houston, TX 77026-5213	YES	
83	1280850010001	3010 Fontinot, Houston, TX 77026	Greater True Vine Baptist Church	3010 Fontinot St, Houston, TX 77026-5210	YES	
84	1280850020001	3011 Fontinot, Houston, TX 77026	Greater True Vine Baptist Church	3011 Fontinot St, Houston, TX 77026-5210	YES	
85	0402660010007	5006 Lucille St, Houston, TX 77026	Eine Barrientos	5006 LUCILLE ST Houston, TX 77026-5222	YES	
86	0402660010008	5008 Lucille St, Houston, TX 77026	Norton Memorial Temple Cogic	5008 LUCILLE ST Houston, TX 77026-5222	YES	
87	0522570000004	0 Lucile, Houston, TX 77026	Norton Memorial Temple Cogic	5008 LUCILLE ST Houston, TX 77026-5222	YES	
88	0522570000003	5014 Lucille St, Houston, TX 77026	Catherine Hall Lawrence	5014 LUCILLE ST Houston, TX 77026-5222	YES	
89	0522570000002	5016 Lucille St, Houston, TX 77026	On Time Lap	2141 W GOVERNORS CIR Houston, TX 77092-8715	YES	
90	0522570000012	0 Lucille, Houston, TX 77026	Fajer Properties Lyc	8621 WESTHEIMER RD Houston, TX 77063-4201	NO	The property is a vacant lot. Fajer Properties, which is listed in the title search as the owner, does not claim ownership. We are unable to locate any additional information regarding the current owner.
91	0522560000009	5015 Lucille St, Houston, TX 77026	Norton Memorial Temple Cogic	5008 LUCILLE ST Houston, TX 77026-5222	YES	
92	0522560000010	5017 Lucille St, Houston, TX 77026	Norton Memorial Temple Cogic	5008 LUCILLE ST Houston, TX 77026-5222	YES	
93	0140340000010	5019 Lucille St, Houston, TX 77026	Herbert L Stewart	4029 MELBOURNE ST Houston, TX 77026-1547	NO	Unresolved probate issues prevent determination of probable heirs and rightful owner.
94	0140340000013	5023 Lucille St, Houston, TX 77026	Leticia Serna, Jose A Martinez	12414 PINE GLEN LN Cypress, TX 77429-2815	YES	

Exhibit B

MAP ID[2]	HCAD ID[3]	PARCEL ADDRESS	PARCEL OWNER	OWNER MAILING ADDRESS	SIGNED RESTRICTIVE COVENANT	REASON FOR NO SIGNED RESTRICTIVE COVENANT
95	0140340000011	3101 Fontinot St, Houston, TX 77026	Frank Lee & Alean D Dorn	3101 FONTINOT ST Houston, TX 77026-5245	YES	
96	0140340000001	5120 Jewel St, Houston, TX 77026	Arditha Morris Woods	5120 JEWEL ST Houston, TX 77026-5254	NO	Unresolved probate issues prevent determination of probable heirs and rightful owner.
97	0140390000005	3120 Fontinot St, Houston, TX 77026	Estate Of Lee Thelma Lowe	3120 FONTINOT ST Houston, TX 77026-5246	NO	Unresolved probate issues prevent determination of probable heirs and rightful owner.
98	0140390000007	5203 Lucille St # 10, Houston, TX 77026	Thomas & Gay Blodgett	17 STONEWALL IRVINE, CA 92620-2649	YES	
100	0651290800938	3300 E Lockwood Dr, Houston, TX 77026	Robert Damian	3300 E Lockwood Dr Houston, TX 77026-1811	NO	This property is occupied by a squatter who claims no knowledge of titled owner. We have been unable to locate any additional information regarding the owner's current location.