

**Environmental
Resources
Management**

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March 12, 2014

Mr. Rodney Bryant
Project Manager
Voluntary Cleanup Section
Texas Commission on Environmental Quality
Mail Code 221
12118 North IH 35, Building D
Austin, Texas 78753

Project No. 0223849

Subject: Second Addendum to the Response Action Plan, dated August 28, 2003 - Former Cameron Iron Works Facility, Houston, Texas VCP No. 221



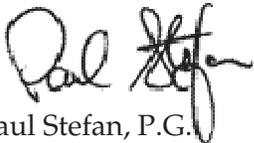
Dear Mr. Bryant:

On behalf of Cameron International Corporation (Cameron), Environmental Resources Management (ERM) is providing this Second Addendum to the Response Action Plan, dated August 28, 2003 for the Former Cameron Iron Works Facility (the Facility) in Houston, Texas to the Texas Commission on Environmental Quality (TCEQ) for review and consideration. This addendum pertains specifically to the response actions necessary to control plume expansion of on-site and off-site ground water as requested in the TCEQ's letter dated June 25, 2013.

Please contact Mr. Ted Fasting of Cameron International Corporation at (713) 513-3325 or me at (281) 600-1000 with any questions or comments.

Sincerely,

Environmental Resources Management



Paul Stefan, P.G.
Principal Partner

PAS/hmh
Attachment

cc: Jason Ybarra, Texas Commission on Environmental Quality, Region 12, Houston
Ted Fasting, Cameron International Corporation
Bruce Himmelreich, Cameron International Corporation, (without attachment)

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY Response Action Plan

Cover Page

Regulatory ID number (Solid waste registration number, VCP ID number, etc) SWR No. 31267, VCP No. 221

check one: Initial submittal for this on-site property Subsequent submittal for this on-site property

Report date: March 10, 2014 TCEQ Region No.: 12

TCEQ Program (check one)

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: Former Cameron Iron Works Site

Street no. 1050 Pre dir: N Street name Silber Street type: Road Post dir: _____

City: Houston County: Harris County Code: 101 Zip: 77024

Nearest street intersection or location description: Shavelson Street and Silber Road

Latitude: Degrees, Minutes, Seconds OR Decimal Degrees (circle one) North 29°47'13"

Longitude: Degrees, Minutes, Seconds OR Decimal Degrees (circle one) West 95°27'56"

Off-Site Affected Property Information

Off-Site Affected Property Name: Off-Site PCLE Zone.

Physical Address:

Street no. _____ Pre dir: _____ Street name _____ Street type: _____ Post dir: _____

City: _____ County: _____ County Code: 101 Zip: 77024

Check if no off-site properties affected

Contact Person Information and Acknowledgement

Person (or company) Name: Cameron International Corporation

Contact Person: Ted Fasting Title: Corporate Director, HSE

Mailing Address: 1333 West Loop South, Suite #1700

City: Houston State: TX Zip: 77027 E-mail address Ted.fasting@c-a-m.com

Phone: 713-513-3300 Fax: 713-513-3421

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

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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.

This report is the Second Addendum to the Response Action Plan (RAP) dated August 28, 2003 for the Former Cameron Iron Works Facility in Houston, Texas. This addendum pertains specifically to Response Actions (RA) necessary to control the plume expansion of on-site and off-site ground water as requested in the TCEQ's letter dated June 25, 2013. The most recent PCLE Zone is shown in Figure 1.

The plume expansion is being caused by a dewatering system constructed by the Texas Department of Transportation (TxDOT) located near the intersection of IH10 and IH610. Unbeknownst to Cameron, construction of the dewatering system commenced in 2003 and was placed into operation in early 2007. The dewatering system was identified by Cameron in May 2011 through an open records request and was first reported to TCEQ in August 2011. TxDOT reported that the system was designed to maintain the ground water elevation in the vicinity of the intersection at approximately 27 feet mean sea level (ft msl) or roughly one foot below the underpass. This roadway has been referred to as the 'Silber Tunnel' in previous reports and connects an entrance ramp to the eastbound main lanes of IH10 from the frontage road. A cross-section map showing the construction elevations of the dewatering system is provided in Figure 2.

As reported to the TCEQ since the 1990's, the ground water at the facility has generally flowed from north to south. The dewatering system has induced an easterly component to the ground water gradient causing the gradient to become more east-southeasterly. Since the construction was completed in 2007, the dewatering system has lowered ground water elevations in monitor wells 1,200-1,500 feet away from the system by more than three feet (Figure 3). This changed condition is causing the plume to migrate into previously unaffected areas. In an effort to address the migration, Cameron responded by installing 30 in-situ injection wells in the Pinewood Estates Subdivision and Memorial Drive areas and has injected nearly 80,000 gallons of oxidant solution. This system is being overwhelmed by the dewatering system.

Cameron has applied intense effort to evaluate and respond to this changed condition. Open records requests to TxDOT in May 2011, October 2011 and March 2012 provided some insight into the dewatering system. Further investigation and correspondence with TxDOT led to a direct ground water discharge measurement at the dewatering system in August 2012. Conducted with TxDOT engineering representatives present, the ground water discharge was measured at approximately 120 gallons per minute (gpm). The dewatering system is passive and will continue to dewater the area in perpetuity.

Cameron discussed the dewatering system and its effects on the current response action with the TCEQ during a meeting in Austin on February 12, 2013. The discussions were focused on the changes in ground water flow conditions associated with the I-610/I-10 Interchange dewatering system and the challenges associated with implementing an effective, sustainable response action. Subsequent discussions and correspondence led to Cameron's submittal entitled "*Former Cameron Iron Works – TxDOT Dewatering System Evaluation and Response*", dated April 16, 2013 (Appendix 1). This report detailed the construction of the dewatering system, showed the observed changes in ground water elevations and flow direction, and included a summary of the potential response actions evaluated.

The TCEQ and Cameron discussed what reasonable and appropriate response action would be needed to counteract the overwhelming nature of the dewatering system. Active response actions were not deemed sufficient to offset the ground water capture effects of the dewatering system. Based on the recent ground water monitoring data, Cameron proposes to monitor the PCLE Zones until such time that the dewatering system has captured the plume. Concentrations at the discharge point are estimated to

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be below applicable levels. No migration will likely occur beyond that location and the remedial objectives will be accomplished. It is estimated that the migration of the PCLE Zone from its current location to the dewatering system discharge point will occur over the next five to ten years. No exposure is likely to occur because this water is not used for any purpose.

Buffalo Bayou to the south will also capture migration toward the south over a longer period of time. This RAP addendum proposes to: (1) maintain the PMZ for the on-site PCLE Zone; and (2) allow the two local ground water withdrawal features (the TxDOT dewatering system and Buffalo Bayou) to be the boundaries of affected ground water. Once the affected ground water has reached these features, no further expansion is anticipated. The progress will be tracked by monitoring ground water up-gradient of to the dewatering features. The concentrations of COCs will continue to attenuate to levels at or near the PCLs as the plume progresses toward the dewatering features. The risk of exposure to affected ground water is minimal because the contribution of affected ground water to the total flow of these features is minimal. The TCEQ approved a similar response action for the western portion of the site (Harris County Flood Control Ditch) in the 2003 RAP.

The extent of affected ground water described above has been investigated and reported separately to TCEQ in documents that are listed in the attached chronology. The constituents of concern (COCs) consist of 1,1-dichloroethane (1,1-DCA), 1,1-dichloroethene (1,1-DCE), 1,2-dichloroethane (1,2-DCA), cis-1,2-dichloroethene (cis-1,2-DCE), trichloroethene (TCE), tetrachloroethene (PCE) and vinyl chloride (VC).

The response actions for the remainder of the site are as described in the 2003 RAP and will continue to be implemented. The ground water recovery system currently operating on the Paraffine Partners Ltd. Property and described in the June 2009 RAP Addendum will cease operation because it is not capable of addressing the migration of affected ground water on the eastern boundary of the off-site PCLE Zone.

No affected or threatened receptors are known to be located within this portion of the affected ground water. Although residential water wells are present within the PCLE Zone south of IH10, the screened intervals of these wells are significantly below the affected shallow water-bearing zone.

What is the selected remedy standard for this affected property? A 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
Shallow, uppermost water-bearing zone	1,1-DCE, TCE, PCE, VC, cis-1,2-DCE, 1,2-DCA		X	X			

Is there a medium that contains a PCLE zone that is not addressed in this RAP? yes no

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

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

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

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

The scope of the RAP has been expanded to address ground water migration due to the installation and operation of a dewatering system by TxDOT.

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

If no, explain why notifications were not made:

All appropriate notifications have been made based on the available information. Future notifications will be made as warranted.

Checklist for Report Completeness	ID No.:	VCP No. 221
	Report Date:	March 10, 2014

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.

			Report Contents
		Required	Cover Page <input checked="" type="checkbox"/>
		Required	Executive Summary <input checked="" type="checkbox"/>
		Required	Checklist for Report Completeness <input checked="" type="checkbox"/>
		Required	Worksheet 1.0 Response Action Objectives <input checked="" type="checkbox"/>
No <input checked="" type="checkbox"/>	Have new data been collected that was not previously submitted?	<input type="checkbox"/> Yes	Attachment 1A* Maps and Cross Sections <input type="checkbox"/>
		→	Attachment 1B* Graphs of Concentration versus Time <input type="checkbox"/>
		Required	Worksheet 2.0 Response Action Design <input checked="" type="checkbox"/>
		Required	Attachment 2A* Response Action Diagrams and Component/Equipment Descriptions <input checked="" type="checkbox"/>
		Required	Attachment 2B* Proposed Well Design <input type="checkbox"/>
No <input checked="" type="checkbox"/>	Is an ecological services analysis or compensatory restoration plan part of the proposed response action?	<input type="checkbox"/> Yes	Attachment 2C* ESA and Compensatory Restoration Plan <input type="checkbox"/>
No <input checked="" type="checkbox"/>	Is a plume management zone proposed as part of the response action?	<input type="checkbox"/> Yes	Worksheet 2.1 Plume Management Zone <input type="checkbox"/>
		→	Attachment 2D* Plume Management Zone Map <input type="checkbox"/>
		→	Attachment 2E* Attenuation Action Levels Determination <input type="checkbox"/>
No <input checked="" type="checkbox"/>	Is a waste control unit proposed as part of the response action?	<input type="checkbox"/> Yes	Worksheet 2.2 Waste Control Unit <input type="checkbox"/>
		→	Attachment 2F* Map of Waste Control Unit <input type="checkbox"/>
No <input checked="" type="checkbox"/>	Is a technical impracticability area proposed as part of the response action?	<input type="checkbox"/> Yes	Worksheet 2.3 Technical Impracticability <input type="checkbox"/>
		→	Attachment 2G* Map of Technical Impracticability Area <input type="checkbox"/>

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

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

Use this worksheet to describe the objectives for the response action in each media.

Response Action Objectives

List the environmental media to which this applies ground water

Repeat this section for each medium that has a different response action objective.

State the property-specific response objectives for the PCLE zone in each media in the context of the response objectives set forth in §350.32 or §350.33 as applicable. Explain how the response action is appropriate based on the hydrogeologic characteristics, COC characteristics, and potential unprotective conditions that could continue or result during the remedial period.

The on-site and off-site PCLE Zones are in compliance with the applicable requirements with one exception. The response action objectives in 30TAC 350.32(f) requires that constituents of concern not migrate beyond the PCLE Zone above the PCLs. Attainment of this objective is not feasible. The migration is caused by the dewatering system constructed by the TxDOT located near the intersection of IH10 and IH610. Evaluation of the available information indicates that this dewatering system is capturing the eastern portions of the on-site and off-site plumes, causing expansion of the plume.

The proposed ground water remedy for affected ground consists of the following components:

- Maintain the PMZ for the on-site PCLE Zone;
- Continued monitoring of the PCLE Zones with additional wells as needed; and
- Notification of affected properties as warranted in accordance with TAC 350.55.

Plume migration will be tracked by monitoring ground water up-gradient of to the dewatering features. The concentrations of COCs will continue to attenuate to levels at or near the PCLs as the plume progresses toward the dewatering features (TxDOT dewatering system and Buffalo Bayou). The TCEQ approved a similar response action in the 2003 RAP for the western portion of the site where affected ground water at similarly low concentrations enters the Harris County Flood Control Ditch. As demonstrated over a nearly 12-year period, the concentrations of COCs discharged from ground water to surface water are below the applicable PCLs.

Exposure to affected ground water is considered unlikely. The land use is residential and construction activities are unlikely to encounter ground water because the depth to ground water is deeper than typical construction activities. The properties within the PCLE zone are supplied with municipal water by the City of Houston. Based on a review of available records, few water wells are present in the area; however, these wells are either known or presumed to be completed in the Chicot or Evangeline aquifers, several hundred feet below the affected water-bearing zone.

Explain how the COCs will be handled, treated, disposed, or transferred to another media and document that the response action will not result in any additional potential exposure conditions due to response action activities.

The COCs in the water-bearing zone will be addressed without creating significant exposure pathways due to response action activities. The progress will be tracked by monitoring ground water throughout the body of the plume. The concentrations of COCs will continue to attenuate to levels at or near the PCLs as the plume progresses toward the dewatering features. The low concentrations observed over the last 20 years are protective of ground water to surface water and ground water to air cross-media transfer criteria.

State the proposed "reasonable time frame" and provide the justification for that time frame in the context of any potential for unprotective exposures to exist or develop, COC characteristics, hydrogeologic and affected property characteristics. If the reasonable time frame is different for the different affected media or for particular tracts of land, be sure to discuss that. Provide how the proposed response action will meet the objectives in a reasonable timeframe.

Response Action Objectives

Associated Information: Attachment 1A, 1B

RAP Worksheet 1.0

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The concentrations of COCs will continue to attenuate to levels at or near the PCLs as the plume progresses toward the dewatering system over the next five to ten years. This period of time was estimated using assumptions for the amount of constituent mass in the water-bearing zone and the amount of ground water removed from the water-bearing zone at a sustained rate from the dewatering system.

For the portion plume that is not captured by the TxDOT dewatering system (the southeastern edge), the concentrations of COCs will continue to attenuate to levels at or near the PCLs as the plume progresses toward Buffalo Bayou. The plume migration period toward Buffalo Bayou, to the extent that it actually occurs, was estimated to be between 25 and 50 years - assuming a ground water velocity of between 100 and 200 feet per year.

Soil Response Action Objectives

When using removal and/or decontamination with controls or controls only, demonstrate how that physical control or combination of measures will reliably contain COCs within and/or derived from the surface soil and subsurface soil PCLE zone materials over time.

Not applicable. Soil is not affected above PCLs in the subject area.

Explain how the removal or decontamination action will reduce the concentration of COCs to the critical surface soil and subsurface soil PCL throughout the soil PCLE zone and prevent COC concentrations above the critical soil PCLs from migrating beyond the existing boundary of the soil PCLE zone.

Not applicable. Soil is not affected above PCLs in the subject area.

Groundwater Response Action Objectives

Name of groundwater-bearing unit to which this information applies _____ Stratum II

Repeat this section for each groundwater-bearing unit for which a different response action is proposed.

Groundwater classification _____ 1 _____ X 2 _____ 3

Is a modified groundwater response action being proposed for any part of the groundwater PCLE zone (§350.33(f)(2), (3), or (4))?

X Yes _____ No

If yes, does the affected property meet the qualifying criteria for a modified groundwater response action using a waste control unit, **plume management zone**, or technical impracticability?

X Yes _____ No

If yes, complete the appropriate portions of this report.

If no to either question, complete the following:

Explain how the removal or decontamination action will reduce the concentration of COCs to the critical groundwater PCL throughout the groundwater PCLE zone and prevent COC concentrations above the critical groundwater PCL from migrating beyond the existing boundary of the groundwater PCLE zone.

The response actions that began in 2003 at the site were on track with achieving the remedial objectives until the influence of the dewatering system caused the unanticipated plume migration. TCEQ has concurred with this finding in their responses to annual monitoring reports from 2004 to 2012.

The expansion of the PCLE zone is being caused by a dewatering system constructed by TxDOT located near the intersection of IH10 and IH610. The response action proposed in this Amended RAP will allow plume expansion to reach the TxDOT dewatering system and Buffalo Bayou. The PCLE zone will be addressed by the dewatering features and these features will remove and/or decontaminate the COCs from ground water. Once the expansion has reached both features, no further expansion of the PCLE zone is possible.

Response Action Objectives

Associated Information: Attachment 1A, 1B

RAP Worksheet 1.0

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Explain how the response action will prevent COCs from migrating to air at concentrations above the PCLs for air if the groundwater-to-air PCLs ($^{Air}GW_{Inh-V}$) is exceeded.

The concentrations of COCs observed over the last 20 years are currently below the concentrations published by TCEQ for Tier 1 $^{Air}GW_{Inh-V}$ PCLs. In the future, concentrations will be lower from attenuation along the flow path.

Explain how the response action will prevent COCs from migrating to surface water at concentrations above the PCLs for groundwater discharges to surface water if surface water is a factor.

The connection between ground water and surface water has been evaluated since 2001 to understand the potential for elevated concentrations in ground water to create a potential surface water issue. The area of evaluation is located along the Harris County Flood Control Ditch on the western edge of the off-site PCLE Zone. As demonstrated to TCEQ through annual reports and routine monitoring, no exceedances of the surface water PCLs have been reported. The weight of this evidence suggests that concentrations of constituents migrating toward the TxDOT dewatering system and Buffalo Bayou (or the eastern edge of the plume) will not represent a significant risk to human health or the environment.

Explain how the response action will prevent human and ecological receptor exposure to the groundwater PCLE zone.

The potential for human and/or ecological exposure to the PCLE Zone is predicted to be insignificant because concentrations of constituents of concern will be below the PCLs published by TCEQ for the air and surface water, based on nearly 15 years of sampling results. The response action provides a high degree of protection for human and/or ecological exposure.

Response Action Design

Use this worksheet to provide detailed descriptions of the response action. Attach design and layout drawings and equipment specifications in Attachment 2A.

Media: Ground water

List all media to which this information applies. If the response action is different for another media, complete a separate worksheet.

Provide a detailed description of the response action. Describe the removal action, decontamination, treatment system(s), and/or physical or institutional control actions that are proposed for each media and discuss the reasons for choosing the response action(s). Identify and describe any ecological services analysis and compensatory restoration plan that will be utilized (if so, include the complete ESA and compensatory restoration plan in Attachment 2C).

The migration is being caused by a dewatering system constructed by TxDOT located near the intersection of IH10 and IH610. During a meeting at the site in May 2013, both TCEQ and Cameron agreed that the effectiveness of a conventional hydraulic control or treatment system would be limited by the overwhelming nature of the dewatering system. Therefore, the most reasonable and appropriate response action is to allow migration to the discharge points, notify landowners of apparent migration as required, monitor plume movement, and document concentrations at the point of discharge.

The response action is similar to the response action for the western portion of the site (Harris County Flood Control Ditch) approved in the 2003 RAP with the exception that the PCLE Zone along the western edge had already reached the ditch before monitoring began in 2002.

Describe all major treatment system components and equipment of the response action. Illustrate the response action design and provide equipment specifications in Attachment 2A.

Additional monitor wells may be installed as necessary to monitor the full extent of the plume.

List permits or registrations needed to construct or implement the response action, including permits or registrations needed to conduct studies or tests. For VCP sites, list the permits that would be required if the site was not in the VCP (required by the VCP).

Permitting/Registration Authority	Type of permit/registration	Permit or registration number if already issued	Anticipated application date
Not applicable.			

Identify and discuss the results of any studies or tests, such as pilot studies, feasibility studies, technical impracticability studies, treatability studies, and/or toxicity studies conducted or proposed to be conducted at the affected property. Discuss the reason for the study or test and how it verifies the effectiveness and appropriateness of the chosen response action or documents that a particular response action is not appropriate for the affected property. Describe how the results of completed studies or tests determined the design or choice of response action. Attach any separate reports and supporting documentation in Appendix 3.

Not applicable.

Performance Measures

List and describe the performance measures for each environmental medium containing a PCLE zone that will be used to determine if reasonable progress is being made by the response action in a timely manner. Use these measures to document effectiveness of the response action in the RAER.

The performance measures for evaluating the effectiveness of the response action are to routinely monitor the concentrations of COCs in monitor wells up-gradient of the dewatering features and document concentrations across time as the plume migrates to the endpoints of the TxDOT dewatering system and Buffalo Bayou.

Potential Problems

Complete the table for the response action. When the response action consists of several components or multiple actions, complete one table for each major component or action.

Response Action Name/Designation: Controlled Migration

List the potential problems that might be reasonably anticipated for the response action, describe the impact of each problem, and the response to the problem.

Description of the Potential Problem	Impact	Will this cause a response action failure?	Corrective Response
Exposure occurs to human or ecological receptors in an expanding PCLE Zone in the uppermost water-bearing zone.	Concentrations are elevated above applicable PCLs at the point of exposure.	Yes	<ul style="list-style-type: none"> • TCEQ requires TxDOT to re-engineer dewatering system and eliminate the capture zone that is causing migration. • Notification requirements to all easement holders and affected properties are maintained throughout time period until concentrations reach PCLs. • A Municipal Setting Designation is approved for the plume by the City of Houston creating an institutional control to protect human health.
Not applicable.			

Monitoring and Sampling

Associated Information: Attachment 3A

RAP Worksheet 3.1

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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							
Subsurface Soil							
Groundwater and Surface water	<u>PPL VOCs:</u> 1,1-Dichloroethane 1,1-Dichloroethene 1,2-Dichloroethane cis-1,2-Dichloroethene Tetrachloroethene Trichloroethene Vinyl Chloride	Monitor wells: pH, specific conductance, dissolved oxygen, temperature,	Up-gradient monitor wells: Low-flow ground water purging and sampling as outlined in the APAR. Surface water: grab	The current well network in the vicinity of the de-watering features. Monitoring locations may be added in the future. Surface water: where accessible.	Up-gradient monitor wells and/or surface water as described in the 2003 RAP.	VOCs: SW-846 8260; Other parameters by field instrument readings following manufacturers'	Monitor wells: quarterly to semiannual depending on results. Surface water: Semiannual

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.

Monitoring and Sampling

Associated Information: Attachment 3A

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Sediment							
Air							
Other Media (specify)							

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

This sampling and analysis plan is based on results of more than 20 years of monitoring data acquired at the site. Each of the facility's COCs will be evaluated to confirm the remedial goals have been attained for all COCs. The proposed monitoring frequency is based on observed site conditions over the past 20 years of monitoring. A map showing monitoring and sampling points is included with Attachment 1A.

Operation and Maintenance	RAP Worksheet 3.2		Page 1 of 1
	ID No.: VPC No. 221	Report Date: March 10, 2014	

Use this worksheet to describe the operation and maintenance (O&M) activities for each response action. In situations where the response action consists of more than one major component, for clarity one worksheet can be completed for each major component.

Response Action Name/Designation: NA

List all portions of the response action to which this information applies.

Describe the O&M and inspection activities that will be required to operate and maintain response action components.

As described for monitor wells in the 2003 RAP.

List and discuss the key operating parameters for a properly functioning response action. Address how changes in these parameters will result in operating changes, providing sufficient detail to explain how the operator will know the component is functioning properly.

As described for monitor wells in the 2003 RAP.

List the routine tasks required to operate the response action.

NA

List the routine tasks required to maintain the response action, including scheduled inspections, maintenance, and component replacement.

As described for monitor wells in the 2003 RAP.

Confirmation Sampling Plan

Associated Information: Attachment 4A

RAP Worksheet 4.0

Page 1 of 1

ID No.: VPC No. 221

Report Date: March 10, 2014

List the COCs and other parameters that will be sampled to confirm completion of the response action. Illustrate the monitoring or sampling locations in Attachment 4A. If monitoring or observation wells will be constructed for the response action, provide well construction details in Attachment 2B if not previously provided. If needed, describe the sample collection and handling methods, if not previously provided, in Appendix 6.

Media	COC ¹	Other parameter (specify)	Sampling Method	Sampling points ²	Depth/height (ft.)	Analytical Method	Sampling Frequency
Surface Soil							
Subsurface Soil							
Groundwater	PPL VOCs: 1,1-Dichloroethane 1,1-Dichloroethene 1,2-Dichloroethane cis-1,2-Dichloroethene Tetrachloroethene Trichloroethene Vinyl Chloride	Monitor wells: pH, specific conductance, dissolved oxygen, temperature	Monitor wells: Low-flow ground water purging and sampling as outlined in the APAR.	Specific area up-gradient monitor wells included in the semi-annual monitoring including: MW-145, MW-163, MW-164, MW-165	Upper-most water-bearing zone	VOCs: SW-846 8260; Other parameters by field instrument readings following manufacturers' guidelines.	Quarterly
Surface water	PPL VOCs: 1,1-Dichloroethane 1,1-Dichloroethene 1,2-Dichloroethane cis-1,2-Dichloroethene Tetrachloroethene Trichloroethene Vinyl Chloride	GPS location of sampling point	Grab.	Locations dependent on accessibility to the dewatering features or their outfalls	Surface water	VOCs: SW-846 8260; Other parameters by field instrument readings following manufacturers' guidelines.	Semi-annual
Sediment							
Other media (specify)							

Explain the reasons for the above-listed sampling plan. Discuss statistical or geostatistical methodology(ies) which will be applied, if any, in the data collection process. Discuss any assumptions made in the statistical/geostatistical assessment, and how they will be met.

The same sampling and analysis plan for ground water described in Section 3.1 of this RAP (described more completely in Section 6.0 of the APAR) will be used to monitor the response action. Because the sampling and analysis plans are the same, Attachment 4A is not included separately.

¹ Specify either a specific COC or type of COC (such as VOCs, metals).

² Specify the sampling point to the degree it is known, (for example, MW-1, or near former boring #2).

Document the proposed schedule for implementing the response action. Include all major response action activities through the life of the project, including all removal, decontamination, and control actions, component installations, O&M, monitoring, and post-response action care activities.

Implementation of Response Action (specify component or action)	Start	Finish	Duration
Semiannual monitor network inspection and ground water monitoring	10/14	12/29	15 years
Annual RAER	Performance will be documented in the annual Ground Water Monitoring and Field Activities Summary Reports.		

List the proposed schedule for report submittals. Add additional lines if more reports than listed will be needed to complete the response action.

Reports	Submittal date
Response Action Effectiveness Report (RAER)	
RAER submittal	Annually

Chronology of Activities Since 2011

March 10, 2014
Project No. 0223849

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281-600-1000

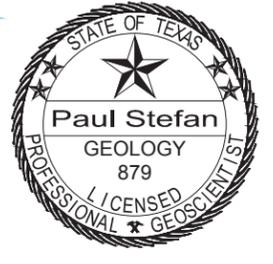
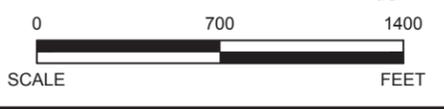
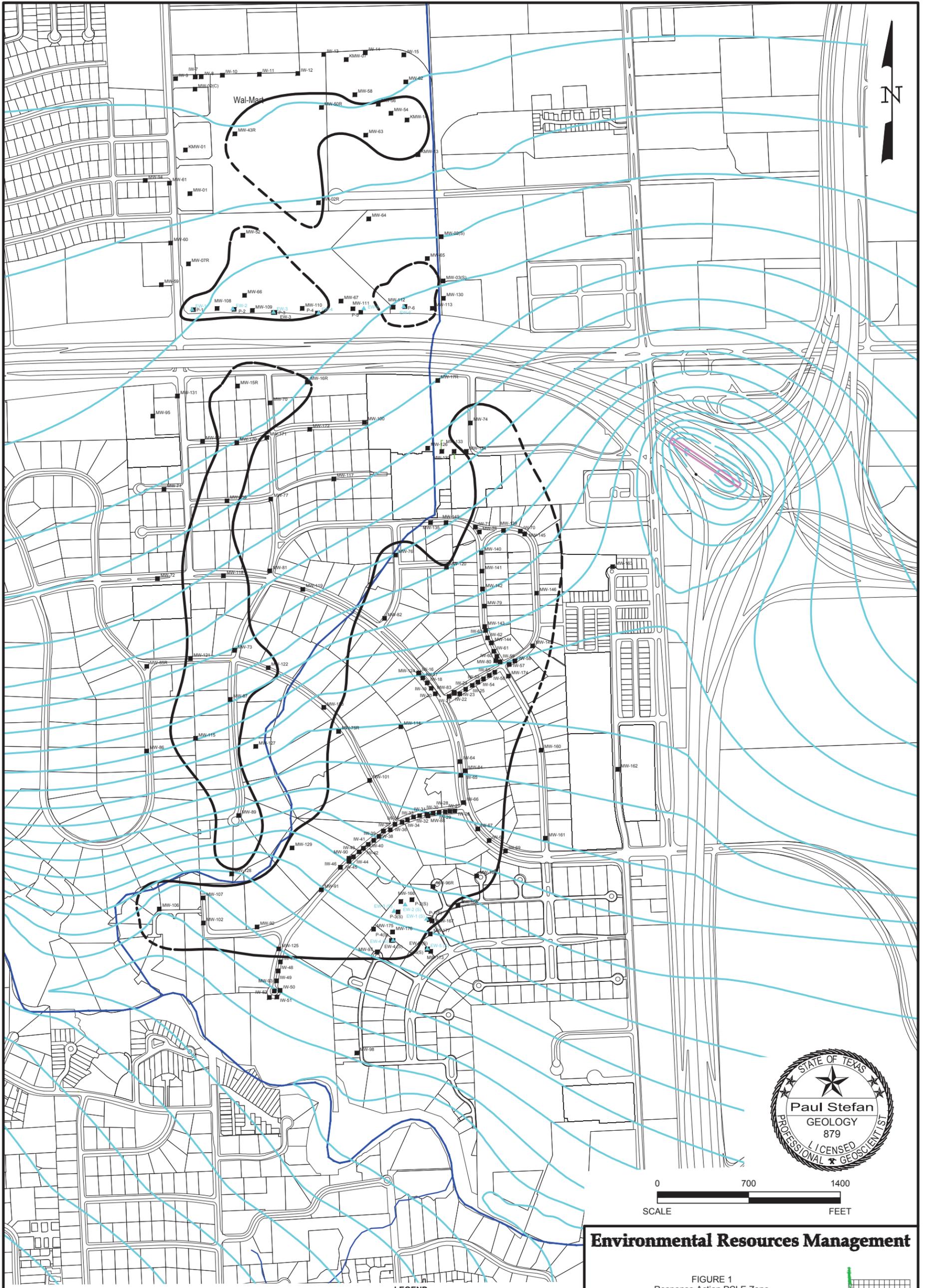
Chronology of Activities Since 2011

Date	Activity
2011 to present	Semiannual ground water monitoring and reporting, including notification of property owners with affected ground water beneath their property.
	Quarterly sampling and reporting of perimeter and plume leading monitor wells that show an increase in COC concentrations.
February 2011	The treatment gallery is expanded along Memorial Drive – 6 injection wells installed (IW-64, IW-65, IW-66, IW-67, IW-68 & IW-69)
April 2011	Semiannual ground water elevation data continues to show decreasing heights over time in the northeastern portion of the plume.
May 2011	Information from TxDOT Open Records Request identifies the Silber Tunnel dewatering system.
July 2011	The treatment gallery along Pinehaven and Chatsworth Drives is expanded – 6 4” diameter injection wells installed - 2 new and 3 replacement injection wells (IW-59R, IW-70 (new), IW-71 (new), MW-138R, MW-155R)
	Sitewide injection event – 45,000 gallons of oxidant injected at over 60 off-site locations (over 6 ½ tons of permanganate total weight).
August 2011	The dewatering system was first described in the First Half 2011 Data Transmittal dated August 15, 2011.
October 2011	Information from a second TxDOT Open Records Request identifies a passive, continuous drainable wall dewatering system. This system maintains ground water elevations in the area of the IH10/IH610 interchange at approximately 27 ft msl - nearly 20 feet below average ground water elevations for the area.
March 2012	Oxidant treatment at select wells in Pinewood Estates – 15,000 gallons of oxidant injected at 16 locations (over 2 tons of permanganate total weight). Information from a third TxDOT Open Records Request provided the FEIS report for the construction project.
April 2012	A review of the ground water data from the First Half 2012 Event shows eastward migration in Pinewood Estates. Re-sampling confirms the PCL exceedances.
June 2012	Notifications made to property owners with affected ground water beneath their property.
August 2012	Correspondence with TxDOT led to the direct ground water discharge measurement at the Silber Tunnel dewatering system. Measurements show 120 gpm discharge rate.
February 2013	The TCEQ and Cameron discussed the dewatering system and its effects on the current response action in Austin. The discussions were focused on the changes in ground water flow conditions associated with the I-610/I-10 Interchange dewatering system and the challenges associated with implementing an effective, sustainable response action.
April 2013	Cameron submittal entitled “ <i>Former Cameron Iron Works – TxDOT Dewatering System Evaluation and Response</i> ”. This report detailed the construction of the dewatering system, showed the observed changes in ground water elevations and flow direction, and included a summary of the potential response actions evaluated.
June 2013	TCEQ letter requesting a RAP to address the plume expansion
March 2014	Response Action Plan Addendum II submitted to the TCEQ.

**Response Action Diagrams and Component/Equipment
Descriptions**
Attachment 2A

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LEGEND

- - Monitor or Injection Well
- ▲ EW-2 (S) - Extraction Well
- - - - May 2013 PCLE zone (dashed where inferred)
- TxDot Dewatering System (Silber Tunnel)
- Ground Water Elevation Contours

Environmental Resources Management

FIGURE 1
Response Action PCLE Zone
Former Cameron Iron Works
Houston, Texas

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Map of Monitoring and Sampling Points
Attachment 3A

March 10, 2014
Project No. 0223849

[see Attachment 2A]

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Map of Confirmation Sampling Points
Attachment 4A

March 10, 2014
Project No. 0223849

[see Attachment 2A]

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References

Appendix 1

March 10, 2014

Project No. 0223849

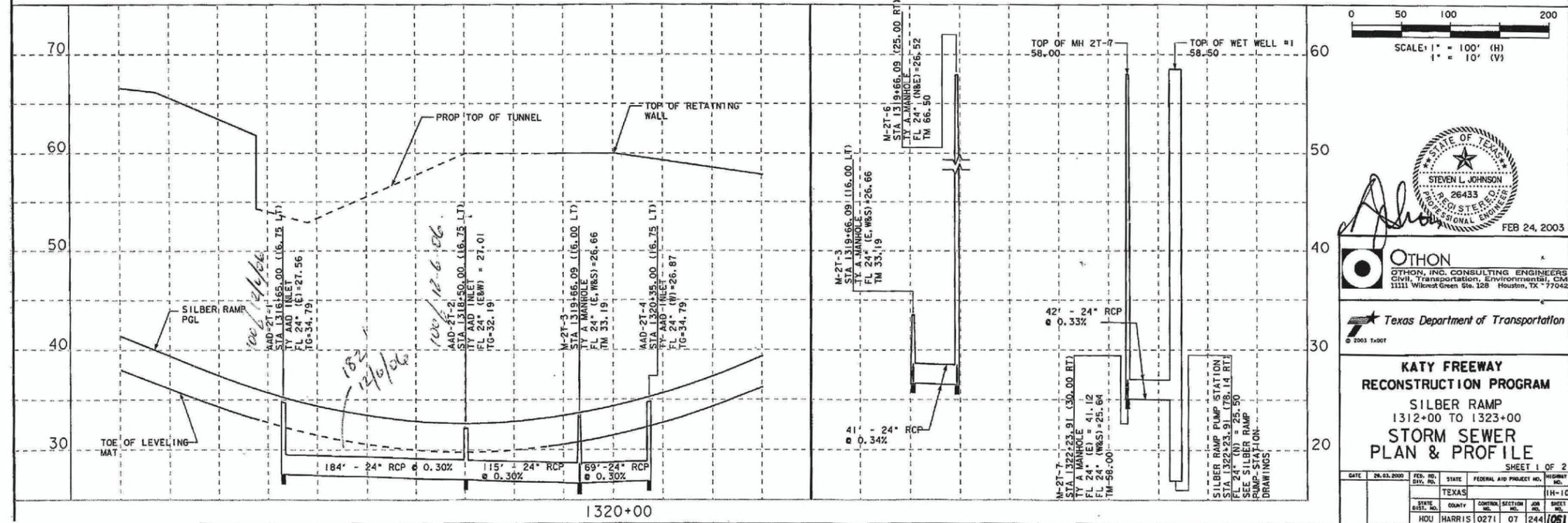
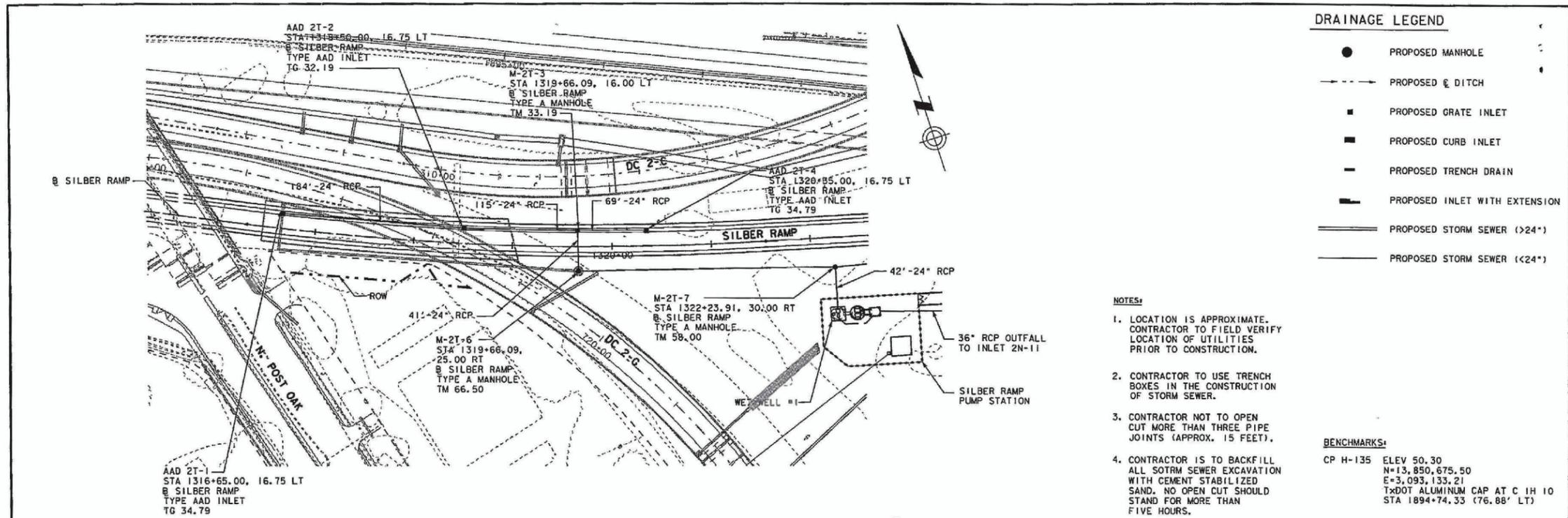
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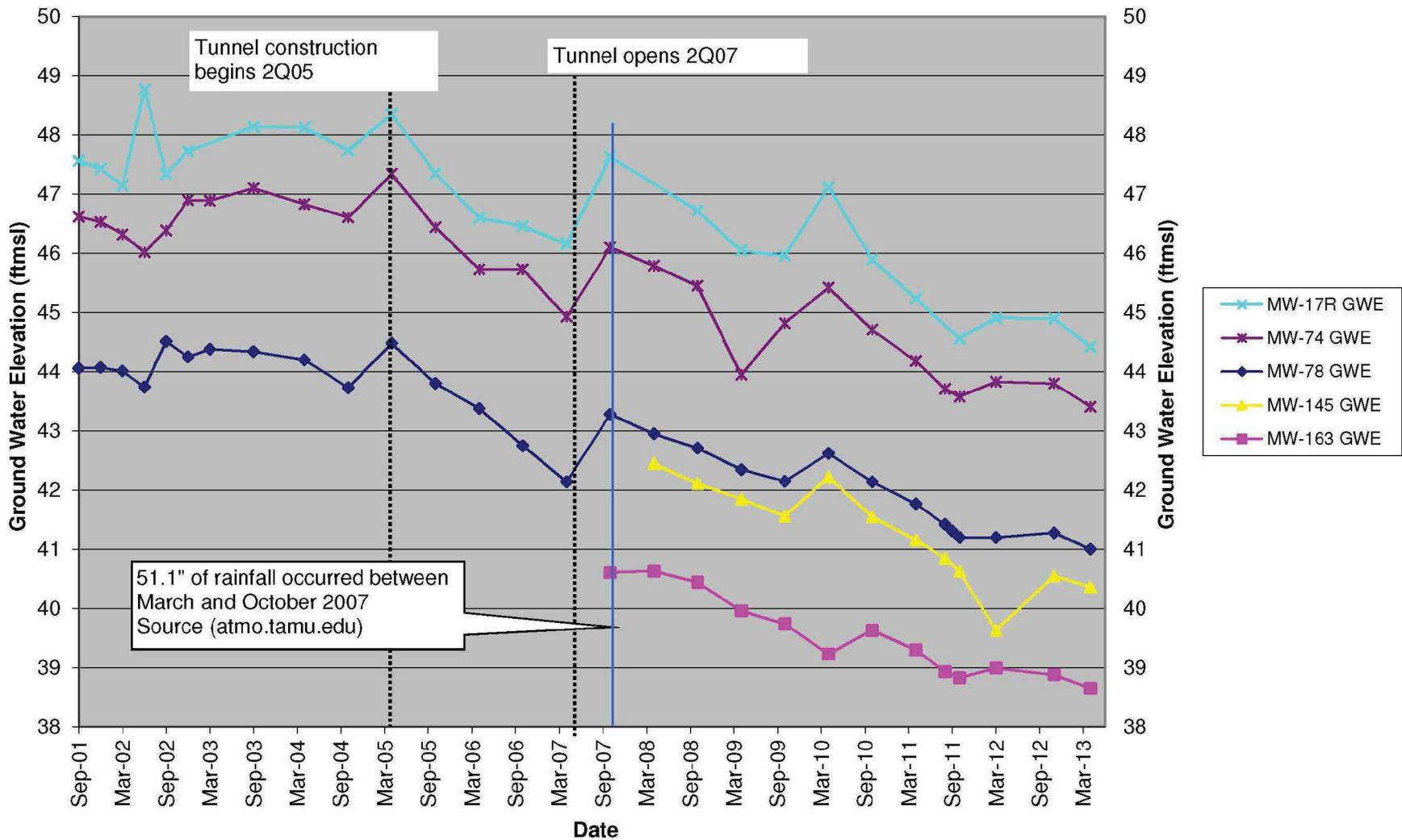
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ERM-Southwest, Inc. TX PE Firm No. 2393



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FIGURE 3
Ground Water Elevations near the TxDOT Dewatering System

Former Cameron Iron Works
Houston, Texas



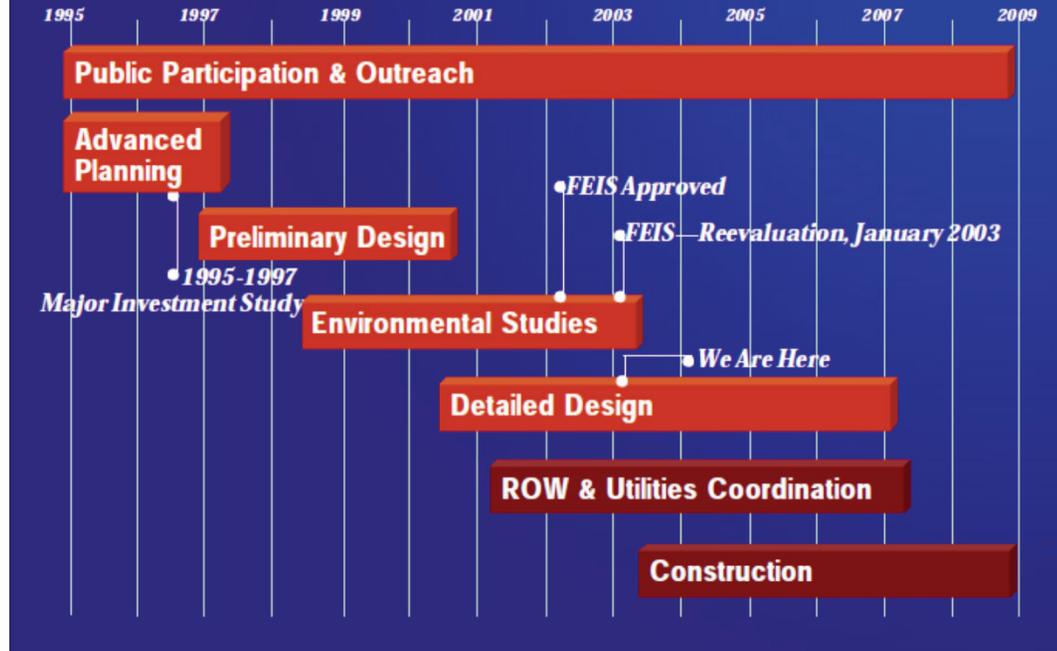
Former Cameron Iron Works - TXDoT Dewatering System Evaluation and Response

April 16, 2013

The world's leading sustainability consultancy



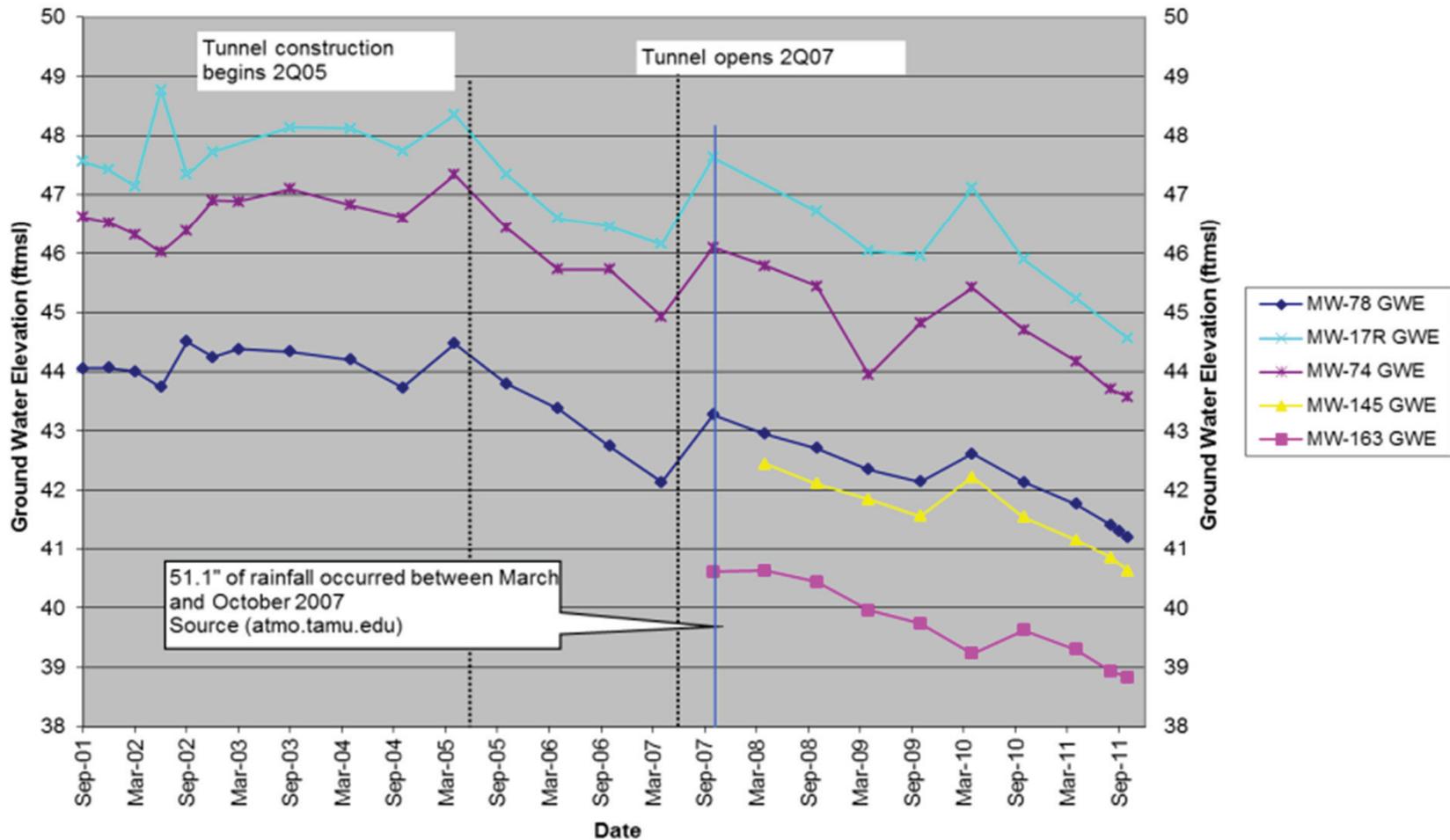
Project Development Process



- Environmental Impact Studies conducted by TxDOT in November 2001
- Former Cameron Iron Works noted in the 2001 EIS
- A re-evaluation of the EIS was conducted in January 2003
- I-10 reconstruction begins in 2003

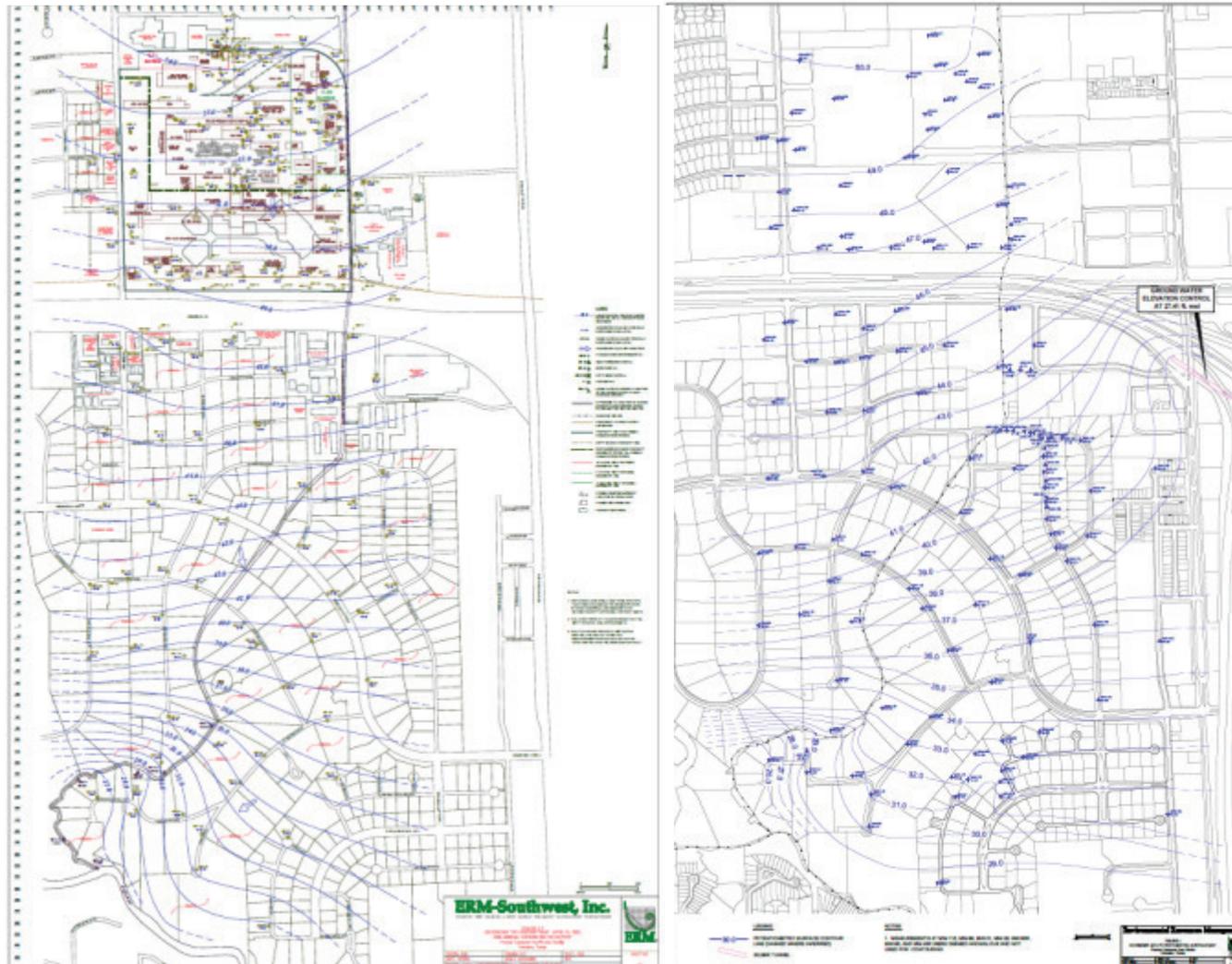
Dewatering Effected Ground Water Elevations

Figure 1
Ground Water Elevations in the Northeastern Off Site Property



- Ground water elevations decrease up to 3 feet in Eastern Off Site Plume

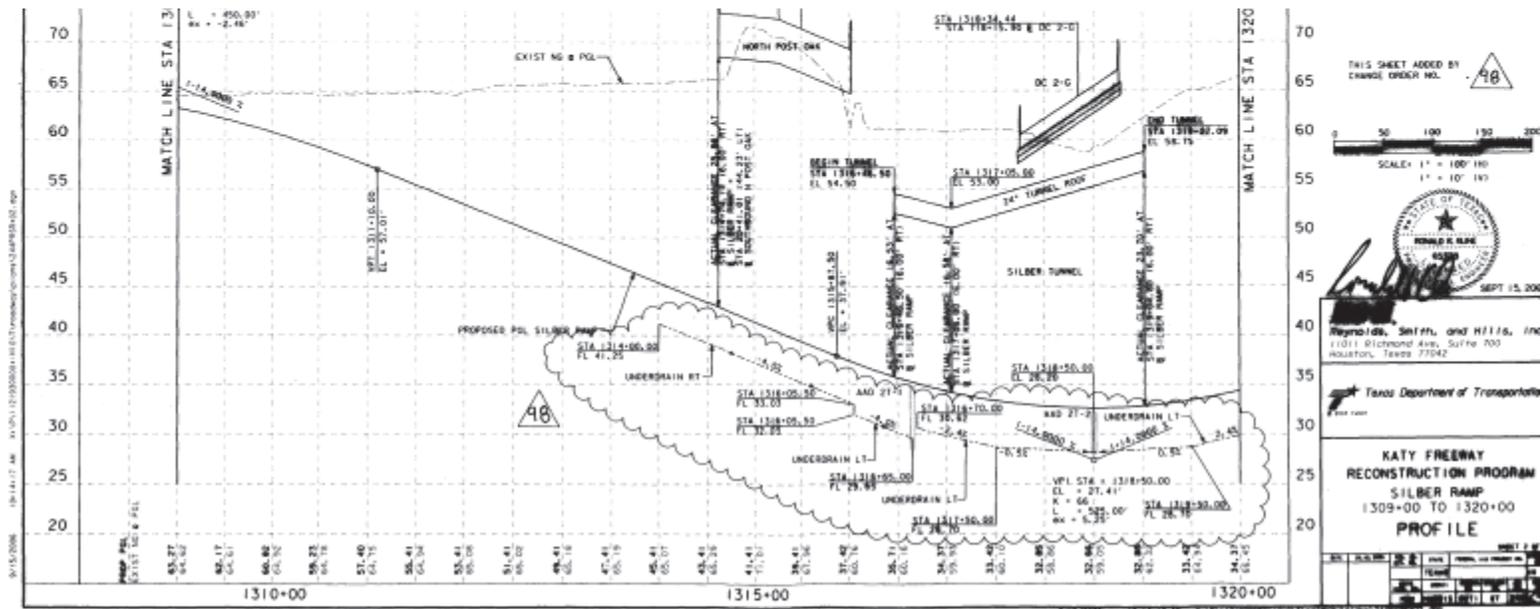
Ground Water Flow Direction Change Observed



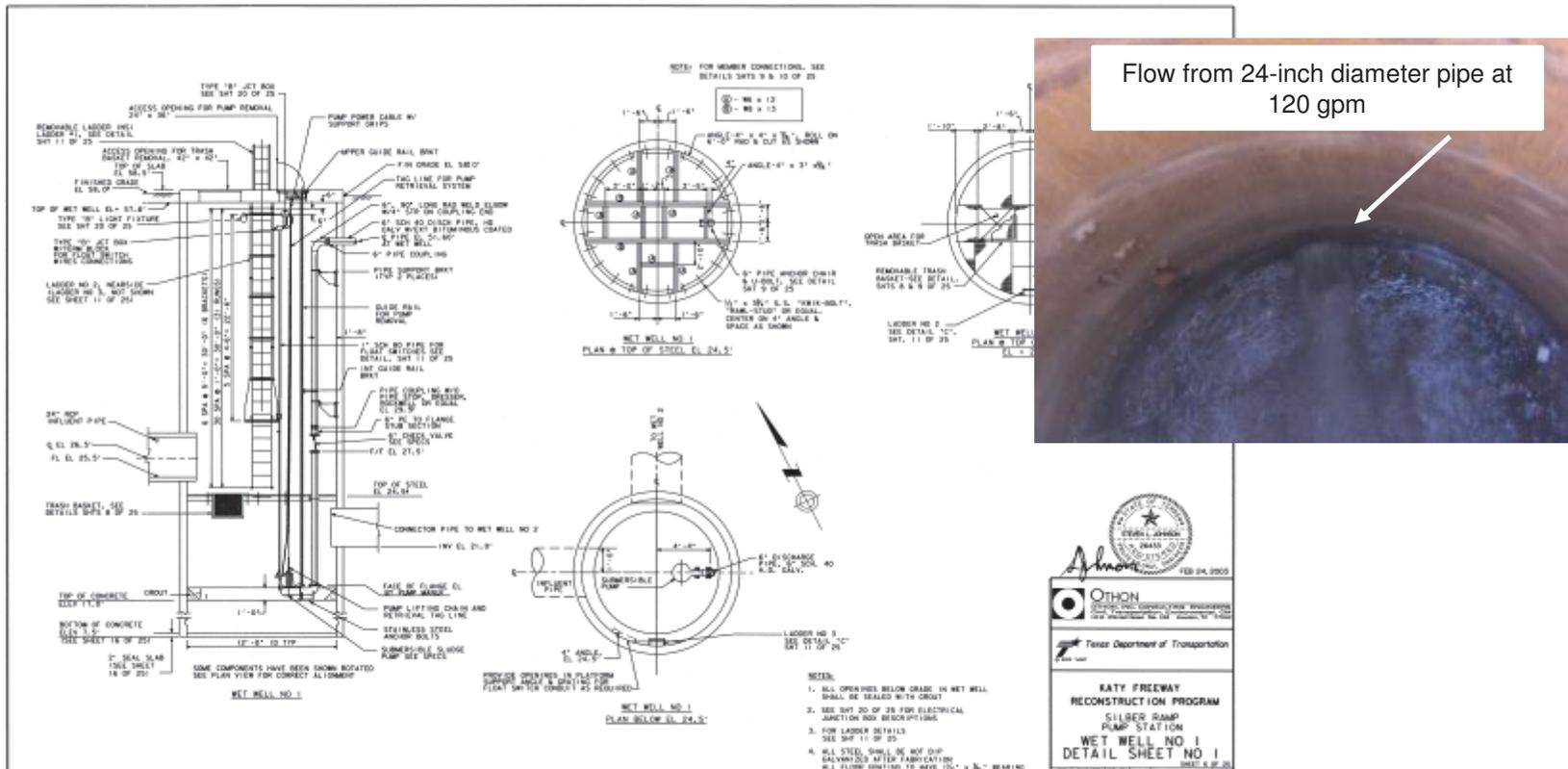
- Silber Tunnel opens in 2007 and between 2005-2012, ground water flow direction shifts toward the east along the eastern edge of the plume, causing migration to occur beneath Pinewood Estates (closest to the Silber Tunnel)

Silber Tunnel Profile

- ERM received information from the Texas Department of Transportation (TxDOT) through an open records request relating to the construction details of the Silber Tunnel in May 2011. The construction drawings indicated the deepest portion of the roadway dips to less than 33 feet above Mean Sea Level (ftMSL) and is greater than 12 feet below the historical water table elevations in the area.
- In October 2011, further information was received from a second records request from TxDOT regarding the I-10/610 Interchange. New information indicated a continuous, passive dewatering system was constructed behind the retaining walls of the tunnel to keep the ground water below the road surface maintaining the water table at less than 28 ftMSL.
- June and July 2012 – Meeting and Correspondence with TxDOT regarding plume movement
- TxDOT took a defensive position, but granted permission to measure to flow into the dewatering system

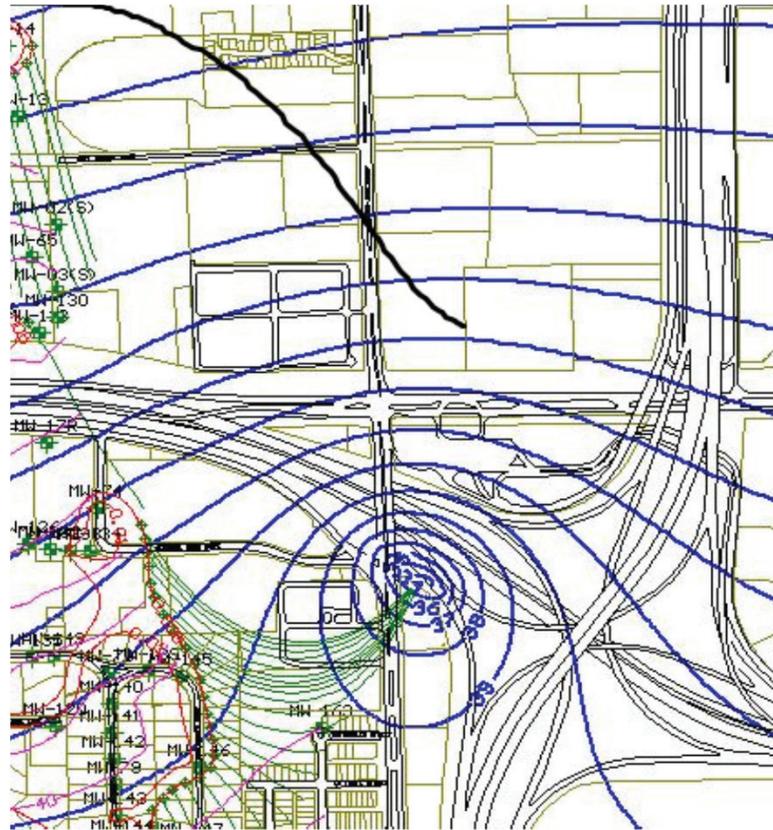


Silber Pump Station



- Silber Tunnel and Drainage System (Silber Pump Station) construction begins in April 2005
- 2 interconnected - 12 foot diameter, cylindrical sumps, roughly 40' deep; 24" diameter pipe drains pavement and area behind retaining walls
- Silber Pump Station measurements collected August 2012. No rain for 5 days (measured ground water withdrawal only; no surface runoff)
- Measured dewatering flow at 118 gpm (picture, upper right); At this rate, an estimated 500,000,000 gallons have been discharged from 2007 to 2012

Modeling



- The capture zone from the Tunnel is estimated to extend to Former Cameron Iron Works Site as well as property south of I-10 toward Memorial Drive
- Drained ground water is pumped to a City of Houston-owned storm water pipe and flows to Buffalo Bayou under I-610
- The drainage system is continuous and perpetual
- Based on available data, the plume is accelerating toward the dewatering system and may reach the Tunnel area in the next five years at low concentrations.

Technical Evaluation of Alternatives

Chemical Oxidation (CURRENT REMEDY) - Chemical oxidation of COCs through injection of sodium permanganate oxidant solution into vertical wells along the plume.

Vertical Well Pump & Treatment System - Ground water recovery utilizing vertical recovery wells followed by treatment using Granular Activated Carbon (GAC) and/or POTW treatment.

Horizontal Well Pump & Treatment System - A single horizontal well placed in the aquifer to recover affected ground water followed by treatment using GAC and/or POTW treatment;

Barrier (Funnel and Gate/Grout curtain/ Sheet piling) - The use of subsurface barriers (50+ feet below ground surface) to divert affected ground water away from the Tunnel's capture zone - potentially limiting future eastward migration.

Summary of Effectiveness

- The scale of the dewatering system is expected to overwhelm the remedies because of the changes in the ground water flow conditions
- Access constraints within the neighborhoods severely limits application.
- Where access is possible, such as along public roads, construction is disruptive.