

Five-Year Review Report

**Third Five-Year Review Report
for the
Crystal Chemical Company Site
Houston, Harris County, Texas**



September 2010

Prepared By:

**United States Environmental Protection Agency
Region 6
Dallas, Texas**

9121725



THIRD FIVE-YEAR REVIEW REPORT
Crystal Chemical Company Superfund Site
EPA ID No. TXD990707010
Houston, Harris County, Texas

This memorandum documents the U.S. Environmental Protection Agency's (EPA) performance, determinations, and approval of the Crystal Chemical Company Superfund Site (Crystal Chemical or the Site) third five-year review (FYR) under Section 121(c) of the Comprehensive Environmental Response, Compensation, and Liability Act, Title 42 United States Code, Section 9621(c), as provided in the attached Third FYR Report.

Background

The third FYR for the Site was performed through a review of Site documents and Site-specific requirements; the Site inspection performed on June 15, 2010; interviews with stakeholders; and a review of data collected at the Site during the third FYR period. The previous FYR was performed in September 2005.

The original remedy for soils contained a component for treating all soils contaminated with arsenic greater than 300 milligrams per kilogram (mg/kg) with a process called *in situ* vitrification; however, unavailability of this technology resulted in an amended Record of Decision (ROD) which called for on-site consolidation and capping of arsenic contaminated soils. The cap effectively contains the arsenic contaminated soils by preventing infiltration of rainwater and preventing direct contact. Regular operation and maintenance activities of the cap are occurring.

The original remedy for ground water called for pumping and treating the arsenic contaminated ground water. Based on data collected after the ROD was issued, it was determined that treatment of ground water is technically impracticable in certain portions of the Site. As a result, a technical impracticability (TI) waiver was issued for the part of the Site where the arsenic plume was not amenable to arsenic removal and a containment remedy (i.e., slurry wall and pressure relief system [PRS]) was specified. This change was specified in an Explanation of Significant Differences.

The construction of a slurry wall and PRS around the portion of the arsenic plume not amenable to the pump and treat remedy was completed in 2003. The PRS has been operating until recently. An evaluation of applying phytohydraulic control (i.e., planting of eucalyptus trees to reduce the water levels within the slurry wall) in lieu of operating the PRS is currently being evaluated.

Pump and treat operations have occurred during the FYR period at portions of the Site outside the slurry wall. The average annual arsenic concentrations in extracted ground water have varied from a high of 36.8 milligrams per liter (mg/L) in 2005 to a low of 6.95 mg/L in 2009. The ground water extraction and treatment system has operated until January of this year, when the evaluation of a phytohydraulic pilot test was initiated. The goal of the pilot test is to evaluate both the PRS and if discernable changes can be observed in the water levels, flow direction, and

arsenic migration after the extraction at recovery well RW-1 ceased, and to make recommendations for remedy changes based on additional data collected during the one year period of the test.

Ground water monitoring in support of remedy performance has been conducted in the three water bearing zones beneath the Site to assess whether arsenic-affected ground water is being contained by the containment system and ground water recovery system, and whether treatment is effective. In order to evaluate these ground water issues, the capture zone for the recovery well RW-1 needs to be defined.

An application for a Municipal Settings Designation (MSD) was submitted to the City of Houston (COH) and MSD Ordinance #2008-253 was approved on March 26, 2008. Union Pacific Railroad Company submitted an application to the Texas Commission on Environmental Quality (TCEQ) on June 23, 2008, to obtain an MSD for the Site and adjacent area; however, due to a delay in approval from the Memorial Villages Water Authority, the TCEQ MSD Application is currently on hold. An MSD certification issued by TCEQ and supported by the COH would prohibit the use of the affected ground water at the Site. The Site owner and the remediation contractor identified this issue in their survey questionnaire.

The discharge of treated water from the ground water treatment plant is regulated by an Industrial Solid Waste Certification of Remediation issued by Harris County on August 10, 2006.

No deed restriction on the monofill cap is currently in place. During the FYR, no activities were observed that would have violated either the institutional or physical controls.

No community concerns were identified during the review.

Summary of Third FYR Findings

This third FYR includes a review of relevant decision documents, implementation documents, remedy performance documents, operation and maintenance documents, and legal documents and is focused on the data obtained during routine cap inspections and ground water sampling and gauging. The following issues are noted:

- Soil remedy:
 1. No institutional control is in place for protection of the monofill cap in perpetuity.
 2. In 2009, one cap inspection was performed. The Operation and Monitoring (O&M) Plan requires that the minimum frequency of inspections be semi-annually.
 3. No surface water samples were collected during the review period. The O&M Plan notes the EPA and COH agreed that surface water samples were to be collected annually from three discharge points.
 4. Grass on the monofill cap was not mowed at the 6-inch height required by the O&M Plan.

5. Recurring problems were recorded during the routine inspections as well as the FYR site inspection: debris accumulation at surface water drains, rutting in the cap cover, ant hills, and minor erosion at the southern gate area. A significant number of ant hills were noted during the FYR inspection and an estimation of extent of the problem was precluded by tall vegetation.
 6. Monofill cap inspections are not performed in April and October as specified in the O&M Plan.
- Ground water remedy:
 1. The RAO in effect for the area outside of the TI waiver zone is 0.050 mg/L, while the new MCL for arsenic is 0.010 mg/L.
 2. The extent of arsenic exceeding the MCL in the 35-foot zone has not been defined.
 3. The capture zone for recovery well RW-1 was not depicted in any documentation available for review. Plume capture by RW-1 has not been demonstrated.
 4. Since 1996, the GWTP has treated more than 7.8 million gallons of water. During the FYR period, arsenic concentrations in the influent samples have ranged from a high of 36.8 milligrams per liter (mg/L) in 2005 to a low of 6.95 mg/L in 2009. While concentrations have decreased, the influent concentrations are still significantly above the RAO for groundwater.
 5. The MSD for the site is pending with TCEQ due to lack of approval from a local utility company.
 6. The performance RAO of the PRS wells is to maintain containment inside of the TI waiver area such that no more than 1-foot elevation difference between the interior and exterior PRS wells is measured. At two times during the FYR period this RAO was exceeded. One exceedance occurred before the PRS was shut down.
 7. Phytohydraulic control performance in the Levy Tract was tested against the performance of the PRS that did not meet RAOs.
 8. Sampling and gauging schedules have changed almost yearly due to pilot testing. The long-term monitoring regimen is not established. Adherence to schedule and commitments is cumbersome to track in present form.
 9. Well protective casings, vaults, and pads are starting to deteriorate.
 10. Access to the Shearton Tract is not controlled due to lack of fencing beyond the drain on the southern border of the tract. The gate to the Levy Tract was not locked.
 11. The location of trees used for phytohydraulic control is not depicted correctly on the Site maps.

Actions Recommended

Based on the issues identified, the following recommendations were made for the Crystal Chemical Company Superfund Site:

- Soil remedy:
 1. File a deed notice for cap protection.
 2. Perform semi-annual inspections, as specified in the O&M Plan.
 3. Collect annually surface water samples, as specified in the O&M Plan.
 4. Mow the grass according to specification. Perform the routine site inspection after grass is mowed so any issues with the monofill cap are visible.
 5. Address recurring problems noted during routine inspections including: debris accumulation at surface water drains, rutting in the landfill cover, ant hills, and minor erosion at the southern gate area.
 6. Evaluate changes that need to be made to eliminate the recurrence of these issues.
 7. Perform the routine monofill cap inspections as scheduled.

- Ground water remedy:
 1. Issue an Explanation of Significant Differences to change the RAO to the current arsenic MCL.
 2. Additional monitoring points are necessary to delineate the extent of the arsenic above the RAO (i.e. MCL). A water well survey will need to be conducted to determine if the impacted water is being utilized. If impacted water is being utilized, appropriate actions will need to be taken to address exposure.
 3. After plume delineation, demonstrate the capture zone for recovery well RW-1 through ground water elevation monitoring or modeling.
 4. Evaluate the ground water extraction and treatment system's effectiveness toward attaining the ground water RAO and if the TI waiver area needs to be expanded, the implementation of the current remedy needs to be more aggressive, or if other alternatives should be implemented.
 5. Determine if the current extent of the MSD is still adequate after the RAO for the area outside of the TI Waiver is changed to the new arsenic MCL. Follow up on the MSD status.
 6. Determine if changes in the current PRS are necessary or additional actions need to be implemented to maintain, on average, inward or at least neutral gradient across the slurry wall/natural levee to maintain containment.
 7. Evaluate the performance of the phytohydraulic control against the ROD requirements.
 8. Gauging and sampling should be adequate for meaningful trend analysis and comparison of data. The schedule of well gauging and sampling should be compiled in tabular format instead of identifying changes in various correspondences and plans. Criteria for performance evaluation should be clearly defined so conclusions and recommendations can be made in a consistent manner.
 9. Assess the condition of all well protective casings, covers, and concrete pads and perform maintenance and repairs as necessary.

10. Assess the extent of the uncontrolled perimeter on the southern boundary of Shearton Tract and complete and lock the fence to preclude unauthorized access to areas where remedies are in place.
11. Use Geographic Positioning System to more accurately locate the remedy features on site maps.

Determinations

The remedy for arsenic impacted soils at the Crystal Chemical Company Superfund Site is protective of human health and the environment and will remain so provided the action items identified in the Five-Year Review Report are addressed as described above.

A protectiveness determination for ground water cannot be made at this time. The extent of impacted ground water exceeding the arsenic MCL is unknown. Addressing the action items described above will ensure the long term protection of human health and the environment.

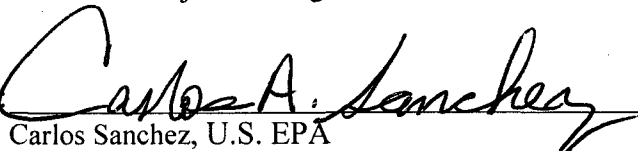
By: *Samuel Coleman*
for Samuel Coleman, P.E.
Director
Superfund Division, Region 6
U.S. Environmental Protection Agency


9-30-10
Date

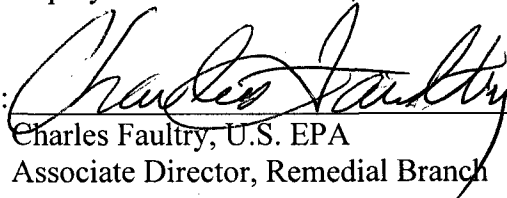
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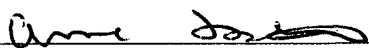
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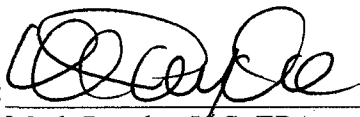
By:  Date: Sept. 08, 2010
Ruben Moya, U.S. EPA
Remedial Project Manager

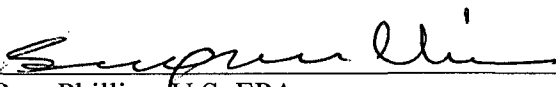
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**TABLE 9 RECOMMENDATIONS AND FOLLOW-UP ACTIONS
CRYSTAL CHEMICAL COMPANY SUPERFUND SITE
HOUSTON, HARRIS COUNTY, TEXAS**

Issue	Recommendations and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Follow-up Actions: Affects Remedy Protectiveness (Yes/No)	
					Current	Future
Soil Remedy						
No institutional control is in place for protection of the monofill cap in perpetuity.	File a deed notice for cap protection.	UPRR	EPA	2011	No	Yes
In 2009, only one cap inspection. The O&M Plan requires that the minimum frequency of inspections be semi-annually.	Perform semi-annual inspections as specified in the O&M Plan.	UPRR	EPA	2010	No	Yes
No surface water samples were collected during the review period. The O&M Plan notes the EPA and City of Houston agreed that surface water samples were to be collected annually from three discharge points.	Collect annually surface water samples as specified.	UPRR	EPA	2010	No	Yes
Grass on the monofill cap was not mowed at the 6-inch height required by the O&M Plan.	Mow the grass according to specification. Perform the routine site inspection after grass is mowed so any issues with the monofill cap are visible.	UPRR	EPA	2010	No	Yes
Recurring problems were recorded during the routine inspections as well as the FYR site inspection: debris accumulation at surface water drains, rutting in the cap cover, ant hills, and minor erosion at the southern gate area. A significant number of ant hills were noted during the FYR inspection and an estimation of extent of the problem was precluded by tall vegetation.	Address recurring problems noted during routine inspections including: debris accumulation at surface water drains, rutting in the landfill cover, ant hills, and minor erosion at the southern gate area.	UPRR	EPA	2011	No	Yes
Monofill cap inspections are not performed in April and October as specified in the O&M Plan.	Perform the routine monofill cap inspections as scheduled.	UPRR	EPA	2010	No	Yes

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Ground Water Remedy						
RAO in effect for the area outside of the TI waiver zone is 0.050 mg/L, while the new MCL for arsenic is 0.010 mg/L.	Issue an Explanation of Significant Differences to change the RAO to the current arsenic MCL.	EPA	EPA	2010	Yes	Yes
The extent of arsenic exceeding the MCL in the 35-foot zone has not been defined.	Additional monitoring points are necessary to delineate the extent of the arsenic impact above RAO (i.e. MCL). A water well survey will need to be conducted to determine if the impacted water is being utilized. If impacted water is being utilized, appropriate actions will need to be taken to address exposure.	UPRR	EPA	2010	Unknown	Yes
The capture zone for recovery well RW-1 was not depicted in any documentation available for review. Plume capture by RW-1 has not been demonstrated.	After plume delineation, demonstrate the capture zone for recovery well RW-1 through ground water elevation monitoring or modeling.	UPRR	EPA	2010	No	Yes
Since 1996, the GWTP has treated more than 7.8 million gallons of water. During the FYR period, arsenic concentrations in the influent samples have ranged from a high of 36.8 mg/L in 2005 to a low of 6.95 mg/L in 2009. While concentrations have decreased, the influent concentrations are still significantly above the RAO for groundwater.	Evaluate the ground water extraction and treatment system's effectiveness toward attaining the ground water RAO and if the TI waiver area needs to be expanded, the implementation of the current remedy needs to be more aggressive, or if other alternatives should be implemented	EPA	EPA	2010	No	Yes
The MSD for the site is pending with TCEQ due to lack of approval from a local utility company.	Determine if the current extent of the MSD is still adequate after the RAO for the area outside of the TI Waiver is changed to the new arsenic MCL. Follow up on the MSD status.	EPA	EPA	2010	No	Yes

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The performance RAO of the PRS wells is to maintain containment inside of TI waiver area such that no more than 1-foot elevation difference between the interior and exterior PRS wells is measured. At two times during the FYR period this RAO was exceeded. One exceedance occurred before the PRS was shut down.	Determine if changes in the current PRS are necessary or additional actions need to be implemented to maintain, on average, inward or at least neutral gradient across the slurry wall/natural levee to maintain containment.	EPA	EPA	2010	No	Yes
Phytohdraulic control performance in the Levy Tract was tested against the performance of the PRS that did not meet RAOs.	Evaluate the performance of the phytohdraulic control against the ROD requirements.	EPA	EPA	2010	No	Yes
Sampling and gauging schedules have changed almost yearly due to pilot testing. Long-term monitoring regimen is not established. Adherence to schedule and commitments is cumbersome to track in present form.	Gauging and sampling should be adequate for meaningful trend analysis and comparison of data. The schedule of well gauging and sampling should be compiled in tabular format instead of identifying changes in various correspondences and plans. Criteria for performance evaluation should be clearly defined so conclusions and recommendations can be made in a consistent manner.	UPRR	EPA	2010	No	Yes
Well protective casings, vaults, and pads are starting to deteriorate.	Assess the condition of all well protective casings, covers, and concrete pads and perform maintenance and repairs as necessary.	UPRR	EPA	2010	No	Yes

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Issue	Recommendations and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Follow-up Actions: Affects Remedy Protectiveness (Yes/No)	
					Current	Future
Access to the Shearton Tract is not controlled due to lack of fencing beyond the drain on the southern border of the tract. Gate to the Levy Tract was not locked.	Assess the extent of the uncontrolled perimeter on the southern boundary of Shearton Tract and complete the fence to preclude unauthorized access to areas where remedies are in place.	UPRR	EPA	2010	Yes	Yes
Location of trees used for phytohydraulic control is not depicted correctly on the site maps.	Use Geographic Positioning System to more accurately locate the remedy features on site maps.	UPRR	EPA	2010	No	No
<p>NOTES: EPA = U.S. Environmental Protection Agency FYR = Five-year review mg/L = Milligram per liter MSD = Municipal Setting Designation mg/L = milligram per liter O&M = Operation and Maintenance Plan</p> <p>RAO = Remedial action objective ROD = Record of Decision TCEQ = Texas Commission on Environmental Quality TI = Technical impracticability UPRR = Union Pacific Railroad</p>						

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LIST OF ACRONYMS AND ABBREVIATIONS

ARAR	Applicable or Relevant and Appropriate Requirement
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COH	City of Houston
CRA	Conestoga-Rovers and Associates
Crystal Chemical	Crystal Chemical Company
EA	EA Engineering, Science, and Technology, Inc.
EPA	U.S. Environmental Protection Agency Region 6
ERM	Environmental Resources Management
ESD	Explanation of Significant Differences
ft/ft	feet/foot
FS	feasibility study
FYR	five-year review
gpm	gallon per minute
GWTP	ground water treatment plant
MCL	Maximum Contaminant Level
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MSD	Municipal Settings Designation
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
O&M	operation and maintenance
PRP	Potentially Responsible Party
PRS	pressure release system

LIST OF ACRONYMS AND ABBREVIATIONS (continued)

RA	remedial action
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RD	remedial design
RI	remedial investigation
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
Shearton	Shearton Development, Inc.
Southern Pacific	Southern Pacific Transportation Company
TCEQ	Texas Commission on Environmental Quality
TI	technical impracticability
TNRCC	Texas Natural Resource Conservation Commission
UPRR	Union Pacific Railroad Company
yd ³	cubic yard

EXECUTIVE SUMMARY

The U.S. Environmental Protection Agency Region 6 (EPA) has conducted the third five-year review (FYR) of the remedial actions (RAs) implemented at the Crystal Chemical Company (Crystal Chemical) Superfund Site (Site) in Harris County, Texas. The purpose of this third FYR was to determine whether the selected remedies for the Site continue to protect human health and the environment. This review was conducted from March to August 2010, covered the timeframe from September 2005 through June 2010, and its findings and conclusions are documented in this report. The second FYR of the RAs was completed in September 2005.

The FYR for the Site was performed through a review of historic site documents and site-specific requirements; the site inspection performed on June 15, 2010; interviews with stakeholders; and a review of data collected at the Site during the previous review periods.

Both soil and ground water were impacted at the Crystal Chemical Site. The remedies are as follows:

- Soil—The selected soil remedy was outlined in the Record of Decision (ROD), dated September 27, 1990, which prescribed the excavation of off-site soils contaminated with arsenic, treatment of soils using an innovative treatment technology (*in situ* vitrification), and capping of the entire site after the soil treatment had been completed. Due to the unavailability of the technology, EPA selected a new soil remedy as outlined in a ROD amendment, dated June 16, 1992. The new remedy consisted of soil consolidation and capping, and implementation was completed in September 1995.
- Ground Water—The ground water remedy selected in the 1990 ROD called for the extraction and treatment of arsenic-contaminated ground water. The remediation goal specified in the 1990 ROD was 0.050 milligrams per liter (mg/L), which, at that time, was the Maximum Contaminant Level (MCL) for arsenic. The 1990 ROD also included several contingency measures that could be implemented if an extraction and treatment system could not attain the ground water remediation goal. During the course of the design for the ground water remedy, EPA and the Texas Natural Resource Conservation Commission (now the Texas Commission on Environmental Quality [TCEQ]) determined that restoration of the ground water was technically impracticable for portions of the Crystal Chemical Site. Therefore, EPA determined that the applicable or relevant and appropriate requirement (ARAR) for ground water restoration to the MCL of 0.050

mg/L for arsenic should be waived, and a slurry wall should be constructed around the portions of the Site where ground water could not be restored. The extraction and treatment of arsenic-contaminated ground water remained the selected remedy for the remainder of the Site, as specified in the 1990 ROD. The decision to waive the ground water ARAR and construct the slurry wall was documented in the Explanation of Significant Differences, dated March 19, 1997.

Issues noted during this FYR include:

- Soil remedy:
 1. No institutional control is in place for protection of the monofill cap in perpetuity.
 2. In 2009, one cap inspection was performed. The O&M Plan requires that the minimum frequency of inspections be semi-annually.
 3. No surface water samples were collected during the review period. The O&M Plan notes the EPA and COH agreed that surface water samples were to be collected annually from three discharge points.
 4. Grass on the monofill cap was not mowed at the 6-inch height required by the O&M Plan.
 5. Recurring problems were recorded during the routine inspections as well as the FYR site inspection: debris accumulation at surface water drains, rutting in the cap cover, ant hills, and minor erosion at the southern gate area. A significant number of ant hills were noted during the FYR inspection and an estimation of extent of the problem was precluded by tall vegetation.
 6. Monofill cap inspections are not performed in April and October as specified in the O&M Plan.

- Ground water remedy:
 1. The RAO in effect for the area outside of the TI waiver zone is 0.050 mg/L, while the new MCL for arsenic is 0.010 mg/L.
 2. The extent of arsenic exceeding the MCL in the 35-foot zone has not been defined.
 3. The capture zone for recovery well RW-1 was not depicted in any documentation available for review. Plume capture by RW-1 has not been demonstrated.
 4. Since 1996, the GWTP has treated more than 7.8 million gallons of water. During the FYR period, arsenic concentrations in the influent samples have ranged from a high of 36.8 milligrams per liter (mg/L) in 2005 to a low of 6.95 mg/L in 2009. While concentrations have decreased, the influent concentrations are still significantly above the RAO for groundwater.
 5. The MSD for the site is pending with TCEQ due to lack of approval from a local utility company.
 6. The performance RAO of the PRS wells is to maintain containment inside of TI waiver area such that no more than 1-foot elevation difference between the interior and exterior PRS wells is measured. At two times during the FYR period this RAO was exceeded. One exceedance occurred before the PRS was shut down.

7. Phytohydraulic control performance in the Levy Tract was tested against the performance of the PRS that did not meet RAOs.
8. Sampling and gauging schedules have changed almost yearly due to pilot testing. The long-term monitoring regimen is not established. Adherence to schedule and commitments is cumbersome to track in present form.
9. Well protective casings, vaults, and pads are starting to deteriorate.
10. Access to the Shearton Tract is not controlled due to lack of fencing beyond the drain on the southern border of the tract. The gate to the Levy Tract was not locked.
11. The location of trees used for phytohydraulic control is not depicted correctly on the site maps.

Five-Year Review Summary Form

SITE IDENTIFICATION

Site Name (from Waste LAN): Crystal Chemical Company

EPA ID (from Waste LAN): TXD 990707010

Region: 6

State: TX

City/County: Harris County

SITE STATUS

NPL Status: Final Deleted Other (specify) _____

Remediation Status (choose all that apply):

Under Construction

Operating

Complete

Multiple OUs?*

YES

NO

Construction Completion Date: 09/1995 for contaminated soil remedy; 11/1996 for ground water treatment plant; 05/1998 for ground water treatment plant modifications; eastern and northern portion of slurry wall – June 2002; pressure relief system (PRS) complete except under Westpark Drive – 10/2002; final segment of PRS under Westpark Drive – 08/2003

Has site been put into reuse? YES NO

REVIEW STATUS

Reviewing Agency: EPA State Tribe Other Federal Agency _____

Author Name: Mr. Ruben Moya

Author Title: Remedial Project Manager

Author Affiliation: EPA Region 6

Review Period:** 09/2005 to 06/2010

Date(s) of Site Inspection: 06/15/2010

Type of Review:

Statutory Policy Post-SARA Pre-SARA

NPL-Removal only Non-NPL Remedial Action Site

NPL State/Tribe-lead Regional Discretion

Review Number: 1 (first) 2 (second) 3 (third) Other (specify) _____

Five-Year Review Triggering Action:

Actual RA Onsite Construction at OU #1 Actual RA Start

Construction Completion Previous Five-Year Review Report

Other (specify) _____

Five-Year Review Triggering Action: Completion of previous five-year review

Due Date (Five Years After Triggering Action Date): 09/2010

* OU = operable unit.

** The review period refers to the period during which the FYR was conducted.

Five-Year Review Summary Form (Continued)

Issues noted during this FYR include:

- Soil remedy:
 1. No institutional control is in place for protection of the monofill cap in perpetuity.
 2. In 2009, one cap inspection was performed. The O&M Plan requires that the minimum frequency of inspections be semi-annually.
 3. No surface water samples were collected during the review period. The O&M Plan notes the EPA and COH agreed that surface water samples were to be collected annually from three discharge points.
 4. Grass on the monofill cap was not mowed at the 6-inch height required by the O&M Plan.
 5. Recurring problems were recorded during the routine inspections as well as the FYR site inspection: debris accumulation at surface water drains, rutting in the cap cover, ant hills, and minor erosion at the southern gate area. A significant number of ant hills were noted during the FYR inspection and an estimation of extent of the problem was precluded by tall vegetation.
 6. Monofill cap inspections are not performed in April and October as specified in the O&M Plan.
- Ground water remedy:
 1. The RAO in effect for the area outside of the TI waiver zone is 0.050 mg/L, while the new MCL for arsenic is 0.010 mg/L.
 2. The extent of arsenic exceeding the MCL in the 35-foot zone has not been defined.
 3. The capture zone for recovery well RW-1 was not depicted in any documentation available for review. Plume capture by RW-1 has not been demonstrated.
 4. Since 1996, the GWTP has treated more than 7.8 million gallons of water. During the FYR period, arsenic concentrations in the influent samples have ranged from a high of 36.8 milligrams per liter (mg/L) in 2005 to a low of 6.95 mg/L in 2009. While concentrations have decreased, the influent concentrations are still significantly above the RAO for groundwater.
 5. The MSD for the site is pending with TCEQ due to lack of approval from a local utility company.
 6. The performance RAO of the PRS wells is to maintain containment inside of TI waiver area such that no more than 1-foot elevation difference between the interior and exterior PRS wells is measured. At two times during the FYR period this RAO was exceeded. One exceedance occurred before the PRS was shut down.
 7. Phytohydraulic control performance in the Levy Tract was tested against the performance of the PRS that did not meet RAOs.
 8. Sampling and gauging schedules have changed almost yearly due to pilot testing. The long-term monitoring regimen is not established. Adherence to schedule and commitments is cumbersome to track in present form.
 9. Well protective casings, vaults, and pads are starting to deteriorate.

10. Access to the Shearton Tract is not controlled due to lack of fencing beyond the drain on the southern border of the tract. The gate to the Levy Tract was not locked.
11. The location of trees used for phytohydraulic control is not depicted correctly on the site maps.

Protectiveness Statement:

The remedy for arsenic impacted soils at the Crystal Chemical Company Superfund Site is protective of human health and the environment and will remain so provided the issues identified in the Five-Year Review Report are addressed as described below:

1. File a deed notice for cap protection.
2. Perform semi-annual inspections, as specified in the O&M Plan.
3. Collect annually surface water samples, as specified in the O&M Plan.
4. Mow the grass according to specification. Perform the routine site inspection after grass is mowed so any issues with the monofill cap are visible.
5. Address recurring problems noted during routine inspections including: debris accumulation at surface water drains, rutting in the landfill cover, ant hills, and minor erosion at the southern gate area.
6. Perform the routine monofill cap inspections as scheduled.

A protectiveness determination for ground water cannot be made at this time. The extent of impacted ground water exceeding the arsenic MCL is unknown. Implementing the recommendations described below will ensure the long term protection of human health and the environment:

1. Issue an Explanation of Significant Differences to change the RAO to the current arsenic MCL.
2. Additional monitoring points are necessary to delineate the extent of the arsenic above the RAO (i.e. MCL). A water well survey will need to be conducted to determine if the impacted water is being utilized. If impacted water is being utilized, appropriate actions will need to be taken to address exposure.
3. After plume delineation, demonstrate the capture zone for recovery well RW-1 through ground water elevation monitoring or modeling.
4. Evaluate the ground water extraction and treatment system's effectiveness toward attaining the ground water RAO and if the TI waiver area needs to be expanded, the implementation of the current remedy needs to be more aggressive, or if other alternatives should be implemented.
5. Determine if the current extent of the MSD is still adequate after the RAO for the area outside of the TI Waiver is changed to the new arsenic MCL. Follow up on the MSD status.

Five-Year Review Summary Form (Continued)

6. Determine if changes in the current PRS are necessary or additional actions need to be implemented to maintain, on average, inward or at least neutral gradient across the slurry wall/natural levee to maintain containment.
7. Evaluate the performance of the phytohydraulic control against the ROD requirements.
8. Gauging and sampling should be adequate for meaningful trend analysis and comparison of data. The schedule of well gauging and sampling should be compiled in tabular format instead of identifying changes in various correspondences and plans. Criteria for performance evaluation should be clearly defined so conclusions and recommendations can be made in a consistent manner.
9. Assess the condition of all well protective casings, covers, and concrete pads and perform maintenance and repairs as necessary.
10. Assess the extent of the uncontrolled perimeter on the southern boundary of Shearton Tract and complete and lock the fence to preclude unauthorized access to areas where remedies are in place.
11. Use Geographic Positioning System to more accurately locate the remedy features on site maps.

1.0 INTRODUCTION

The U.S. Environmental Protection Agency Region 6 (EPA) has conducted the third five-year review (FYR) of the remedial actions (RAs) implemented at the Crystal Chemical Company (Crystal Chemical) Superfund Site (Site) in Harris County, Texas (Figure 1). The purpose of this third FYR was to determine whether the selected remedies for the Site continue to protect human health and the environment. This review was conducted from March to August 2010 and covered the timeframe from September 2005 through June 2010. The findings and conclusions of the FYR are documented in this report. The second FYR of the RAs was completed in September 2005 (EPA 2005).

The purpose of an FYR is to determine whether the remedy or remedies at a site remain protective of human health and the environment, and to document the methods, findings, and conclusions of the FYR in a report. FYR reports identify issues found during the review, if any, and make recommendations to address the issues. This third FYR Report for the Site documents the results of the review, which was conducted in accordance with EPA guidance on FYRs (EPA 2001).

The FYR process is required by federal statute. The EPA must implement FYRs consistent with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 United States Code § 9601, *et seq.*, and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 Code of Federal Regulations (CFR) Part 300 *et seq.* CERCLA Section 121(c), as amended, states the following:

“If the President selects an RA that results in any hazardous substances, pollutants, or contaminants remaining at the Site, the President shall review such RA no less often than each 5 years after the initiation of such RA to assure that human health and the environment are being protected by the RA being implemented.”

NCP Section 300.430(f) (4) (ii) states the following:

"If an RA is selected that results in hazardous substances, pollutants, or contaminants remaining at the Site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every 5 years after the initiation of the selected RA."

Because hazardous substances, pollutants, or contaminants at the Site remain above levels that allow for unlimited use and unrestricted exposure, an FYR is required.

The period addressed by this FYR for the Crystal Chemical Site extended from September 2005 to August 2010. The triggering action for this review was the completion of the second FYR in September 2005 (EPA 2005). The third FYR was conducted from March to August 2010, and its methods, findings, conclusions, and recommendations are documented in this report.

The property leased by Crystal Chemical was added to the NPL in 1983. Both soil and ground water are impacted.

The remedy selected for soil was outlined in the Record of Decision (ROD), dated September 27, 1990 (EPA 1990b), which prescribed the excavation of off-site soils contaminated with arsenic, treatment of soils using an innovative treatment technology (*in situ* vitrification), and capping of the entire site after the soil treatment had been completed. Due to the unavailability of this technology, EPA selected a new soil remedy as outlined in a ROD amendment, dated June 16, 1992 (EPA 1992b). The new remedy was soil consolidation and capping, and implementation was completed in September 1995.

The remedy for ground water was selected in the 1990 ROD (EPA 1990b), and called for the extraction and treatment of arsenic-contaminated ground water. The remediation goal specified in the 1990 ROD was 0.050 milligram per liter (mg/L), which at that time was the Maximum Contaminant Level (MCL) for arsenic. The 1990 ROD also included several contingency measures that could be implemented if an extraction and treatment system could not attain the ground water remediation goal. During the course of the design for the ground water remedy,

EPA and the Texas Natural Resource Conservation Commission (TNRCC) (now the Texas Commission on Environmental Quality [TCEQ]) determined that restoration of the ground water was technically impracticable for portions of the Crystal Chemical Site. Therefore, EPA determined that for certain portions of the Site, the applicable or relevant and appropriate requirement (ARAR) for ground water restoration to the MCL of 0.050 mg/L for arsenic should be waived, and a slurry wall should be constructed around the area where ground water could not be restored. The extraction and treatment of arsenic-contaminated ground water remained the selected remedy for the remainder of the site as specified in the 1990 ROD. The decision to waive the ground water ARAR and construct the slurry wall was documented in the Explanation of Significant Differences (ESD), dated March 19, 1997 (EPA 1997).

This report documents the FYR for the Site by providing the following information: site chronology (Section 2.0), background information (Section 3.0), an overview of the RAs (Section 4.0), progress since the previous FYR (Section 5.0), the FYR process (Section 6.0), technical assessment of the Site (Section 7.0), institutional controls (Section 8.0), issues (Section 9.0), recommendations and follow-up actions (Section 10.0), protectiveness statement (Section 11.0), and discussion of the next review (Section 12.0). The report text is followed by figures and tables. Attachment 1 provides a list of documents reviewed. Attachment 2 provides the site inspection checklist. Attachment 3 provides the interview records. Attachment 4 provides the site inspection photographs. Attachment 5 provides the deed recordation for the Site. Attachment 6 provides the affidavit of Public Notice publication.

2.0 SITE CHRONOLOGY

A chronology of site events for the Crystal Chemical Site is provided in Table 1.

3.0 BACKGROUND

This section discusses the Site's physical characteristics, land and resource use near the Site, history of site contamination, initial response actions, and basis for the response.

3.1 PHYSICAL CHARACTERISTICS

The Crystal Chemical Site is located at 10985 Westpark Drive (formerly 3502 Rogerdale Road), in southwest Houston, Harris County, Texas (Figure 1). The Site spans approximately 6.8 acres and is bounded to the west by the Harris County Flood Control District drainage ditch (No. D124-00-00); to the east by the Union Pacific Railroad (UPRR) 5-acre tract that houses the ground water treatment plant (GWTP); to the south by the Shearton Development, Inc. (Shearton) tract (purchased by UPRR in November 2004), which is currently undeveloped; and to the north by Westpark Drive.

The tract to the north of Westpark Drive spans 12.5 acres and was purchased from the Levy estate by UPRR in April 2000; this tract houses a portion of the pressure relief system (PRS). The land is currently undeveloped and bounded by light industrial property. The tract to the south, formerly owned by Shearton, houses the ground water recovery system for purposes of hydraulic control and spans 3.8 acres.

According to the previous FYR Report (EPA 2005), soils at the site are poorly drained and consist primarily of silty clay and sandy clay. Surface waters that enter the flood control channel flow south and are discharged into Brays Bayou approximately 1 mile south of the site. Brays Bayou drains into the Houston Ship Channel, which terminates at Galveston Bay. Two shallow ground water sand zones are located under the site at approximately 15 and 35 feet (ft) below ground surface (bgs). A third water-bearing zone is located under the site at approximately 100 ft bgs. A clay confining layer is located beneath the 35-ft zone that reduces the potential for vertical migration between the 35-ft zone and the 100-ft zone and deeper water-bearing zones. The 15-ft zone is discontinuous and is generally present along Westpark Drive. The 35- and 100-ft zones are continuous at and in the vicinity of the site. Information regarding use or potential use of ground water from these three zones was not available in the documentation reviewed.

According to the most recent hydraulic testing that took place in October 2009 (Conestoga-Rovers and Associates [CRA] 2010a), the direction of ground water flow in the 35-ft zone was

toward the northeast at a gradient of approximately 0.006-0.0085 ft/ft, which was consistent with 2008 data. South of the capped monofill, ground water flow in the 35-ft zone is estimated to be toward the southwest at an approximate gradient of 0.012 ft/ft, although there are only two monitoring wells installed in this area of the site and the zone is influenced by the pumping effects from RW-1. In the 100-ft water-bearing sand zone, the direction of ground water flow is toward the west-northwest at a gradient of approximately 0.0006 ft/ft, lower than that indicated by the 2008 data. Water levels were gauged at only two wells in the 15-ft zone; therefore, ground water flow direction was not evaluated.

3.2 LAND AND RESOURCE USE

The site is located in a mixed use commercial, light industry, and residential area.

Crystal Chemical produced arsenical, phenolic, and amine-based herbicides on the site from 1968 to 1981. Between 1968 and 1979, Crystal Chemical leased the 6.8-acre tract from the owner Southern Pacific Transportation Company (Southern Pacific), now UPRR. In 1979, Crystal Chemical purchased the property. In 1981, Crystal Chemical ceased operations, filed for bankruptcy, and abandoned the site. With the exception of investigation and remedial activities, the site has been inactive since September 1981 (EPA 2005). The area surrounding the Crystal Chemical Site is primarily used for commercial, light industry, and residential purposes. Figure 2 presents the site layout.

3.3 HISTORY OF CONTAMINATION

The production of arsenical, phenolic, and amine-based herbicides at the Crystal Chemical Site from 1968 to 1981 affected soils and ground water on the site and adjacent properties. The contamination covered approximately 24.4 acres, which included 6.8 acres on site and 17.6 acres off site. The following paragraphs summarize the assessment and remedial history at the site (EPA 2005).

Operation and maintenance (O&M) problems at the Crystal Chemical facility during the late

1970s resulted in several violations of State of Texas environmental standards. Although the site is not located within a flood prone area, as defined by Federal Emergency Management Agency Flood Insurance Rate Maps, the site lies within the limits of the 100-year flood plain of the adjacent Harris County Flood Control District drainage ditch. In 1976, the site was subject to repeated flooding, which carried arsenic contaminated wastewaters off site. In 1978, Crystal Chemical applied to the State of Texas for an on-site deep well injection permit to dispose of the process wastewaters. The permit was denied by the State of Texas (EPA 2005).

In September 1981, Crystal Chemical filed for bankruptcy and abandoned the site. EPA initiated an emergency removal action to stabilize the site. Approximately 99,000 gallons of arsenic trioxide were sold along with the building and process equipment. Approximately 600,000 gallons of wastewater from the evaporation ponds were disposed of off site. The top 12 inches of pond soils were treated with lime and re-deposited into the ponds. In 1983, the Crystal Chemical property was added to the NPL (EPA 2005).

EPA is the lead agency for the site, and through a cooperative agreement with the State regulatory body, the TCEQ, formerly the TNRCC, has been involved in all site activities. In 1982 and 1983, EPA identified 13 potential responsible parties (PRPs) for the site. All PRPs declined to participate in the remedial investigation (RI)/feasibility study (FS) for the site. Therefore, EPA and TCEQ conducted an RI/FS to define the types and extent of contamination at the site (EPA 2005).

In January 1984, EPA issued the RI/FS Report, which indicated that arsenic and phenol were detected in surface and subsurface soil and ground water. The RI/FS Report delineated arsenic contamination across the site to an average depth of 5-6 ft bgs. Arsenic concentrations of 5,000 milligrams per kilogram (mg/kg) were found to have penetrated from 3 to 10 ft bgs in areas throughout the site. Off-site soil borings reported arsenic concentrations of 50 mg/kg as deep as 9 ft bgs. Contamination of ground water and subsurface soils was determined to have been caused by percolation of storm water and surface water. The volume of off-site soils contaminated with arsenic greater than 30 mg/kg was reported to be 55,000 cubic yards (yd³). The volume of on-site soils contaminated with arsenic greater than 300 mg/kg was estimated to

be 16,500 yd³. An estimated 101,000 yd³ of on-site soils were reported to be contaminated with arsenic greater than 30 mg/kg (EPA 2005).

During the RI/FS, 21 monitoring wells were installed. Based upon soil borings collected during the well installation, three water-bearing zones (15, 35, and 100 ft bgs) were identified. Based on the information gathered during the RI/FS, an estimated 3 million gallons of water were contaminated with arsenic. The highest concentrations of contaminants were found in the 35- to 50-ft water-bearing sand layer (EPA 2005).

Based on the data collected during the RI, it was determined that if no action was taken to address the soil and ground water contamination, hazardous substances could be released from the Crystal Chemical Site and endanger public health, welfare, or the environment.

The final ROD for soil and ground water at the Crystal Chemical Site was issued in September 1990 (EPA 1990b). Due to unavailability of the *in situ* vitrification technology, the soil remedy was revised in a ROD Amendment issued in June 1992 (EPA 1992b). In 1996, the selected ground water remedy was determined to be technically impracticable for portions of the affected area, and an ESD was issued in March 1997 (EPA 1997).

Southern Pacific (now UPRR), was identified as a PRP. UPRR had previously owned the property and responded to EPA's request to participate in the remedial design (RD). In March 1992, an administrative order on consent (U.S. EPA Docket No. 6-11-92) (EPA 1992a) was signed by the EPA and Southern Pacific for the ground water RD. In September 1992, EPA issued an administrative order (U.S. EPA Docket No. VI-15-92) to Southern Pacific for the soil RD/RA specified in the June 16, 1992 amended ROD (EPA 1992c) and the ground water remedy RA (as specified in the September 27, 1990 ROD (EPA 1990b).

The soil remedy involved the excavation of approximately 55,000 yd³ of off-site soils with arsenic concentrations exceeding 30 mg/kg and placement of excavated soils into a capped monofill on the Crystal Chemical Site. The soil remedy was completed in September 1995. The ground water remedy involved the construction of a GWTP and installation of a ground water

containment system consisting of a slurry wall and PRS. The GWTP was completed in November 1996, with major modifications completed in May 1998. The ground water containment system was completed in several phases from 1995 to 2003 (EPA 2005).

3.4 INITIAL RESPONSE

As noted in the previous section, after Crystal Chemical filed for bankruptcy and abandoned the site, EPA initiated an Emergency Removal Action in September 1981 to stabilize the site and sold arsenic trioxide with the building and process equipment and disposed of wastewater from the evaporation ponds off site. Pond soils were treated with lime and re-deposited into the ponds (EPA 2005).

3.5 BASIS FOR TAKING ACTION

Several violations of State of Texas environmental standards due to problems with the maintenance of the Crystal Chemical facility during the late 1970s constituted the original basis for taking action at this site. Moreover, in 1976, the site was subject to repeated flooding, which carried arsenic contaminated wastewaters off site (EPA 2005).

4.0 REMEDIAL ACTIONS

This section discusses the selected remedy, remedy implementation, O&M activities, and O&M costs.

4.1 SELECTED REMEDY

4.1.1 Soil Selected Remedy

The soil remedy specified in the 27 September 1990 ROD (EPA 1990b) called for the excavation of off-site soils contaminated with arsenic, treatment of soils using an innovative treatment technology (*in situ* vitrification), and capping of the entire site after the soil treatment had been completed. Due to the unavailability of the treatment technology, EPA selected a new soil remedy consisting of soil consolidation and capping in the ROD amendment issued on 16 June 1992 (EPA 1992b). The soil consolidation and capping remedy was completed in September 1995.

The ROD Amendment (EPA 1992b) described the remedy as follows:

1. Resample off-site areas previously identified as contaminated with arsenic in order to identify all off-site soils with arsenic concentrations exceeding 30 mg/kg
2. Excavate approximately 55,000 yd³ of off-site soils with arsenic concentrations exceeding 30 mg/kg. Backfill off-site excavated areas to previously existing grades
3. Place excavated soils into a monofill on the Crystal Chemical Site
4. Install multi-layer low permeability cap over entire Crystal Chemical Site after excavated off-site soils have been placed on site.

4.1.2 Ground Water Selected Remedy

The ground water remedy specified in the 1990 ROD (EPA 1990b) called for the extraction and treatment of arsenic-contaminated ground water. The remediation goal specified in the 1990 ROD for the affected ground water zones was 0.050 mg/L, the MCL for arsenic at that time. The

1990 ROD also included several contingency measures that could be implemented if an extraction and treatment system would not yield the ground water remediation goal.

During the course of the design for the ground water remedy, EPA and TNRCC determined that restoration of the ground water is technically impracticable for portions of the Crystal Chemical Superfund Site. Laboratory data and model calculations showed that achievement of a 0.050 mg/L concentration in ground water of the 35-ft zone would require a minimum of 650 years, if the goal can be attained at all (Terranext 1996). As a result, pump and treatment of ground water to the ROD-specified 50-microgram per liter ($\mu\text{g/L}$) level was determined to be technically impracticable and, therefore, the contingency measures provided in the ROD were evaluated. The timing of this technical impracticability (TI) decision was consistent with EPA's program guidance on such waivers, *Guidance for Evaluating the Technical Impracticability of Ground Water Restoration (OSWER Directive 9234.2-25, September, 1993)* (EPA 1993). EPA determined that the ARAR for ground water restoration to the MCL of 0.050 mg/L for arsenic should be waived for some parts of the site and a slurry wall should be constructed around the portions of the site where ground water cannot be restored. In 2001, EPA revised the arsenic standard for drinking water to 0.010 mg/L. This value became enforceable in January 2006.

Extraction and treatment of arsenic-contaminated ground water remained the selected remedy for the remainder of the site, as specified in the 1990 ROD (EPA 1990b). In June 1996, an RD addendum that addressed the slurry wall design was prepared. The decision to waive the ground water ARAR for a portion of the site and construct a ground water containment system is documented in the 1997 ESD (EPA 1997). Figure 3 of the ESD depicts the area of the TI, which encompasses the monofill area, the majority of the Levy Tract, and extends slightly into the northern portion of Shearton Tract. Recovery well RW-1 and monitoring wells MW-30 and MW-33, which are located outside of the TI area (Figure 2), are thus subject to the requirements of the 1990 ROD for treatment of arsenic in ground water above 0.050 mg/L.

The ground water containment system is meant to horizontally isolate the 15-ft and 35-ft zones through a slurry wall, a natural subsurface levee, and a PRS (Terranext 1996). This would be accomplished by properly keying the slurry wall and the underlying clay (Terranext 1996). The

site is underlain by a moderate plastic clay that continues to prevent the downward migration of impacted ground water to the 100-ft sand zone, as demonstrated by analytical data from monitoring wells screened in the 100-ft sand zone.

Because the slurry wall is designed to prevent impacted ground water from migrating beyond the limits of the slurry wall, rainfall which seeps into the ground surface within the limits of the wall will add to the volume of water within the wall. The rainfall will result in a gradual increase in the water level inside the slurry wall and hydraulic gradient from the inside of the wall outwards. The southern part of the slurry wall containment area is covered by the soil monofill and a multi-layer cap, which effectively prevents infiltration of the rainfall into the subsurface environment. The property to the north (Levy property) is not covered by an impermeable cap and recharge can occur. The need for a PRS to prevent the buildup of a hydraulic head inside of the slurry wall was investigated using the site MODFLOW model. The results of the study indicated a linear drainage system located in the center of the Levy property would effectively control the rise of water levels caused by water recharge.

The performance criterion of the PRS is to remove water from the interior of the containment system as needed to reduce pressure on the barrier walls, thereby reducing the potential that affected ground water could migrate through the containment walls. The system was designed so that if the level of the water in the interior well is more than 1 ft higher than in the exterior well, pumps will recover ground water and deliver it to the GWTP. The 1-ft criterion was selected based on reasonable judgment and experience with other similar containment systems. This criterion may be revised in the future depending on site-specific conditions. Prior to the automated functions being in place, ground water was pumped manually when water levels in the pairs of performance monitoring wells exceeded the performance criteria (Environmental Resources Management [ERM] 2003).

In 2004, UPRR and their contractor, CRA, initiated evaluation of alternatives to the PRS (CRA 2004). In 2004, a CRA letter to EPA summarizes a discussion that took place on August 17, 2004, between UPRR, EPA, TCEQ, and CRA. This discussion involved the appropriate level of hydraulic potential maintenance within the slurry wall containment by the PRS, and the

hydrogeological documentation necessary to reduce or terminate PRS ground water recovery and treatment. The PRS functions to reduce the potentiometric surface inside of the containment area to at least 1 ft below the potentiometric surface outside of the wall. Over time, the average potentiometric surface inside the wall fluctuates from relatively neutral to slightly negative. This standard of proposed long-term PRS operation and maintenance (O&M) of appropriate hydraulic conditions along the slurry wall was accepted and approved by EPA and TCEQ (CRA 2004). In absence of other RA goals, this decision constitutes the standard against which a replacement solution for the PRS has been evaluated. The goal of CRA and UPRR is to decrease the PRS ground water recovery for the reduction or diversion of rainfall on the northern Levy Tract, through either capping, paving, or phytohydraulic control. A formal design for phytohydraulic control was not available for review. The criteria noted above will be utilized to determine the efficacy of the phytohydraulic control implemented at the Site.

4.2 REMEDY IMPLEMENTATION

UPRR (formerly Southern Pacific) has performed the remediation activities for the Crystal Chemical Site. EPA provided oversight during the RD and RA, and continues in this function during the O&M phase. Remedial activities have been completed in phases.

4.2.1 Soil Remedy Implementation

The soil remedial activities for the Crystal Chemical Site were initiated in August 1992. The remediation consisted of excavating approximately 55,000 yd³ of soil with arsenic concentrations greater than 30 mg/kg located off site. The excavated soils were consolidated into a monofill at the Crystal Chemical Site (see Figure 2 for monofill location). The monofill was covered with an engineered cap consisting of a geocomposite clay liner covered by 18 inches of buffer soil and 6 inches of seeded topsoil. The geocomposite clay liner consists of a 20-millimeter high-density polyethylene flexible membrane liner with a bentonite backing. The monofill is located over the entire 6.8-acre Crystal Chemical Site and extends onto a portion of the adjacent eastern property owned by UPRR.

After excavation areas were completed, the excavations were backfilled with clean fill from off-site sources. A security fence with locking gate was installed to prevent access to the site. The soil remedy was completed in September 1995.

4.2.2 Ground Water Remedy Implementation

The ground water remedy for the Crystal Chemical consists of a ground water recovery and treatment system, in accordance with the requirements of the 1990 ROD (EPA 1990b), and a ground water containment system in accordance with the requirements of the ESD (EPA 1997). The following paragraphs summarize the ground water remedies operated at the Crystal Chemical Site.

Ground Water Recovery and Treatment System

The ground water recovery and treatment system consists of a recovery well (designated RW-1) located south of the monofill on the 3.8-acre tract, a GWTP located east of the monofill on the UPRR owned 5-acre tract, and associated piping connecting RW-1 to the GWTP (Figure 2). Recovery well RW-1 is located outside of the southern tip of the TI zone (see Figure 3 of the ESD for TI boundary [EPA 1997]).

Ground water is pumped and conveyed from the 35-ft zone at RW-1 and treated at the GWTP. Construction of the GWTP was completed in October 1996, followed by pilot testing and startup operations. In May 1997, the City of Houston (COH) shut down the GWTP due to an exceedance of the discharge permit for arsenic. The discharge permit requires arsenic concentrations of less than 3 mg/L for grab samples and less than 2 mg/L for composite samples. In response to the discharge exceedance, a pump-around loop system was installed in 1998. The pump-around loop system allows for the storage of treated ground water while waiting for laboratory analytical results. Subsequent to the installation of the pump-around loop system, additional pilot testing and startup operations were conducted. The GWTP was issued a revised COH discharge permit and went back online in January 1999. Currently, the discharge of treated water to the COH's sewer system is covered under a permit issued by the COH Department of

Public Health and Engineering; grab samples are being collected for analysis. This permit was renewed in March 2010 and expires on April 4, 2012 (COH 2010).

According to the construction documentation report (ERM 2003), the GWTP was designed to remove arsenic from the affected ground water using an iron precipitation process, operating 7 days a week, 24 hours per day, at a maximum influent flow rate of 10 gallons per minute (gpm).

The major elements of the ground water recovery and treatment system include (ERM 2003):

- Recovery well, RW-1, south of the monofill.
- Approximately 900 linear ft of double-walled recovery pipe from RW-1 to the GWTP.
- A building for weather and security protection.
- GWTP where the major treatment operations are conducted in the following equipment components:
 - Influent Storage Tank, T-1
 - Oxidation Tank, T-2
 - Co-Precipitation Tank, T-3
 - pH Adjustment Tank, T-4
 - Clarifier
 - Filter Feed Tank, T-5
 - Solids Holding Tank, T-6
 - Sump Tank, T-7
 - Filter Press
 - Effluent Storage Tanks, T-A, B, and C.

A Pump-Around loop was added later, with three storage tanks. Process chemicals delivered to the site and stored in tanks include hydrogen peroxide (Oxidant Storage Tank, T-8), ferric chloride (storage tank, T-9), and caustic sodium hydroxide (storage tank, T-10). Flocculent polymer and acid are also delivered to the plant. The design maximum limit for arsenic concentrations in the influent was 310 mg/L. The GWTP decreases arsenic concentrations in the affected ground water to less than 3 mg/L and discharges the effluent via a batch mode to the COH wastewater system. The ground water discharged into the COH wastewater system is subsequently treated at a COH publicly-owned treatment works.

A phytohydraulic control pilot test using eucalyptus trees located in the southern portion of the Shearton Tract south of recovery well RW-1 is currently underway. The goal of the test is to: (1) evaluate if discernable changes will be observed in water levels, flow direction, and arsenic migration after extraction at RW-1 ceases; and (2) make recommendations for remedy changes based on additional data collected during the one-year period of the test. EPA approved this test in a letter dated November 13, 2009 (EPA 2009). As part of the test, the ground water treatment system operations were temporarily suspended on January 14, 2010. This test is described in the section below. During this one-year period, EPA requested supplemental ground water monitoring activities be included as part of the study (see frequency of sampling discussed in Section 6 of this report).

Ground Water Containment System

The ground water containment system is composed of a natural subsurface levee, the slurry wall, and the PRS. The natural subsurface levee consists of low-permeability clay that serves as a natural barrier to ground water migration along the northwestern boundary of the plume on the 12.5-acre tract formerly owned by the Levy Estate. The slurry wall was installed along the eastern boundary of the plume on the 12.5-acre tract, under Westpark Drive, and along the western, southern, and eastern edges of the monofill. Figure 2 shows the locations of the slurry wall and natural subsurface levee. The depth of the slurry wall ranges from approximately 39 ft along the eastern segments to 52 ft along the western edge of the monofill. Testing was performed during construction to ensure that at least two feet of the slurry wall penetrated into the clay layer underneath the 35-foot zone. The eastern and northern portions of the slurry wall and most of the PRS, including performance monitoring wells, were installed in 2002. Construction of the ground water remedy was completed when the final section of the PRS beneath Westpark Drive was installed in August 2003 (ERM 2003).

The PRS was installed inside the ground water containment barrier to reduce the buildup of hydraulic head. The PRS consists of six pairs of performance monitoring wells screened in the 35-ft zone, electric submersible pumps, and double-walled recovery piping. Each well pair consists of a 4-inch-diameter monitoring well capable of containing an electric submersible

pump located inside the water containment barrier (interior well), and a 2-inch-diameter monitoring well located outside of the water containment barrier (exterior well). Five of the PRS well pairs are located on the 12.5-acre tract, and one pair is located on the GWTP property. Only the interior wells located on the 12.5-acre tract are equipped with submersible pumps (ERM 2003). Figure 2 shows the locations of the PRS and associated wells. Ground water elevations at each pair of the PRS wells are monitored to assess the hydraulic head across the ground water containment barrier. Ground water is pumped from the interior wells, as necessary, to regulate the hydraulic head inside the water containment barrier. These wells can be used to discharge water from inside the containment system via the double-walled recovery piping to the GWTP. Ground water is pumped to a 500-gallon storage tank located in a containment area adjacent to the southwest corner of the GWTP building. The recovered ground water is pumped from the storage tank into piping that runs between the sump and Tank T-7. From Tank T-7, the water is pumped into Tank T-1 for treatment. The tank is equipped with a solenoid valve that shuts off the PRS pumps in the wells if the storage tank is full. The sixth well pair is located on the GWTP property (MW-SW1/MW-SW2) and is of similar construction to the other pairs. The inner well of this pair is not currently included in the PRS, but can be incorporated in the PRS should the need arise (ERM 2003). The PRS has been set to operate in automatic mode since August 2003.

In an effort to evaluate alternative methods to relieve the hydraulic pressure on the slurry wall containment system, a phytohydraulic control pilot test was approved by EPA in January 2005 and implemented in late February 2005. Approximately 60 hybrid eucalyptus trees (*Eucalyptus camaldulensis*) were planted in a 100- × 40-ft area within the northeast corner of the slurry wall on the Levy Tract, upgradient of PRS wells MW-SW3 and MW-SW5. Each tree was planted in a 20-ft deep, 12-inch-diameter soil boring that was extended to the top of the 35-ft zone using Geoprobe techniques; borings were backfilled with sand and mulch. O&M activities are performed as necessary to inspect, water, weed, or replace the trees; monitor their growth; and evaluate the effectiveness of the pilot test. In a similar fashion, an additional 60 trees were planted in a 200- × 20-ft area to the immediate south and west of recovery well RW-1 in the southern Shearton Tract. These trees were planted in this area in the event that, if the Levy Tract

pilot test area is deemed effective, the effectiveness of a phytohydraulic control approach could also be evaluated and considered for the RW-1 area of the Shearton Tract. Three piezometers were also installed in each area into the 35-ft zone immediately upgradient, downgradient, and within the pilot test area to allow quarterly monitoring of the potentiometric surface across the tree stands (CRA 2007).

As of the time of the FYR, the PRS was turned off based on the success of the Levy Tract pilot test (EPA 2009).

4.3 OPERATION AND MAINTENANCE

This section presents information regarding the O&M activities performed during the review period. The O&M is presented separately for the soil and ground water.

4.3.1 O&M for the Soil Remedy

After the construction phase of the soil remedy was completed in September 1995, the maintenance of the monofill cap was initiated in accordance with the RA O&M Plan, dated November 30, 1994 (Industrial Compliance 1994). In 2009, the date of the last inspection performed, the monofill cap was in its fourteenth year of operation.

The O&M Plan requires that the soil remedy be monitored for 30 years, or such time as determined by the EPA. After completion of the monofill cap in September 1995, UPRR conducted monthly inspections of the monofill cap until July 2002, at which time UPR reduced the frequency of inspections to once every quarter. In 2003, UPRR reduced the frequency of the inspections to semi-annually (in April and October), consistent with the minimum frequency required in the O&M Plan (Industrial Compliance 1994). However, in 2009, only one inspection was performed on 16 October (CRA 2010a). There was no formal documentation available during the FYR that formally revised the semi-annual inspection schedule to an annual schedule. The O&M Plan also provided for special site inspections to assess the integrity of the cap to be

performed after a 5-year/24-hour storm, which is the equivalent of 7.2 inches of rain in 24 hours. No such inspections were noted during the review period.

O&M activities for the monofill cap include addressing the following issues (Industrial Compliance 1994):

1. Stressed vegetation and bare spots
2. Burrow holes
3. Fire ant nests
4. Depressions or eroded areas or other signs of settlement of the monofill cap
5. Incidental growth of wooded species with root structures that might negatively impact the cap integrity
6. Desiccation cracks in the final cover.

O&M activities for the surface structures include addressing the following issues (Industrial Compliance 1994):

1. Erosion that could cause failure of a structure.
2. Silt buildup and debris accumulation that could cause overtopping of structures.
3. Rip-rap or erosion management structures to ensure that they are operating as designed.

As per the ROD (EPA 1992b), surface water runoff needs to comply with Clean Water Act regulations to meet water quality criteria for arsenic of 0.0175 µg/L. The 1994 O&M Plan (Industrial Compliance 1994) notes that EPA and COH agreed that surface water samples should be collected annually from three discharge points: the COH sewer, the ditch to the south of the site, and the entrance to the Harris County Flood Control District drainage backslope drop

structure to the west of the site.

Additional features that the site inspections should also include are fencing, signage, and road conditions.

Maintenance of the monofill cap should generally consist of mowing once every 2 months during the growing season (March through October), application of herbicide and insecticide, minor erosion repair of the side slopes, and maintenance of the perimeter fence. The grass should be mowed to a height of 6 inches. Contractors for UPRR conduct these maintenance activities during the regularly scheduled site inspections. The semi-annual inspection reports for 2005 through 2008 and the annual inspection performed in 2009 are included as appendices to the annual RA reports. Dates of inspections and noted major observations from the O&M inspection reports that were included as Appendix A to the 2005, 2006, 2007, 2008, and 2009 annual reports, are as follows for the FYR period from June 2005 to June 2010:

- **16 December 2005**—No major findings; minor rutting on north side of cap and other areas may require repairs later on; one drainage inlet on the west side required cleaning.
- **28 June 2006**—No major findings; minor ruts, areas of minor erosion, and patches of distressed vegetation were observed; debris was removed from inlets on the west side.
- **4 December 2006**—No major findings; erosion was noted on the west-central area of the cap; fence braces were broken on the northwest and southwest corners of the cap; vegetation has accumulated in the area of fences and around drains.
- **24 May 2007**—No major findings; ruts were noted in the southwest and northwest areas of the cap from mowing and in the central area from drilling; fence braces were broken on the northwest and southwest corners of the cap; vegetation was removed from the fencing around the monofill cap; estimates were made for proposed repairs to the security fencing in the southeast, northwest, and southwest corners; and tire ruts were filled with topsoil and seed.
- **10 November 2007**—No major findings; the fence was still broken on the northwest and southwest corners of the cap.
- **6 June 2008**—No major findings; the sections of broken fence on the northwest and southwest corners of the cap and by the southeast gate were repaired; an animal borrow was noted in the southwest corner and several ant mounds were observed.

- **17 November 2008**—Ant mounds were observed.
- **16 November 2009**—Active ant mounds were observed; some repairs were made to the fencing surrounding the monofill cap and elsewhere at the Site.

In general, the annual reports state that the monofill cap was well maintained during the review period. However, repairs to the damaged fence were made with some delay after they were first noted during the semi-annual inspections; some of the problems observed were recurring with each inspection. Also, inspections are supposed to take place in April and October, and actually none of the inspections performed during this FYR were completed during the prescribed timeframes. Observations during the FYR process indicate problems with the O&M for the soil remedy as documented in this report.

4.3.2 O&M for the Ground Water Remedies

The ground water recovery and treatment system was designed to operate continuously unless operation was ceased for either maintenance, repairs, or other reasons related to site remedy testing (i.e., the phytohydraulic pilot testing). Water removed through the PRS is being treated in the GWTP; and, as a consequence, O&M activities for the recovery well and piping or wells related to the PRS may all affect the performance of the GWTP. Similarly, the unavailability of the GWTP to treat water from the PRS may affect the amount of water that can be pumped due to limits set by storage capability. Because of the interconnectedness of the ground water remedies, O&M information is summarized jointly for both the ground water treatment system and the PRS wells and piping system. The slurry wall O&M is discussed separately.

Ground Water Treatment System and PRS Wells and Piping

Maintenance of the ground water recovery and treatment system generally consists of replacing piping, pumps, and valves as necessary to maintain recovery. During the time it was active within the FYR timeframe, the treatment plant operations were inspected using a daily checklist. Routinely, influent and effluent samples were collected and filter cake material was disposed off

site. Contractors for UPRR are supposed to conduct maintenance activities on an as-needed basis. Annual inspection reports, the semi-annual inspection reports, semi-annual and annual ground water monitoring laboratory reports, and GWTP influent and effluent sample data are submitted to EPA and TCEQ. Dates of noted significant O&M activities, proposed and effective changes in operation of the ground water remedies, as well as PRS inspection findings are as follows for the period of June 2005 to June 2010:

- **June to December 2005 (information source is CRA 2006, unless otherwise specified):**

- From June through December 2005, approximately 217,091 gallons of ground water were recovered and 243,718 gallons were treated and discharged from the GWTP under permit authorization from the COH.
- For most of 2005, ground water was pumped from RW-1 to the treatment system at a rate of approximately 5 gpm.
- PRS inspections took place on June 8 and December 16.
- Minor water infiltration into a few of the six PRS cleanout/leak detection vaults during the latter part of 2005 was observed intermittently; however, overall, the vaults remained dry.
- Recovery wells MW-SW3 and MW-SW5 were not operational from July through October, and the operational condition of the pumps and PRS was evaluated during this period. A blockage was found in the recovery piping and was cleared out on October 26, and operation of these recovery wells was restored. Discharge lines from these wells were also replaced in November to assure good recovery flow, and an activation switch was bypassed in December.
- 100-ft zone monitoring well MW-32, affected by arsenic in 2004, and inactive monitoring well MW-29 were plugged and abandoned in April 2005. MW-32 was replaced by monitoring well MW-32A, located in the southeast corner of the Levy Tract. Well MW-29 was not designated for ground water monitoring or recovery purposes in the Sampling and Analysis Plan, was not considered integral to the achievement of the ROD, and represented potential contaminant pathways between the surface and subsurface. State of Texas Water Well and Well Plugging Reports are included in Appendix B of the 2005 Annual Report.
- From August 3 to 10, RW-1 was shut down due to GWTP flocculation tank agitator motor failure and replacement.

- **2006 (information source is CRA 2007, unless otherwise specified):**

- In 2006, approximately 240,070 gallons of ground water were recovered and 233,937 gallons were treated and discharged from the GWTP under permit authorization from the COH.
- During 2006, ground water was pumped from RW-1 to the treatment system at a rate of approximately 5 gpm.
- PRS inspection took place on June 28 and December 4.
- PRS recovery wells MW-SW3 and MW-SW5 were shut down on January 20 due to a cracked recovery line within a contained area in the GWTP. The line was repaired on February 6, and PRS operations were resumed.
- The PRS recovery pumps at MW-SW3 and MW-SW5 were turned off in August 2006 due to GWTP discharge disruptions, approximately 1 year after the phytohydraulic test was initiated at the Levy Tract (CRA 2008d). The PRS recovery wells had been kept inactive in order to observe and assess the effect of ground water uptake from the eucalyptus trees as they became fully established, as well as their potential effect on the hydraulic conditions in the 35-ft saturated zone.
- Seals were repaired at vaults of the PRS as they were assumed to be the cause for water present in the vaults.
- The line from Tank 04 to the flocculation tank was backed up on April 26, with continued blockage problems until July 12, when the line was replaced.
- A break in the treated ground water discharge line unit was discovered during COH utility activities on August 1. This was initially identified as a result of a water main release near a power pole along the south side of the Westpark Drive right-of-way, north of the GWTP. A leaning and previously braced CenterPoint Energy power pole was also noted at this location. When the water main was uncovered and determined to be in good repair, it was discovered that the power pole installation had ruptured the GWTP discharge line. Discharge from this line was discontinued until appropriate repairs could be made.
- Cleaning and repairs were made to the clarifier discharge line on September 26, as required in the EPA FYR. This involved removing the outer corrosion and wrapping the discharge pipe with a strength-enhancing tape.
- A cotter pin connecting the clarifier mixer to the mixing shaft was discovered to have dislodged. The motor was rebolted to the shaft on October 11.

- Repairs were performed on leaking vaults.
- The cover of an electrical box was found broken by well MW-SW3; no note was made regarding a repair of this cover.
- **2007 (information source is CRA 2008a, unless otherwise specified)**
 - In 2007, approximately 420,109 gallons of ground water were recovered and 417,733 gallons were treated and discharged from the GWTP under permit authorization from the COH.
 - Until March 5, the GWTP was not operational due to a piping rupture. Starting in March, ground water was pumped from RW-1 to the treatment system at a rate of approximately 5 gpm.
 - PRS inspections took place on May 24 and October 11.
 - In October 2007, vaults were filled with water, which was attributed to leaking seals in the vaults; no repairs to the seals were made.
 - The broken discharge line, previously discovered during COH utility inspection activities on August 1, 2006, was located and repaired by CenterPoint Energy on February 27, 2007. The power pole that caused the discharge line break was relocated several feet from its original location to facilitate this repair. Discharge of treated water from the GWTP resumed on March 5, 2007, and recovery of affected ground water from RW-1 resumed in late March.
 - Several components of the treatment plant systems required attention in the effort to restart the GWTP. The dilution flow pump motor and discharge pump motor required maintenance and repair in March. The pH probes also were not registering and were replaced 13 March 2007. The filter feed, unit feed, and ferric acid pump motors required maintenance and repair in April. O-rings were replaced on the filter feed pump and another filter feed pump was replaced in May.
 - The air valve to the filter press was replaced in June, restoring the filter press to operational status.
 - Three mixer shafts were repaired in July, replacing worn-out propellers.
- **2008 (information source is CRA 2009a, unless otherwise specified):**
 - In 2008, approximately 2,304,474 gallons of ground water were recovered and 1,722,922 gallons were treated and discharged from the GWTP under permit authorization from the COH; the increase in pumped volume is directly related to the

repair of the discharge line that ruptured on August 1, 2006, and improvements in the recovery and processing of ground water by the GWTP system.

- The pumping rate for 2008 was not specified in the annual report.
- A recommendation was made that, based on the observations from previous years, inspections at the PRS be performed annually rather than semi-annually.
- During a conference call on February 29 (CRA 2008b), it was agreed to continue the suspension of the PRS operation for a minimum of 2 years, so that the effectiveness of the phytohydraulic pilot test at the Levy Tract could be evaluated.
- PRS inspections took place on June 6 and November 17.
- Vaults filled with water were addressed by the subcontractor.
- Potable water supply was temporarily shut off by the COH (June 2–4).
- Process was shut down due to a power failure (July 18–25).
- Site was shut down due to power outages from Hurricane Ike (September 11–16).
- Treated water discharge was temporarily suspended; samples were not submitted for analysis while waiting on laboratory to regain power (September 17–25).
- During discussion of the results of the Levy Tract phytohydraulic pilot test, it was recommended that this approach be applied to the Shearson Tract tree plot. Recommendations also included that ground water levels at existing piezometers and monitoring wells MW-30 and MW-33 be gauged on a monthly basis to monitor the effectiveness of this pilot test (documented on October 27, CRA 2008c).
- **2009 (information source is CRA 2010a, unless otherwise specified):**
 - In 2009, approximately 2,048,270 gallons of ground water were recovered and 1,929,752 gallons were treated and discharged from the GWTP under permit authorization from the COH; the quantity of treated water discharged to the COH in 2009 was 1,929,752 gallons, representing an approximate 12 percent increase in the amount that was discharged in 2008 (1,722,922 gallons); the increase in volume is directly a result of improvements in the recovery and processing of ground water by the GWTP system, as well as somewhat elevated ground water levels.
 - From October 1996 through December 2009, 8,153,242 gallons were recovered by RW-1, and 7,820,013 gallons were discharged into the COH sewer system.
 - Operator interface on programmable logic control failed, which was repaired and reinstalled (from January 12 to February 16).

- Repaired cracked flange at RW-1 (July 13–15).
- Filter feed pump failed over the weekend (July 25–27).
- Chemical metering pump failed over the weekend (September 18–26).
- PRS inspection took place on October 16.
- The Phytohydraulic Control Pilot Test Proposal for the Shearton Tract (revised) (CRA 2009c) was approved by EPA on November 13, 2009 (EPA 2009). This proposal included suspension of active RW-01 operation for 1 year and monthly monitoring of potentiometric levels in MW-30, MW-33, RW-1, and the three piezometers; rainfall was to be measured during this timeframe.
- Air compressor shut down over the weekend (November 7–9, and 14–16).
- On November 30, CRA submitted the revised pilot test report for the Levy Tract (CRA 2009c), recommending that the PRS remain inactive and the phytocontrol in the Levy Tract be used instead.
- The revised Phytohydraulic Control Pilot Test Plan for the Shearton Tract was submitted on December 10, 2009 (CRA 2009d). This revision added monthly ground water sampling in wells MW-30 and MW-33 and semi-annual sampling for arsenic in well MW-31A, which is screened in the 100-ft zone.

Slurry Wall O&M

The slurry wall O&M is performed in conformance with the requirements set forth in the revised O&M Plan (Environmental Resources Management [ERM] 2004). This plan outlines a schedule for semi-annual inspections between 2005 and 2008, and annual inspections thereafter through 2032. The primary inspection requirement for the slurry wall consists of walking the length of the slurry wall to note locations where settlement of the backfill has created a drainage problem.

According to the O&M Plan (ERM 2004), the PRS is inspected concurrent with the slurry wall inspections and ground water sampling events. Inspections should include tests of the main system components and maintenance required by equipment manufacturers. The system components are wells, vaults, pumps, piping, electrical parts, and storage tank of recovered ground water; findings relative to these components are outlined in the section above.

Slurry wall inspection findings are as follows:

- **2005 (CRA 2006):**
 - Inspections took place on June 8 and December 16.
 - No issues were identified during either one of the inspections.

- **2006 (CRA 2007):**
 - Inspections took place on June 28 and December 4.
 - During the December inspections, settlement was observed and gravel had to be placed at Shearton Tract by the gate at RW01 to bring the ground surface to grade.

- **2007 (CRA 2008a):**
 - Inspections took place on May 24 and October 11.
 - During both inspections, settlement was observed and gravel had to be placed at Shearton Tract, by the gate at RW01 to bring the ground surface to grade.

- **2008 (CRA 2009a):**
 - Inspections took place on June 6 and November 17 (note that according to the O&M Plan, only one inspection was required in 2008).
 - During both inspections, settlement was observed and gravel had to be placed at Shearton Tract, by the gate at RW01 to bring the ground surface to grade.

- **2009 (CRA 2010a):**
 - An inspection took place on October 16. During the inspection, settlement was observed and gravel had to be placed at entrances to both the Shearton and Levy Tracts.

Ground water quality and elevation monitoring is conducted at the Crystal Chemical Site to assess whether the remedies are operating as designed. For part of the FYR period, the ground water monitoring was conducted on a regular basis as specified in the Ground Water Monitoring

Plan, dated July 23, 2003 (UPRR 2003a), and amended 12 December 2003 (UPRR 2003b). Ground water from the three shallowest water-bearing zones (15-, 35-, and 100-ft sand zones) are monitored. The monitoring well network consists of two wells in the 15-ft sand zone, 15 wells in the 35-ft sand zone, and 3 wells in the 100-ft sand zone.

Ground water elevation measurements are meant to assess ground water flow direction and the head difference between the interior and exterior wells located in the 35-ft zone so that containment can be evaluated.

Ground water samples are collected to assess the performance of the treatment and containment systems and evaluate the potential migration of arsenic contamination. Samples were to be analyzed using EPA SW-846 Methods 3020A and 7060A. Quality control samples were to be collected with a frequency of 5 percent and consist of a duplicate sample, additional aliquot for the laboratory to prepare a matrix spike/matrix spike duplicate sample, and an equipment blank, if non-disposable sampling equipment is used. The frequency of sampling and gauging was not established after 2004 in the monitoring plan (UPRR 2003b). Rather, the gauging results and analytical data for 2004 monitoring were going to be evaluated and a proposal for further monitoring provided in the 2004 annual report. The Second FYR Report (EPA 2005) notes that, since December 2003, water level measurements have been collected on the same frequency as the regularly scheduled O&M activities. However, due to phytohydraulic control pilot tests, the frequency of monitoring has changed during the reporting period. Additional changes are described in the Data Review section of this report.

4.4 OPERATION AND MAINTENANCE COST

The CRA project manager, Mr. Wisnowiecki, provided approximate associated costs for the Crystal Chemical Site from January 2005 through April 2010. The costs are listed in Table 2. This table also depicts the non-routine activities that took place at this Superfund Site during the review period. Routine activities should include the following:

- Maintain the monofill cap and surrounding fencing

- Operate and maintain the ground water recovery and treatment system, slurry wall and PRS, and surrounding fencing
- Conduct sampling and analysis of GWTP influent and effluent
- Collect ground water elevation measurements
- Conduct sampling and analysis of ground water.

The 1992 Amended ROD (EPA 1992b) for the soil remedy did not specifically list annual O&M costs; no itemized annual O&M costs were available for comparison of the actual cost incurred during the review period to projected costs.

5.0 PROGRESS SINCE THE SECOND FYR

This is the third FYR for the Crystal Chemical Site. The Second FYR Report was conducted in September 2005 (EPA 2005). The next FYR will be conducted by September 2015.

5.1 PROTECTIVENESS STATEMENT FROM SECOND FYR

The FYR Report Memorandum accompanying the Second FYR Report (EPA 2005) determined that the selected soil and ground water remedies for Crystal Chemical are protective of human health and the environment and will remain so, provided that the action items identified in the Second FYR Report are addressed as described in the executive summary. Action items included maintaining the monofill cap and perimeter fence, continuing ground water monitoring to determine if the ground water pump and treat system and containment system are performing as designed, and recording the appropriate institutional control documents.

5.2 SECOND FYR RECOMMENDATIONS AND FOLLOW-UP ACTIONS

The Second FYR Report (EPA 2005) recommended the follow-up actions presented below:

1. Continue to monitor the areas of the monofill cap experiencing minor erosion, and reseed when appropriate to prevent impact upon the monofill cap and slurry wall.
2. Instruct lawn maintenance crew to be careful during lawn maintenance activities to prevent rutting of monofill cap grass surface cover.
3. Repair damage to fencing at the front gate and fence at the 12.5-acre northern tract.
4. Place fill material under the southeast corner of the fence at the 12.5-acre northern property where an approximately 1.5- x 1-ft gap exists under the fencing.
5. Continue to inspect cleanout/leak detection vaults to assess whether or not rainwater infiltration is occurring, and conduct additional repairs if needed to prevent ground water infiltration. Vacuum and/or evaporate all standing water in vaults.
6. Leaf debris over drainage outlets should be removed during routine mowing activities.
7. Replace corroded sludge decant pipe from the clarifier in the GWTP.
8. Continue to communicate with COH during their review of the deed recordation documents. Complete deed recordation upon approval of all parties.

5.3 STATUS OF RECOMMENDED ACTIONS

The status of the actions recommended in the Second FYR Report (EPA 2005) is presented below:

1. Recommendation—Continue to monitor the areas of the monofill cap experiencing minor erosion, and reseed when appropriate to prevent impact upon the monofill cap and slurry wall. *Action*—Regular inspections have been performed and some repairs were conducted as necessary.
2. Recommendation—Instruct lawn maintenance crew to be careful during lawn maintenance activities to prevent rutting of monofill cap grass surface cover. *Action*—It appears that rutting continues to be a problem at the Site. Also, mowing is not occurring at the specified frequency.
3. Recommendation—Repair damage to fencing at the front gate and fence at the 12.5-acre northern tract. *Action*—Completed.
4. Recommendation—Place fill material under the southeast corner of the fence at the 12.5-acre northern property where an approximately 1.5- x 1-ft gap exists under the fencing. *Action*—Completed.

5. Recommendation—Continue to inspect cleanout/leak detection vaults to assess whether or not rainwater infiltration is occurring, and conduct additional repairs if needed to prevent ground water infiltration. Vacuum and/or evaporate all standing water in vaults. *Action*—Inspections revealed continued problems with water being present in the vaults. Repairs were implemented several times during the review period, as seals were assumed to be the problem. However, a permanent solution to address this recommendation has not been implemented to date.
6. Recommendation—Leaf debris over drainage outlets should be removed during routine mowing activities. *Action*—Debris cleanup should be taking place routinely at the drainage outlets.
7. Recommendation—Replace corroded sludge decant pipe from the clarifier in the GWTP. *Action*—Completed on September 26, 2006 (CRA 2007).
8. Recommendation: Continue to communicate with COH during their review of the deed recordation documents. Complete deed recordation upon approval of all parties. *Action*—Recordation of restrictions on ground water was completed on March 7, 2006 (see Attachment 5). No institutional controls are currently in place for the maintenance of the monofill cap in perpetuity at the site.

6.0 FYR PROCESS

This section presents the process and findings of the third FYR. Specifically, this section presents the findings of surveys, a site inspection, an ARAR review, and a data review.

6.1 ADMINISTRATIVE COMPONENTS

The Crystal Chemical Site FYR team was lead by Mr. Ruben Moya of EPA, Remedial Project Manager for the Crystal Chemical Site. Ms. Cristina Radu of EA Engineering, Science, and Technology, Inc. (EA), assisted in the review process.

The review team established the review schedule, which included the following components:

- Community involvement
- Document review

- Data review
- ARARs review
- Site inspection
- Site interviews.

6.2 COMMUNITY INVOLVEMENT

Activities to involve the community in the FYR were initiated with a Public Notice published in the local daily newspaper, *The Houston Chronicle*, on April 30, 2010. This Notice informed the public that an FYR was to be conducted and that the results of the review would be made available to the public at the information repository, the Judson Robertson-Westchase Library. A copy of the public notice and the affidavit of publication is available in Attachment 6.

6.3 DOCUMENT REVIEW

This third FYR for the Site included a review of relevant site documents, including Court Orders, annual remedial status reports, operation and monitoring plans and reports, pilot test plans and reports, and other ancillary documents. The complete list of documents reviewed during this third FYR is provided in Attachment 1, which also constitutes the list of references for this document.

6.4 DATA REVIEW

Information about the site activities, monitor well data, ground water recovery and treatment data, and water elevation data were summarized in the following reports:

- Annual RA Reports for 2005, 2006, 2007, 2008, and 2009
- Monthly Progress Reports for RA for January through June 2010
- Phytohydraulic control pilot test proposals and reports
- Operation and monitoring plans
- Correspondence documenting outcome of meetings.

6.4.1 GWTP

Review of annual RA reports and monthly progress reports indicate that between June 2005 and December 2010, approximately 5,256,557 gallons were recovered from the GWTP, monitoring wells, and PRS, while 4,604,167 gallons were treated and discharged under permit to the COH sewer system (Table 3). This is more than a 100 percent increase compared to 2,054,503 gallons recovered and 2,286,848 gallons treated and discharged during the previous FYR period (January 1, 2000 to May 31, 2005). The increase in volume for 2008 is directly related to the repair of the discharge line that ruptured on August 1, 2006, and improvements in the recovery and processing of ground water by the GWTP system. The total volume of discharged treated water exceeds the amount recovered because purge water from ground water sampling, leak detection vaults, and water used for hydrotesting of new tanks and floor washdown was also treated and discharged. Major shutdowns, repairs, and modifications to the GWTP and PRS wells that have impacted ground water recovery from RW-1 and the PRS wells are discussed in Section 4.3.2.

As mentioned in Section 4.3.2, the increase in pumped volume in 2008 is directly a result of repairing the discharge line that ruptured on August 1, 2006, and improvements in the recovery and processing of ground water by the GWTP system.

Information on the volume of water extracted by PRS wells is not available in the annual reports with the exception of data for 2004, presented in the Revised Phytohydraulic Control Pilot Test Report (CRA 2009c). This report states that ground water recovery from the two PRS recovery wells in operation prior to the phytohydraulic test, MW-SW3 and MW-SW5, ranged from approximately 19 to 728 gallons per day, with an average groundwater recovery rate of 349 gallons per day.

Laboratory-reported concentrations of arsenic in the influent samples have historically ranged from 20 to 80 mg/L since the GWTP began operations. During the FYR reporting period, they ranged between 6.95 mg/L and 36.8 mg/L, so concentrations have decreased. Discharge of treated water is authorized under a COH permit, with arsenic concentrations limits of 2 mg/L for

a composite sample and 3.0 mg/L for a grab sample. Grab samples have been collected and used for evaluation purposes, and no exceedances in the discharge effluent occurred during the review period. Arsenic was detected at a concentration of 4.59 mg/L in a sample of treated water collected on July 6, 2005; and, as a result, that batch of treated water was not discharged to the COH sewer system. Table 4 presents the range of concentrations detected in influent (RW-1) and effluent samples collected during the review period.

Between October 1996, when the treatment plant was put into service and December 2009, more than 7.8 million gallons were treated (CRA 2010a). The only mass removal calculation performed on the GWTP is based on 2008 arsenic concentration and recovery data (CRA 2009b). CRA estimates that approximately 108 kilograms of arsenic were removed in 2008.

6.4.2 Ground Water Monitoring Program

Ground water monitoring is conducted in the three shallowest water-bearing zones: 15-, 35-, and 100-ft sand zones.

The Site's Groundwater Monitoring Plan was revised in December 2003 (UPRR 2003b). Its objectives were as follows:

- Collect representative ground water data using EPA-approved sample collection techniques
- Perform data quality assurance/quality control procedures in accordance with the Quality Assurance Project Plan for the site
- Evaluate ground water elevation data to assess whether or not the ground water elevations inside the slurry wall and natural levee (e.g., the ground water containment system) are protective of the containment system components (i.e., no significant gradient between inside and outside the containment system walls)
- Demonstrate that affected ground water is contained by the containment system and ground water recovery system at pumping well RW-1
- Compare the ground water monitoring data with the remedial action objective (RAO), which is the removal or containment of ground water with concentrations of arsenic

greater than 0.050 mg/L. In 2001, EPA set a revised arsenic standard for drinking water at 0.010 mg/L. This value became enforceable in January 2006.

Subsequent changes to the ground water elevation monitoring have been implemented in various documents during the reporting period. Additional monitoring objectives were added when the phytohydraulic control pilot tests were initiated; the ground water elevation monitoring was also used to demonstrate if eucalyptus trees can be used to provide containment of the ground water contaminated above the standard.

Well gauging frequency is depicted in Table 5 and gauging results are presented in the respective annual reports (CRA 2006, 2007, 2008a, 2009a, 2010a) and in the Revised Phytohydraulic Control Pilot Test Report (CRA 2009c). Well sampling frequency is depicted in Table 6 and gauging results are presented in the respective annual reports (CRA 2006, 2007, 2008a, 2009a, 2010a) and in the Revised Phytohydraulic Control Pilot Test Report (CRA 2009c). Additional changes to the monitoring program were outlined in the 2004 annual report.

According to The Amended Phytohydraulic Control Pilot Test Proposal (CRA 2009b), increased (monthly) gauging frequency will be employed in 2010 in wells MW-30, MW-33, and RW-1, and piezometers PZ-1, PZ-2, and PZ-3 to test the efficacy of the Shearton Tract phytohydraulic control. Ground water sampling frequency for select wells in the 15-ft and exterior 35-ft zones was semi-annual starting in the second half of 2005 and continued through 2007, with annual sampling beginning in 2008. Interior wells in the 35-ft zone were to be sampled once every 5 years; they were sampled once in March 2005, an event which is outside of the current third FYR period (starting in June 2005). Higher frequency of monitoring was being employed in select wells during phytohydraulic control pilot testing activities at the Levy Tract. Increased (monthly) sampling frequency has also been specified in wells MW-30 and MW-33 during 2010 for the pilot test at the Shearton Tract (CRA 2009d). Until 2010, all wells in the 100-ft zone wells were sampled annually.

Annual maximum values for arsenic concentrations in well samples are summarized in Table 7.

6.4.3 Ground Water Monitoring Data Analysis

The following sections present the analysis of the data collected during the third FYR period.

15-Foot Zone

Only one well was sampled and two wells gauged in this zone; therefore, data is very limited. A summary of the maximum annual arsenic concentrations in ground water samples collected from the well screened in the 15-ft sand zone during the third FYR period is presented in Table 7. All data for the 15-foot zone is available in Table 4 for each of the annual reports (CRA 2005, 2006, 2007, 2008a, 2009a, and 2010a). All arsenic concentrations for ground water samples collected from the 15-ft zone were reported below the RAO of 0.050 mg/L. Furthermore, all reported arsenic concentrations were below the new MCL of 0.010 mg/L.

35-Foot Zone

A summary of arsenic maximum annual concentrations in ground water samples collected from the 35-ft sand zone PRS wells and monitoring wells during the third FYR reporting period is presented in Table 7. A complete set of analytical data through 2009 is summarized in Table 6 of the 2009 annual report (CRA 2010a).

The general 2009 gauging data for wells screened in the 35-ft zone indicate the direction of ground water flow is toward the northeast in the northern portion of the site and toward recovery well RW-1 in the southern portion of the site.

Wells located outside of the TI waiver area that are screened in this zone are as follows: RW-1, MW-30, MW-33, MW-SW2, MW-SW4, MW-SW6, MW-SW8, MW-SW10, and MW-SW12. The range of concentrations detected in RW-1 is presented in Table 4 and the maximum annual concentrations for wells sampled between June 2005 and December 2009 are presented in Table 7. Well MW-30 was only sampled on November 21, 2002, when a concentration of 0.656 mg/L was measured. Moreover, 2010 monthly analytical results for arsenic in monitoring wells

MW-30 and MW-33 are presented in Table 8. With the initiation of the Shearton Tract pilot test in January 2010 (CRA 2009b, 2009c; and EPA 2009), extraction of ground water at recovery well RW-1 ceased, as has sampling of this well, which has exhibited the highest concentrations of arsenic to date.

Concentrations in wells RW-1, MW-30, and MW-33 are significantly higher than the RAOs and the new arsenic MCL (as high as 36.8 mg/L in RW-1 in 2005, 700 times the RAO). Moreover, because of the limited number of wells in the Shearton Tract area, an arsenic plume map delineating the area impacted above the original 0.050 mg/L goal cannot be drawn. It is unclear why CRA considers that RW-1, located outside of the TI waiver zone, was not constructed as the recovery well for the pump-and-treat remedy to satisfy the initial ground water ROD (CRA 2009b). CRA states that this area should be part of the TI waiver zone, as concentrations are significantly higher than in samples collected from wells within the TI waiver area.

Additionally, CRA is proceeding with the evaluation of the phytohydraulic control as a remedy that provides only containment of contamination rather than treatment of arsenic, as required by the ROD. Based on the data available to date, the extent of the ground water impact above the RAO in the Shearton Tract area cannot be delineated. Gauging data for wells screened in the 35-ft zone indicate the direction of ground water flow is toward the northeast in the northern portion of the site and toward recovery well RW-1 in the southern portion of the site. Although treatment of ground water extracted at RW-1 has been successful and potentiometric surface maps compiled during the review period indicate that this well provides hydraulic containment in the area, it cannot be determined if the zone of influence for RW-1 encompasses the entire arsenic plume above the revised arsenic MCL of 0.010 mg/L or even the prior arsenic MCL of 0.050 mg/L. As mentioned before, testing of the eucalyptus tree stand as a replacement for hydraulic control in the Shearton Tract is currently under way.

Arsenic concentrations in PRS exterior wells MW-SW2, MW-SW4, MW-SW6, MW-SW8, MW-SW10, and MW-SW12 are all below the ROD goal for arsenic of 0.050 mg/L, as well as the current MCL of 0.010 mg/L, indicating that the ground water containment system is operating effectively. Interior PRS wells were not sampled during the review period, although they should have been sampled in March 2010. These wells are required to be sampled every 5

years, and they were last sampled in March 2005, prior to the beginning of the current FYR period. Analytical results for samples collected from these interior wells in March 2005 were as follows (in decreasing order): 9.05 mg/L in well MW-SW5, 0.0728 mg/L in MW-SW7, 0.0417 mg/L in MW-SW9, 0.0293 mg/L in MW-SW11, and 0.0171B in MW-SW3. All reported concentrations exceeded the current arsenic MCL, and MW-SW5 and MS-SW-7 both exceeded the current RAO for arsenic. The difference between these concentrations and the highest arsenic values reported for the exterior paired wells indicate that, to date, the containment of contamination is successful.

The phytohydraulic pilot test (CRA 2009b) states that gauging data indicate a difference in ground water elevation within the containment area, as defined by the natural subsurface levee and the slurry wall; since the PRS has been taken out of service, potentiometric level differences between paired PRS wells did not appear to have changed to a noticeable extent. In addition, the gauging data were used in conjunction with additional information, i.e., precipitation data to assess the efficacy of phytohydraulic control that could potentially replace the PRS operation. The phytohydraulic pilot test in the Levy Tract was initiated in March 2005 and concluded in October 2008. This pilot test was one of several alternative ground water control approaches to the current hydraulic control activities being performed (slurry wall barriers). The revised pilot test report (CRA 2009c) presents the data collected between May 2005 and October 2008. The report concludes that the data indicate phytohydraulic control is occurring within the slurry wall area without the PRS. The lack of ground water removal by the PRS system over more than 2 years indicates that rainfall infiltration within the slurry wall area is minimal; ground water transpiration by the eucalyptus trees and other non-PRS hydraulic processes (deeper vertical infiltration, evaporation, etc.) approximately matches or exceeds any such infiltration; and that hydraulic difference across the slurry wall has been maintained without use of the PRS (CRA 2008c, 2008d). As a result, CRA recommended that the PRS remain inactive and that the phytohydraulic control replace the PRS in the Levy Tract. On November 11, 2009, EPA concurred with this recommendation (EPA 2009). Following EPA's approval, a revised phytohydraulic control report for the Levy Tract was prepared by CRA (CRA 2009c).

An evaluation of the apparent lateral gradients for the FYR was performed for PRS well pairs

(MW-SW3/MW-SW4; MW-SW5/MW-SW6; MW-SW7/MW-SW8A) and piezometers (PZ-1, PZ-2, and PZ-3) located close to the Levy Tract tree stand, and as a consequence, most likely to be influenced by the uptake of the eucalyptus trees. The desired influence of the eucalyptus trees is the creation of a hydraulic sink in the area of the stand that would be similar to the effects of pumping water from the interior PRS wells. This analysis was performed using potentiometric maps from November 2005 through October 2009, as available in the Revised Phytohydraulic Pilot Test Report (CRA 2009c) and the 2009 annual report (CRA 2010a). The findings are as follows:

- November 14, 2005—The apparent gradients between well pairs is toward the outside of the containment zone for all pairs. The flow on the approximate axis of the piezometers and MW-SW5/MW-SW6 points outward as well (note that MW-SW5 at 9.5 mg/L arsenic in 2005 has the highest impact of all the PRS wells).
- May 30, 2006—The apparent gradient is outward between MW-SW3/MW-SW4 and inward for MW-SW7/ MW-SW8A; there is a small capture zone around PZ-2, but then the gradient reverses again and flow direction is from PZ-3 to MW-SW5/MW-SW6; in August 2006, the PRS was shut down.
- October 31, 2006—The apparent gradient is inward for MW-SW3/MW-SW4 and outward for MW-SW7/ MW-SW8A; apparent gradient is toward PZ-3 from MW-SW5; however, there is a high elevation at MW-SW5, and the apparent gradient reverses toward MW-SW6.
- April 4, 2007—Similar to October 31, 2006, with the exception MW-SW7/ MW-SW8A where the gradient is now inward.
- October 11, 2007—Similar to 2005, the apparent gradients between well pairs point toward the outside of the containment zone for all pairs; the flow on the approximate axis of the piezometers and MW-SW5/MW-SW6 points outward.
- April 30, 2008—The apparent gradient is inward for MW-SW3/MW-SW4 and outward for MW-SW7/MW-SW8A; the flow on the approximate axis of the piezometers and MW-SW5/MW-SW6 points outward.
- October 13, 2008—The apparent gradient is inward for MW-SW3/MW-SW4 and outward for MW-SW7/ MW-SW8A; the flow on the approximate axis of the piezometers and MW-SW5/MW-SW6 points outward.

- October 16, 2009—The apparent gradient is inward for MW-SW3/MW-SW4 and outward for MW-SW7/ MW-SW8A; the flow on the approximate axis of the piezometers and MW-SW5 and MW-SW6 points outward.

From the data above, apparent gradient between PZ-3 and MW-SW5 indicates that flow is toward the patch of trees during only two monitoring events: October 31, 2006 and April 4, 2007. All other gauging events indicate the trees are not drawing water away from the containment zone. The apparent gradient between MW-SW7 and PZ-2 shows consistent flow toward the trees with the exception of the April 4, 2007 event. The apparent gradient between SW-MW-3 and PZ-2 shows flow toward the trees.

Appendix A of the Revised Phytohydraulic Control Pilot Test Report (CRA 2009c) depicts the variation of potentiometric levels for the paired PRS wells and piezometers in the Levy Tract area. These graphs show that gradients at well pairs – MW-SW-5/MW-SW6 and MW-SW7/MW-SW8 were consistently outward during the entire FYR period.

The PRS was designed to recover ground water from inside the containment zone if the level was 1 ft higher than in the exterior well. After pumping in the PRS was ceased in August 2006, interior well elevations exceeded the exterior well elevation on two occasions: on October 31, 2006, elevation in interior well MW-SW01 was 61.73 ft mean sea level versus 59.51 ft mean sea level in exterior well MW-SW2; and on April 7, 2007, the elevation in interior well MW-SW11 was 63.00 ft mean sea level versus 61.95 ft mean sea level in exterior well MW-SW12 (CRA 2009c).

100-Foot Zone

A summary of maximum annual concentrations for arsenic in ground water samples collected from the 100-ft sand zone PRS wells and monitoring wells during the FYR reporting period is presented in Table 7. A complete set of analytical data through 2009 is summarized in Table 8 of the 2009 annual report (CRA 2010a). The reported arsenic concentrations from the 100-ft monitoring wells were all below both the RAO of 0.050 mg/L and the arsenic MCL of 0.010 mg/L. These data indicate that contaminant flux between the 35- and 100-ft zones is not occurring.

6.5 ARAR REVIEW

The amended ROD (EPA 1992b) identified the following ARARs for the Crystal Chemical Site soil RA:

- Resource Conservation and Recovery Act (RCRA) landfill requirements in 40 CFR 264.111 Subpart G, which specify a cap with permeability less than or equal to the permeability of any bottom liner of natural sub-soils present at the site
- RCRA requirements in 40 CFR 264.228 Subpart K, which provides closure requirements for surface impoundments
- RCRA landfill closure requirements in 40 CFR 264.310 Subpart N
- RCRA post-closure and monitoring requirements in 40 CFR 264.117(a) (1), which requires a 30-year post-closure period and another period determined by the EPA Regional Administrator
- Ambient air quality standards in 40 CFR 50 to protect the quality of air during implementation of the soil remedy
- Clean Water Act regulations in 33 CFR 303 that require on-site surface water to meet the water quality criteria for arsenic of 0.0175 µg/L
- RCRA requirements in 40 CFR 264.18 that address the location of a hazardous waste transportation, storage, or disposal facility in a 100-year flood plain
- Flood plain protection requirements in 40 CFR 6, Appendix A.

One of the requirements of an FYR is to determine if there have been any changes to the ARARs recommended in the ROD, or if there are any new requirements that may pertain to the site. One change identified in the Second FYR Report (EPA 2005) was a federal requirement that needs to be considered: the new arsenic MCL, discussed in detail below.

ARARs pertaining to RA activities at the Crystal Chemical Site are divided into chemical-, location-, and action-specific categories and are discussed below.

6.5.1 Chemical-Specific ARARs

Chemical-specific ARARs are usually health- or risk-based numerical values or methodologies that, when applied to site-specific conditions, result in the establishment of numerical values. These values establish the acceptable amount or concentration of a chemical that may remain in or be discharged to the ambient environment. As more than one chemical-specific ARAR exists for a contaminant of concern, the most stringent level will be identified as an ARAR for the RA. As noted above, there was a change in the chemical-specific ARAR for arsenic in ground water from 0.050 mg/L to 0.010 mg.L.

For ground water remediation, the chemical-specific ARAR cited in the original ROD was the MCL standard for arsenic, which at the time was 0.050 mg/L. The MCL for arsenic was reduced from 0.050 to 0.010 mg/L on January 22, 2002, and became effective on January 23, 2006. This change may be relevant to the active ground water remediation ongoing at the site.

EPA issued an ESD in March 1997 (EPA 1997) based on the "Assessment of the Technical Impracticability of Ground-Water Remediation," which granted an ARAR waiver for the 0.050 mg/L arsenic cleanup level for a limited portion of the aquifer. The TI waiver was granted to avoid pumping and treating in fine-grained sediments for an impracticable amount of time (i.e., 200-650 years). The waiver applies to portions of the ground water contamination in the splay deposits or off-channel deposits.

The other portion of the contaminated ground water within the subsurface stream channel is not subject to the ARAR waiver and, therefore, must be remediated to 0.050 mg/L using the extraction and treatment remedy selected in the 1990 ROD. Ground water within the subsurface stream channel currently exceeds both the arsenic MCL specified in the ROD and the current MCL, as indicated by the measured arsenic concentrations from recovery well RW-1. The measured arsenic concentrations from RW-1 have historically ranged from 20 to 80 mg/L since the GWTP began operations. The adoption of the new arsenic MCL of 0.010 mg/L by EPA for the Crystal Chemical Site ground water will result in a longer duration for the extraction and treatment of contaminated ground water in the subsurface stream channel.

6.5.2 Location-Specific ARARs

Location-specific ARARs are restrictions placed on the concentration of hazardous substances or the conduct of activities solely because they are in special locations. No changes to location-specific requirements were identified for the Crystal Chemical Site.

6.5.3 Action-Specific ARARs

Action-specific ARARs are usually technology- or activity-based requirements or limitations on actions taken with respect to hazardous wastes or requirements to conduct certain actions to address particular site circumstances. These requirements are triggered by the particular remedial activities that are selected to accomplish a remedy. No changes to action-specific requirements were identified for the Crystal Chemical Site.

6.6 SITE INSPECTION

A site inspection was conducted on June 15, 2010, to assess the condition of the site and the measures employed to protect human health and the environment. Participants included: (1) Ruben Moya of EPA, (2) Keith Kilson of CRA, (3) Tim Unruh of Hatch Mott MacDonald, (4) Lam Tran of TCEQ, and (5) Cristina Radu of EA. Attachment 2 provides the site inspection

checklist. Attachment 3 provides the interview records. Attachment 4 provides the site inspection photographs.

No evidence of contamination was visible at the site. Details on the site inspection are provided in the following paragraphs.

Monofill Cap

In general, the surface of the monofill cap is in good condition. However, ant hills are present within the capped area; the fact that the grass was about 8 inches high and the ant hills were generally about 1 ft in diameter and 6-8 inches high made it difficult for an observer to notice the hills unless viewing them from directly above. As a consequence, an estimation of the number of hills was not possible. The frequency with which they were encountered indicated that there is likely a considerable number of hills present. In addition, a few patches of sparser vegetation were noted. The former rutting issues due to the use of mowing equipment were still visible during the inspection. Debris accumulation within drains still occurs on the western side of the monofill cap, which was a reoccurring problem also noted during previous routine inspections. Erosion repairs were visible in the southeastern corner by the gate. As mentioned before, the height of grass was generally about 8 inches, which is tall considering that, according to Tim Unruh, the grass cover was mowed just days before the site visit.

During the site visit, it was noted that previous site maps in the historical site reports indicated the location of the PRS as being underneath the monofill cap; this was found to be inaccurate during the inspection. As a consequence, CRA has revised the site layout map which was used as a source for the Figure 2 of this report.

Slurry Wall/PRS

The vegetation over the cover of the slurry wall was in good condition and about 8 inches high. As a result, the location of the slurry was hard to discern without the aid of the PRS wells and the electrical supply to the PRS wells. No erosion or settling was observed over the slurry wall legs; however, due to the height of the grass, some settling may have gone unnoticed. No ant hills or

burrowing animal activity was observed on the slurry wall legs along the 12.5- and 6.5-acre tracts. The caps for the leak detection/clean-out vaults were sealed and the bolts cut, so that the inside of the vaults could not be inspected to determine if rainwater infiltration noted in the semi-annual inspections was still present; given that this system is not operational any more, this fact may be of little consequence.

The eucalyptus tree stands appear to be in good condition. However, their location on the site figures is incorrect as indicated by the position of PRS wells relative to the trees observed during the site inspection. Because the Levy Tract stand has been integrated into the remedy of the site to provide hydraulic control in the containment area, the location of the trees should be depicted with greater accuracy on the site maps.

Ground Water Recovery and Monitoring Network and GWTP

The recovery well (RW-1) was generally in good condition, but the well vault was not secure (hinge is broken and the vault is not locked). Some water was noted in the vault at the time of the inspection.

The GWTP was not operational at the time of the visit and was supposed to be shut down for several more months for the testing of the phytohydraulic control at Shearton Tract. As a result, only small quantities of treatment chemicals were stored at the plant.

Monitoring wells at the site seem to have gradually deteriorated since the previous FYR site visit. Well protective caps are damaged, most wells are not locked, and when locks are present, they are rusted precluding access. Wasps have been noted during the visit and have been reported at the site, which may explain the duct tape used to prevent insects access into the well casings. Well concrete pads are deteriorating and erosion at the base of the wells is visible in a few places.

General Site Conditions

No signs of vandalism were observed during the visit. However, the fence is not continuous around the Shearton Tract; as such, recovery well RW-1, the monitoring wells and piezometers located in this area, and the tree stands are not protected from trespassing and possible vandalism. Due to dense vegetation along the southern boundary of this tract, the fence gap, located to the east of the southern gate was not easily visible or accessible. The paved access road to the GWTP was also in good condition, as was the unpaved road leading to the wells and tree stand in the Shearton Tract. Site signage was visible along the fence surrounding the monofill and the GWTP properties, but was missing along the fence surrounding the Levy Tract. The access gate to this property off of Westpark Drive was not locked, which could permit unrestricted access to the site features located within this area.

6.7 SITE INTERVIEWS

In accordance with the community involvement requirements of the FYR process, key individuals to be surveyed for the FYR were identified by the EPA. Completed survey forms for the following individuals are included in Attachment 3:

- Geoffrey Reeder, UPRR
- Luda Voskov, TCEQ
- Michael Wisniowiecki, CRA
- Tim Unruh, Hatch Mott MacDonald

A list of continuing or unresolved issues discovered during the interview process is as follows:

- Mr. Geoffrey B. Reeder of UPRR stated that, during the review period, a Municipal Settings Designation (MSD) was obtained from the COH. Before this can be submitted to TCEQ, it must be approved by retail public utilities within a 5-mile radius. However, to date, the Memorial Village Water Authority is the only utility that refuses to support the MSD. UPRR is working on alleviating any concerns the utility has and to gain their support. UPRR previously asked EPA for guidance on whether it is possible to remove the on-site monofill and dispose of the contaminated soils off site.

- Ms. Luda Voskov stated that one municipality is not participating in the MSD and as a consequence the treatment plant will need to stay current and open for treatment. Ms. Voskov suggested that alternatives be evaluated for soil treatment so that the cost-effectiveness of the soil remedy is improved and the potential for property reuse is increased.
- Mr. Michael Wisniowiecki of CRA noted the recordation of the ground water deed and the fact that the MSD is pending with TCEQ.
- Mr. Unruh, the Hatch Mott MacDonald site process operator responsible for O&M activities at the Site, stated that he is moderately informed about the Site progress and would like to receive additional information by electronic communication.

No other continuing or unresolved issues were discovered during the interview process. It was noted by Ms. Unruh and Mr. Wisniowiecki that the volume of treated and discharged water has increased significantly during the review period, while the use of chemicals has been drastically reduced.

7.0 TECHNICAL ASSESSMENT

The conclusions presented in this section support the determination that the selected remedies for the Crystal Chemical Site are or are not currently protective of human health and the environment. EPA guidance indicates that to assess the protectiveness of a remedy, three questions shall be answered.

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

- RA Performance:
 - Soil – Based on review of documents, ARARs, and the site inspection, the selected remedy for soil has been completed in accordance with the 1990 ROD and 1992 amended ROD. Cleanup goals and performance standards were achieved as documented by the annual inspection reports.
 - Ground Water:

- Ground water extraction and treatment remedy: the treatment of ground water outside of the TI waiver zone is functioning as designed, but is not meeting the RAO established in the 1990 ROD; the extent of the arsenic plume above the RAO in the 35-ft zone has not been defined and the extent of the capture zone for the recovery well could not be ascertained. Although the performance of the remedy is as intended, it cannot be ascertained whether it extends over the entire impacted area. Moreover, this remedy is currently not operating and a hydraulic control test, which does not include any ground water treatment, is currently being performed.
 - Ground water containment: based on a review of documents, ARARs, and the site inspection, the selected remedy for ground water containment is generally operating in accordance with the 1997 ESD.
- Cost of System and O&M—Total O&M cost for January 2005 through April 2010 was approximately \$1,188,000; this included costs for evaluation of alternative hydraulic control remedies.
- Opportunities for Optimization
 - Soil – In an effort to increase the potential for site redevelopment, UPRR will be evaluating alternatives to the current affected soil containment remedy.
 - Ground Water – Before discontinuing treatment operations, UPRR and their contractor, CRA, have optimized the performance of the GWTP as reflected in the significant increase of treatment capacity, as well as decrease of chemicals use. UPRR and CRA have successfully pursued an alternative to the PRS within the TI waiver zone, obtaining EPA approval for use of phytohydraulic control in lieu of the PRS. They are currently testing the applicability of phytocontrol for containment at the Shearton Tract. However, that area is outside of the TI waiver zone and currently requires ground water treatment.
- Early Indicators of Potential Issues:
 - Soil – Routine maintenance shall be performed in accordance with the O&M Plan, and fencing shall be repaired.
 - Ground Water – At the present time, the alternate remedy for the TI waiver area, phytohydraulic control, appears to be functioning as designed. For the area not included in the TI waiver, potential issues are as follows:
 - The uncertainty of the extent of the area requiring remediation and of the capture zone for RW-1 are actual issues identified.

- As the new arsenic MCL is adopted, the treatment of ground water may have to be reevaluated.
 - Implementation of only hydraulic control, currently being tested, will not satisfy the ground water RAO which requires ground water treatment.
- Implementation of Institutional Controls:
 - Soil – The restriction for non-disturbance for the monofill cap has not been filed at the time of this FYR. The process for implementing this institutional control has not been initiated.
 - Ground Water – Deed recordation that ground water requires post-closure care or engineering control measures for ground water in this area was filed with the County Clerk of Harris County on March 7, 2006. The MSD prohibiting the use of ground water is still pending with TCEQ until Memorial Villages Water Authority approves it.

Question B: Are the assumptions used at the time of remedy selection still valid?

- Changes in Standards and to be Considered :
 - Soil – None.
 - Ground Water – The MCL for arsenic has been changed from 0.050 to 0.010 mg/L, which became effective on January 23, 2006. The new arsenic MCL will need to be considered for both the containment remedy and the area outside of the TI Waiver area.
- Changes in Exposure Pathways—There have been no changes that bear on the protectiveness of the selected remedy.
- Changes in Toxicity and Other Contaminant Characteristics—None.
- Changes in Risk Assessment Methodologies—There have been no changes that bear on the protectiveness of the selected remedy.
- Expected Progress Toward Meeting RAOs:
 - Soil – The RAOs for the remedy have been met with the exception of the institutional controls, which are not in place for protection of the monofill cap.
 - Ground Water – The MSD is still pending for the Site. Outside of the TI waiver area, the extent of the contaminated ground water impact has not been defined,

and as a consequence it cannot be determined if the RAO for the ground water has been met. The new arsenic MCL of 0.010 mg/L will result in a longer duration for the extraction and treatment of contaminated ground water.

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

- No other information has been identified that calls the protectiveness of the selected remedy into question.

Technical Summary

According to documents and data reviewed, the site inspection, and the interviews, the soil remedy generally appears to be functioning as intended by the 1990 ROD and 1992 amended ROD. Based on data reviewed, the site inspection, and the interviews, the remedy for ground water within the TI waiver area appears to be currently functioning as intended by the 1990 ROD and 1997 ESD. The extraction and treatment remedy for arsenic impacted ground water outside the TI waiver area was operating as designed until earlier this year. The extraction and treatment system operations were temporarily shut down in order to conduct a one-year evaluation of a phytohydraulic control approach for the RW-1 area of the Shearton tract.

8.0 INSTITUTIONAL CONTROLS

Institutional controls are generally defined as non-engineered instruments such as administrative and legal tools that do not involve construction or physically changing the Site and that help minimize the potential for human exposure to contamination and/or protect the integrity of a remedy by limiting land and/or resource use. Institutional controls can be used for many reasons, including restriction of Site use, modifying behavior, and providing information to individuals. Institutional controls may include easements, covenants, restrictions, or other conditions on deeds, and/or ground water and/or land use restriction documents. The following sections describe the institutional controls implemented at the Site, the potential effect of future land use plans on institutional controls, and any plans for changes to site contamination status.

8.1 TYPES OF INSTITUTIONAL CONTROLS IN PLACE AT THE SITE

Deed recordation documents for the site and affected off-site properties were prepared by the site owner, UPRR, and were submitted on May 13, 2005 to the COH. The Industrial Solid Waste Certification of Remediation, executed on August 10, 2005, notes that contaminants of concern remaining at the site in ground water require post-closure care or engineering control measures for ground water in this area. Institutional or legal controls placed at the site should ensure appropriate future use. Future land use is considered suitable for nonresidential (i.e., industrial/commercial) purposes in accordance with EPA and TCEQ risk reduction standards applicable at the time of this filing, with the exception of the monofill. Future land use is intended to be nonresidential. This document was filed with the County Clerk of Harris County on March 7, 2006.

An MSD application was submitted to COH on November 1, 2007. MSD Ordinance #2008-253 was approved by COH on March 26, 2008. UPRR submitted an application to the TCEQ on June 23, 2008, to obtain an MSD for the site and adjacent area. An MSD certification issued by TCEQ and supported by the COH would prohibit the use of the affected ground water at the Site, thus eliminating the ground water ingestion exposure pathway for the site itself. In turn, this should promote redevelopment of the property. Discussions on the application of an MSD were held in a meeting between EPA, UPRR, TCEQ, and the COH on November 20, 2007, at the EPA Region 6 Dallas offices. UPRR has received support for the MSD from all municipalities and retail public utilities within the required 5-mile radius with the exception of one municipality, the Memorial Villages Water Authority. UPRR is currently working to obtain a Resolution in Support of the MSD Application from this one remaining municipality; therefore, the TCEQ MSD Application is currently on hold until UPRR can obtain this resolution.

During the FYR, no activities were observed that would have violated either the institutional or physical controls.

8.2 EFFECT OF FUTURE LAND USE PLANS ON INSTITUTIONAL CONTROLS

The future land use for the Site is industrial/commercial. Current and pending institutional controls have accounted for this future so there are no adjustments to the institutional controls currently being implemented are anticipated, with the exception of institutional controls for the protection of the site monofill.

8.3 PLANS FOR CHANGES TO SITE CONTAMINATION STATUS

No changes to the status of the contamination at the Site are anticipated.

9.0 ISSUES

This section describes issues associated with the Crystal Chemical Site identified during the FYR.

The following issues were identified for the soil remedy:

1. No institutional control is in place for protection of the monofill cap in perpetuity.
2. In 2009, one cap inspection was performed. The O&M Plan requires that the minimum frequency of inspections be semi-annually.
3. No surface water samples were collected during the review period. The O&M Plan notes the EPA and COH agreed that surface water samples were to be collected annually from three discharge points.
4. Grass on the monofill cap was not mowed at the 6-inch height required by the O&M Plan.
5. Recurring problems were recorded during the routine inspections as well as the FYR site inspection: debris accumulation at surface water drains, rutting in the cap cover, ant hills, and minor erosion at the southern gate area. A significant number of ant hills were noted during the FYR inspection and an estimation of extent of the problem was precluded by tall vegetation.
6. Monofill cap inspections are not performed in April and October as specified in the O&M Plan.

The following issues were identified for the ground water remedy:

1. The RAO in effect for the area outside of the TI waiver zone is 0.050 mg/L, while the new MCL for arsenic is 0.010 mg/L.
2. The extent of arsenic exceeding the MCL in the 35-foot zone has not been defined.
3. The capture zone for recovery well RW-1 was not depicted in any documentation available for review. Plume capture by RW-1 has not been demonstrated.
4. Since 1996, the GWTP has treated more than 7.8 million gallons of water. During the FYR period, arsenic concentrations in the influent samples have ranged from a high of 36.8 mg/L in 2005 to a low of 6.95 mg/L in 2009. While concentrations have decreased, the influent concentrations are still significantly above the RAO for groundwater.
5. The MSD for the site is pending with TCEQ due to lack of approval from a local utility company.
6. The performance RAO of the PRS wells is to maintain containment inside of TI waiver area such that no more than 1-foot elevation difference between the interior and exterior PRS wells is measured. At two times during the FYR period, this RAO was exceeded. One exceedance occurred before the PRS was shut down.
7. Phytohydraulic control performance in the Levy Tract was tested against the performance of the PRS that did not meet RAOs.
8. Sampling and gauging schedules have changed almost yearly due to pilot testing. The long-term monitoring regimen is not established. Adherence to schedule and commitments is cumbersome to track in present form.
9. Well protective casings, vaults, and pads are starting to deteriorate.
10. Access to the Shearton Tract is not controlled due to lack of fencing beyond the drain on the southern border of the tract. The gate to the Levy Tract was not locked.
11. The location of trees used for phytohydraulic control is not depicted correctly on the site maps.

10.0 RECOMMENDATIONS AND FOLLOW-UP ACTIONS

Table 9 describes the issues and recommendations and follow-up actions associated with the Site that were identified during the third FYR. When signed, Mr. Geoffrey Reeder, representing the responsible party, Union Pacific Railroad Company, will be provided a hard copy of the Crystal Chemical Third Five Year Review with a cover letter denoting the recommendations and follow-up actions identified in the site's Third Five-Year Review. This cover letter will request that the Union Pacific Railroad Company provide the US Environmental Protection Agency (USEPA), Region 6 office with a schedule to complete the identified action items. All of these action items

will be completed within two years. Upon the completion of said identified requirements, the Union Pacific Railroad Company will be required to provide written and photographic documentation that these action items have been completed. Upon receipt of this documentation, a site visit between the USEPA, the Texas Commission of Environmental Quality (TCEQ) and Mr. Geoffrey Reeder will be conducted to inspect the completed work.

11.0 PROTECTIVENESS STATEMENT

The remedy for arsenic impacted soils at the Crystal Chemical Company Superfund Site is protective of human health and the environment and will remain so provided the action items identified in the FYR Report are addressed as described below:

1. File a deed notice for cap protection.
2. Perform semi-annual inspections, as specified in the O&M Plan.
3. Collect annually surface water samples, as specified in the O&M Plan.
4. Mow the grass according to specification. Perform the routine site inspection after grass is mowed so any issues with the monofill cap are visible.
5. Evaluate changes that need to be made to eliminate the recurrence of these issues.
6. Perform the routine monofill cap inspections as scheduled.

A protectiveness determination cannot be made at this time for ground water. The extent of impacted ground water exceeding the arsenic MCL is unknown. Implementing the action items described below will ensure the long term protection of human health and the environment:

1. Issue an Explanation of Significant Differences to change the RAO to the current arsenic MCL.
2. Additional monitoring points are necessary to delineate the extent of the arsenic above the RAO (I.e. MCL). A water well survey will need to be conducted to determine if the impacted water is being utilized. If impacted water is being utilized, appropriate actions will need to be taken to address exposure.
3. After plume delineation, demonstrate the capture zone for recovery well RW-1 through ground water elevation monitoring or modeling.
4. Evaluate the ground water extraction and treatment system's effectiveness toward attaining the ground water RAO and if the TI waiver area needs to be expanded, the implementation of the current remedy needs to be more aggressive, or if other alternatives should be implemented.
5. Determine if the current extent of the MSD is still adequate after the RAO for the area outside of the TI Waiver is changed to the new arsenic MCL. Follow up on the MSD status.

6. Determine if changes in the current PRS are necessary or additional actions need to be implemented to maintain, on average, inward or at least neutral gradient across the slurry wall/natural levee to maintain containment.
7. Evaluate the performance of the phytohydraulic control against the ROD requirements.
8. Gauging and sampling should be adequate for meaningful trend analysis and comparison of data. The schedule of well gauging and sampling should be compiled in tabular format instead of identifying changes in various correspondences and plans. Criteria for performance evaluation should be clearly defined so conclusion and recommendations can be made in a consistent manner.
9. Assess the condition of all well protective casings, covers, and concrete pads and perform maintenance and repairs as necessary.
10. Assess the extent of the uncontrolled perimeter on the southern boundary of Shearton Tract and complete and lock the fence to preclude unauthorized access to areas where remedies are in place.
11. Use Geographic Positioning System to more accurately locate the remedy features on site maps.

12.0 NEXT REVIEW

The Crystal Chemical Site requires ongoing FYRs. The next review will be conducted within the next 5 years, but no later than September 2015.

FIGURES

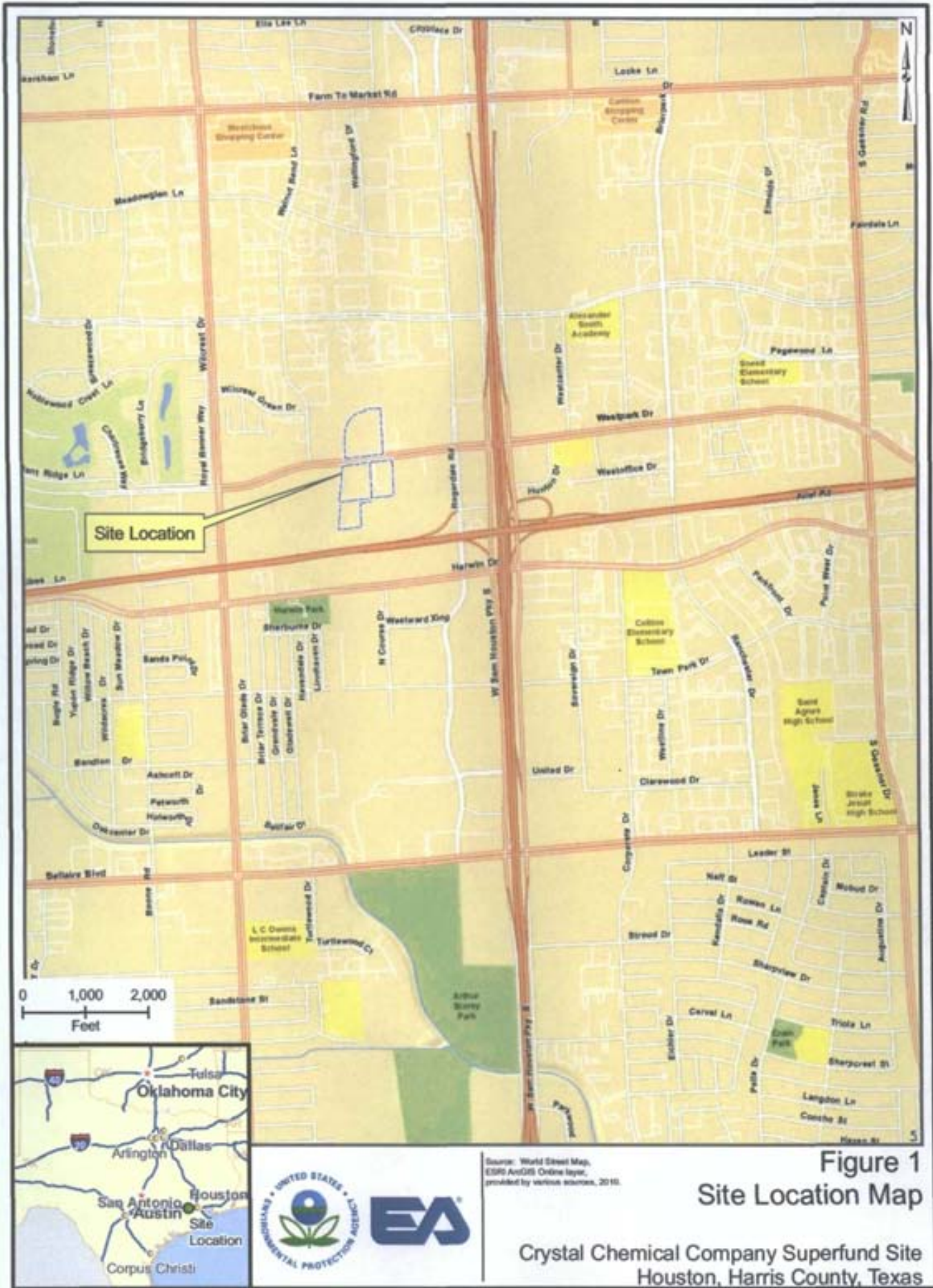


Figure 1
Site Location Map

Source: World Street Map, ESRI ArcGIS Online layer, provided by various sources, 2010.

Crystal Chemical Company Superfund Site
Houston, Harris County, Texas





- Legend:**
- 15-foot Sand Zone Wells
 - ⊕ Containment System Well (35-foot Sand Zone)
 - ▲ 35-foot Sand Zone Wells
 - ⊙ Recovery Well Location
 - 100-foot Sand Zone Well
 - ⊞ Phytohydraulic Control Piezometer (Pilot Test)
 - Chain Link Fence
 - Pressure Relief System
 - - - Existing Slurry Wall
 - ⋯ Subsurface Levee (Approximate Location)
 - Boundary
 - ▨ Approximate Phytohydraulic Control Pilot Test Area (Eucalyptus Tree Plantings)
- NPL - National Priority List
 UPRR - Union Pacific Railroad
 GWTP - Ground Water Treatment Plant

Figure 2
Site Layout Map

Crystal Chemical Company Superfund Site
 Houston, Harris County, Texas



Source: Updated site layout features by Corwedge Rivers and Associates in electronic communication on July 8, 2010
 Image Source: 2009-2008 Texas Orthoregistry Program, Texas Strategic Mapping Program, THRS, 2008

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TABLES

**TABLE 1 CHRONOLOGY OF SITE EVENTS
CRYSTAL CHEMICAL COMPANY SUPERFUND SITE
HOUSTON, HARRIS COUNTY, TEXAS**

Date	Event
1968	Crystal Chemical began production of arsenical, phenolic, and amine-based herbicides.
June 1976	Flooding occurred at the site, causing runoff from process and material storage areas.
1977	Harris County Flood Control ditch No. D 124-00-00 was constructed along the western portion of the site.
December 1977	Texas Department of Water Resources cited operation and maintenance problems for several environmental standard violations.
1978	Crystal Chemical submitted an application to the State of Texas for an on-site deep well injection permit to dispose of wastewaters being stored in four evaporation ponds; permit was denied.
September 1981	Crystal Chemical filed for bankruptcy and abandoned the site.
September 1981 through February 1983	EPA initiated the following emergency removal action activities to stabilize the Site: <ol style="list-style-type: none"> 1. disposed of pond wastewater 2. treated top 12 inches of pond soil with lime and placed back in ponds 3. installed temporary cap 4. sold arsenic trioxide that was stored on site 5. disassembled, decontaminated, and sold buildings and process equipment.
September 1983	Crystal Chemical was added to the National Priorities List.
1983	EPA took measures to further control surface water runoff and site access by constructing drains, and fencing and placing additional fill on site.
1983	Texas Department of Water Resources, through a cooperative agreement with EPA, initiated a site characterization study.
1984	"Final Report Site Investigation Crystal Chemical Company, Houston, Texas" was published citing arsenic as the primary contaminant of concern.
June 1984	Texas Department of Water Resources completed an Initial FS.
December 1984	EPA and Texas Department of Water Resources completed an Addendum FS modifying the selected remedy as a response to public concerns on cost.
October 1986	Passage of the SARA, which called for FS to focus on use of treatment technologies for the site.
May 1987	EPA entered into an Administrative Order of Consent with Southern Pacific to conduct the Supplemental FS.
1988	EPA took additional measures to further control surface water runoff and site access by constructing additional drains, and fencing and placing fill on site.
January 1988	Southern Pacific suspended work on the Supplemental FS.
February 1989	New federal regulations allowing off-site treatability studies were promulgated.
July 1989	Nine water supply wells near the site were sampled, which aided the delineation of the ground water contamination.
September 1989	Southern Pacific requested an extension to complete the Supplemental FS; EPA denied the request.
June 1990	Regulation published identifying <i>in situ</i> vitrification as the best demonstrated available treatment technology for arsenic as a RCRA characteristic waste, as well as a RCRA-listed waste.
May 1990	EPA completed the Supplemental FS.
June 1990	Proposed Plan for the site was released for public comment.
September 1990	ROD for the site was issued by EPA Region 6.
February 1992	Amended Proposed Plan was released for public comment due to the unavailability of the RODs selected soil treatment technology, <i>in situ</i> vitrification.

**TABLE 1 CHRONOLOGY OF SITE EVENTS
CRYSTAL CHEMICAL COMPANY SUPERFUND SITE
HOUSTON, HARRIS COUNTY, TEXAS**

Date	Event
March 1992	EPA entered into an Administrative Order of Consent with Southern Pacific for ground water remedy at the site.
June 1992	The amended ROD for the site was issued by EPA Region 6.
September 1992	EPA issued a Unilateral Administrative Order to Southern Pacific addressing the RD/RA for the site.
November 1994	Southern Pacific implemented the RA Operation and Maintenance Plan to ensure the long-term integrity of the multi-layer cap.
January 1995	EPA approved Soil RA Documentation Report summarizing the construction of the soil remedy design.
September 1995	Construction of portion of slurry wall within boundary of site, and under Westpark Drive; completion of monofill cap.
February 1996	Assessment of the TI of ground water remediation for the site was completed; physical containment of contaminated ground water was the recommended alternative.
November 1996	Construction of GWTP completed.
June 1996	RD Addendum for the slurry wall is issued.
March 1997	Explanation of Significant Differences of the ROD for the ground water remedy was issued.
May 1998	Major modifications to GWTP completed.
August 1998 Revised July 1999	Revised Work Plan for additional investigation of ground water was submitted.
January 1999	GWTP went online with COH.
July - December 1999	A review of historical information and confirmation sampling was conducted on the 12.5-acre tract (north of the site) to identify potential environmental issues prior to approving a proposed property transfer; ownership of this property was required to complete the slurry wall construction.
April 2000	EPA initiates the first FYR; UPRR purchased 12.5-acre tract north of Westpark Drive from Levy estate.
August 2000	Additional monitoring of the 15- and 35-ft zones occurred as defined in the Work Plan for Additional Ground Water Investigation.
September 2002	EPA issued first FYR Report.
June 2002	Eastern and northern portions of slurry wall complete.
October 2002	PRS construction complete with exception of recovery piping under Westpark Drive.
November 2002	Ground water samples collected from Shearton Tract.
August 2003	Final section of PRS installed beneath Westpark Drive; ground water remedy construction complete.
September 2003	Site investigation activities conducted at properties to the west of Shearton Tract.
December 2003	Revised Groundwater Monitoring Plan was issued; ground water monitoring resumed in fourth Quarter 2003.
December 2004	UPRR purchased western 3.8 acres of the Shearton Tract located south of the site.
March 7, 2005	Installation of phytohydraulic control pilot test completed.
June 2005	EPA initiates the second FYR.
September 2005	Second FYR is completed.
February 2006	2005 Annual RA Report is completed.
March 2006	Deed Recordation with Harris County for ground water use.
April 2007	2006 Annual RA Report is completed.
January 2008	2007 Annual RA Report is completed.

**TABLE 1 CHRONOLOGY OF SITE EVENTS
CRYSTAL CHEMICAL COMPANY SUPERFUND SITE
HOUSTON, HARRIS COUNTY, TEXAS**

Date	Event	
March 2008	COH ordinance 2008-253 for Municipal Setting Designation for ground water at the site is approved.	
October 2008	Phytohdraulic Control Pilot Test Report is submitted.	
January 2009	2008 Annual RA Report is completed.	
March 2009	Phytohdraulic Control Pilot Test Proposal, Shearton Tract is submitted.	
November 2009	EPA provides response to the Shearton Tract proposal.	
November 2009	Revision of the Phytohdraulic Control Pilot Test Report, Levy Tract.	
December 2009	Amendment of the Phytohdraulic Control Pilot Test Proposal for Shearton Tract.	
January 2010	Site-Specific Health and Safety Plan.	
January 2010	2009 Annual RA Report is completed.	
March 2010	Third FYR is initiated.	
NOTES: Crystal Chemical Crystal Chemical Company COH City of Houston EPA U.S. Environmental Protection Agency FS Feasibility study Ft Feet/foot FYR Five-year review GWTP Ground water treatment plant PRS Pressure relief system RA Remedial action RCRA Resource Conservation and Recovery Act	RD Remedial design ROD Record of Decision SARA Superfund Amendments and Reauthorization Action of 1986 Shearton Shearton Development, Inc. Southern Pacific Southern Pacific Transportation Company TI Technical impracticability UPRR Union Pacific Railroad Company	

**TABLE 2 ANNUAL OPERATION AND MAINTENANCE COSTS
CRYSTAL CHEMICAL COMPANY SUPERFUND SITE
HOUSTON, HARRIS COUNTY, TEXAS**

Year	Annual Costs (inclusive)	Notes on Activities Performed Outside of the Routine Site Activities
2005	\$331,050	<ul style="list-style-type: none"> • Planted 120 eucalyptus trees and installed 6 piezometers for phytohydraulic control pilot tests • Plugged and abandoned well MW-29 • Replaced 100-ft zone well MW-32 with MW-32A in southeast corner of Levy Tract • Samples interior wells of the containment system as required every 5 years in May 2005.
2006	\$234,771	<ul style="list-style-type: none"> • None
2007	\$228,062	<ul style="list-style-type: none"> • Prepared and submitted the Municipal Settings Designation application to the City of Houston.
2008	\$216,928	<ul style="list-style-type: none"> • Completed and submitted Municipal Settings Designation application to Texas Commission on Environmental Quality. • Began the evaluation of the phytohydraulic control pilot test on Levy Tract, which lasted longer than 1 year.
2009	\$176,295	<ul style="list-style-type: none"> • Completed the evaluation of the phytohydraulic control pilot test on Levy Tract.
2010 (as of April)	\$47,373	<ul style="list-style-type: none"> • Performing 1-year phytohydraulic control pilot test in Shearton Tract; the ground water treatment plant was temporarily shut down.
TOTAL	\$1,187,106	<ul style="list-style-type: none"> • See items listed above for the individual years.

**TABLE 3 VOLUME OF WATER RECOVERED AND DISCHARGED
CRYSTAL CHEMICAL COMPANY SUPERFUND SITE
HOUSTON, HARRIS COUNTY, TEXAS**

Timeframe	Volume Recovered (gallons)	Volume Discharged (gallons)
June–December 2005	217,091	243,718
2006	240,070	233,937
2007	420,109	417,733
2008	2,304,474	1,722,922
2009	2,048,270	1,929,752
January 1-13, 2010*	26,543	56,105
TOTAL JUNE 2005 - JUNE 2010**	5,256,557	4,604,167
* The Ground Water Treatment Plant ceased operation on January 13, 2010.		
** Depicts the entire period of the five-year review.		

**TABLE 4 RANGE OF CONCENTRATIONS FOR INFLUENT AND
EFFLUENT WATER SAMPLES
CRYSTAL CHEMICAL COMPANY SUPERFUND SITE
HOUSTON, HARRIS COUNTY, TEXAS**

Timeframe	Range of Concentrations (mg/L)		Reference
	Influent (RW-1)	Effluent Grab Sample	
June–December 2005	26.1 - 36.8	1 - 2.77*	CRA 2006
2006	19.3 - 30.7	0.831 - 1.85	CRA 2007
2007	19.3 - 41.8	0.038 - 1.13	CRA 2008a
2008	9.9 - 19.0	0.182 - 2.26	CRA 2009a
2009	6.95 - 16	0.331 - 2.26	CRA 2010a
January–June 2010	None collected	1.11 - 1.46	CRA 2010b

NOTE: CRA = Conestoga-Rovers and Associates.

**TABLE 5 FREQUENCY OF WELL GAUGING
CRYSTAL CHEMICAL COMPANY SUPERFUND SITE
HOUSTON, HARRIS COUNTY, TEXAS**

Well ID	Gauging Frequency				
	JUN-DEC 2005	2006	2007	2008	2009
15-ft Zone Wells					
MW-19	Once	Semi-annually	Semi-annually	Annually	Annually
MW-21	Once	Semi-annually	Quarterly	Semi-annually	Annually
35-ft Zone – Interior Wells					
MW-8	Once	Semi-annually	Quarterly	Annually	Not gauged
MW-20	Once	Semi-annually	Semi-annually	Annually	Not gauged
MW-23	Once	Semi-annually	Quarterly	Not measured	Not gauged
MW-SW1	Once	Semi-annually	Monthly April, May, and July through December	August, October, November, and December	Annually
MW-SW3	Once	Semi-annually	Monthly April, May, and July through December	Monthly; January and September missing	Annually
MW-SW5	Once	Semi-annually	Monthly April, May, and July through December	Monthly; January and September missing	Annually
MW-SW7	Once	Semi-annually	Monthly April, May, and July through December	Monthly; January and September missing	Annually
MW-SW9	Once	Semi-annually	Monthly April, May, and July through December	August, October, November, and December	Annually
MW-SW11	Once	Semi-annually	Monthly April, May, and July through December	August, October, November, and December	Annually
PZ-1	Twice	Quarterly	Monthly April, May, and July through December	Monthly starting in March; September missing	Not gauged
PZ-2	Twice	Quarterly	Monthly April, May, and July through December	Monthly starting in March; September missing	Not gauged
PZ-3	Twice	Quarterly	Monthly April, May, and July through December	Monthly starting in March; September missing	Not gauged
35-ft Zone – Exterior Wells					
MW-17A	Once	Semi-annually	Semi-annually	Annually	Not gauged
MW-30	Once	Semi-annually	Three times	Quarterly	Not gauged
MW-33	Once	Semi-annually	Three times	Quarterly	Not gauged
MW-SW2	Once	Semi-annually	Monthly April, May, and July through December	August, October, November, and December	Annually
MW-SW4	Once	Semi-annually	Monthly April, May, and July through December	Monthly; January and September missing	Annually
MW-SW6	Once	Semi-annually	Monthly April, May, and July through December	Monthly; January and September missing	Annually

**TABLE 5 FREQUENCY OF WELL GAUGING
CRYSTAL CHEMICAL COMPANY SUPERFUND SITE
HOUSTON, HARRIS COUNTY, TEXAS**

Well ID	Gauging Frequency				
	JUN-DEC 2005	2006	2007	2008	2009
MW-SW8A	Once	Semi-annually	Monthly April, May, and July through December	Monthly; January and September missing	Annually
MW-SW10	Once	Semi-annually	Monthly April, May, and July through December	August, October, November, and December	Annually
MW-SW12	Once	Semi-annually	Monthly April, May, and July through December	August, October, November, and December	Annually
PZ-4	Twice	Quarterly	Quarterly	Monthly starting in March; September missing	Not gauged
PZ-5	Twice	Quarterly	Quarterly	Monthly starting in March; September missing	Not gauged
PZ-6	Twice	Quarterly	Quarterly	Monthly starting in March; September missing	Not gauged
100-ft Zone Wells					
MW-28A	Once	Semi-annually	Semi-annually	Annually	Annually
MW-31A	Once	Semi-annually	Semi-annually	Annually	Annually
MW-32A	Once	Semi-annually	Semi-annually	Annually	Annually

**TABLE 6 FREQUENCY OF WELL SAMPLING
CRYSTAL CHEMICAL COMPANY SUPERFUND SITE
HOUSTON, HARRIS COUNTY, TEXAS**

Well ID	Sampling Frequency				
	JUN-DEC 2005	2006	2007	2008	2009
15-ft Zone Wells					
MW-19	Not required	Not required	Not required	Not required	Not required
MW-21	Once	Semi-annually	Annually	Annually	Annually
35-ft Zone – Interior Wells					
MW-8	Not required	Not required	Not required	Not required	Not required
MW-20	Not required	Not required	Not required	Not required	Not required
MW-23	Not required	Not required	Not required	Not required	Not required
MW-SW1	Not required	Not required	Not required	Not required	Not required
MW-SW3	Not required	Not required	Not required	Not required	Not required
MW-SW5	Not required	Not required	Not required	Not required	Not required
MW-SW7	Not required	Not required	Not required	Not required	Not required
MW-SW9	Not required	Not required	Not required	Not required	Not required
MW-SW11	Not required	Not required	Not required	Not required	Not required
PZ-1	Not required	Not required	Not required	Not required	Not required
PZ-2	Not required	Not required	Not required	Not required	Not required
PZ-3	Not required	Not required	Not required	Not required	Not required
35-ft Zone – Exterior Wells					
MW-17A	Not required	Not required	Not required	Not required	Not required
MW-30	Not required	Not required	Not required	Not required	Not required
MW-33	Once	Not required	Semi-annually	Annually	Annually
MW-SW2	Once	Semi-annually	Semi-annually	Annually	Annually
MW-SW4	Once	Semi-annually	Semi-annually	Annually	Annually
MW-SW6	Once	Semi-annually	Semi-annually	Annually	Annually
MW-8A	Once	Semi-annually	Semi-annually	Annually	Annually
MW-SW10	Once	Semi-annually	Semi-annually	Annually	Annually
MW-SW12	Once	Semi-annually	Semi-annually	Annually	Annually
PZ-4	Not required	Not required	Not required	Not required	Not required
PZ-5	Not required	Not required	Not required	Not required	Not required
PZ-6	Not required	Not required	Not required	Not required	Not required
100-ft Zone Wells					
MW-28A	Once	Annually	Annually	Annually	Annually
MW-31A	Once	Annually	Annually	Annually	Annually
MW-32A	Once	Annually	Annually	Annually	Annually

**TABLE 7 MAXIMUM ANNUAL CONCENTRATIONS
CRYSTAL CHEMICAL COMPANY SUPERFUND SITE
HOUSTON, HARRIS COUNTY, TEXAS**

Well ID	Maximum Annual Arsenic Concentration (mg/L)				
	2005	2006	2007	2008	2009
15-ft Zone Wells					
MW-21	0.0098 B	0.00637 B	0.00637 B	0.00717 J	0.00348 J
35-ft Zone – Interior Wells					
MW-SW1	Sampled in March 2005	NR	NR	NR	NR
MW-SW3	Sampled in March 2005	NR	NR	NR	NR
MW-SW5	Sampled in March 2005	NR	NR	NR	NR
MW-SW7	Sampled in March 2005	NR	NR	NR	NR
MW-SW9	Sampled in March 2005	NR	NR	NR	NR
MW-SW11	Sampled in March 2005	NR	NR	NR	NR
35-ft Zone – Exterior Wells					
MW-33	0.701	0.839	1.78	0.164	0.114
MW-SW2	<0.034	0.00726 B	<0.0031	<0.00328	0.00481 J
MW-SW4	0.0070 B	<0.00324	<0.0031	<0.00328	0.00126 J
MW-SW6	0.0041 B	<0.00324	0.0083 B	0.00739 J	0.00393 J
MW-SW8A	0.0053 B	0.00351 B	0.0046 B	<0.00328	0.00211 J
MW-SW10	0.0023 B	<0.00324	0.00380 B	<0.00328	0.00244 J
MW-SW12	0.0050 B	0.00391 B	<0.0031	<0.00328	0.00269 J
100-ft Zone Wells					
MW-28A	0.0027 B	<0.00324	<0.0031	<0.00328	0.00137 J
MW-31A	0.0020 B	<0.00324	<0.0031	0.00330 J	0.00241 J
MW-32A	0.0091 B	0.00456 B	0.00360 B	<0.00328	0.00407 J
NOTES: mg/L = Milligrams per liter. B = Also detected in method blank J = Estimated value. NR = Not required.					

**TABLE 8 2010 ARSENIC CONCENTRATIONS
CRYSTAL CHEMICAL COMPANY SUPERFUND SITE
HOUSTON, HARRIS COUNTY, TEXAS**

Well ID	Arsenic Concentration (mg/L)				
	1/27/2010	2/26/2010	3/30/2010	4/24/2010	5/29/2010
MW-30	2.92	0.802	0.472	0.406	0.645
MW-33	0.00908	0.418	0.397	0.392	0.316

NOTE: mg/L = Milligram per liter.

**TABLE 9 RECOMMENDATIONS AND FOLLOW-UP ACTIONS
CRYSTAL CHEMICAL COMPANY SUPERFUND SITE
HOUSTON, HARRIS COUNTY, TEXAS**

Issue	Recommendations and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Follow-up Actions: Affects Remedy Protectiveness (Yes/No)	
					Current	Future
Soil Remedy						
No institutional control is in place for protection of the monofill cap in perpetuity.	File a deed notice for cap protection.	UPRR	EPA	2011	No	Yes
In 2009, only one cap inspection. The O&M Plan requires that the minimum frequency of inspections be semi-annually.	Perform semi-annual inspections as specified in the O&M Plan.	UPRR	EPA	2010	No	Yes
No surface water samples were collected during the review period. The O&M Plan notes the EPA and City of Houston agreed that surface water samples were to be collected annually from three discharge points.	Collect annually surface water samples as specified.	UPRR	EPA	2010	No	Yes
Grass on the monofill cap was not mowed at the 6-inch height required by the O&M Plan.	Mow the grass according to specification. Perform the routine site inspection after grass is mowed so any issues with the monofill cap are visible.	UPRR	EPA	2010	No	Yes
Recurring problems were recorded during the routine inspections as well as the FYR site inspection: debris accumulation at surface water drains, rutting in the cap cover, ant hills, and minor erosion at the southern gate area. A significant number of ant hills were noted during the FYR inspection and an estimation of extent of the problem was precluded by tall vegetation.	Address recurring problems noted during routine inspections including: debris accumulation at surface water drains, rutting in the landfill cover, ant hills, and minor erosion at the southern gate area.	UPRR	EPA	2011	No	Yes
Monofill cap inspections are not performed in April and October as specified in the O&M Plan.	Perform the routine monofill cap inspections as scheduled.	UPRR	EPA	2010	No	Yes

**TABLE 9 RECOMMENDATIONS AND FOLLOW-UP ACTIONS
CRYSTAL CHEMICAL COMPANY SUPERFUND SITE
HOUSTON, HARRIS COUNTY, TEXAS**

Issue	Recommendations and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Follow-up Actions: Affects Remedy Protectiveness (Yes/No)	
					Current	Future
Ground Water Remedy						
RAO in effect for the area outside of the TI waiver zone is 0.050 mg/L, while the new MCL for arsenic is 0.010 mg/L.	Issue an Explanation of Significant Differences to change the RAO to the current arsenic MCL.	EPA	EPA	2010	Yes	Yes
The extent of arsenic exceeding the MCL in the 35-foot zone has not been defined.	Additional monitoring points are necessary to delineate the extent of the arsenic impact above RAO (i.e. MCL). A water well survey will need to be conducted to determine if the impacted water is being utilized. If impacted water is being utilized, appropriate actions will need to be taken to address exposure.	UPRR	EPA	2010	Unknown	Yes
The capture zone for recovery well RW-1 was not depicted in any documentation available for review. Plume capture by RW-1 has not been demonstrated.	After plume delineation, demonstrate the capture zone for recovery well RW-1 through ground water elevation monitoring or modeling.	UPRR	EPA	2010	No	Yes
Since 1996, the GWTP has treated more than 7.8 million gallons of water. During the FYR period, arsenic concentrations in the influent samples have ranged from a high of 36.8 mg/L in 2005 to a low of 6.95 mg/L in 2009. While concentrations have decreased, the influent concentrations are still significantly above the RAO for groundwater.	Evaluate the ground water extraction and treatment system's effectiveness toward attaining the ground water RAO and if the TI waiver area needs to be expanded, the implementation of the current remedy needs to be more aggressive, or if other alternatives should be implemented	EPA	EPA	2010	No	Yes
The MSD for the site is pending with TCEQ due to lack of approval from a local utility company.	Determine if the current extent of the MSD is still adequate after the RAO for the area outside of the TI Waiver is changed to the new arsenic MCL. Follow up on the MSD status.	EPA	EPA	2010	No	Yes

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					Current	Future
The performance RAO of the PRS wells is to maintain containment inside of TI waiver area such that no more than 1-foot elevation difference between the interior and exterior PRS wells is measured. At two times during the FYR period this RAO was exceeded. One exceedance occurred before the PRS was shut down.	Determine if changes in the current PRS are necessary or additional actions need to be implemented to maintain, on average, inward or at least neutral gradient across the slurry wall/natural levee to maintain containment.	EPA	EPA	2010	No	Yes
Phytohdraulic control performance in the Levy Tract was tested against the performance of the PRS that did not meet RAOs.	Evaluate the performance of the phytohdraulic control against the ROD requirements.	EPA	EPA	2010	No	Yes
Sampling and gauging schedules have changed almost yearly due to pilot testing. Long-term monitoring regimen is not established. Adherence to schedule and commitments is cumbersome to track in present form.	Gauging and sampling should be adequate for meaningful trend analysis and comparison of data. The schedule of well gauging and sampling should be compiled in tabular format instead of identifying changes in various correspondences and plans. Criteria for performance evaluation should be clearly defined so conclusions and recommendations can be made in a consistent manner.	UPRR	EPA	2010	No	Yes
Well protective casings, vaults, and pads are starting to deteriorate.	Assess the condition of all well protective casings, covers, and concrete pads and perform maintenance and repairs as necessary.	UPRR	EPA	2010	No	Yes

**TABLE 9 RECOMMENDATIONS AND FOLLOW-UP ACTIONS
CRYSTAL CHEMICAL COMPANY SUPERFUND SITE
HOUSTON, HARRIS COUNTY, TEXAS**

Issue	Recommendations and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Follow-up Actions: Affects Remedy Protectiveness (Yes/No)	
					Current	Future
Access to the Shearton Tract is not controlled due to lack of fencing beyond the drain on the southern border of the tract. Gate to the Levy Tract was not locked.	Assess the extent of the uncontrolled perimeter on the southern boundary of Shearton Tract and complete the fence to preclude unauthorized access to areas where remedies are in place.	UPRR	EPA	2010	Yes	Yes
Location of trees used for phytohydraulic control is not depicted correctly on the site maps.	Use Geographic Positioning System to more accurately locate the remedy features on site maps.	UPRR	EPA	2010	No	No
NOTES: EPA = U.S. Environmental Protection Agency FYR = Five-year review mg/L = Milligram per liter MSD = Municipal Setting Designation mg/L = milligram per liter O&M = Operation and Maintenance Plan RAO = Remedial action objective ROD = Record of Decision TCEQ = Texas Commission on Environmental Quality TI = Technical impracticability UPRR = Union Pacific Railroad						

ATTACHMENT 1
DOCUMENTS REVIEWED

DOCUMENTS REVIEWED

- City of Houston (COH). 2008. Municipal Setting Designation, Ordinance #2008-253. March 26.
- COH. 2010. Renewal of Industrial Waste Permit Number 6109. Issued by the Department of Public Health and Engineering. March 4.
- Coneestoga-Rovers and Associates (CRA). 2004. Letter from Mr. Wisniowiecki, CRA Project Manager, to Mr. Chris Villarreal, EPA Project Manager. August 17.
- CRA. 2006. 2005 Annual Remedial Action Report, Crystal Chemical NPL Site, CERCLA VI-15-92. February.
- CRA. 2007. 2006 Annual Remedial Action Report, Crystal Chemical NPL Site, CERCLA VI-15-92. April.
- CRA. 2008a. 2007 Annual Remedial Action Report, Crystal Chemical NPL Site, CERCLA VI-15-92. January.
- CRA. 2008b. Memorandum on the 29 February Conference Call Regarding the Pressure Relief System and Phytohydraulic Control Pilot Test Status. March 14.
- CRA. 2008c. Revised Phytohydraulic Control Pilot Test Report, Levy Tract. November 30.
- CRA. 2008d. Phytohydraulic Control Pilot Test Report. October 27.
- CRA. 2009a. 2008 Annual Remedial Action Report, Crystal Chemical NPL Site, CERCLA VI-15-92. January.
- CRA. 2009b. Phytohydraulic Control Pilot Test Proposal, Shearton Tract. March 27.
- CRA. 2009c. Revised Phytohydraulic Control Pilot Test Report for Levy Tract. November 30.
- CRA. 2009d. Amended Phytohydraulic Control Pilot Test Proposal, Shearton Tract, Crystal Chemical Site, Alief, Texas. December 10.
- CRA. 2010a. 2009 Annual Remedial Action Report, Crystal Chemical NPL Site, CERCLA VI-15-92. January.
- CRA. 2010b. EPA Docket No. CERCLA VI15-92 – Crystal Chemical Site, Houston, Texas. Monthly Progress Report for the Remedial Action for January 2010. February 2.
- CRA. 2010c. EPA Docket No. CERCLA VI15-92 – Crystal Chemical Site, Houston, Texas. Monthly Progress Report for the Remedial Action for February 2010. March 3.

- CRA. 2010d. EPA Docket No. CERCLA VII5-92 – Crystal Chemical Site, Houston, Texas. Monthly Progress Report for the Remedial Action for March 2010. April 8.
- CRA. 2010e. EPA Docket No. CERCLA VII5-92 – Crystal Chemical Site, Houston, Texas. Monthly Progress Report for the Remedial Action for April 2010. May 6.
- CRA. 2010f. EPA Docket No. CERCLA VII5-92 – Crystal Chemical Site, Houston, Texas. Monthly Progress Report for the Remedial Action for May 2010. June 9.
- CRA. 2010g. EPA Docket No. CERCLA VII5-92 – Crystal Chemical Site, Houston, Texas. Monthly Progress Report for the Remedial Action for June 2010. July 8.
- (U.S.) Environmental Protection Agency (EPA). 1990a. Administrative Order, Docket No. VI-15-92, addressing the Remedial Design/Remedial Action for Crystal Chemical Company Superfund Site. September 3.
- EPA. 1990b. CERCLA Record of Decision for Crystal Chemical Company Site, Houston, Texas. September 27.
- EPA. 1992a. Region 6 Administrative Order, Docket No. VI-11-92, on Consent for the Remedial Design of Ground Water Contamination at Crystal Chemical Company Site. March 31.
- EPA. 1992b. Amended CERCLA Record of Decision for Crystal Chemical Company Site, Houston, Texas. June 16.
- EPA. 1992c. Region 6 Administrative Order, Docket No. VI-15-92, on implementing the soil remedy specified in the amended ROD dated June 16, 1992, at Crystal Chemical Company Site. September 3.
- EPA. 1993. Guidance for Evaluating the Technical Impracticability of Ground Water Restoration (OSWER Directive 9234.2-25. September.
- EPA. 1997. Explanation of Significant Difference for Record of Decision: Crystal Chemical Company Superfund Site, Houston, Texas. March 19.
- EPA. 2001. Comprehensive Five-Year Review Guidance. EPA 540-R-01-007. June.
- EPA. 2005. Second Five-Year Review Report for the Crystal Chemical Company Site, Houston, Harris County, Texas. September 29.
- EPA. 2009. EPA Approval of Phytohydraulic Pilot Test Report for the Shearton Tract (revised). November 13.

Environmental Resources Management (ERM). 2003. Construction Documentation and Remedial Action Report for Ground Water Remedy Crystal Chemical NPL Site. October 6.

ERM. 2004. Operation and Maintenance Plan for Ground Water Remedial Design Addendum – Revised Slurry Wall with Pressure Relief System. March.

Harris County. 2006. Industrial Solid Waste Certification of Remediation; acknowledged on August 10, 2006.

Industrial Compliance. 1994. Remedial Action Operation and Maintenance Plan, prepared for Southern Pacific Transportation Company, San Francisco, California. November 30.

Terranext. 1996. Ground Water Remedial Design Addendum. Slurry Wall Design. June 21.

Union Pacific Railroad (UPRR). 2003a. Groundwater Monitoring Plan. Crystal Chemical Site, Houston, Texas. EPA Docket No. CERCLA VI-15-92. July 23.

UPRR. 2003b. Revision 2 of Groundwater Monitoring Plan. Crystal Chemical Site, Houston, Texas. EPA Docket No. CERCLA VI-15-92. December 12.

ATTACHMENT 2

SITE INSPECTION CHECKLIST

FIVE-YEAR REVIEW SITE VISIT CHECKLIST

I. SITE INFORMATION	
Site Name: Crystal Chemical Company Superfund Site	Date of Inspection: June 15, 2010
Location and Region: Houston, Harris County, Texas	EPA ID: TXD990707010
Agency leading the five-year review: EPA Region 6	Weather/temperature: Hot, humid, temperatures in the upper 90s, rain shower in early afternoon
Remedy Includes: (Check all that apply)	
<input checked="" type="checkbox"/> Landfill cover/containment	<input checked="" type="checkbox"/> Ground water pump-and-treatment
<input checked="" type="checkbox"/> Access controls	<input type="checkbox"/> Surface water collection and treatment
<input checked="" type="checkbox"/> Institutional controls	<input type="checkbox"/> Other
Attachments: <input checked="" type="checkbox"/> Inspection team roster attached <input checked="" type="checkbox"/> Site map attached to report	
II. INTERVIEWS (Check all that apply)	
1. O&M Site Manager <u>M. Wisniowiecki</u> Project Mgr., Conestoga-Rovers & Associates Various	
Name	Title
Date	Date
Interviewed: <input checked="" type="checkbox"/> by mail <input type="checkbox"/> at site <input checked="" type="checkbox"/> by phone	Phone no. (713) 734-3090
Problems, suggestions: <input checked="" type="checkbox"/> <u>Project manager was not present during the site visit; most communication was by electronic mail, with supplemental discussion by telephone; survey questionnaire received and included in this report.</u>	
2. O&M Staff <u>T. Unruh</u> O&M Staff, Process Operator, Hatch Mott, McDonald 6/15/10	
Name	Title
Date	Date
Interviewed: <input checked="" type="checkbox"/> by mail <input checked="" type="checkbox"/> at site <input type="checkbox"/> by phone	Phone no. Not applicable
Problems, suggestions: <input checked="" type="checkbox"/> <u>Interviewed at the site, during the inspection; also submitted a survey questionnaire, included in this report</u>	
3. Local regulatory authorities and response agencies (i.e.; State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.). Fill in all that apply.	
Agency <u>Texas Commission on Environmental Quality</u>	
Contact <u>Tran Lam</u> Local representative	6/15/2010 (713) 767-3559
Name	Title
Date	Phone no.
Problems, suggestions: <input type="checkbox"/> Report attached <u>None</u>	
Agency <u>N/A</u>	
Contact <u>N/A</u>	
Name	Title
Date	Phone no.
Problems, suggestions: <input type="checkbox"/> Report attached	
4. Other interviews (optional): <input checked="" type="checkbox"/> Reports attached	
III. ONSITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)	
1. O&M Documents	
<input checked="" type="checkbox"/> O&M manual (long-term monitoring plan)	<input checked="" type="checkbox"/> Readily available <input checked="" type="checkbox"/> Up to date <input type="checkbox"/> N/A
<input checked="" type="checkbox"/> As-built drawings	<input checked="" type="checkbox"/> Readily available <input checked="" type="checkbox"/> Up to date <input type="checkbox"/> N/A
<input checked="" type="checkbox"/> Maintenance logs (current and cumulative monitoring reports)	<input checked="" type="checkbox"/> Readily available <input checked="" type="checkbox"/> Up to date <input type="checkbox"/> N/A
Remarks: <u>Some information checked at the site, and some received by electronic communication from Mr. Wisniowiecki</u>	

2. Site-Specific Health and Safety Plan		<input checked="" type="checkbox"/> Readily available	<input checked="" type="checkbox"/> Up to date	<input type="checkbox"/> N/A
<input type="checkbox"/> Contingency plan/emergency response plan		<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
Remarks: <u>Site-specific Health and Safety Plan received electronically; no Contingency Plan exists for the site</u>				
3. O&M and OSHA Training Records		<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input type="checkbox"/> N/A
Remarks: <u>On file at Conestoga-Rovers and Associates offices</u>				
4. Permits and Service Agreements				
<input type="checkbox"/> Air discharge permit	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A	
<input checked="" type="checkbox"/> Effluent discharge	<input checked="" type="checkbox"/> Readily available	<input checked="" type="checkbox"/> Up to date	<input type="checkbox"/> N/A	
<input type="checkbox"/> Waste disposal, Publicly Owned Treatment Works	<input type="checkbox"/> Readily available		<input type="checkbox"/>	
Up to date	<input checked="" type="checkbox"/> N/A			
<input type="checkbox"/> Other permits _____	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A	
Remarks:				
5. Gas Generation Records		<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
6. Settlement Monument Records		<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
7. Ground Water Monitoring Records		<input checked="" type="checkbox"/> Readily available	<input checked="" type="checkbox"/> Up to date	<input type="checkbox"/> N/A
8. Leachate Extraction Records		<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
9. Discharge Compliance Records				
<input type="checkbox"/> Air	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A	
<input checked="" type="checkbox"/> Water (effluent)	<input checked="" type="checkbox"/> Readily available	<input checked="" type="checkbox"/> Up to date	<input type="checkbox"/> N/A	
Remarks:				
10. Daily Access/Security Logs		<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
Remarks: <u>None maintained</u>				
IV. O&M COSTS				
1. O&M Organization				
<input type="checkbox"/> State in-house	<input type="checkbox"/> Contractor for State	<input type="checkbox"/> PRP in-house		
<input checked="" type="checkbox"/> Contractor for PRP	<input type="checkbox"/> Other _____			
2. O&M Cost Records				
<input checked="" type="checkbox"/> Readily available	<input checked="" type="checkbox"/> Up to date	<input type="checkbox"/> Funding mechanism/agreement in place		
<input type="checkbox"/> Original O&M cost estimate	<input checked="" type="checkbox"/> Breakdown attached			
<u>Annual costs, as provided by Mr. Wisniowiecki, are included in the five-year review report.</u>				
3. Unanticipated or Unusually High O&M Costs During Review Period				
<u>See five-year review report</u>				
V. ACCESS AND INSTITUTIONAL CONTROLS				
			<input checked="" type="checkbox"/> Applicable	<input type="checkbox"/> N/A
A. Fencing				
1. Fencing damaged		<input checked="" type="checkbox"/> Location shown on site map	<input type="checkbox"/> Gates secured	<input type="checkbox"/> N/A
Remarks: <u>The security fence is 9-ft high and consists of an 8-ft high chain-link fabric and three strands of barbed-wire supported by 45-degree extensions. The fence surrounds the monofill, the ground water treatment plant (GWTP) lot, and the Levy Tract. The fence is not continuous around the Shearton Tract, where the recovery well and several contaminated wells are located; fence is leaning where it crosses the drainage ditch along the southern border of the Shearton Tract, but ground support is not available in the area. The gate to the Levy Tract was not locked.</u>				
B. Other Access Restrictions				
1. Signs and other security measures		<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> N/A	
Remarks: <u>Signs posted around the monofill and GWTP lot. No signs visible around the Levy and Shearton Tracts.</u>				

C. Institutional Controls

1. Implementation and enforcement

Site conditions imply institutional controls not properly implemented Yes No N/A

Site conditions imply institutional controls not being fully enforced Yes No N/A

Type of monitoring (e.g., self-reporting, drive by) Self-reporting for the City of Houston Industrial Waste Permit in place for discharge of treated water. No monofill cover IC currently in place. No reporting necessary for other ground water ICs currently in place, which are: deed recordation with Harris County and Municipal Setting Designation (MSD) approved by City of Houston but pending with TCEQ.

Frequency as treated water is discharged to sewer system As needed, based on analytical sample results.

Responsible party/agency Union Pacific Railroad

Contact Name: Goffrey Reeder Title Manager Date NA Phone no. (281) 350-7197

Reporting is up-to-date Yes No N/A

Reports are verified by the lead agency Yes No N/A

Specific requirements in deed or decision documents have been met Yes No N/A

Violations have been reported Yes No N/A

Other problems or suggestions:

Institutional control for the monofill cap maintenance is not in place; MSD for ground water use still pending with TCEQ upon approval by a local water authority – see report for details.

2. Adequacy Institutional controls are adequate Institutional controls are inadequate N/A

Remarks: Lack of IC is currently adequate, because the property is still owned by the potentially responsible party. Upon sale, not having an IC preventing cap disturbance will be inadequate.

D. General

1. Vandalism/trespassing Location shown on site map No vandalism evident

Remarks: _____

2. Land use changes onsite N/A

Remarks: _____

3. Land use changes offsite N/A

Remarks: The land use is predominantly industrial, which is unlikely to change in the future.

VI. GENERAL SITE CONDITIONS

A. Roads Applicable N/A

Remarks: The roads were in good condition.

B. Other Site Conditions Applicable N/A

Remarks: The site's general appearance was good. GWTP not in use, but appears to be in good condition, should it be restarted for ground water treatment.

VII. LANDFILL COVERS Applicable N/A

A. Landfill Surface

1. Settlement (Low spots) Location shown on site map Settlement not evident

Areal extent _____ Depth _____

Remarks: _____

2.	Cracks	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> Cracking not evident
	Lengths _____	Widths _____	Depths _____
	Remarks: _____		
3.	Erosion	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> Substantial erosion not evident
	Areal extent _____	Depth _____	
	Remarks: <u>Some erosion at the south monofill gate was filled at the time of the visit.</u>		
4.	Holes	<input checked="" type="checkbox"/> Holes evident	<input type="checkbox"/> Holes not evident
	Areal extent _____	Depth _____	
	Remarks: <u>Fairly significant number of ant hills visible on the cap</u>		
5.	Vegetative Cover	<input checked="" type="checkbox"/> Grass	<input checked="" type="checkbox"/> Cover properly established
	<input type="checkbox"/> Trees/Shrubs (indicate size and locations on a diagram) (None)	<input type="checkbox"/> No signs of stress	
	Remarks: <u>Some areas of sparse grass cover were observed</u>		
6.	Alternative Cover (armored rock, concrete, etc.)	<input checked="" type="checkbox"/> N/A	
	Remarks: _____		
7.	Bulges	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> Bulges not evident
	Areal extent _____	Depth _____	
	Remarks: _____		
8.	Wet Areas/Water Damage	<input checked="" type="checkbox"/> Wet areas/water damage not evident	
	<input type="checkbox"/> Wet areas	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> Areal extent _____
	<input type="checkbox"/> Ponding	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> Areal extent _____
	<input type="checkbox"/> Seeps	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> Areal extent _____
	<input type="checkbox"/> Soft subgrade	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> Areal extent _____
	Remarks: _____		
9.	Slope Instability	<input type="checkbox"/> Slides	<input type="checkbox"/> Location shown on site map
	<input checked="" type="checkbox"/> No evidence of slope instability	Areal extent _____	
	Remarks: _____		
B.	Benches	<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A
	Remarks: <u>(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)</u>		
1.	Flows Bypass Bench	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> N/A or okay
	Remarks: _____		
2.	Bench Breached	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> N/A or okay
	Remarks: _____		
3.	Bench Overtopped	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> N/A or okay
	Remarks: _____		
C.	Letdown Channels	<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A
1.	Settlement	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> No evidence of settlement
	Areal extent _____	Depth _____	
	Remarks: _____		
2.	Material Degradation	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> No evidence of degradation
	Material type _____	Areal extent _____	
	Remarks: _____		
3.	Erosion	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> No evidence of erosion
	Areal extent _____	Depth _____	
	Remarks: _____		

4.	Undercutting	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> No evidence of undercutting
	Areal extent _____	Depth _____	
	Remarks: _____		
5.	Obstructions	Type _____	
	<input type="checkbox"/> No obstructions	<input type="checkbox"/> Location shown on site map	
	Areal extent _____	Size _____	
	Remarks: _____		
6.	Excessive Vegetative Growth	Type _____	
	<input type="checkbox"/> No evidence of excessive growth	<input type="checkbox"/> Vegetation in channels does not obstruct flow	
	<input type="checkbox"/> Location shown on site map	Areal extent _____	
	Remarks: Grass height during the site visit was higher than dictated in the O&M Plan.		
D.	Cover Penetrations	<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A
1.	Gas Vents	<input type="checkbox"/> Active	<input type="checkbox"/> Passive
	<input type="checkbox"/> Properly secured/locked	<input type="checkbox"/> Functioning	<input type="checkbox"/> Routinely sampled
	<input type="checkbox"/> Evidence of leakage at penetration	<input type="checkbox"/> Needs O&M	<input type="checkbox"/> Good condition
			<input type="checkbox"/> N/A
	Remarks: _____		
2.	Gas Monitoring Probes	<input type="checkbox"/> Properly secured/locked	<input type="checkbox"/> Functioning
	<input type="checkbox"/> Evidence of leakage at penetration	<input type="checkbox"/> Routinely sampled	<input type="checkbox"/> Good condition
		<input type="checkbox"/> Needs O&M	<input type="checkbox"/> N/A
	Remarks: _____		
3.	Monitoring Wells (within surface area of landfill)	<input type="checkbox"/> Evidence of leakage at penetration	<input type="checkbox"/> Needs O&M
			<input type="checkbox"/> N/A
	Remarks: _____		
4.	Leachate Extraction Wells	<input type="checkbox"/> Properly secured/locked	<input type="checkbox"/> Functioning
	<input type="checkbox"/> Evidence of leakage at penetration	<input type="checkbox"/> Routinely sampled	<input type="checkbox"/> Good condition
		<input type="checkbox"/> Needs O&M	<input type="checkbox"/> N/A
	Remarks: _____		
5.	Settlement Monuments	<input type="checkbox"/> Located	<input type="checkbox"/> Routinely surveyed
			<input type="checkbox"/> N/A
	Remarks: _____		
E.	Gas Collection and Treatment	<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A
1.	Gas Treatment Facilities	<input type="checkbox"/> Flaring	<input type="checkbox"/> Thermal destruction
	<input type="checkbox"/> Good condition	<input type="checkbox"/> Needs O&M	<input type="checkbox"/> Collection for reuse
	Remarks: _____		
2.	Gas Collection Wells, Manifolds, and Piping	<input type="checkbox"/> Good condition	<input type="checkbox"/> Needs O&M
	Remarks: _____		
3.	Gas Monitoring Facilities (e.g., gas monitoring of adjacent homes or buildings)	<input type="checkbox"/> Good condition	<input type="checkbox"/> Needs O&M
		<input type="checkbox"/> N/A	
	Remarks: _____		
F.	Cover Drainage Layer	<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A
1.	Outlet Pipes Inspected	<input type="checkbox"/> Functioning	<input checked="" type="checkbox"/> N/A
	Remarks: _____		
2.	Outlet Rock Inspected	<input type="checkbox"/> Functioning	<input checked="" type="checkbox"/> N/A
	Remarks: _____		
G.	Detention/Sedimentation Ponds	<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A

1. Siltation	Areal extent _____	Size _____
<input type="checkbox"/> N/A	<input type="checkbox"/> Siltation not evident	
Remarks: _____		
2. Erosion	Areal extent _____	Depth _____
<input type="checkbox"/> Erosion not evident		
Remarks: _____		
3. Outlet Works	<input type="checkbox"/> Functioning	<input type="checkbox"/> N/A
Remarks: _____		
4. Dam	<input type="checkbox"/> Functioning	<input type="checkbox"/> N/A
Remarks: _____		
H. Retaining Walls	<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A
1. Deformations	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> Deformation not evident
Horizontal displacement _____	Vertical displacement _____	
Rotational displacement _____		
Remarks: _____		
2. Degradation	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> Degradation not evident
Remarks: _____		
I. Perimeter Ditches/Off-Site Discharge	<input checked="" type="checkbox"/> Applicable	<input type="checkbox"/> N/A
1. Siltation	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> Siltation not evident
Areal extent _____	Depth _____	
Remarks: _____		
2. Vegetative Growth	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> N/A
<input type="checkbox"/> Vegetation does not impede flow		
Areal extent _____	Type _____	
Remarks: _____		
3. Erosion	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> Erosion not evident
Areal extent _____	Depth _____	
Remarks: _____		
4. Discharge Structure	<input checked="" type="checkbox"/> Functioning	<input type="checkbox"/> N/A
Remarks: <u>Debris, mostly dried vegetation, accumulates at drains</u>		
VIII. VERTICAL BARRIER WALLS		
	<input checked="" type="checkbox"/> Applicable	<input type="checkbox"/> N/A
1. Settlement	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> Settlement not evident
Areal extent _____	Depth _____	
Remarks: <u>High grasses encumbered the observation of potential settlement</u>		
2. Performance Monitoring	Type of monitoring: <u>paired wells</u>	
<input type="checkbox"/> Performance not monitored	Frequency <u>variable – see report</u>	<input type="checkbox"/> Evidence of breaching
<u>Head differential elevation measured in interior pressure relief system (PRS) wells not to exceed the ground water elevation in the paired exterior PRS well by more than 1 foot</u>		
Remarks: <u>PRS vaults could not be inspected as they were sealed shut.</u>		
IX. GROUND WATER/SURFACE WATER REMEDIES		
	<input checked="" type="checkbox"/> Applicable	<input type="checkbox"/> N/A
A. Ground Water Extraction Wells, Pumps, and Pipelines	<input checked="" type="checkbox"/> Applicable	<input type="checkbox"/> N/A
1. Pumps, Wellhead Plumbing, and Electrical	<input type="checkbox"/> Good condition	<input checked="" type="checkbox"/> All required wells located
	<input checked="" type="checkbox"/> Needs O&M	<input type="checkbox"/> N/A
Remarks: <u>Deterioration of recovery well vault noted: water accumulated in recovery well vault</u>		
2. Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances		

<input checked="" type="checkbox"/> Good condition <input type="checkbox"/> Needs O&M Remarks: Pipelines mostly underground, so they could not be observed; currently not in use
3. Spare Parts and Equipment <input type="checkbox"/> Readily available <input type="checkbox"/> Good condition <input type="checkbox"/> Requires upgrade <input type="checkbox"/> Needs to be provided Remarks: Recovery/treatment system not operating
B. Surface Water Collection Structures, Pumps, and Pipelines <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A
1. Collection Structures, Pumps, and Electrical <input type="checkbox"/> Good condition <input type="checkbox"/> Needs O&M Remarks:
2. Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances <input type="checkbox"/> Good condition <input type="checkbox"/> Needs O&M Remarks:
3. Spare Parts and Equipment <input type="checkbox"/> Readily available <input type="checkbox"/> Good condition <input type="checkbox"/> Requires upgrade <input type="checkbox"/> Needs to be provided Remarks:
C. Treatment System <input checked="" type="checkbox"/> Applicable <input type="checkbox"/> N/A
1. Treatment Train (Check components that apply) <input checked="" type="checkbox"/> Metals removal <input type="checkbox"/> Oil/water separation <input type="checkbox"/> Bioremediation <input type="checkbox"/> Air stripping <input type="checkbox"/> Carbon absorbers <input checked="" type="checkbox"/> Filters <u>Serfilco 50-micron filters</u> <input checked="" type="checkbox"/> Additive (e.g., chelation agent, flocculent) <input checked="" type="checkbox"/> Others _____ <input checked="" type="checkbox"/> Good condition <input type="checkbox"/> Needs O&M <input checked="" type="checkbox"/> Sampling ports properly marked and functional <input type="checkbox"/> Sampling/maintenance log displayed and up to date <input checked="" type="checkbox"/> Equipment properly identified <input checked="" type="checkbox"/> Quantity of ground water treated annually <u>See report</u> <input type="checkbox"/> Quantity of surface water treated annually _____ Remarks: <u>System shut down for 1 year in January 2010</u>
2. Electrical Enclosures and Panels (Properly rated and functional) <input type="checkbox"/> N/A <input checked="" type="checkbox"/> Good condition <input type="checkbox"/> Needs O&M Remarks: <u>Currently not used</u>
3. Tanks, Vaults, Storage Vessels <input type="checkbox"/> N/A <input checked="" type="checkbox"/> Good condition <input checked="" type="checkbox"/> Proper secondary containment <input type="checkbox"/> Needs O&M Remarks: <u>Currently not used</u>
4. Discharge Structure and Appurtenances <input type="checkbox"/> N/A <input checked="" type="checkbox"/> Good condition <input type="checkbox"/> Needs O&M Remarks: <u>Currently not used</u>
5. Treatment Building(s) <input type="checkbox"/> N/A <input checked="" type="checkbox"/> Good condition (esp. roof and doorways) <input type="checkbox"/> Needs repair <input checked="" type="checkbox"/> Chemicals and equipment properly stored Remarks: <u>Currently not used; minimal quantities of chemicals stored on site</u>
6. Monitoring Wells (Pump-and-treatment remedy)

<input type="checkbox"/> Properly secured/locked <input type="checkbox"/> Functioning <input checked="" type="checkbox"/> Routinely sampled <input type="checkbox"/> Good condition <input checked="" type="checkbox"/> All required wells located <input checked="" type="checkbox"/> Needs O&M <input type="checkbox"/> N/A
Remarks: <u>Functionality of wells was not observed during the site inspection; most wells were not locked; some locks were rusted and could not be opened; above-ground well components require repairs and maintenance</u>
D. Monitored Natural Attenuation <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A
1. Monitoring Wells (Natural attenuation remedy) <input type="checkbox"/> Properly secured/locked <input type="checkbox"/> Functioning <input type="checkbox"/> Routinely sampled <input type="checkbox"/> Good condition <input type="checkbox"/> All required wells located <input type="checkbox"/> Needs O&M <input type="checkbox"/> N/A
Remarks: _____
X. OTHER REMEDIES
If there are remedies applied at the site that are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.
XI. OVERALL OBSERVATIONS
A. Implementation of the Remedy <u>No visual observations made during the site visit provided any indication that the remedy did not function as designed. Site currently under monitoring, with no active remediation being performed; hydraulic control being tested at Shearton Tract. See report for issues identified during data review.</u>
B. Adequacy of O&M <u>Current O&M activities for wells are not sufficient to maintain the wells in good condition. Additional O&M activities at monofill needed to address recurring issues.</u>
C. Early Indicators of Potential Remedy Failure <u>No indicators were observed during the site visit. For indicators based on data review, see report.</u>
D. Opportunities for Optimization <u>See report.</u>

Inspection Team Roster – Crystal Chemical Company Superfund Site

Name	Organization	Title
Ruben Moya	U.S. EPA Region 6	Remedial Project Manager
Keith Kilson	Conestoga-Rovers and Associates	Contractor's representative
Tim Unruh	Hatch, Mott, McDonald	Operations and maintenance staff/process operator
Lam Tran	Texas Commission on Environmental Quality	Houston office representative
Cristina Radu	EA Engineering, Science, and Technology, Inc.	Project Manager

ATTACHMENT 3
INTERVIEW RECORDS

SUPERFUND FIVE-YEAR REVIEW SITE SURVEY

Site Name: Crystal Chemical Company Superfund Site	EPA ID No.: TXD990707010
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Location: Harris County, TX	Date: 6/14/2010
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Contact Made By:

Name: Ruben Moya	Title: Remedial Project Manager	Organization: U.S. EPA
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Telephone No.: (214) 665-2755 E-Mail: Moya.Ruben@epamail.epa.gov	Street Address: 1445 Ross Avenue, Suite 1200 City, State, Zip: Dallas, Texas 75202	
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Name: Cristina Radu	Title: Project Manager	Organization: EA Engineering, Science, and Technology, Inc.
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Telephone No.: (505) 224-9013 E-Mail: cradu@eaest.com	Street Address: 320 Gold Avenue SW, Suite 1210 City, State, Zip: Albuquerque, NM 87102	
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Individual Contacted:

Name: Geoffrey Reeder	Title: Manager, Environmental Remediation	Organization: Union Pacific Railroad
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Telephone No.: 281 350 7197 E-Mail Address: gbreeder@up.com	Street Address: 24125 Aldine Westfield Road City, State, Zip: Spring, TX 77373	
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Survey Questions

The purpose of the five-year review is to evaluate the implementation and performance of the remedy, and to confirm that human health and the environment continue to be protected by the remedial actions that have been performed at the site. This interview is being conducted as a part of the third five-year review for the Crystal Chemical Company Superfund Site. Should you choose to respond, please return your survey form to Cristina Radu at EA Engineering, Science, and Technology, Inc. via e-mail or U.S. Postal Service by July 9, 2010]. The scope of the review is from 2005 to present.

1. What is your general impression of the work conducted at the site during this review period? During the past five years, Union Pacific has improved the site. UP has installed trees to do manage the water and reduce the amount of water that requires treatment and disposal. This improves the visual appeal of the site and reduces the amount of resources needed to operate it.

SUPERFUND FIVE-YEAR REVIEW SITE SURVEY

Site Name: Crystal Chemical Company Superfund Site

EPA ID No.: TXD990707010

Location: Harris County, TX

Date: 6/14/2010

2. From your perspective, what effects have site operations had on the surrounding community? Site operations have minimal effect on the surrounding community.

Survey Questions (Continued)

3. During this review period, are you aware of any community concerns regarding the site or its operation and administration? If so, please provide details. Union Pacific was granted a Municipal Setting Designation (MSD) from the City of Houston. Before this can be submitted to the Texas Commission on Environmental Quality, it must be approved by retail public utilities within a five mile radius. To date, the Memorial Villages Water Authority is the only public utility that refuses to support the MSD. UP is working to alleviate their concerns in order to gain their support.

4. Are you aware of any events, incidents, or activities at the site during this review period, such as vandalism, trespassing, or emergency responses from local authorities? If so, please provide details. The only event that comes close to fitting this category is that a vehicle ran through the corner of the fence. UP repaired the fence and no other incidents have occurred.

5. Do you feel well informed about the site's activities and progress? If not, please indicate how you would like to be informed about the site activities – for example, by e-mail, regular mail, fact sheets, meetings, etc. N/A

SUPERFUND FIVE-YEAR REVIEW SITE SURVEY

Site Name: Crystal Chemical Company Superfund Site

EPA ID No.: TXD990707010

Location: Harris County, TX

Date: 6/14/2010

6. Do you have any comments, suggestions, or recommendations regarding the site's management or operation? N/A

Survey Questions (Continued)

7. Have there been routine communications or activities (site visits, inspections, reporting activities, etc.) conducted by your office regarding the site? If so, please describe the purpose and results. N/A

8. Have there been any complaints, violations, or other incidents related to the site that required a response by your office? If so, please summarize the events and results. N/A

9. Are you aware of any problems or difficulties encountered which impacted the effectiveness of the remedial action or caused a change in operation and maintenance procedures? If so, please describe changes and impacts. Union Pacific has planted trees to manage the ground water. With USEPA approval the pressure relief system was turned off after a pilot study demonstrated the effectiveness of the trees. The recovery well is currently undergoing a similar pilot test to determine whether the trees are effectively controlling the ground water and will allow the discontinuation of the waste water treatment plant.

SUPERFUND FIVE-YEAR REVIEW SITE SURVEY

Site Name: Crystal Chemical Company Superfund Site

EPA ID No.: TXD990707010

Location: Harris County, TX

Date: 6/14/2010

10. Have there been any changes in state or federal environmental standards which may call into question the protectiveness or effectiveness of the remedial action? N/A

Survey Questions (Continued)

11. Do you know of opportunities to optimize the operation, maintenance, or sampling efforts at the site?
See the discussions of the trees in the questions above.

SUPERFUND FIVE-YEAR REVIEW SITE SURVEY

Site Name: Crystal Chemical Company Superfund Site

EPA ID No.: TXD990707010

Location: Harris County, TX

Date: 6/14/2010

Please add any other comments in the space below.

SUPERFUND FIVE-YEAR REVIEW SITE SURVEY

Site Name: Crystal Chemical Company Superfund Site	EPA ID No.: TXD990707010
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Location: Harris County, TX	Date: 6/14/2010
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Contact Made By:

Name: Ruben Moya	Title: Remedial Project Manager	Organization: U.S. EPA
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Telephone No.: (214) 665-2755 E-Mail: Moya.Ruben@epamail.epa.gov	Street Address: 1445 Ross Avenue, Suite 1200 City, State, Zip: Dallas, Texas 75202	
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Name: Cristina Radu	Title: Project Manager	Organization: EA Engineering, Science, and Technology, Inc.
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Telephone No.: (505) 224-9013 E-Mail: cradu@eaest.com	Street Address: 320 Gold Avenue SW, Suite 1210 City, State, Zip: Albuquerque, NM 87102	
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Individual Contacted:

Name: Tim Unruh	Title: Process Operator	Organization: Hatch Mott MacDonald
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Telephone No.: 281-798-6988 E-Mail Address: timothy.unruh@hatchmott.com	Street Address: 2950 Cullen Blvd, Ste 201 City, State, Zip: Pearland, TX 77584	
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Survey Questions

The purpose of the five-year review is to evaluate the implementation and performance of the remedy, and to confirm that human health and the environment continue to be protected by the remedial actions that have been performed at the site. This interview is being conducted as a part of the third five-year review for the Crystal Chemical Company Superfund Site. Should you choose to respond, please return your survey form to Cristina Radu at EA Engineering, Science, and Technology, Inc. via e-mail or U.S. Postal Service by July 9, 2010]. The scope of the review is from 2005 to present.

1. What is your general impression of the work conducted at the site during this review period?

The work done during the three years that I have been associated with the site has been of good quality. The general condition of the site has been improved including fencing repairs, better vegetation control, and treatment plant improvements. During the past three years, the volume of water treated by the plant increased by 500%.

SUPERFUND FIVE-YEAR REVIEW SITE SURVEY

Site Name: Crystal Chemical Company Superfund Site

EPA ID No.: TXD990707010

Location: Harris County, TX

Date: 6/14/2010

2. From your perspective, what effects have site operations had on the surrounding community?

The operations of the site have had little or no effect on the surrounding community. There have been no activities at the site that would pose problems for the people in the area.

Survey Questions (Continued)

3. During this review period, are you aware of any community concerns regarding the site or its operation and administration? If so, please provide details.

None that I am aware of

4. Are you aware of any events, incidents, or activities at the site during this review period, such as vandalism, trespassing, or emergency responses from local authorities? If so, please provide details.

A damaged gate on the NE corner of site was discovered in March, 2010. It was presumed that a vehicle struck it, but no entry to the site was visible. The fencing was not damaged in a way that would allow access to the site and was repaired promptly.

5. Do you feel well informed about the site's activities and progress? If not, please indicate how you would like to be informed about the site activities – for example, by e-mail, regular mail, fact sheets, meetings, etc.

I am kept moderately informed of the site's progress. I would appreciate any information available by email at timothy.unruh@hatchmott.com

SUPERFUND FIVE-YEAR REVIEW SITE SURVEY

Site Name: Crystal Chemical Company Superfund Site

EPA ID No.: TXD990707010

Location: Harris County, TX

Date: 6/14/2010

6. Do you have any comments, suggestions, or recommendations regarding the site's management or operation?

No

Survey Questions (Continued)

7. Have there been routine communications or activities (site visits, inspections, reporting activities, etc.) conducted by your office regarding the site? If so, please describe the purpose and results.

As an O&M operator, I make routine visits to the site to maintain the treatment plant and keep the landscaping and fencing in good condition. There have been no environmental incidents over the period of time that I have been with the site. Activities that I perform are documented and sent to Mike Wisnioweicki at CRA.

8. Have there been any complaints, violations, or other incidents related to the site that required a response by your office? If so, please summarize the events and results.

The alarm at the treatment plant has gone off in the past due to a malfunctioning sensor on one of the doors. No unapproved entry has occurred to my knowledge.

9. Are you aware of any problems or difficulties encountered which impacted the effectiveness of the remedial action or caused a change in operation and maintenance procedures? If so, please describe changes and impacts.

No water was recovered from RW-1 between September 2006 and March 2007 because the discharge line going to the City of Houston was damaged by the power company.

SUPERFUND FIVE-YEAR REVIEW SITE SURVEY

Site Name: Crystal Chemical Company Superfund Site

EPA ID No.: TXD990707010

Location: Harris County, TX

Date: 6/14/2010

10. Have there been any changes in state or federal environmental standards which may call into question the protectiveness or effectiveness of the remedial action?

None that I am aware of

Survey Questions (Continued)

11. Do you know of opportunities to optimize the operation, maintenance, or sampling efforts at the site?

Since I have been operating the plant, chemical usage has been decreased by over 80% reducing treatment costs and chemicals discharged to the City of Houston sewer system. Also, eucalyptus trees have been strategically planted to reduce the need for the treatment facility.

SUPERFUND FIVE-YEAR REVIEW SITE SURVEY

Site Name: Crystal Chemical Company Superfund Site

EPA ID No.: TXD990707010

Location: Harris County, TX

Date: 6/14/2010

Please add any other comments in the space below.

SUPERFUND FIVE-YEAR REVIEW SITE SURVEY

Site Name: Crystal Chemical Company Superfund Site

EPA ID No.: TXD990707010

Location: Harris County, TX

Date: 6/14/2010

Contact Made By:

Name: Ruben Moya

Title: Remedial Project Manager

Organization: U.S. EPA

Telephone No.: (214) 665-2755

E-Mail: Moya.Ruben@epamail.epa.gov

Street Address: 1445 Ross Avenue, Suite 1200

City, State, Zip: Dallas, Texas 75202

Name: Cristina Radu

Title: Project Manager

Organization: EA Engineering, Science, and Technology, Inc.

Telephone No.: (505) 224-9013

E-Mail: cradu@eaest.com

Street Address: 320 Gold Avenue SW, Suite 1210

City, State, Zip: Albuquerque, NM 87102

Individual Contacted:

Name: Michael J. Wisniowiecki, PG

Title: Project Manager

Organization: Conestoga-Rovers & Associates, Inc.

Telephone No.: 713-734-3090

E-Mail Address:
mwisniowiecki@craworld.com

Street Address: 6320 Rothway, Suite 100

City, State, Zip: Houston, TX 77040

Survey Questions

The purpose of the five-year review is to evaluate the implementation and performance of the remedy, and to confirm that human health and the environment continue to be protected by the remedial actions that have been performed at the site. This interview is being conducted as a part of the third five-year review for the Crystal Chemical Company Superfund Site. Should you choose to respond, please return your survey form to Cristina Radu at EA Engineering, Science, and Technology, Inc. via e-mail or U.S. Postal Service by July 9, 2010]. The scope of the review is from 2005 to present.

1. What is your general impression of the work conducted at the site during this review period?

Generally very good, progressing on alternative groundwater approaches.

SUPERFUND FIVE-YEAR REVIEW SITE SURVEY

Site Name: Crystal Chemical Company Superfund Site

EPA ID No.: TXD990707010

Location: Harris County, TX

Date: 6/14/2010

2. From your perspective, what effects have site operations had on the surrounding community?
None, other than deed recordation of affected groundwater and pending TCEQ Municipal Settings Designation (MSD) certification.

Survey Questions (Continued)

3. During this review period, are you aware of any community concerns regarding the site or its operation and administration? If so, please provide details.

None, other than discussion held during community review of pending TCEQ MSD certification (approved by City of Houston, no objections from nearby water well and property owners).

4. Are you aware of any events, incidents, or activities at the site during this review period, such as vandalism, trespassing, or emergency responses from local authorities? If so, please provide details.

None

5. Do you feel well informed about the site's activities and progress? If not, please indicate how you would like to be informed about the site activities – for example, by e-mail, regular mail, fact sheets, meetings, etc.

Yes, I am well informed on the site's activities and progress.

SUPERFUND FIVE-YEAR REVIEW SITE SURVEY

Site Name: Crystal Chemical Company Superfund Site

EPA ID No.: TXD990707010

Location: Harris County, TX

Date: 6/14/2010

6. Do you have any comments, suggestions, or recommendations regarding the site's management or operation?

Continue ongoing maintenance of site facilities in support of groundwater monitoring and containment efforts, consider results of ongoing Shearton Tract pilot test in early 2011 regarding long-term groundwater recovery and treatment requirements.

Survey Questions (Continued)

7. Have there been routine communications or activities (site visits, inspections, reporting activities, etc.) conducted by your office regarding the site? If so, please describe the purpose and results.

Routine communications and activities conducted by CRA include semiannual/annual site inspections of the Pressure Relief System (PRS), slurry wall and monofill cap; submission of Monthly Progress Reports summarizing site activities, submission of Annual Remedial Action Reports, coordination and site visits with EPA and TCEQ representatives regarding site issues, and discussions with Hatch, Mott & MacDonald site representative as needed to discuss Groundwater Treatment Plant and general site maintenance.

8. Have there been any complaints, violations, or other incidents related to the site that required a response by your office? If so, please summarize the events and results.

None

9. Are you aware of any problems or difficulties encountered which impacted the effectiveness of the remedial action or caused a change in operation and maintenance procedures? If so, please describe changes and impacts.

None

SUPERFUND FIVE-YEAR REVIEW SITE SURVEY

Site Name: Crystal Chemical Company Superfund Site

EPA ID No.: TXD990707010

Location: Harris County, TX

Date: 6/14/2010

10. Have there been any changes in state or federal environmental standards which may call into question the protectiveness or effectiveness of the remedial action?

None

Survey Questions (Continued)

11. Do you know of opportunities to optimize the operation, maintenance, or sampling efforts at the site?

Groundwater treatment operations, prior to their 1-year suspension in 2010 for the Shearton Tract Phytohydraulic Pilot Test, had been optimized by increasing groundwater recovery volumes and reducing or eliminating chemicals used in their treatment while remaining within discharge limits. Groundwater monitoring has been reduced from semiannually to annually based on groundwater results and Groundwater Monitoring Plan. Additional optimization of groundwater treatment is ongoing.

SUPERFUND FIVE-YEAR REVIEW SITE SURVEY

Site Name: Crystal Chemical Company Superfund Site

EPA ID No.: TXD990707010

Location: Harris County, TX

Date: 6/14/2010

Please add any other comments in the space below.

ATTACHMENT 4
SITE INSPECTION PHOTOGRAPHS

Site Inspection Photographs
Crystal Chemical Superfund Site Third Five-Year Review



Photograph No. 1
Description: Southeast gate to monofill.
Date: June 15, 2010

Site: Crystal Chemical Superfund Site

Direction: SW



Photograph No. 2
Description: Gate to Shearton Tract (the eastern monofill fence is seen to the right).
Note new fill brought in for erosion repair.
Date: June 15, 2010

Site: Crystal Chemical Superfund Site

Direction: SE

Site Inspection Photographs
Crystal Chemical Superfund Site Third Five-Year Review



Photograph No. 3

Description: View along the south fence of the Ground Water Treatment Plant (GWTP) property neighboring Shearton Tract. Note new fill along fence for erosion repair.

Date: June 15, 2010

Site: Crystal Chemical Superfund Site

Direction: E



Photograph No. 4

Description: Southwest view of Shearton Tract. Eucalyptus trees in the distance.

Date: June 15, 2010

Site: Crystal Chemical Superfund Site

Direction: SW

Site Inspection Photographs
Crystal Chemical Superfund Site Third Five-Year Review



Photograph No. 5

Description: Vegetation along the drainage ditch.

Date: June 15, 2010

Site: Crystal Chemical Superfund Site

Direction: NE



Photograph No. 6

Description: Northwest view of Shearton Tract; monitoring well MW-31A seen in the foreground and recovery well RW-1 in the background.

Date: June 15, 2010

Site: Crystal Chemical Superfund Site

Direction: NW

Site Inspection Photographs
Crystal Chemical Superfund Site Third Five-Year Review



Photograph No. 7
Description: Monitoring well MW-31A; note damaged pad and eroded soil.
Date: June 15, 2010

Site: Crystal Chemical Superfund Site
Direction: S



Photograph No. 8
Description: Protective cap and lock at MW-31A covered in duct tape.
Date: June 15, 2010

Site: Crystal Chemical Superfund Site
Direction: NA

Site Inspection Photographs
Crystal Chemical Superfund Site Third Five-Year Review



Photograph No. 9
Description: Typical setup of dedicated tubing at monitoring wells.
Date: June 15, 2010

Site: Crystal Chemical Superfund Site
Direction: NA



Photograph No. 10
Description: View of recovery well RW-1; well vault is unlocked.
Date: June 15, 2010

Site: Crystal Chemical Superfund Site
Direction: NA

Site Inspection Photographs
Crystal Chemical Superfund Site Third Five-Year Review



Photograph No. 11
Description: View inside the vault at RW-1; note ponded water.
Date: June 15, 2010

Site: Crystal Chemical Superfund Site
Direction: NA



Photograph No. 12
Description: Alternate view inside the vault at RW-1.
Date: June 15, 2010

Site: Crystal Chemical Superfund Site
Direction: NA

Site Inspection Photographs
Crystal Chemical Superfund Site Third Five-Year Review



Photograph No. 13

Site: Crystal Chemical Superfund Site

Description: Detail inside the vault at RW-1; note hole at bottom of well casing in vault; remediation and operation and maintenance (O&M) contractors were not aware of the purpose for that hole.

Date: June 15, 2010

Direction: NA



Photograph No. 14

Site: Crystal Chemical Superfund Site

Description: Detail at RW-1; the float shuts off the pump if the vault floods.

Date: June 15, 2010

Direction: NA

Site Inspection Photographs
Crystal Chemical Superfund Site Third Five-Year Review



Photograph No. 15
Description: Eucalyptus tree stands in Shearton Tract.
Date: June 15, 2010

Site: Crystal Chemical Superfund Site
Direction: S



Photograph No. 16
Description: Detail of vault cover at RW-1; note broken hinge in upper right side corner.
Date: June 15, 2010

Site: Crystal Chemical Superfund Site
Direction: NA

Site Inspection Photographs
Crystal Chemical Superfund Site Third Five-Year Review



Photograph No. 17

Site: Crystal Chemical Superfund Site

Description: View of western Site boundary toward Westpark Drive.

Direction: NW

Date: June 15, 2010



Photograph No. 18

Site: Crystal Chemical Superfund Site

Description: Eucalyptus tree detail, Shearton Tract.

Direction: NA

Date: June 15, 2010

Site Inspection Photographs
Crystal Chemical Superfund Site Third Five-Year Review



Photograph No. 19

Description: Line of piezometers at Shearton Tract; PZ-6 is the closest in the foreground.
Date: June 15, 2010

Site: Crystal Chemical Superfund Site

Direction: SW



Photograph No. 20

Description: PZ-5; note lid is not secured due to ground subsidence.

Date: June 15, 2010

Site: Crystal Chemical Superfund Site

Direction: NA

Site Inspection Photographs
Crystal Chemical Superfund Site Third Five-Year Review



Photograph No. 21
Description: PZ-5 cap detail.
Date: June 15, 2010

Site: Crystal Chemical Superfund Site

Direction: NA



Photograph No. 22
Description: PZ-4; note one bolt not attached.
Date: June 15, 2010

Site: Crystal Chemical Superfund Site

Direction: NA

Site Inspection Photographs
Crystal Chemical Superfund Site Third Five-Year Review



Photograph No. 23
Description: View toward south along western fence.
Date: June 15, 2010

Site: Crystal Chemical Superfund Site
Direction: S



Photograph No. 24
Description: MW-33.
Date: June 15, 2010

Site: Crystal Chemical Superfund Site
Direction: W

Site Inspection Photographs
Crystal Chemical Superfund Site Third Five-Year Review



Photograph No. 25

Site: Crystal Chemical Superfund Site

Description: MW-33 – view toward the Harris County Flood Control District concrete channel.

Date: June 15, 2010

Direction: W



Photograph No. 26

Site: Crystal Chemical Superfund Site

Description: Fence damage at drainage ditch crossing on southern boundary of Shearton Tract.

Date: June 15, 2010

Direction: NA

Site Inspection Photographs
Crystal Chemical Superfund Site Third Five-Year Review



Photograph No. 27
Description: South gate lock.
Date: June 15, 2010

Site: Crystal Chemical Superfund Site

Direction: NA



Photograph No. 28
Description: Well MW-30; metal protective casing cover is broken and was sealed with duct tape.
Date: June 15, 2010

Site: Crystal Chemical Superfund Site

Direction: W

Site Inspection Photographs
Crystal Chemical Superfund Site Third Five-Year Review



Photograph No. 29
Description: MW-30 detail of taped cover.
Date: June 15, 2010

Site: Crystal Chemical Superfund Site
Direction: NA



Photograph No. 30
Description: MW-30 detail with duct tape removed.
Date: June 15, 2010

Site: Crystal Chemical Superfund Site
Direction: NA

Site Inspection Photographs
Crystal Chemical Superfund Site Third Five-Year Review



Photograph No. 31
Description: View of eucalyptus tree stand in Shearton Tract.
Date: June 15, 2010

Site: Crystal Chemical Superfund Site
Direction: SE



Photograph No. 32
Description: Southern tree stand.
Date: June 15, 2010

Site: Crystal Chemical Superfund Site
Direction: SW

Site Inspection Photographs
Crystal Chemical Superfund Site Third Five-Year Review



Photograph No. 33

Site: Crystal Chemical Superfund Site

Description: Ant mound in southwestern corner of Shearton Tract.

Date: June 15, 2010

Direction: NA



Photograph No. 34

Site: Crystal Chemical Superfund Site

Description: Southern fence at Shearton Tract stops shortly after it crosses the drainage ditch.

Date: June 15, 2010

Direction: NA

Site Inspection Photographs
Crystal Chemical Superfund Site Third Five-Year Review



Photograph No. 35
Description: View of RW-1 and tree stand.
Date: June 15, 2010

Site: Crystal Chemical Superfund Site

Direction: S



Photograph No. 36
Description: Southwest corner of monofill fence; hole possibly dug by surveyors the week prior to the site visit.
Date: June 15, 2010

Site: Crystal Chemical Superfund Site

Direction: NW

Site Inspection Photographs
Crystal Chemical Superfund Site Third Five-Year Review



Photograph No. 37
Description: West view along northern monofill fence, from inside of the south gate.
Date: June 15, 2010

Site: Crystal Chemical Superfund Site
Description: West view along northern monofill fence, from inside of the south gate.
Direction: W



Photograph No. 38
Description: Irrigation outlet for the monofill used during the establishment of the vegetative cover.
Date: June 15, 2010

Site: Crystal Chemical Superfund Site
Description: Irrigation outlet for the monofill used during the establishment of the vegetative cover.
Direction: NA

Site Inspection Photographs
Crystal Chemical Superfund Site Third Five-Year Review



Photograph No. 39

Description: West view along western fence of the monofill from the south gate.

Date: June 15, 2010

Site: Crystal Chemical Superfund Site

Direction: N



Photograph No. 40

Description: View of treatment plant from Shearton Tract.

Date: June 15, 2010

Site: Crystal Chemical Superfund Site

Direction: N

Site Inspection Photographs
Crystal Chemical Superfund Site Third Five-Year Review



Photograph No. 41
Description: Monitoring well SW-2.
Date: June 15, 2010

Site: Crystal Chemical Superfund Site

Direction: NA



Photograph No. 42
Description: Monitoring well SW-2 detail – lock is rusted and cannot be opened.
Date: June 15, 2010

Site: Crystal Chemical Superfund Site

Direction: NA

Site Inspection Photographs
Crystal Chemical Superfund Site Third Five-Year Review



Photograph No. 43
Description: Monitoring well SW-1; cover was unlocked; inside view.
Date: June 15, 2010

Site: Crystal Chemical Superfund Site
Direction: NA



Photograph No. 44
Description: Storm drainage along the exterior side of the monofill eastern fence.
Date: June 15, 2010

Site: Crystal Chemical Superfund Site
Direction: NA

Site Inspection Photographs
Crystal Chemical Superfund Site Third Five-Year Review



Photograph No. 45

Site: Crystal Chemical Superfund Site

Description: Access to the pressure relief system (PRS); the cap is sealed and bolts are cut out.

Date: June 15, 2010

Direction: N



Photograph No. 46

Site: Crystal Chemical Superfund Site

Description: View of front site entrance off Westpark Drive.

Date: June 15, 2010

Direction: N

Site Inspection Photographs
Crystal Chemical Superfund Site Third Five-Year Review



Photograph No. 47

Description: View of front entrance gate to Westpark Drive and signage posted.

Date: June 15, 2010

Site: Crystal Chemical Superfund Site

Direction: NW



Photograph No. 48

Description: MW-19, the GWTP, and storage tanks.

Date: June 15, 2010

Site: Crystal Chemical Superfund Site

Direction: S

Site Inspection Photographs
Crystal Chemical Superfund Site Third Five-Year Review



Photograph No. 49

Site: Crystal Chemical Superfund Site

Description: View of northeast corner of the GWTP lot where the fence damaged by a traffic incident was repaired.

Date: June 15, 2010

Direction: NE



Photograph No. 50

Site: Crystal Chemical Superfund Site

Description: Power transformer in northeastern corner of the GWTP lot.

Date: June 15, 2010

Direction: SE

Site Inspection Photographs
Crystal Chemical Superfund Site Third Five-Year Review



Photograph No. 51

Site: Crystal Chemical Superfund Site

Description: View along the interior eastern fence of the GWTP lot.

Date: June 15, 2010

Direction: S



Photograph No. 52

Site: Crystal Chemical Superfund Site

Description: Backflow preventer for discharge water.

Date: June 15, 2010

Direction: W

Site Inspection Photographs
Crystal Chemical Superfund Site Third Five-Year Review



Photograph No. 53
Description: MW-19.
Date: June 15, 2010

Site: Crystal Chemical Superfund Site

Direction: NE



Photograph No. 54
Description: Detail of MW-19.
Date: June 15, 2010

Site: Crystal Chemical Superfund Site

Direction: NA

Site Inspection Photographs
Crystal Chemical Superfund Site Third Five-Year Review



Photograph No. 55
Description: Storage tanks (each green tank is 20,000-gallon usable capacity).
Date: June 15, 2010

Site: Crystal Chemical Superfund Site
Direction: S



Photograph No. 56
Description: Detail of effluent valve at storage tanks.
Date: June 15, 2010

Site: Crystal Chemical Superfund Site
Direction: NA

Site Inspection Photographs
Crystal Chemical Superfund Site Third Five-Year Review



Photograph No. 57

Description: View of the top of the blue storage tank.

Date: June 15, 2010

Site: Crystal Chemical Superfund Site

Direction: E



Photograph No. 58

Description: Influent line.

Date: June 15, 2010

Site: Crystal Chemical Superfund Site

Direction: N

Site Inspection Photographs
Crystal Chemical Superfund Site Third Five-Year Review



Photograph No. 59

Site: Crystal Chemical Superfund Site

Description: Ports for connecting treatment chemicals; northern exterior wall of the GWTP.

Date: June 15, 2010

Direction: S



Photograph No. 60

Site: Crystal Chemical Superfund Site

Description: Southeast corner of monofill; bare dirt is from erosion backfilling that took place the week prior to the site visit.

Date: June 15, 2010

Direction: SW

Site Inspection Photographs
Crystal Chemical Superfund Site Third Five-Year Review



Photograph No. 61

Description: Animal activity – ant mound on the monofill cap, along the southern edge.

Date: June 15, 2010

Site: Crystal Chemical Superfund Site

Direction: NA



Photograph No. 62

Description: Sparse vegetation on southern edge of the monofill cap.

Date: June 15, 2010

Site: Crystal Chemical Superfund Site

Direction: NE

Site Inspection Photographs
Crystal Chemical Superfund Site Third Five-Year Review



Photograph No. 63

Site: Crystal Chemical Superfund Site

Description: Variation in vegetative cover density along the southern edge of the monofill cap.

Date: June 15, 2010

Direction: NW



Photograph No. 64

Site: Crystal Chemical Superfund Site

Description: Ant mound.

Date: June 15, 2010

Direction: NA

Site Inspection Photographs
Crystal Chemical Superfund Site Third Five-Year Review



Photograph No. 65

Site: Crystal Chemical Superfund Site

Description: Stressed vegetative monofill cover.

Date: June 15, 2010

Direction: W



Photograph No. 66

Site: Crystal Chemical Superfund Site

Description: Example of typical ant hill. Note grass height over 8 inches; mowing supposedly took place just before the site inspection, suggesting grass is likely cut too high.

Date: June 15, 2010

Direction: NA

Site Inspection Photographs
Crystal Chemical Superfund Site Third Five-Year Review



Photograph No. 67

Site: Crystal Chemical Superfund Site

Description: Ruts in southwestern corner of the monofill cap.

Date: June 15, 2010

Direction: NE



Photograph No. 68

Site: Crystal Chemical Superfund Site

Description: Drain along the western interior fence of the monofill; note accumulation of debris.

Date: June 15, 2010

Direction: W

Site Inspection Photographs
Crystal Chemical Superfund Site Third Five-Year Review



Photograph No. 69

Site: Crystal Chemical Superfund Site

Description: View of drain along western border of landfill.

Date: June 15, 2010

Direction: W



Photograph No. 70

Site: Crystal Chemical Superfund Site

Description: Drain and debris accumulation along the western monofill fence.

Date: June 15, 2010

Direction: W

Site Inspection Photographs
Crystal Chemical Superfund Site Third Five-Year Review



Photograph No. 71

Site: Crystal Chemical Superfund Site

Description: Western monofill fence; note no indication the slurry wall follows the edge of the monofill.

Date: June 15, 2010

Direction: S



Photograph No. 72

Site: Crystal Chemical Superfund Site

Description: Monofill fence and western slope.

Date: June 15, 2010

Direction: S

Site Inspection Photographs
Crystal Chemical Superfund Site Third Five-Year Review



Photograph No. 73

Site: Crystal Chemical Superfund Site

Description: Northern monofill fence just south of Westpark Drive.

Date: June 15, 2010

Direction: E



Photograph No. 74

Site: Crystal Chemical Superfund Site

Description: View along the top of the monofill toward the GWTP.

Date: June 15, 2010

Direction: SE

Site Inspection Photographs
Crystal Chemical Superfund Site Third Five-Year Review



Photograph No. 75
Description: Ant hills along the northern edge of the monofill.
Date: June 15, 2010

Site: Crystal Chemical Superfund Site
Direction: NA



Photograph No. 76
Description: Rut in the northeast corner of monofill about 4 inches wide.
Date: June 15, 2010

Site: Crystal Chemical Superfund Site
Direction: NE

Site Inspection Photographs
Crystal Chemical Superfund Site Third Five-Year Review



Photograph No. 77
Description: View of GWTP from on top of the monofill.
Date: June 15, 2010

Site: Crystal Chemical Superfund Site
Direction: SE



Photograph No. 78
Description: Entry to the Levy Tract; note no signage posted on fence.
Date: June 15, 2010

Site: Crystal Chemical Superfund Site
Direction: NE

Site Inspection Photographs
Crystal Chemical Superfund Site Third Five-Year Review



Photograph No. 79
Description: MW-32A
Date: June 15, 2010

Site: Crystal Chemical Superfund Site

Direction: SE



Photograph No. 80
Description: PRS well MW-SW-3; note electrical box for the PRS in background, marked by yellow tape during mowing.
Date: June 15, 2010

Site: Crystal Chemical Superfund Site

Direction: E

Site Inspection Photographs
Crystal Chemical Superfund Site Third Five-Year Review



Photograph No. 81
Description: Levy Tract eucalyptus tree stand.
Date: June 15, 2010

Site: Crystal Chemical Superfund Site

Direction: N



Photograph No. 82
Description: Piezometer PZ-1.
Date: June 15, 2010

Site: Crystal Chemical Superfund Site

Direction: NA

Site Inspection Photographs
Crystal Chemical Superfund Site Third Five-Year Review



Photograph No. 83
Description: PRW well MW-SW4.
Date: June 15, 2010

Site: Crystal Chemical Superfund Site

Direction: NA

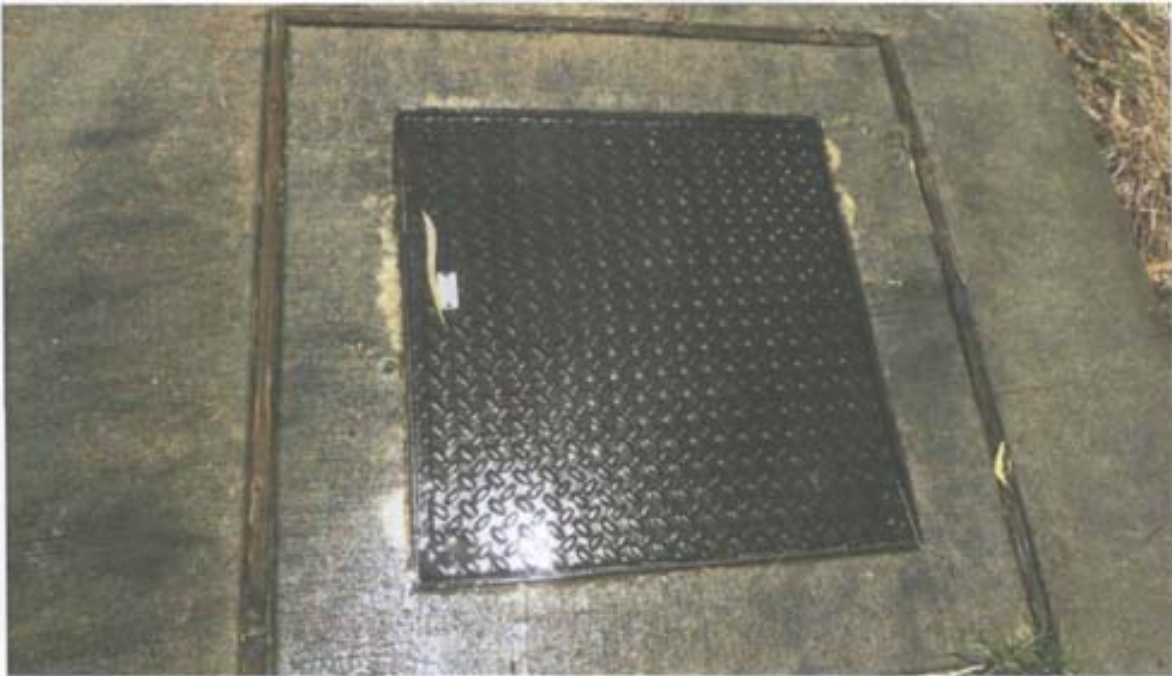


Photograph No. 84
Description: PRS electrical box.
Date: June 15, 2010

Site: Crystal Chemical Superfund Site

Direction: NA

Site Inspection Photographs
Crystal Chemical Superfund Site Third Five-Year Review



Photograph No. 85
Description: PRS well MW-SW3.
Date: June 15, 2010

Site: Crystal Chemical Superfund Site

Direction: NA



Photograph No. 86
Description: PRS well MW-SW6; Levy Tract eucalyptus tree stand in the background.
Date: June 15, 2010

Site: Crystal Chemical Superfund Site

Direction: SW

Site Inspection Photographs
Crystal Chemical Superfund Site Third Five-Year Review



Photograph No. 87

Description: View along Western boundary of slurry wall at Levy Tract.

Date: June 15, 2010

Site: Crystal Chemical Superfund Site

Direction: SW



Photograph No. 88

Description: Influent from RW-1 at GWTP.

Date: June 15, 2010

Site: Crystal Chemical Superfund Site

Direction: NA

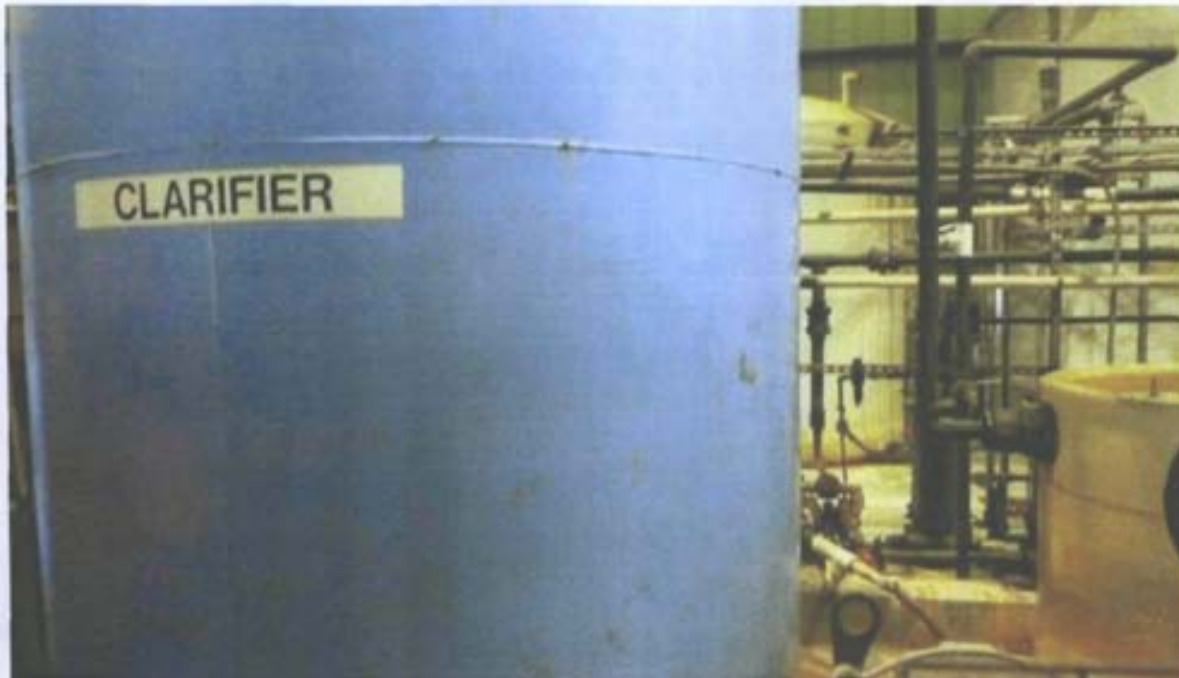
Site Inspection Photographs
Crystal Chemical Superfund Site Third Five-Year Review



Photograph No. 89
Description: Control panel.
Date: June 15, 2010

Site: Crystal Chemical Superfund Site

Direction: NA



Photograph No. 90
Description: Clarifier and connection to filter feed tank.
Date: June 15, 2010

Site: Crystal Chemical Superfund Site

Direction: NA

Site Inspection Photographs
Crystal Chemical Superfund Site Third Five-Year Review



Photograph No. 91
Description: Connection from the clarifier to the filter feed tank.
Date: June 15, 2010

Site: Crystal Chemical Superfund Site
Direction: NA



Photograph No. 92
Description: Serfilco 50-micron filters.
Date: June 15, 2010

Site: Crystal Chemical Superfund Site
Direction: NA

Site Inspection Photographs
Crystal Chemical Superfund Site Third Five-Year Review



Photograph No. 93

Site: Crystal Chemical Superfund Site

Description: Air compressors (primary to the left, backup up to right); all pumps are air driven.

Date: June 15, 2010

Direction: NA



Photograph No. 94

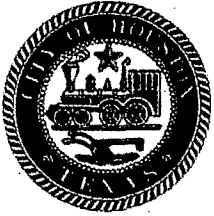
Site: Crystal Chemical Superfund Site

Description: Waste material from ground water treatment.

Date: June 15, 2010

Direction: NA

ATTACHMENT 5
DEED RECORDATION



CITY OF HOUSTON
Department of Public Works and Engineering

Annise D. Parker

Mayor

Michael S. Marcotte, P.E., D.WRE, BCEE
Director
P.O. Box 1562
Houston, Texas 77251-1562

T. 713 837-0037
F. 713 837-0040
www.houstontx.gov

March 4, 2010

**UNION PACIFIC RAILROAD
24125 ALDINE WESTFIELD
SPRING, TX 77373-9015**

**ATTN: GEOFFEY REEDER
MANAGER/ENV. SITE REMEDIATION**

GENTLEMEN:

Attached is your firm's Industrial Waste Permit. Please refer to the permit number in all future correspondence. A copy of page one (1) of this permit should be exhibited in an area for public viewing.

Part II of this permit is the City's Industrial Waste Ordinance; Chapter 47, Article V. (Disposal of Industrial Wastes Through City Sewer System).

Also attached Please find a posting for accidental discharges to the sanitary sewer system. The posting should be placed in your process area in accordance with Section 47-195(c) of the Ordinance.

Should you have any questions, please call the Industrial Wastewater Service at (281) 575-2800.

Sincerely,

Clyde Smith
Environmental Investigator V
Industrial Wastewater Service
Department of Public Works & Engineering

CITY OF HOUSTON

Industrial Waste Permit Number: 6109

Department Of Public Works And Engineering
Wastewater Operations
Industrial Wastewater Service
10500 Bellaire Blvd.
Houston, Texas 77072
Phone: (281) 575-2800

Authorization to discharge under City of Houston Industrial Waste Ordinance
Chapter 47; Article V.

UNION PACIFIC RAILROAD


is authorized to discharge into the City's collection system raw liquid waste in accordance with the effluent limitations, monitoring requirements and other conditions set forth in this permit at the following location:

10965 WESTPARK
HOUSTON, TX 77042

Regulated Waste Offsite Disposal: Yes
EPA Categorical Limits Applicable: No
Significant Industrial User: No
Pretreatment: Yes
Category: GROUNDWATER REMEDIATION
Product/Service: GROUNDWATER REMEDIATION - ARSENIC CONTAMINATION
NAICS Code(s): 562910
Key Map No.: 489-Z Sewer Map No.: 36A
Treatment Plant: BELTWAY

This permit shall become effective on 04/04/2010 and the authorization to discharge shall expire at midnight 04/04/2012.

Signed this 4th day of March 2010


Clyde Smith
Environmental Investigator V
City of Houston Pretreatment Program

PART I

SECTION A. EFFLUENT LIMITS AND SPECIAL PROVISIONS

1. **Local Limits** - City Ordinance: Chapter 47, Article V.; Disposal of Industrial Waste Through City Sewer System:
2. **Special Provisions:**

Endorsement D3 - Special Sampling Requirement

Endorsement P17 - City Discharge Limits for Expected Pollutants: pH and Arsenic

Endorsement U2 - Sewer Rate for Industrial Accounts - Industry is not monitored for BOD / TSS

SECTION B. WATER ACCOUNTS AND SAMPLING POINTS

1. **Water and/or Sewer Account Number(s):**
4327-3532-901 5010-0017-201

2. **Sampling Points:**

Sample Point Number: **1**
Sample Point Location: **N.E. CORNER OF REM BLDG.**
Sample Point Description: **TAP#1**
Discharge Limits: **LOCAL**
Discharge Type: **Batch**

Permitted Discharges, Process Operations and City Discharge Limits

Authorized Pollutants and Discharge Limits:

The permittee is authorized to discharge the pollutants, at the allowable City of Houston discharge limits, which are listed on permit endorsement P(x). "x" will be a number after the P. There are different P endorsements used for different industries. The authorized pollutants are those pollutants that have a potential to be present, or those pollutants that the City will monitor for, in the wastewater that is discharged to the sanitary sewer from the process operations that were at the permitted facility the time this permit was issued.

Process Operation Changes & Unauthorized Pollutant Discharges:

If the permittee modifies, adds or removes an industrial process operation, the permittee is required to provide written notification to the Industrial Wastewater Service to include a description of the process change and information concerning any changes in the type and or concentration of pollutants expected in the permittee's industrial discharge to the City' sanitary sewer.

The permittee is required to notify the Industrial Wastewater Service before discharging a wastestream with an unauthorized pollutant to the City's sanitary sewer. The permittee's authorized pollutants are listed on permit endorsement P.

Part 2 of this permit is the City of Houston's Industrial Waste Ordinance; Chapter 47 Article V. (Disposal of Industrial Wastes Through City Sewer System). The City of Houston's sanitary sewer discharge limits and prohibited Discharges are listed in Section 47-194 (Standard of Quality) of the Industrial Waste Ordinance.

Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS):

If a permitted discharge has an average BOD5 concentration exceeding 350 mg/L or an average TSS concentration exceeding 375 mg/L, the permittee will have a sewer rate surcharge. If the City is monitoring for BOD and TSS endorsement U will be part of this permit. If there are any water meter accounts or discharge meter accounts that are surcharged, permit endorsement U will provide the current surcharged sewer billing rate.

Bypass:

(a.) Definitions.

- (1) " Bypass" means the intentional diversion of wastestreams from any portion of a treatment facility.
- (2) "Severe property damage" means substantial physical damage to property, damage to the treatment facilities which causes them to become in operable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

Bypass (Continued):

(b) Bypass not violating applicable Pretreatment Standards or requirements.

An Industrial User may allow any bypass to occur which does not cause Pretreatment Standards or Requirements to be violated, but only if it also is for the essential maintenance to assure efficient operation. These bypasses are not subject to the provision of paragraphs (c) and (d) of this section.

(c) Notice.

- (1) If an Industrial User knows in advance of the need for a bypass, it shall submit prior notice to the City of Houston's Industrial Wastewater Service (Control Authority); if possible, at least ten days before the date of the bypass.
- (2) An Industrial User shall submit oral notice of an unanticipated bypass that exceeds applicable Pretreatment Standards to the Control Authority within 24 hours from the time the Industrial User becomes aware of the bypass. A written submission shall also be provided within five days of the time that the Industrial User becomes aware of the bypass. The written submission shall contain a description of the bypass and its cause; the duration of the bypass, including exact dates and times, and, if the bypass has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate,

and prevent reoccurrence of the bypass. The Control Authority may waive the written report on a case-by-case basis if the oral report has been received within 24 hours.

(d) Prohibition of bypass.

- (1) Bypass is prohibited, and the Control Authority may take enforcement action against an Industrial User for a bypass, unless;
 - (i) Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;
 - (ii) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occurred during normal periods of equipment downtime or preventative maintenance; and
 - (iii) The Industrial User submitted notices as required under paragraph (c) of this Bypass Section of this Industrial Waste Permit.

- (2) The Control Authority may approve an anticipated bypass, after considering its adverse effects, if the Control Authority determines that it will meet the three conditions listed in paragraph (d) (1) of this section.

Slug Load / Slug Discharge and Slug Discharge Control Plans:

Slug Load or Slug Discharge is defined as any discharge of a non-routine, episodic nature, including but not limited to an accidental spill or a non-customary batch discharge, which has a reasonable potential to cause interference or pass through, or in any other way violate the POTW's regulations, local limits or permit conditions.

Industrial Users of the City's sanitary sewer are required to notify the Industrial Wastewater Service immediately of any change at its facility that affects the potential for a slug discharge to the sanitary sewer.

The City will determine by inspection of the permitted facility if the potential exists for a slug discharge to the sanitary sewer. If it is determined that the potential exists for a slug discharge a Slug Discharge Control Plan or other action to prevent / control a slug discharge will be required. The permittee's Industrial Waste Permit may be amended to add a permit endorsement to require a Slug Discharge Control Plan. The permit endorsement will include the minimum elements of an acceptable Slug Discharge Control Plan.

ENDORSEMENT D3

The following Sampling and Reporting Requirements for batch discharges are hereby added to Industrial Waste Permit No.6109:

To demonstrate compliance with the sanitary sewer discharge limits of Industrial Waste Permit No.6109 your firm shall perform self-monitoring of the discharge from the groundwater remediation treatment system during the months of May and November of each year.

The self-monitoring sample collection shall be performed as follows:

Collect one (1) grab sample at Sample Point No. One (1) (see page two of permit).

Have the sample analyzed in accordance with 40 CFR Part 136 for:

Arsenic
pH

Review Attachment L (attached to this permit Endorsement D3) and submit the analytical laboratory report and the chain of custody form(s) on or before the fifteen (15th) day of the following month.

Sample results for the sample collected during May are due on or before June 15th of each year.

Sample results for the sample collected during November are due on or before December 15th of each year.

If your firm does not have a batch discharge during May or November the self-monitoring sampling requirement will be for the next batch discharge that follows the months of May or November. The analytical laboratory reports should be submitted within three (3) weeks of the batch discharge date.

ENDORSEMENT P17

AUTHORIZED POLLUTANTS AND CITY DISCHARGE LIMITS

Authorized Pollutant

Grab Sample Limit

pH pH value for a grab sample:

Shall not be less than 5

Shall not be greater than 11

Grab Sample Limit

Composite Sample Limit

Arsenic 3.0 mg/L 2.0 mg/L

ENDORSEMENT U2

Sewer User Charge for Industries that are not monitored for BOD or TSS

The following information concerns the establishment of your firm's wastewater billing rate:

The process operations and or services at the permitted facility are not expected to contribute a wastewater discharge to the City's sanitary sewer that exceeds an average biochemical oxygen demand (BOD) concentration of 350 mg/L or an average total suspended solids (TSS) concentration of 375 mg/L.

Therefore, water/sewer accounts, that have been identified as industrial accounts, for each City water meter or sewer discharge meter that services the permitted facility will be billed for sewer usage at the base rate. Currently the base rate is \$5.08 per 1,000 gallons.

PART II
CITY OF HOUSTON
INDUSTRIAL WASTE ORDINANCE

A MUNICIPAL SETTING DESIGNATION ORDINANCE PROHIBITING THE USE OF DESIGNATED GROUNDWATER FROM BENEATH A 15.6635-ACRE (682,302 SQUARE FOOT) TRACT OF LAND OUT OF THE DAIRY SUBDIVISION, A SUBDIVISION RECORDED IN VOLUME 1, PAGE 23 AND BLOCK I, RESERVE "A" OF CORPORATE CENTRE WESTCHASE, A SUBDIVISION RECORDED AT FILM CODE NUMBER 528260, BOTH OF THE HARRIS COUNTY MAP RECORDS, AND SAME BEING OUT OF THE RESIDUE OF A 99.416-ACRE TRACT CONVEYED TO TEXAS AND NEW ORLEANS RAILROAD COMPANY AS RECORDED IN VOLUME 3091, PAGE 298 AND VOLUME 3091, PAGE 305 OF THE HARRIS COUNTY DEED RECORDS (H.C.D.R.), WEST PARK DRIVE, A 100-FOOT RIGHT-OF-WAY (R.O.W.) AS RECORDED IN THE HARRIS COUNTY CLERK'S FILE NUMBER (H.C.C.F. NO.) F324484, THE RESIDUE OF A 6.7912-ACRE TRACT CONVEYED TO CRYSTAL CHEMICAL COMPANY AS RECORDED IN H.C.C.F. NO. G154538, THE HARRIS COUNTY FLOOD CONTROL DISTRICT EASEMENTS AS RECORDED IN VOLUME 6872, PAGE 340 AND VOLUME 7185, PAGE 146 H.C.D.R., AND A CALLED 3.8001-ACRE TRACT CONVEYED TO UNION PACIFIC RAILROAD COMPANY AS RECORDED IN H.C.C.F. NO. X654066, LOCATED IN THE HENRY WOODRUFF SURVEY, ABSTRACT 844, CITY OF HOUSTON, HARRIS COUNTY, TEXAS, GENERALLY LOCATED NEAR THE INTERSECTION OF BELTWAY 8 AND WESTPARK DRIVE; AND SUPPORTING ISSUANCE OF A MUNICIPAL SETTING DESIGNATION BY THE TEXAS COMMISSION ON ENVIRONMENTAL QUALITY; PROVIDING FOR SEVERABILITY; AND DECLARING AN EMERGENCY.

* * * * *

WHEREAS, Subchapter W, "Municipal Setting Designations," of Chapter 361, "Solid Waste Disposal Act," of the Texas Health and Safety Code authorizes the Texas Commission on Environmental Quality ("TCEQ") to create municipal setting designations; and

WHEREAS, on August 22, 2007, by Ordinance No. 2007-959, the City Council adopted Article XIII, of Chapter 47, Code of Ordinances, Houston, Texas, to provide a process for establishing municipal setting designation ordinances; and

WHEREAS, Sections 47-765(f) and 47-767(a) of the Code of

Ordinances, Houston, Texas, authorize municipal setting designation ordinances that prohibit the use of designated groundwater as potable water and thereby enable the TCEQ to certify a municipal setting designation for designated property; and

WHEREAS, on November 1, 2007, Union Pacific Railroad Company ("applicant") applied to the Director of the Public Works and Engineering Department, requesting that the City Council support a municipal setting designation ordinance for its property that is part of the Crystal Chemical Superfund Site; and

WHEREAS, on January 29, 2008, the Director of the Public Works and Engineering Department conducted a public meeting as required by section 47-764, and notified the community when the City Council public hearing would occur; and

WHEREAS, City Council conducted a public hearing on March 12, 2008; and

WHEREAS, the City Council finds that:

(1) the application meets the eligibility criteria of Section 361.803 of the Texas Health and Safety Code;

(2) the municipal setting designation will not have an adverse effect on the current or future water resource needs or obligations of the City of Houston;

(3) there is a public drinking water supply system that satisfies the requirements of Chapter 341 of the Texas Health and Safety Code and that supplies or is capable of supplying drinking water to the designated property

and property within one-half mile of the designated property; and

(4) this Municipal Setting Designation Ordinance is necessary because the concentration of contaminants of concern exceeds human ingestion protective concentration levels, and the establishment of a municipal setting designation will allow the property to be brought back into productive use; and

WHEREAS, City Council finds that the Director of the Public Works and Engineering Department on behalf of City Council, in accordance with the Charter of the City of Houston, state law, and the ordinances of the City of Houston, has given the required notices, City Council has held the required public hearing regarding this Municipal Setting Designation Ordinance and all procedural requirements have been satisfied; **NOW THEREFORE;**

BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF HOUSTON:

Section 1. That for purposes of this Municipal Setting Designation Ordinance, the "designated property" means the property described in Exhibit A, attached to this Ordinance and incorporated by reference herein.

Section 2. That for purposes of this Municipal Setting Designation Ordinance, "designated groundwater" means groundwater beneath the designated property to a depth not to exceed 200 feet that is prohibited from use as potable water by this Ordinance.

Section 3. That use of the designated groundwater from beneath the designated property as potable water, as that term is defined in section 47-761 of the Code of Ordinances, Houston, Texas, is prohibited.

Section 4. That the use of the designated groundwater from beneath

public rights-of-way immediately adjacent to the designated property as potable water, as that term is defined in section 47-761 of the Code of Ordinances, Houston, Texas, is prohibited,

Section 5. That the designated property must receive a certificate of completion or other analogous documentation issued by the TCEQ or the United States Environmental Protection Agency ("EPA") showing that any site investigations and response actions required pursuant to Section 361.808 of the Texas Health and Safety Code have been completed to the satisfaction of the TCEQ or EPA within the time period required by them.

Section 6. That the City Council supports the application to the TCEQ for a municipal setting designation on the designated property, with the following comment:

(1) The TCEQ and the EPA, as agencies charged to protect human health and the environment, are requested to thoroughly review the conditions on the designated property and issue a certificate of completion only when all contaminants of concern, through the applicable routes of exposure, have been addressed.

Section 7. That any person owning, operating, or controlling the designated property remains responsible for complying with all applicable federal and state laws and regulations and all ordinances, rules, and regulations of the City of Houston. The City Council's approval of a municipal setting designation ordinance in itself does not change any environmental assessment or cleanup requirements applicable to the designated property.

Section 8. That approval of this Municipal Setting Designation Ordinance shall not be construed to subject the City of Houston to any responsibility or liability for any injury to persons or damages to property caused by any contaminant of concern.

Section 9. That within 30 days after adoption of this Municipal Setting Designation Ordinance, the applicant shall provide the Director of the Public Works and Engineering Department with an electronic file showing the location of the designated property and the designated groundwater in a format compatible with the City's geographic information system and its integrated land management system, and shall provide an electronic file showing the location of the designated property and the designated groundwater to the Harris County Appraisal District in a format compatible with its system.

Section 10. That within 30 days after adoption of this Municipal Setting Designation Ordinance, the Director of the Public Works and Engineering Department shall send a certified copy of this ordinance to the applicant, TCEQ and EPA.

Section 11. That the applicant shall provide the Director of the Public Works and Engineering Department with a copy of the municipal setting designation certificate issued by the TCEQ pursuant to section 361.807 of the Texas Health and Safety Code within 30 days after issuance of the certificate.

Section 12. That within 30 days after receipt of the municipal setting designation certificate from the TCEQ, the Director of the Public Works and Engineering Department shall file a certified copy of this Municipal Setting

Designation Ordinance in the deed records of Harris County.

Section 13. That if any provision, section, subsection, sentence, clause or phrase of this Ordinance, or the application of same to any person or set of circumstances is for any reason held to be unconstitutional, void or invalid, the validity of the remaining portions of this Ordinance or their applicability to other persons or sets of circumstances shall not be affected thereby, it being the intent of the City Council in adopting this Ordinance that no portion hereof or provision or regulation contained herein shall become inoperative or fail by reason of any unconstitutionality, voidness or invalidity of any other portion hereof, and all provisions of this Ordinance are declared to be severable for that purpose.


Section 14. There exists a public emergency requiring that this Ordinance be passed finally on the date of its introduction as requested in writing by the Mayor; therefore, this Ordinance shall be passed finally on such date and shall take effect immediately upon its passage and approval by the Mayor.

PASSED AND APPROVED this 26th day of March, 2008.



Mayor of the City of Houston

Prepared by the Legal Department



March 5, 2008, Ceil Price, Senior Assistant City Attorney ^{DFM}

Requested by Michael Marcotte, P.E., DEE, Director, Public Works and Engineering Department
L.D. File No. 0760700009001

CAPTION PUBLISHED IN DAILY COURT
REVIEW
DATE: APR 01 2008

AYE	NO	
✓		MAYOR WHITE
••••	••••	COUNCIL MEMBERS
✓		LAWRENCE
✓		JOHNSON
✓		CLUTTERBUCK
✓		ADAMS
	ADAMS	SULLIVAN
✓		KHAN
✓		HOLM
✓		GARCIA
✓		RODRIGUEZ
✓		BROWN
✓		LOVELL
✓		NORIEGA
✓		GREEN
✓		JONES
CAPTION	ADOPTED	

Exhibit A

A 15.6635-ACRE (682,302 SQUARE FOOT) TRACT OF LAND OUT OF THE DAIRY SUBDIVISION, A SUBDIVISION RECORDED IN VOLUME 1, PAGE 23 AND BLOCK I, RESERVE "A" OF CORPORATE CENTRE WESTCHASE, A SUBDIVISION RECORDED AT FILM CODE NUMBER 528260, BOTH OF THE HARRIS COUNTY MAP RECORDS, AND SAME BEING OUT OF THE RESIDUE OF A 99.416-ACRE TRACT CONVEYED TO TEXAS AND NEW ORLEANS RAILROAD COMPANY AS RECORDED IN VOLUME 3091, PAGE 298 AND VOLUME 3091, PAGE 305 OF THE HARRIS COUNTY DEED RECORDS (H.C.D.R.), WEST PARK DRIVE, A 100-FOOT RIGHT-OF-WAY (R.O.W.) AS RECORDED IN THE HARRIS COUNTY CLERK'S FILE NUMBER (H.C.C.F. NO.) F324484, THE RESIDUE OF A 6.7912-ACRE TRACT CONVEYED TO CRYSTAL CHEMICAL COMPANY AS RECORDED IN H.C.C.F. NO. G154538, THE HARRIS COUNTY FLOOD CONTROL DISTRICT EASEMENTS AS RECORDED IN VOLUME 6872, PAGE 340 AND VOLUME 7185, PAGE 146 H.C.D.R., AND A CALLED 3.8001-ACRE TRACT CONVEYED TO UNION PACIFIC RAILROAD COMPANY AS RECORDED IN H.C.C.F. NO. X654066, LOCATED IN THE HENRY WOODRUFF SURVEY, ABSTRACT 844, CITY OF HOUSTON, HARRIS COUNTY, TEXAS.

COMMENCING: At a found 5/8-inch iron rod in the south line of Westpark Drive, the most northerly northwest corner of said Corporate Centre Westchase;

THENCE: South 81 deg 42 min 51 sec West, a distance of 276.02 feet to a found 5/8-inch iron rod with cap, a point that is south of the south line of Westpark Drive, the POINT OF BEGINNING;

THENCE: Along the east line of the herein described tract the following two (2) courses and distances:

South 00 deg 23 min 36 sec East, a distance of 230.97 feet to a found monitor well (SW2);

South 01 deg 55 min 11 sec West, a distance of 314.57 feet to a found 5/8-inch iron rod with cap;

THENCE: Along the south line of the herein described tract the following six (6) courses and distances:

South 80 deg 30 min 09 sec West, a distance of 51.90 feet to a found 5/8-inch iron rod with cap;

South 65 deg 58 min 10 sec West, passing a found 5/8-inch iron rod with cap at 158.72 feet, for a total distance of 171.54 feet to a set 5/8-inch iron rod with cap (LIN 2414);

South 34 deg 56 min 47 sec West, a distance of 178.56 feet to a found

Exhibit A

5/8-inch iron rod with cap;

South 64 deg 22 min 24 sec West, a distance 139.76 feet to a found 5/8-inch iron rod with cap;

South 13 deg 52 min 13 sec West, a distance of 185.94 feet to a found 5/8-inch iron rod with cap;

South 58 deg 21 min 24 sec West, a distance of 89.06 feet to a found 5/8-inch iron rod with cap, the most southerly corner of the herein described tract;

THENCE: Along the west line of the herein described tract, the following nine (9) courses and distances:

North 14 deg 04 min 47 sec West, a distance of 105.27 feet to a found 5/8-inch iron rod with cap;

North 01 deg 50 min 06 sec East, a distance of 102.21 feet to a found 5/8-inch rod with cap;

North 03 deg 41 min 34 sec East, a distance of 105.32 feet to a found 5/8-inch iron rod with cap;

North 09 deg 06 min 40 sec East, a distance of 133.15 feet to a found 5/8-inch iron rod with cap;

North 05 deg 25 min 57 sec East, a distance of 562.80 feet to a found 5/8-inch iron rod with cap, a point that is south of the south line of Westpark Drive;

North 26 deg 45 min 47 sec East, a distance of 125.80 feet to a found 5/8-inch iron rod with cap, a point that is north of the north line of Westpark Drive;

North 21 deg 46 min 25 sec East, a distance of 190.40 feet to a found monitor well (SW12);

North 30 deg 34 min 51 sec East, a distance of 312.74 feet to a found monitor well (SW10);

North 20 deg 09 min 14 sec East, a distance of 222.01 feet to a found monitor well (SW8A), the northwest corner of the herein described tract;

THENCE: Along the north line of the herein described tract, the following two (2) courses and distances:

Exhibit A

North 73 deg 41 min 19 sec East, a distance of 177.47 feet to a found 5/8-inch iron rod with cap;

North 87 deg 06 min 28 sec East, a distance of 65.18 feet to a found 5/8-inch iron rod with cap, the northeast corner of the herein described tract;

THENCE: Along the east line of the herein described tract, the following four (4) courses and distance:

South 01 deg 18 min 33 sec East, a distance of 160.66 feet to a found monitor well (SW4);

South 01 degree 26 min 24 sec East, a distance of 434.36 feet to a found 5/8-inch iron rod with cap;

South 62 deg 41 min 00 sec West, a distance of 120.68 feet to a found 5/8-inch iron rod with cap, a point that is north of the north line of Westpark Drive;

South 00 deg 31 min 04 sec East, a distance of 112.99 feet to the POINT OF BEGINNING and containing 15.6635 acres or 682,302 square feet of land, more or less.

Notice
32
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03/07/06 300790323 \$32.00

033813
MDW 8/15/06

STATE OF TEXAS
HARRIS COUNTY

INDUSTRIAL SOLID WASTE
CERTIFICATION OF REMEDIATION

KNOW ALL MEN BY THESE PRESENTS THAT:

Pursuant to the Rules of the Texas Commission on Environmental Quality pertaining to Industrial Solid Waste Management, this document is hereby filed in the Deed Records of Harris County, Texas in compliance with the recordation requirements of said rules:

I

Union Pacific Railroad Company (UPRR) has performed a remediation of the land described herein and has performed a Risk Evaluation for groundwater pursuant to the rules of the Environmental Protection Agency (EPA) and of the Texas Commission on Environmental Quality (TCEQ), on the metal constituents present in groundwater on the site described herein. As part of the Record of Decision (ROD) ordered for this property by EPA, a notification of any remaining Constituents of Concern (COCs) above concentration levels prescribed in the ROD must be attached to the property deed. A list of the known waste constituents, including known concentrations, which have been left in place is attached hereto as **Exhibit A** and is made part of this filing. Further information concerning this matter may be found by an examination of company records or at the USEPA Region 6 offices in Dallas, Texas and at the TCEQ Headquarters offices in Austin, Texas. The controlling and descriptive documents for this property are listed below:

- USEPA Record of Decision (ROD), dated September 27, 1990;
- USEPA Amended ROD, dated June 16, 1992;
- The Unilateral Order on Consent (UAO), dated September 3, 1992; and
- Assessment of the Technical Impracticability (TI) of Ground-Water Remediation, dated February 1996.

The Texas Commission on Environmental Quality derives its authority to review the remediation of this tract of land from Texas Health and Safety Code, §361.002, which enables the Texas Commission on Environmental Quality to promulgate closure and remediation standards to safeguard the health, welfare and physical property of the people of the State and to protect the environment by controlling the management of solid waste. In addition, pursuant to the Texas Water Code, §5.012 and §5.013, Texas Water Code, Annotated, Chapter 5, the Texas Commission on Environmental Quality is given primary responsibility for implementing the laws of the State of Texas relating to water and shall adopt any rules necessary to carry out its powers and duties under the Texas Water Code. In accordance with this authority, the Texas Commission on Environmental Quality requires certain persons to provide certification and/or recordation in the real property records to notify the public of the conditions of the land and/or the occurrence of remediation. This deed certification is not a representation or warranty by the Texas Commission on Environmental Quality of the suitability of this land for any purpose, nor does it constitute any guarantee by the Texas Commission on Environmental Quality that the

RP 018-77-0595



214465

remediation standards specified in this certification have been met by Union Pacific Railroad Company.

II


Being a 1.1078 acre tract, more or less, of the 100 foot right-of-way in Westpark Drive located in the Henry Woodruff survey, said 1.1078 acre tract being more particularly described in Exhibit B.

Constituents of concern present in the groundwater have been remediated to a level of 0.050 ppm or physically controlled to meet non-residential criteria for groundwater in accordance with the ROD, which is a plan that meets TCEQ's requirements of 30 Texas Administrative Code § 335.551 et seq. The remediation plan requires post closure care or engineering control measures for groundwater in this area. As required by the ROD and described in related remediation documents, the majority of the groundwater with arsenic above ROD level is physically contained within a subsurface engineered slurry wall, with potentiometric levels inside the contained area maintained near potentiometric levels observed outside the slurry wall. Institutional or legal controls placed at the site to ensure appropriate future use include exposure control via the use of proper health and safety measures as recommended by applicable health and safety protocols and regulations prior to extraction of groundwater of the site within the area of interest as depicted on the attached drawing and made part of this filing. The current or future owner must undertake actions as necessary to protect human health or the environment in accordance with the rules of USEPA and TCEQ for non-residential criteria for groundwater (30 Texas Administrative Code Chapter 350), which may be more stringent, and the ROD requirements for groundwater for this site. Future land use is considered suitable for non-residential (i.e., industrial/commercial) purposes in accordance with USEPA and TCEQ risk reduction standards applicable at the time of this filing. Future land use is intended to be non-residential.

III

The owner of the site is the City of Houston, and its address is 611 Travis Street, Houston, Texas 77002, where more specific information may be obtained from the Senior Assistant Director, Real Estate Division, Department of Public Works and Engineering.

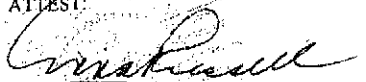
IN WITNESS WHEREOF, Grantor has executed these presents this 10th day of August, 2005.



BILL WHITE
Mayor of the City of Houston, Texas

187

ATTEST



ANNA RUSSELL, City Secretary

RP 018-77-0596

THE STATE OF TEXAS

COUNTY OF HARRIS

This instrument was acknowledged before me on the 10th day of August, 2005, by **BILL WHITE**, Mayor of the City of Houston, Texas, a Municipal Corporation, on behalf of said Corporation.

(Notary Seal)



Casandria P. Jones
Notary Public, State of Texas

Approved as to Form:

[Signature]

Chil Price
Senior Assistant City Attorney

LD # 015-440002-05

RP 018-77-0597

EXHIBIT A

Known Waste Constituents

Known Concentrations

Arsenic

Greater than 0.050 milligrams/liter (mg/l or ppm)

RP 018-77-0598

Return To:

MIKE WISNIOWIECKI
13731 CULLEN BLVD.
HOUSTON, TX 77041

✓✓

EXHIBIT B

**METES AND BOUNDS DESCRIPTION
1.1078 ACRES (48,255 SQUARE FEET)
HENRY WOODRUFF SURVEY, ABSTRACT NUMBER 844
CITY OF HOUSTON, HARRIS COUNTY, TEXAS**

Let

A 1.1078 ACRE (48,255 SQUARE FOOT) TRACT OF LAND BEING A PORTION OF WEST PARK DRIVE, A 100-FOOT RIGHT-OF-WAY (R.O.W.) RECORDED UNDER HARRIS COUNTY CLERK'S FILE NUMBER (H.C.C.F. NO.) F324484, LOCATED IN THE HENRY WOODRUFF SURVEY, ABSTRACT 844, CITY OF HOUSTON, HARRIS COUNTY, TEXAS.

COMMENCING: At a found 5/8-inch iron rod in the south line of Westpark Drive, said point being the most northerly northwest corner of Block 1, Reserve "A" of Corporate Centre Westchase, a subdivision recorded at Film Code Number 528260;

THENCE: Along the common line of the south line of said Westpark Drive and the north line of said Corporate Centre Westchase, South 82 deg 58 min 00 sec West, a distance of 275.28 feet to the POINT OF BEGINNING, the southeast corner of the herein described tract;

THENCE: Along the common line of the south of Westpark Drive and the herein described tract, South 82 deg 58 min 00 sec West, a distance of 510.31 feet to a point for the southwest corner of the herein described tract;

THENCE : Along the west line of the herein described tract, North 26 deg 45 min 47 sec East, a distance of 125.80 feet to a point in the north line of Westpark Drive for the northwest corner of the herein described tract;

THENCE: Along the common line of the north line of Westpark Drive and the herein described tract, North 82 deg 58 min 00 sec East, a distance of 454.80 feet to a point for the northeast corner of the herein described tract;

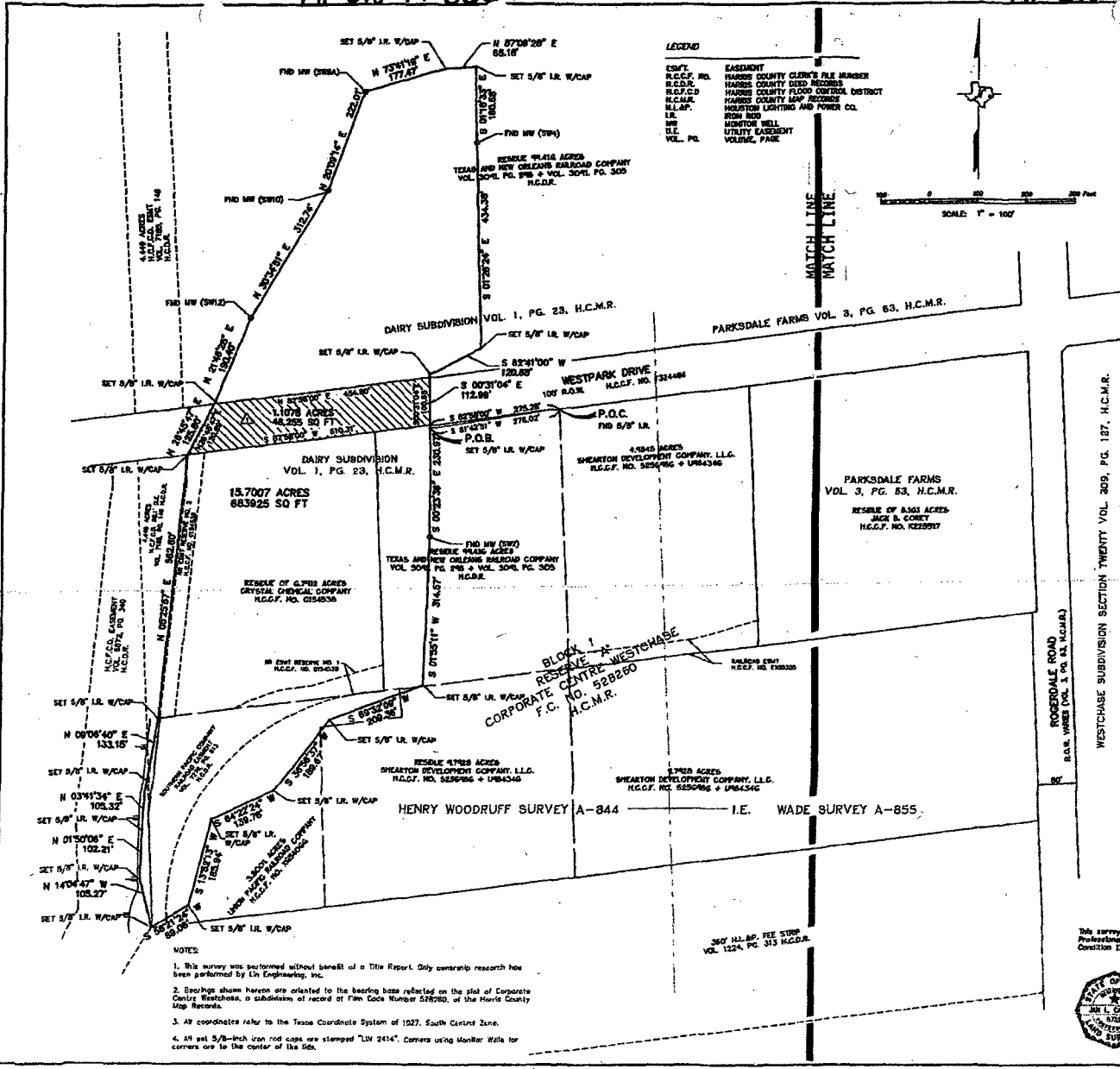
THENCE: Along the east line of the herein described tract, South 00 deg 31 min 04 sec East, a distance of 100.65 feet to the POINT OF BEGINNING and containing 1.1078 acres or 48,255 square feet of land, more or less.

This description is based upon a Standard Land Survey and plat prepared by Lin Engineering, Inc., LEI Project Number 0485, revised on June 10, 2005.

REF 018-77-0599

KP 018-11-0601

KP 018-77-0608



A 15,7007 ACRE (683,925 SQUARE FEET) TRACT OF LAND OUT OF THE DAIRY SUBDIVISION A SUBDIVISION RECORDED IN VOLUME 1, PAGE 23 AND OUT OF BLOCK 1, RESERVE "A" OF CORPORATE CENTRE WESTCHASE, SUBDIVISION RECORDED AT FIRM COOK ALIGNED COUNTY, CITY OF HOUSTON, HARRIS COUNTY TEXAS, LOCATED IN THE HENRY WOODRUFF SURVEY, ABSTRACT 844, CITY OF HOUSTON, HARRIS COUNTY, TEXAS. THE ROAD TRACT BEING A PORTION OF THE RESERVE OF A 68.48 ACRE TRACT CONVEYED BY DEED TO TEXAS AND NEW ORLEANS RAILROAD COMPANY, RECORDED IN VOLUME 301, PAGE 298 AND VOLUME 309, PAGE 303 OF THE HARRIS COUNTY DEED RECORDS (H.C.D.R.), A PORTION OF WESTPARK DRIVE, A 100'-WIDE (EIGHTY-FOUR (84) FEET) RECORDED UNDER HARRIS COUNTY CLERK'S FILE NUMBER (H.C.C.F. NO. 7284484; A PORTION OF THE RESERVE OF A 3,762 ACRE TRACT CONVEYED BY DEED TO CENTRAL MEDICAL COMPANY UNDER H.C.C.F. NO. 6154215; A PORTION OF THE RESERVE OF A 3,762 ACRE TRACT CONVEYED BY DEED TO SHANTON DEVELOPMENT COMPANY, L.L.C. RECORDED UNDER H.C.C.F. NO. 528280; AND BY CONNECTION DEEDS RECORDED UNDER H.C.C.F. NO. 4984346; AND A PORTION OF A CALLED 3.001 ACRE TRACT CONVEYED BY DEED TO UNION PACIFIC RAILROAD COMPANY, RECORDED UNDER H.C.C.F. NO. 2854084.

COMMENTS: All a found 5/8-inch iron rod in the south line of Westpark Drive, said point being the most northerly northward corner of said Corporate Centre Westchase.

THENCE: South 81 deg 43 min 31 sec West, a distance of 276.02 feet to a set 5/8-inch iron rod with cap (LN 2414) at a point that is south of the south line of Westpark Drive, for the POINT OF BEGINNING.

THENCE: Along the easterly side of the herein described tract the following seven (7) courses and distances:

- South 00 deg 25 min 30 sec East, a distance of 230.97 feet to a found monitor well (SW10);
- South 01 deg 32 min 11 sec West, a distance of 314.57 feet to a set 5/8-inch iron rod with cap (LN 2414);
- South 88 deg 32 min 00 sec West, a distance of 209.36 feet to a set 5/8-inch iron rod with cap (LN 2414);
- South 30 deg 08 min 37 sec West, a distance of 184.67 feet to a set 5/8-inch iron rod with cap (LN 2414);
- South 84 deg 22 min 24 sec West, a distance of 139.76 feet to a set 5/8-inch iron rod with cap (LN 2414);
- South 13 deg 52 min 13 sec West, a distance of 185.94 feet to a set 5/8-inch iron rod with cap (LN 2414);
- South 88 deg 21 min 26 sec West, a distance of 88.06 feet to a set 5/8-inch iron rod with cap (LN 2414) for the most southerly point of the herein described tract;

THENCE: Along the westerly line of the herein described tract, the following eleven (11) courses and distances:

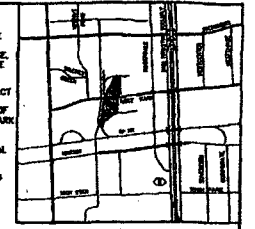
- North 14 deg 04 min 47 sec West, a distance of 105.27 feet to a set 5/8-inch iron rod with cap (LN 2414);
- North 01 deg 30 min 08 sec East, a distance of 102.21 feet to a set 5/8-inch iron rod with cap (LN 2414);
- North 03 deg 41 min 34 sec East, a distance of 105.32 feet to a set 5/8-inch iron rod with cap (LN 2414);
- North 00 deg 00 min 40 sec East, a distance of 133.15 feet to a set 5/8-inch iron rod with cap (LN 2414);
- North 00 deg 23 min 57 sec East, a distance of 582.80 feet to a set 5/8-inch iron rod with cap (LN 2414) at a point that is south of the south line of Westpark Drive;
- North 28 deg 45 min 47 sec East, a distance of 121.30 feet to a set 5/8-inch iron rod with cap (LN 2414) at a point that is north of the north line of Westpark Drive;
- North 21 deg 46 min 25 sec East, a distance of 190.40 feet to a found monitor well (SW12);
- North 30 deg 34 min 51 sec East, a distance of 312.74 feet to a found monitor well (SW10);
- North 20 deg 00 min 14 sec East, a distance of 222.01 feet to a found monitor well (SW14) for the northward corner of the herein described tract;
- North 73 deg 41 min 19 sec East, a distance of 177.47 feet to a set 5/8-inch iron rod with cap (LN 2414);
- North 87 deg 06 min 28 sec East, a distance of 65.18 feet to a set 5/8-inch iron rod with cap (LN 2414) for the northeast corner of the herein described tract.

THENCE: Along said easterly line of the herein described tract, South 01 deg 18 min 33 sec East, a distance of 180.88 feet to a found monitor well (SW14);

THENCE: Continuing along said easterly line, South 01 deg 28 min 34 sec East, a distance of 434.36 feet to a set 5/8-inch iron rod with cap (LN 2414);

THENCE: Continuing along said easterly line, South 02 deg 41 min 00 sec West, a distance of 120.88 feet to a set 5/8-inch iron rod with cap at a point that is north of the north line of Westpark Drive;

THENCE: Continuing along said easterly line, South 00 deg 31 min 01 sec East, a distance of 112.88 feet to POINT OF BEGINNING and containing 15,7007 acres or 683,925 square feet of land, more or less.



NOTES:

1. This survey was performed without benefit of a Title Report. Only ownership research has been performed by Lin Engineering, Inc.
2. Bearings shown herein are oriented to the bearing base reflected on the plot of Corporate Centre Westchase, a subdivision of record of Firm Data Number 518780, of the Harris County Map Records.
3. All coordinates refer to the Texas Coordinate System of 1927, South Central Zone.
4. All set 5/8-inch iron rod caps are stamped "LN 2414". Convey using Monitor Wells for corners are to the center of the Well.

This survey substantially complies with the current Texas Society of Professional Surveyors Standards and Specifications for a Category II Survey.



Jan L. Carrido 02/10/26
 JAN L. CARRIDO
 Registered Professional Land Surveyor
 Registration No. 5752
 State of Texas

Lin Engineering, Inc.
 17005 WILSON, SUITE 200
 HOUSTON, TEXAS 77031
 (281)530-3198

LAND TITLE SURVEY

A 15,7007 ACRE TRACT (683,925 SQ. FT.) TRACT OF LAND OUT OF THE HENRY WOODRUFF SURVEY, ABSTRACT 844, CITY OF HOUSTON, HARRIS COUNTY, TEXAS

DATE REVISION	DRAWN BY	APPROVED
SCALE: 1" = 100'	LN 2414	02/10/26

FILED

2016 MAR -7 PM 3:08

Beverly B. Kopfman
COUNTY CLERK
HARRIS COUNTY, TEXAS

ANY DOCUMENTS WHICH REQUIRE THE SALE, RECALL, OR USE OF THE RECORDS ARE
PROPERTY OF THE STATE OF TEXAS AND SHALL REMAIN THE PROPERTY OF THE STATE OF TEXAS
UNTIL THE RECORDS ARE DESTROYED OR OTHERWISE DISPOSED OF BY THE STATE OF TEXAS
IN ACCORDANCE WITH THE PROVISIONS OF THE ARCHIVES AND RECORDS MANAGEMENT ACT
AND THE ARCHIVES AND RECORDS MANAGEMENT ACT. THIS DOCUMENT IS FILED IN THE
PUBLIC RECORDS OF THE COUNTY CLERK OF HARRIS COUNTY, TEXAS. FOR THE
COUNTY CLERK OF HARRIS COUNTY, TEXAS.

MAR - 7 2006



Beverly B. Kopfman
COUNTY CLERK
HARRIS COUNTY, TEXAS

ATTACHMENT 6

AFFIDAVIT OF PUBLIC NOTICE PUBLICATION

Legal Notices

LEGAL NOTICES LEGAL NOTICES LEGAL NOTICES LEGAL NOTICES LEGAL NOTICES LEGAL NOTICES LEGAL NOTICES LEGAL NOTICES LEGAL NOTICES

ADVERTISEMENT
3008

CITY OF HOUSTON

The City Secretary for the City of Houston will receive bids at 900 Bagby, Room 1181, Houston, Texas for the following project: Aviation South Airport System Project.

Project Name and Address: IAH Terminal A 4th Gate A3 Expansion, Project 041

Date: Monday, May 20, 2010

Project Location: Dept. Bush Intercontinental Airport, Houston, Texas 77032

Contact Manager: City Council, P.O. Box 1225-1229

Bid Meeting: Wednesday, May 12, 2010 9:30 AM

Location: 35950 JFH Blvd., H.H.E. Auditorium, Houston, Texas 77052

Note: Meeting attendance is only opportunity to inspect site prior to bid. All at Aviation Office (2nd floor), 900 Bagby, Houston, Texas 77032 (281-233-6701).

Bids will be accepted until 10:00 a.m. local time on the date shown. Bids received after 10:00 a.m. will not be opened. Bids will be publicly opened and read at 11:00 a.m. on the day in City Council Chambers. All interested parties are invited to attend. Place and date of opening may be changed in accordance with Sections 18.001(1) & 18.001(2) of the City of Houston Code of Ordinances. Law Officer shall comply with City of Houston Code of Ordinances, Article 10, Chapter 25, of the Houston Code of Ordinances.

10:00 a.m.

10:00 a.m. 10:00 a.m. 10:00 a.m. 10:00 a.m. 10:00 a.m. 10:00 a.m. 10:00 a.m. 10:00 a.m. 10:00 a.m.

10:00 a.m. 10:00 a.m. 10:00 a.m. 10:00 a.m. 10:00 a.m. 10:00 a.m. 10:00 a.m. 10:00 a.m. 10:00 a.m.

NOTICE OF PUBLIC HEARING
City of Houston Police Department
NEIGHBORHOOD PROTECTION CORPS
MAY 31, 2010
7125 Ardmore Street, 1st Floor
Houston, Texas 77054

The City of Houston Hearing Officer will hear testimony and review evidence for the following properties located in Harris County, Texas (unless otherwise indicated); at the listed times:

9:00 a.m. 1227 W. Little York Rd. (Lot 7, in Block 7 of Highland Heights Annex 2, an addition in Harris County, Texas, according to the map or plat thereof recorded in Volume 4, Page 47 of the Map Records of Harris County, Texas.)

10:00 a.m. 3351 Eglis St. (Lot 15, in Block 17 of Booker T. Washington Addition, an addition in Harris County, Texas, according to the map or plat thereof recorded in Volume 5, Page 73 of the Map Records of Harris County, Texas.)

10:00 a.m. 3299 Orange St. (Part of Lot Twelve (12), in Block Two (2) of Snyder Addition, an unrecorded subdivision in Harris County, Texas and being more particularly described by metes and bounds in instrument recorded in Volume 4744, Page 214 of the Deed Records of Harris County, Texas. Also known as Tract 24, in Block 2 of Snyder.)

10:00 a.m. 11263 Hughes Rd. (5.401 acre tract, more or less, out of the Dickson Pulham Survey, Abstract Number 438, of Harris County, Texas and being more particularly described by metes and bounds in instrument recorded under Clerk's File Number R-527313 of the Real Property Records of Harris County, Texas. Save and except that portion described in instrument recorded under Clerk's File Number R-344448 of the Real Property Records in Harris County, Texas.)

10:00 a.m. 1524 Diplomat Way (Lot 238, in Block 24 of Willow Run Section Six, an addition in Harris County, Texas, according to the map or plat thereof recorded in Volume 158, Page 24 of the Map Records of Harris County, Texas.)

10:00 a.m. 7908 Bur1 St. - Bldg. #2 (Tract 4 in Lot 1, in Block 1 of Highland Acres Homes Addition, an addition in Harris County, Texas, according to the map or plat thereof recorded in Volume 5, Page 43 of the Map Records of Harris County, Texas, being more particularly described in instrument recorded under Clerk's File Number U86482 of the Real Property Records of Harris County, Texas.)

10:00 a.m. 8295 Montalva Dr. (Lot 51, in Block 4 of Ridgecrest Addition, an addition in Harris County, Texas, according to the map or plat thereof recorded in Volume 31, Page 7 of the Map Records of Harris County, Texas.)

10:00 a.m. 378 La Fonda Dr. - Main Structure (Lot 22, in Block 33 of Green Ridge North, Section 9, an addition in Harris County, Texas, according to the map or plat thereof recorded in Volume 144, Page 8 of the Map Records of Harris County, Texas.)

10:00 a.m. 3476 Winding Way Dr. (Lot 10, in Block 1 of Sheraton Oaks, Section 1, an addition in Harris County, Texas, according to the map or plat thereof recorded in Volume 136, Page 13 of the Map Records of Harris County, Texas.)

10:00 a.m. 1905 Mansfield St. (Lot 41, in Block 4 of Highland Heights Addition, Annex No. 1, an addition in Harris County, Texas, according to the map or plat thereof recorded in Volume 479, Page 271 of the Map Records of Harris County, Texas.)

10:00 a.m. 5415 Harvard St. - Bldg. #1, and Bldg. #2 - #4 (The South 543 feet of Lot Two (2) and the adjoining North 7.1 feet of Lot Four (4), in Block Five (5) of Yale Street Acres, Section Two (2), an addition in Harris County, Texas, according to the map or plat thereof recorded in Volume 72, Page 261 of the Deed Records of Harris County, Texas.)

10:00 a.m. 12415 W. Hardy Rd. (Lot 38, in Block 2 of Alton Park Townhomes, an addition in Harris County, Texas, according to the map or plat thereof recorded in Volume 144, Page 14 of the Map Records of Harris County, Texas.)

10:00 a.m. 4106 McKimery St. (Lot 15, in Block 26 of Houston City Railway Addition No. 1, an addition in Harris County, Texas, according to the map or plat thereof recorded in Volume 12, Page 479 of the Deed Records of Harris County, Texas.)

10:00 a.m. 1425 Fairdale St. - Detached Garage Apartment (Lot 1, in Block 1 of Bradmoor Addition, an addition in Harris County, Texas, according to the map or plat thereof recorded in Volume 144, Page 14 of the Map Records of Harris County, Texas.)

10:00 a.m. 10:00 a.m. 10:00 a.m. 10:00 a.m. 10:00 a.m. 10:00 a.m. 10:00 a.m. 10:00 a.m. 10:00 a.m.



CRYSTAL CHEMICAL COMPANY SUPERFUND SITE
PUBLIC NOTICE
U.S. Environmental Protection Agency Region 6
Third Five-Year Review of Site Remedy
April 2010

The U.S. Environmental Protection Agency Region 6 (EPA) has begun the third five-year review of the remedy for the Crystal Chemical Company Superfund Site in Harris County, Texas. The review will evaluate if the remedy continues to protect public health and the environment.

The Crystal Chemical Company Site is located in southwest Houston, Harris County, Texas.

From 1968 to 1981, arsenical, phenolic, and amine-based herbicides were produced at the Crystal Chemical Company Site and have contaminated soil and ground water. The contamination covered approximately 24.4 acres, which included 6.8 acres onsite and 17.6 acres offsite.

Soil and ground water remedies are in place at the Site and will be subject of the five-year review. Once completed, the results of the five-year review will be made available to the public at the following information repository:

Judson Robinson Westchase Library
3223 Wilcrest Drive
Houston, TX 77042-3349
Phone: (832) 393-2011

Information about the Crystal Chemical Company Superfund Site is also available on the internet at:

www.epa.gov/region6/superfund/

For more information about the site, contact:

Mr. Ruben Moya
214-665-2755

or 1-800-533-3508 (toll-free)

or by e-mail at Moya.Ruben@epa.gov

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

NOTICE OF COMPETITIVE BIDS

Harris County is soliciting bids for various items, including construction projects, goods and services. Specific items with dates and times for bid or proposal submission, whether or not there will be a public or site opening, the method of payment by the County, the name of the County's official responsible for the bid, all necessary information may be obtained on line at www.hcc.net/purchasing

NOTICE OF PUBLIC HEARINGS

The City Council of the City of Houston, Texas will conduct a public hearing at 9:00 a.m. on Wednesday, May 12, 2010 in Houston City Council Chambers, Houston City Hall, 901 Bagby, Houston, Texas.

AFFIDAVIT OF PUBLICATION

STATE OF TEXAS:

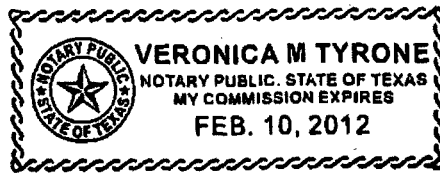
COUNTY OF HARRIS:

Before me, the undersigned authority, a Notary Public in and for the State of Texas, on this day personally appeared, the ACCOUNTS RECEIVABLE LEAD at the HOUSTON CHRONICLE, a daily newspaper published in Harris County, Texas, and that the publication, of which the annexed herein, or attached to, is a is a true and correct copy, was published to-wit:

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Kate Chastan
ACCOUNTS RECEIVABLE LEAD

Sworn and subscribed to before me, this the 30th Day of April A.D. 2010



Veronica M Tyrone
Notary Public in and for the State of Texas



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All media inquiries should be directed to the EPA
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