EPA Region 6 Announces Proposed Plan To Amend the Record of Decision

United States Environmental Protection Agency

Jones Road Groundwater Plume Superfund Site
Houston, Harris County, Texas August 2017

The Purpose of this Proposed Plan is to:

- Identify the United States Environmental Protection Agency's (EPA) preferred remedial alternative to amend the 2010 Record of Decision to revise the selected remedial action for the shallow source area soil and to propose a remedial alternative for a deep Chicot unsaturated sand at the Jones Road Groundwater Plume Superfund Site ("Site");
- Provide the EPA's Optimization Review Report recommendations and supporting information provided by the Supplemental Remedial Investigation and Focused Feasibility Study;
- Describe the remedial alternatives evaluated in the Focused Feasibility Study Report to mitigate the shallow and deeper soil zone to eliminate, or reduce, those continuing sources of contaminants to underlying groundwater;
- Solicit public review and comment on the proposed remedial alternatives and the supporting information contained in the Administrative Record file; and
- Provide information on how the public can be involved in the remedy selection process.

The Preferred Remedy for soil will implement a Soil Vapor Extraction (SVE) treatment technology to remove, or reduce, vapor-phase contaminants present in two soil zones. The vapor-phase contaminants in the Shallow Source Area Soil and the Deep Unsaturated Chicot Sand will, if not addressed, provide a continuous source of contaminants to underlying groundwater, in particular, the Chicot Aquifer.

The Environmental Protection Agency (EPA) is issuing this Proposed Plan to solicit public comment on the remedial alternatives to mitigate vapor-phase contaminants in two soil zones, which are sources of continuous contamination to underlying groundwater. The actions proposed in this Plan are a continuation of those previous actions selected for the Site in the initial 2010 ROD. This Proposed Plan is being issued in accordance with and as part of its public participation responsibilities under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) §117(a), 42 U.S.C. 42 § 9617(a) and the Code of Federal Regulations (CFR) § 40 Code of Federal Regulations §300.430(f)(2).

The EPA will accept comments on the Proposed Plan during the public comment period. The **30-day public comment period** on this Proposed Plan and the information contained in the Administrative

Record file **begins on August 7, 2017, and closes on September 5, 2017**. Written comments postmarked no later than **September 5, 2017**, should be sent to:

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In addition, oral comments may be made on the record at the public meeting on **August 10, 2017.** EPA will include responses to all comments that are received during the official public comment period in a responsiveness summary that will accompany the cleanup plan, as the ROD Amendment.

The recommendations and alternatives set forth in this Proposed Plan are based on information and documents contained in the Administrative Record file for the Site. The EPA will select a final remedy for the two soil zones after the public comment period has ended and the comments have been reviewed and considered, and the EPA has responded to the comments received. The EPA may select a different alternative or a modified version of the Preferred Remedy based on new information or public comments.

The EPA Region 6 office is the lead agency for this Site. The Texas Commission on Environmental Quality (TCEQ) is the support agency. As the support agency, the State reviews and comments on the remedial investigation and feasibility study, the proposed plan, the Record of Decision (ROD) or ROD Amendment. As part of the Public Comment Period, the state's position and key concerns related to the preferred alternative, and other alternatives, will be assessed prior to making a final remedy selection under this action.

Scope and Role of this Response Action

The 2010 ROD selected in-situ treatment of the impacted shallow soil ("Shallow Source Area Soil") and groundwater, and the deep groundwater plume, with further testing to determine the most effective technologies. Technologies considered would include in-situ chemical oxidation (ISCO) for the Shallow Source Area Soil and the Shallow Water-Bearing Zone ("Shallow WBZ"), and bioaugmentation for the deep groundwater plume in the Chicot Aquifer. The ROD also provided for a hydraulic containment by pump-and-treat operations for the Shallow WBZ and the deep groundwater to prevent further migration of contaminants in groundwater. During the post-ROD remedial design phase, tests confirmed the effectiveness of in-situ bioaugmentation for the Shallow WBZ and soil vapor extraction for the Shallow Source Area

Soil. Additional characterization during the design phase confirmed the presence of vapor-phase contaminants in an unsaturated zone ("Deep Unsaturated Chicot Sand") overlying the deep Chicot aquifer. The additional vapor-phase zone was not considered in the 2010 ROD, but is being addressed through the remedial alternatives considered in this Proposed Plan.

The purpose of this proposed response action is to implement a Sitewide strategy to reduce the source of contaminants to groundwater by addressing those two key soil zones with vapor-phase contaminant concentrations with the potential to impact both the Shallow Water-Bearing Zone ("Shallow WBZ") and the deep Chicot Aquifer. This response action will:

- Remove, or reduce, the vapor-phase contaminant concentrations in the Shallow Source Area Soil and the Deep Unsaturated Chicot Sand; and
- Decrease impacts to underlying groundwater contaminant concentrations over time, as the overlying active vapor-phase contaminant sources are eliminated.

The Preferred Alternative, S-2 and DZ-2, as Soil Vapor Extraction (SVE), will effectively remove or significantly reduce the Site-related vapor-phase contamination in two soil zones that are active sources of contaminants to underlying groundwater.

Community Participation

This Proposed Plan discusses information developed since the initial 2010 ROD that supports the evaluation of the preferred alternative. That information is available in the Administrative Record prepared for this Proposed Plan. The EPA encourages the public to review these documents in order to gain a more comprehensive understanding of the Jones Road Groundwater Plume Superfund Site and the evaluation of the proposed alternate remedy. The EPA also encourages the public to participate in the decision-making process for the Site by providing comments on all aspects of the Administrative Record File including those documents which have been added to amend the record and support the decisions proposed in this Plan.

The amended Administrative Record file, which contains complete documentation of the analysis, will be available for public review starting on August 7, 2017, at the following information repositories:

Northwest Branch Harris County Library
11355 Regency Green Drive
Cypress, Texas 77429
Phone: 281-890-2665
Hours: *Monday – 1:00 pm to 8:00 pm; Tuesday – 10 am to 6 pm; Wednesday - 12 pm to 8 pm; Thursday – 10 am to 6 pm; Friday – 1 pm to 6 pm; Saturday – 10 am to 5 pm; Sunday – Closed*.

Texas Commission on Environmental Quality
Building E, Records Management, First Floor
12100 Park 35 Circle
Austin, Texas 78753
(512) 239-2920
512-239-1850 (fax)
Hours: *Monday – Friday – 8:00 am to 5:00 pm*

The Record of Decision Amendment Proposed Plan summarizing the basis for the EPA's analysis of the alternate ground water remedy will also be available for public review on EPA's public web page:

https://www.epa.gov/superfund/jones-road

A public meeting to receive comments will be held at the **Bleyl Middle School**, 10800 Mills Road, Houston, Texas, 77070, on **August 10, 2017, from 6:30 pm to 8:00 pm.** The public is invited to comment on this Proposed Plan to amend the Record of Decision. Final decisions regarding the remediation of the Jones Road Groundwater Superfund Site will only be made after public comments are considered.

The public meeting is being held in a fully accessible facility. Should you have questions about this facility's compliance with the Americans with Disabilities Act, please contact the EPA Community Involvement Coordinator (contact information provided below). For specific information about the TCEQ's participation in the Superfund process, please contact the TCEQ Project Manager (contact information provided below):

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Site History

The Site is located in the northwest portion of Harris County, Texas, just outside the city limits of Houston, Texas (**Figure 1**). The Site contamination originated from the former Bell Dry Cleaners, located within the Cypress Shopping Center on Jones Road, approximately 0.5 miles north of the intersection of Jones Road and Farm-to-Market (FM) Road 1960. Jones Road is the principal north-south corridor through the area, with mixed commercial and residential properties. The former dry cleaners is currently the site of a convenience store. In reference to earlier actions taken for the site, **Figure 1** also shows the boundary of a restricted water well drilling area, designated by the Texas Department of Licensing and Regulation (TDLR) in January 2003, with requirements for drilling depth and well construction of new wells to prevent cross-contamination. In 2008, the EPA conducted a time-critical removal action to construct a water line and provide connections to a public water supply. The outline of the water connection area is also included on that figure.

The Bell facility operated between 1988 and 2002 and used perchloroethene (PCE) in their cleaning process. Releases of chlorinated volatile organic compounds (VOC) from improper disposal of dry cleaning solvents migrated vertically downward through the unsaturated zone to perched water and to lower aquifers, where multiple private water supply wells were and are presently located. The hazardous substances present at the Site include PCE and related daughter products trichloroethene (TCE), 1,2-dichloroethene (DCE), and vinyl chloride (VC).

The Jones Road Site was proposed to National Priorities List (NPL) on April 30, 2003 (23094 - 23101 Federal Register / Vol. 68, No. 83). The Site was finalized to the NPL on September 29, 2003 (55875 - 55882 Federal Register / Vol. 68, No. 188). The ROD for the site was signed on September 23, 2010, and set forth the selected remedy for all areas and media within the Site (EPA 2010). Currently, there is only one planned operable unit for the site, which includes soil and ground water, and the selected remedial action is intended to address all areas of concern. The selected remedy is in-situ Enhancements to Pump and Treat. The in-situ treatments involve treating the soil and ground water without removing them, including an in-situ treatment for the shallow source area in the area of the initial release from surface to ~25' below ground surface and an underlying Shallow Water-Bearing Zone (WBZ), at 25-35' below ground surface.

The first phase of the remedial design activities, initiated in March 2011, included additional field work to address data gaps remaining from the first Remedial Investigation/Feasibility Study. Based on that work through October 2011, an unsaturated zone, from approximately 60-110' below ground surface, was found to contain significant vapor-phase concentrations of site contaminants. Note that the vapor contaminant source in this Deep Unsaturated Chicot Sand was not detected during the initial site investigations and was not, therefore, included in the 2010 ROD. The extent of the Deep Unsaturated Chicot Sand vapor-phase contamination was further investigated in March 2012, with a pilot test confirming that a soil vapor extraction approach would effectively reduce the vapor mass. This is the deeper soil zone, and vapor plume, that is being addressed in this Proposed Plan.

It was in 2013, during the intermediate design phase for the Jones Road remedy, that the Region 6 Superfund Office requested an optimization review of the selected remedy to better prioritize issues for the site; to sequence remediation activities to address priorities; and then streamline final designs to reduce cleanup costs and efficiently achieve cleanup goals. The EPA Office of Solid Waste and Emergency Response (OSWER)/Office of Superfund Remediation and Technology (OSRTI) nationally supports the optimization review process and brought together independent technical expertise to further assess Superfund sites, along with the regional and state project teams.

The optimization review of the Jones Road project was critical in identifying additional work necessary for design, but also in prioritizing the importance of source control for three source areas. The *Optimization Review for the Jones Road Superfund Site, Harris County, Texas*, EPA 542-R-14-006, August 2014 identified work needed to define the extent of contamination for the deep Chicot ground water zone relevant to design/construction of the remedy. That work is ongoing. Additional work was recommended to define a soil vapor phase (in the Deep Unsaturated Chicot Sand) that was not identified in the 2010 Record of Decision. And, most significantly, the Optimization Review recommended that the remedial action prioritize the source mitigation of two zones of soil vapor-phase contaminants contributing to the deep Chicot groundwater contamination and initiate the in-situ bioremediation (ISB) of the Shallow WBZ, the third source contributing to the deeper migration of contaminants. This approach prioritizes source reduction and groundwater monitoring to establish decreasing contaminant trends in both the Shallow WBZ and the deep Chicot aquifer. As more groundwater monitoring data is developed and extent of contamination is refined, the future need for pump and treat to contain the migration of ground water contaminants will be further evaluated. The Optimization Review concludes that addressing the continuing sources for contaminants to the dissolved phase ground water will be more cost-effective at this time, with long-ranging benefits over time. It is the source mitigation of the two soil vapor sources that is the focus of this Proposed Plan.

Post-ROD Activities Supporting this Proposed Plan

The Site has undergone numerous investigations by private environmental consulting companies and regulatory agencies and their contractors. The work to support the ROD Amendment is included in both the Focused Feasibility Study Report (EA, 2017) and the Remedial Alternatives Technical Memorandum (EA, 2017). In addition, work done to support the actions of this Proposed Plan and the related recommendations are included in Optimization Review Report (EPA, 2014).

Site Characteristics

At the location of the former Bell Cleaners, releases of chlorinated volatile organic compounds from improper disposal of dry cleaning solvents migrated vertically down through the surface soil to shallow perched water to a deeper unsaturated zone to the deeper Chicot Aquifer. **Figure 2** provides a conceptual diagram of the relationship between release point under the dry cleaner located in "*Shopping Center*" as depicted. The release likely occurred from leaking drains, dumping behind the building, and dumping into a storm sewer drop inlet immediately behind the store. From the release point, PCE migrated by density driven flow through the Shallow Source Area Soil, or "*shallow clay*" as shown on **Figure 2**, and into the S*hallow WBZ (Water Bearing Zone).* The surface soil ("Shallow Source Area Soil") below the shopping center is composed of dense clay, extending to a depth of approximately 25 feet below ground surface (bgs). The Shallow WBZ is located below the surface clay unit, in the Upper Chicot aquifer, with a saturated thickness of 10 feet or less. Underlying the Shallow WBZ is an unsaturated clay (35 to 60 feet bgs) and an unsaturated sand (60 to 110 feet bgs) ("Deep Unsaturated Chicot Sand"). The Deep Chicot aquifer is encountered at a depth below 110 feet bgs and extends to a depth of approximately 400 feet bgs. Area aquifers include the Chicot (ground surface to approximately 400 feet bgs) and the Evangeline (below 400 feet bgs). The Chicot aquifer is a local source of drinking water, utilized through private wells. The Evangeline aquifer is a regional water supply source.

The presence of residual DNAPL is inferred for the Shallow WBZ (USEPA 1992) and Shallow Source Area Soils, as no physical evidence of DNAPL has ever been detected during site investigations. However, dissolved-phase contaminant concentrations in Shallow WBZ MW-1, located immediately downgradient of the release point, were at one time 10 percent (%) of PCE solubility. Dense non-aqueous phase liquid (DNAPL) is suspected to be present when the concentration of a chemical in groundwater is greater than 1% of its pure-phase solubility.

Residual soil contamination, including a vapor plume and likely residual DNAPL, resides in the shallow clay ("Shallow Source Area Soil") above the Shallow WBZ. This contamination is providing a leaching source to groundwater as well as a vapor intrusion pathway to indoor air. From the Shallow Source Area Soil, PCE continued to migrate to the underlying the Shallow WBZ, into and through the 25-footthick confining clay at the base of the Shallow WBZ. This too was likely density driven flow as DNAPL. Once PCE migrated to the base of the clay, it discharged into an unsaturated sand component ("Deep Unsaturated Chicot Sand") of the regional Chicot Aquifer. Once PCE entered the permeable Deep Unsaturated Chicot Sand, it partitioned into a vapor phase via evaporation, and continued its vertical migration as DNAPL. The vapor phase in turn migrates horizontally by diffusion, and by density flow to the saturated water surface on the Chicot Aquifer as PCE vapors are more than 5 times denser than air. At the water table, PCE vapors can partition into water by Henry's Law. Finally, PCE continued to migrate to depth: multi-level monitoring well CMT-1 indicates PCE contamination more than 150 feet into the Chicot Aquifer at the source area. These impacts are beneath several intercalated low permeability clayey marls in the sand, and again indicate sharply vertical migration by density driven flow.

The 2014 Optimization Review identified three sources contributing contaminants to the deep Chicot aquifer:

- Shallow WBZ: Remedial action for the Shallow WBZ was selected in the 2010 ROD; initiated in January 2016 with the injection of amendments to support enhanced reductive dechlorination (ERD) to degrade the Site contaminants; and is ongoing as in-situ enhanced bioremediation and degradation of PCE and daughter products TCE, DCE and VC.
- Shallow Source Area Soil: Remedial action for the Shallow Source Area Soils was also included in the 2010 ROD selected remedy. The remedial action in this Proposed Plan changes the initial in-situ treatment remedy (2010 ROD) from in-situ chemical oxidation to soil vapor extraction (SVE) to address the vapor-phase contaminants impacting underlying groundwater, after the 2016 Pilot Test confirmed the effectiveness of that technology.
- Deep Unsaturated Chicot Sand: This interval of significant soil-vapor contaminant concentrations presents the final continuing source of contamination to the deep Chicot groundwater that is being addressed, for the first time in this Proposed Plan.

The Optimization Review concluded that the Shallow Source Area Soil, the Shallow WBZ and the Deep Unsaturated Chicot Sand in the immediate area of the shopping center east and just west of Jones Road contain the majority of contaminant mass. This Proposed Plan focuses on source mitigation of the Shallow Source Area Soils and the Deep Unsaturated Chicot to eliminate or reduce further migration of vapor-phase contaminants to underlying groundwater.

Source Materials and Principal Threat Wastes

The NCP establishes an expectation that EPA will use treatment to address the principal threats posed by a Site wherever practicable. The "principal threat" concept is applied to the characterization of "source materials" at a Superfund site. A source material is material that includes or contains hazardous substances, pollutants or contaminants that act as a reservoir for migration of contamination to ground water, surface water or air, or acts as a source for direct exposure. Contaminated ground water generally is not considered to be a source material; however, non-aqueous Phase Liquids (NAPL) in ground water may be viewed as source material. Principal threat wastes are those materials considered to be highly toxic or highly mobile that generally cannot be reliably contained, or would present a significant risk to human health or the environment should exposure occur. Non-principal threat wastes are those source materials that generally can be reliably contained and that would present only a low risk in the event of exposure.

The impacted soil associated with the former dry cleaner is considered a principal threat waste because of its potential to impact additional groundwater. The limited lateral extent of the PCE vapor-phase in both the Shallow Source Area Soil and the Deep Unsaturated Chicot Sand indicates that the primary pathway for PCE transport was likely vertical in the form of dense non-aqueous phase liquid DNAPL. However, although high concentrations of PCE have been detected in soil, no DNAPL was observed during Site investigations. As referenced in the 2010 ROD, the lack of observed DNAPL in soils and/or groundwater is a common occurrence at dry cleaner sites based on the experience of the TCEQ Dry Cleaner Remediation Program. Contamination that exists in the dissolved-phase groundwater plume at the Site is considered low-level threat waste.

Nature and Extent of Contamination

Shallow Soil Source Area: The Shallow Source Area Soil was further characterized, during the remedial design, by Passive Gas Sampling (PGS), mapped in three phases (May 2011, June 2011, and September 2011) to determine nature and extent of soil gas impacts in and around the source area and to refine the volume of impacted soil requiring cleanup.

In summary, the **Figure 5** indicates the highest PCE concentrations are on the north and northwest side of the former Bell Cleaners, consistent with the previous soil investigation and conceptual site model. There is some indication of migration and degradation of the vapor phase just to the south of the west end of the strip building, but generally the source is still concentrated in the soils adjacent and underlying the building. The passive soil gas survey, considered with the earlier soil investigation, confirms the SVE treatment area for the shallow source soils.

Deep Unsaturated Chicot Sand: In January 2013, soil gas samples were collected within the deep unsaturated sand of the deep Chicot. Four additional SVE wells were added in 2016 to establish the extent of the vapor-phase contaminants in this deep unsaturated zone. **Figure 4** shows the extent of contamination as defined by PCE soil vapor concentrations from the 2013 and 2016 events.

Figures 3 and 4 references cross-section A-A' across the Jones Road Site. Note the estimated 50' section of unsaturated silty sand with the deeper vapor plume. Vapor concentrations are highest, and focused at the west edge and under the building, but disperse laterally across the site away from the vapor contaminant core, as expected with the higher permeable fine-grained sand. There is also an indication of ongoing degradation of the PCE, as PCE concentrations decrease away from the source, but there is some increase in daughter products (i.e. TCE in SVE-5) along the north-south transect A-A'.

A SVE pilot test was conducted in January 2013. The purpose of the pilot test was to support the presumptive remedy selection of SVE and collect design parameters to support the remedial design for use of SVE to treat the soil vapor plume in the unsaturated portion above the deep water-bearing zone. The 2013 SVE test demonstrated the effectiveness of remedial technology for the Deep Unsaturated Chicot Sand, and supporting the recommendation of the SVE presumptive remedy.

Scope and Role of Response Actions

The purpose of this response action is to implement source mitigation for two soil zones with vapor-phase contaminants, to prevent/minimize the continuous migration of site-related contaminants to underlying groundwater. In addition, the Shallow Source Area Soil is also considered a principle threat waste. The anticipated long-term effect would be to eliminate future impacts to, in particular, the deep Chicot aquifer to meet the restoration goal (2010 ROD) for groundwater.

This Proposed Plan changes the 2010 remedy for the Shallow Source Area Soil from an in-situ treatment, as in-situ chemical oxidation (as ISCO), to the preferred alternative soil vapor extraction (SVE). The soil vapor extraction process more effectively removes vapor-phase contaminants through vapor extraction and surface treatment and is more adaptable to site constraints (i.e. overlying building). The implementation time for the project is estimated at a relatively quick 1-1/2 years. SVE is considered the standard, or presumptive remedy for soils with VOC contaminants. A 2016 Pilot Test confirmed the effectiveness of this technology for the shallow source area soil underlying the point of initial release. SVE is also the preferred alternative to mitigate the Deep Unsaturated Chicot Sand and is evaluated as the presumptive remedy.

By targeting the two soil vapor zones with the preferred alternative evaluated in this Proposed Plan and completing the ongoing remedial action for the Shallow WBZ (selected in the 2010 ROD), the majority of the contaminant mass with the most potential for continued contribution to the Lower Chicot will be significantly reduced.

Summary of Site Risks

The focus of this Proposed Plan is removal of two continuing sources of contaminants to groundwater. This Plan evaluates those actions to remediate two soil zones and eliminate, or reduce, the vapor-phase contaminant concentrations present in each, which have provided a continuous source of contaminants to underlying groundwater. DNAPL is inferred in soil and groundwater based upon groundwater concentrations. Both the impacted Shallow Source Area Soil (considered a principle threat waste in the 2010 ROD) and the Deep Unsaturated Chicot Sand are considered as active sources to groundwater. The presence of DNAPL is inferred as the primary mechanism for vertical migration of contaminants. As the residual soil VOCs partition into a vapor phase through evaporation, the resulting vapor plume continues to diffuse horizontally through the soil zones and vertically to the groundwater interface, PCE vapors can partition into the water by Henry's Law. The resulting dissolved-phase groundwater contaminants can then migrate horizontally to water wells and points of exposure.

The 2010 ROD also recognizes the potential for the shallow soil contaminants to impact indoor air in the space overlying the initial release area. However, further evaluation of indoor air is not included in this Proposed Plan. The 2008 Baseline Risk Assessment (BLRA) considers the estimated risk from inhalation of indoor air through a vapor intrusion pathway from the shallow source area soil to the sub-slab to the overlying commercial space. Based on PCE and TCE indoor air measurements, the BLRA concluded those contaminant concentrations do not pose an unacceptable cancer risk or non-cancer hazard to hypothetical residents or to workers at the Site. However, the 2010 ROD and the 2014 Optimization Review both recommended additional sub-slab and indoor air monitoring to evaluate seasonal variability in vapor-phase concentrations, particularly for indoor area. Additional sub-slab and indoor air monitoring, is ongoing for the commercial building overlying the release area. Sampling results are evaluated for changes in indoor air concentrations, or for changes in the condition of the commercial structure, which has been effective in minimizing the flow of vapor from the sub-slab to indoor air. The conclusions of the 2010 ROD are unchanged for the vapor intrusion pathway.

The 2008 Baseline Risk Assessment also concluded that the chemicals identified as Chemicals of Potential Concern (COPCs) in groundwater, from wells that are not anticipated to receive municipal drinking water (PCE, TCE and VC), do not represent unacceptable cancer risk or non-cancer hazard to residents or workers from groundwater ingestion based on the risk assessment methodology. However, concentrations of these chemicals do exceed MCL values specified in the Safe Drinking Water Act (SDWA). Therefore, these chemicals present an unacceptable risk to human health and the environment, based on OSWER Directive 9355.0-30, which states that MCLs may be used to determine whether an exposure is associated with an unacceptable risk to human health or the environment and whether remedial action is warranted. It is expected that mitigation of the two soil source areas will result in the eventual reduction groundwater contaminant concentrations to the drinking water remedial goals.

Remedial Action Objectives

According to the NCP, 40 CFR §300.430(a)(1)(i), the "national goal of the remedy selection process is to select remedies that are protective of human health and the environment, that maintain protection over time, and that minimize untreated waste." The 2010 ROD establishes that the basis for taking action at the Site was the exceedance of drinking water standards (i.e., the MCLs) in groundwater that is a current or potential source of drinking water (EPA 2010). The RAO was developed for the Site for those COCs that exceed the MCLs. The RAO are also defined such that ARARs are met.

The Site consists of the source area near the former Bell Dry Cleaner facility, where shallow soil and groundwater were impacted, and the deeper groundwater plume underlying the Site. The expectations for contaminated groundwater in the NCP and the Site-specific conditions can be used to define the RAOs that the selected remedy should accomplish at the Site. Considering expectations for contaminated groundwater in the NCP and the Site conditions, the RAOs that the 2010 ROD's selected remedy should accomplish for the Site include the following:

<u>Source Area RAOs</u>

- Prevent future human exposure to contaminated groundwater at unacceptable risk levels.
- Prevent or minimize further migration of contaminants from source materials to groundwater (source control).
- Prevent or minimize further migration of the contaminant plume (plume containment).
- Return groundwater to its expected beneficial uses wherever practicable (aquifer restoration).

<u>Deep Groundwater Plume RAOs</u>

- Prevent future human exposure to contaminated groundwater at unacceptable risk levels.
- Prevent or minimize further migration of the contaminant plume (plume containment).
- Return groundwater to its expected beneficial uses wherever practicable (aquifer restoration).

Proposed Plan RAO

For the evaluation of remedial alternatives in this Proposed Plan, the applicable RAO is following Source Area RAO:

- Prevent or minimize further migration of contaminants from source materials to groundwater (source control)

The remedial alternatives in this Proposed Plan will address two soil zones that are sources of contamination which are impacting groundwater at the Site. The Source Area RAO provides an action for source control for the Shallow Source Area Soil and the Deeper Unsaturated Chicot Sand. Mitigation of the two soil zones will eliminate or reduce the vapor-phase contaminant mass in each and minimize the continued migration of COCs to underlying groundwater. Groundwater concentrations will decrease over time in response to a diminished source.

Preliminary Remediation Goals(PRGs) for the Proposed Action

There is a remedy performance PRG for the Deep Unsaturated Chicot Sand and the Shallow Source Area Soil, which will be based upon treatment expectations for specific site conditions, including the reduction of contaminant mass and vapor-phase concentrations, and verified by monitoring throughout soil treatment. The PRG and closure of the SVE system will be based on four components considered integral to successful venting application: (1) site characterization, (2) design, (3) performance monitoring, and (4) mass flux to and from groundwater. These four components form converging lines of reasoning or a preponderance of evidence regarding attainment of remediation achieved and closure. Each component is interrelated and requires continuous evaluation during the operating period for the remedy component. The use of converging lines of evidence for evaluating continued operation of the SVE system is outlined in EPA's "Development of Recommendations and Methods to Support Assessment of Soil Venting Performance and Closure" (EPA 2001).

There is also a PRG for the RAO to prevent or minimize further migration of COCs from vadose zone soils (source control) to groundwater, which will be set at the remediation goals for groundwater. The achievement of the MCLs will indicate that the RAO for source control was effective. The following cleanup levels provide numerical criteria that can be used to measure the progress in meeting in the RAOs for the cleanup. PCE and daughter product concentrations in groundwater that exceed federal MCLs pose a risk to human health if consumed. The MCL values, which are established to protect the public against consumption of drinking water contaminants that present a risk to human health, constitute the allowable exposure level for these contaminants in groundwater. The 2010 ROD set remediation goals for groundwater equal to the MCLs.

- Tetrachloroethylene (Tetrachloroethene) 5 µg/L
- Trichloroethylene (Trichloroethene) 5 µg/L
- cis-1,2-Dichloroethylene (Dichloroethene) 70 µg/L
- trans-1,2-Dichloroethylene (Dichloroethene) 100 µg/L
- Vinyl Chloride 2 µg/L

The RAO for preventing or minimizing further migration of contaminants from source materials (source control) to groundwater will be deemed to be achieved when groundwater achieves the MCLs. Because groundwater contaminants may be initially reduced below the cleanup levels and then subsequently rebound, a period of monitoring is necessary after the cleanup levels are achieved to insure that any rebound does not result in a future exceedance of the cleanup levels. Therefore, the remedial action will include provisions for a monitoring period following attainment of the system performance goals to insure that rebound above the cleanup levels does not occur. Performance monitoring will be used to evaluate the effectiveness of the remedial technology in preventing or minimizing COC impacts on the ground water. In addition, monitoring COC concentrations in the underlying groundwater can be used to effectively monitor the progress in reducing residual contamination.

Applicable or Relevant and Appropriate Requirements (ARARs)

ARARs are substantive federal and state environmental laws and regulations that specify remediation levels or performance standards for CERCLA sites. Section 121(d) of CERCLA, as amended by Superfund Amendments and Reauthorization Act, states that remedial actions must attain ARARs. ARARs may include regulations, standards, criteria, or limitations promulgated under federal or state laws. An ARAR may be either "applicable" or "relevant and appropriate," but not both. The NCP in 40 CFR §300 defines ARARs.

Three categories of ARARs exist: chemical-, location-, and action-specific requirements. Chemical-specific ARARs are health- or risk-based numerical values or methodologies that, when applied to site-specific conditions, result in the establishment of numerical remediation levels. These values establish the acceptable amount or concentration of a chemical that may be detected in or discharged to the ambient environment. Location-specific ARARs are restrictions on the concentrations of hazardous substances or on activities conducted that result from site characteristics or its immediate environment. For example, location of the Site or proposed remedial action in a flood plain, wetland, historic place, or sensitive ecosystem may trigger location-specific ARARs. Action-specific ARARs are technology- or activity-based requirements or limitations on actions taken. These requirements are triggered by the specific remedial activities selected. Action-specific ARARs do not in themselves determine the remedial alternative; rather, they indicate how an alternative must be conducted.

The ARARs applicable to the Jones Road Groundwater Plume Site are detailed in the 2010 ROD and would also apply to, and include, the action in this Proposed Plan, associated with the soil vapor extraction process. Specifically, the ARARs for the proposed alternatives in this Proposed Plan would be applied for the separation and disposal of treated water, as potentially applicable chemical-specific ARARs. The Texas Surface Water Quality Standards would apply to any surface water discharges; the City of Houston publicly-owned treatment works (POTW) pre-treatment requirements, would apply as ARARs. For re-injection of treated water, the Texas Underground Injection Control, 30 TAC 331, rules would apply. In addition, the Harris County rule, which prohibits drilling of water wells in a contaminated plume designated by USEPA or TCEQ, would apply as a location-specific ARAR. The Texas General Air Quality Rules, 30 TAC 101, and Subchapter X: Waste Processes and Remediation, 30 TAC 106.533, are applicable for the remedial actions that involve air emissions (i.e., soil vapor treatment by air stripping).

Summary of Remedial Alternatives

Remedial alternatives were developed to change the remedial action selected by the 2010 ROD for the Shallow Source Area Soil. The initial action, in-situ treatment as ISCO, for the soil vapor-phase contaminants, has not been implemented. The remedial action proposed in this Plan mitigates the soil vapor-phase contaminants through removal by SVE. The remedial alternatives were developed to address the RAO for source control by attaining performance goals for the proposed technology and the long-term RAO of meeting MCLs in the impacted groundwater.

Note that this remedial alternatives assessment was not performed for the deeper unsaturated zone of the Chicot aquifer, as the preferred presumptive remedy is SVE. Presumptive remedies are preferred technologies for common categories of sites, based on the remedy's historic effectiveness. The purpose of presumptive remedies is to use past experiences to streamline the selection of cleanup actions. This approach eliminates the need to identify potential treatment technologies and screen technologies in site specific feasibility studies. Instead, the preferred presumptive remedy alternative would be analyzed with the no action (NA) alternative. In order to use the presumptive remedy approach at this site, VOCs must be present in soils and non-VOCs cannot preclude a VOC remedy. Since the site COC are limited to chlorinated solvents, the presumptive remedy approach can be applied to the VOCs in the deeper unsaturated zone of the Chicot aquifer at the Site.

The remedial alternative development process for the Shallow Source Area Soil starts with identifying General Response Actions (GRA) and associated technologies that will satisfy the RAO, including the original selection (ISCO treatment) for comparison. The GRA identify technologies as no further action, treatment, or removal. The no action is provided as a baseline against which the effectiveness of all other remedial alternatives are judged for effectiveness. The treatment alternatives are technologies that alter or transform contaminants to innocuous forms or reduce contaminant mobility. Removal alternatives are technologies that remove contaminants from, in this case, soil vapor-phase contaminants are removed.

Tables 1, 2, and 3 present comparisons for no action; and those technologies which would treat, or remove the Shallow Area Source Soil Site vapor-phase contaminants. There are three preliminary screening criteria (i.e., effectiveness, implementability, and cost) which were used for the following remedial technologies:

- No Action;
- Excavation;
- Soil Vapor Extraction;
- Enhanced Soil Vapor Extraction with Hot Air Injection;
- Thermal Desorption;
- Bioventing;
- In-situ Chemical Oxidation (original 2010 ROD selection;
- Ex-situ Chemical Oxidation.

<u>Effectiveness</u> is the criterion that is a measure of the ability of an option to: (1) reduce toxicity, mobility, or volume; (2) minimize residual risks; (3) afford long-term protection; (4) comply with ARARs; (5) minimize short-term impacts; and (6) achieve protectiveness in a limited duration. Technologies that

offer significantly less effectiveness than other proposed technologies may be eliminated from the alternative development process. Options that do not provide adequate protection of human health and the environment likewise are eliminated from further consideration.

Implementability is a measure of the technical feasibility and availability of the option and the administrative feasibility of implementing it (e.g., obtaining permits for activities, right-of-way, or construction). Options that are technically or administratively infeasible or that would require equipment, specialists, or facilities that are not available within a reasonable period may be eliminated from further consideration.

Costs: Qualitative relative costs for implementing the remedy are considered. Costs were obtained from published sources. Technologies that cost more to implement, but that offer no benefit in effectiveness or implementability over other technologies, may be excluded from the alternative development process.

Screening Summary: The results of the technology screening are summarized below, and the screening is presented in greater detail, including the explanation for whether technologies were retained or not, in Table 2. From the list of technologies potentially applicable for remediation of the chemicals and media of concern, the following technologies were retained for development of alternatives because they were considered effective, implementable, and cost effective relative to the other alternatives under consideration:

- No Action
- Soil Vapor Extraction (SVE)

Development of Remedial Alternatives

This section presents the alternatives that were retained for the Shallow Source Area Soil and the presumptive remedial technology preferred for the Deep Unsaturated Chicot Sand.

Shallow Source Area Soils

The following remedial alternatives were identified as potential alternatives for the remediation of the Shallow Source Area Soil:

- Alternative S-1: No Action
- Alternative S-2: Soil Vapor Extraction (Preferred Alternative)

Alternative S-1: No Action
Estimated Implementation Time: 0 months
Estimated Capital Cost: $0
Estimated Annual O&M Costs: $0
Estimated LTM Costs: $0
Estimated Present Worth (7%): $0

As required by the NCP (40 CFR § 300.430 [e][6]), the NFA alternative must be included. This to be used as the baseline alternative against which the effectiveness of all other remedial alternatives are judged. Under NA, no remedial actions will be conducted at the Site and contaminants will remain in place.

Alternative S-2: Soil Vapor Extraction (Preferred Alternative)
Estimated Implementation (Construction) Time: 1 month
Estimated Time to Meet Performance Goal: 2 years
Estimated Capital Cost: $1,175,000
Estimated O&M Costs: $322,600
Estimated LTM Costs: $40,100
Estimated Present Worth (7%): $1,538,000

The alternative would replace the in-situ treatment (as ISCO) remedy selected in the 2010 ROD with soil vapor extraction to extract the vapor-phase contaminants in the Shallow Source Area Soils.

Alternative S-2 utilizes SVE wells to induce airflow, increase the volatility and remove COCs from the source area soil by inducing a vacuum. Soil gas collected by the vacuum will either be directly discharged or treated prior to discharge to the atmosphere. Water will be separated from the vapor stream and treated prior to discharge or injection. The treatment option for the vapor and water streams include Granular Activated Charcoal (GAC). This alternative will remediate the shallow source area soil as a contributing source of contaminants, which will prevent further migration of those COCs into groundwater.

Deep Unsaturated Chicot Sand

The following remedial alternatives were identified as potential alternatives for the remediation of the Deep Unsaturated Chicot Sand:

- Alternative DZ-1: No Action
- Alternative DZ-2: Soil Vapor Extraction (Preferred Alternative)

Alternative DZ-1: No Action
Estimated Implementation Time: 0 months
Estimated Capital Cost: $0
Estimated Annual O&M Costs: $0
Estimated Present Worth (7%): $0

The NCP, 40 C.F.R. § 300.430(e)(6) requires that the "no action" alternative be evaluated at every site to establish a baseline for comparison. Under this alternative, EPA would take no action at the Site to prevent exposure to the contaminants remaining at the Site.

Alternative DZ-2: Soil Vapor Extraction
Estimated Implementation (Construction) Time: 1 month
Estimated Time to Reach SVE Performance Goal: 2.5 years
Estimated Capital Cost: $790,000
Estimated O&M Costs: $312,700
Estimated LTM Costs: $37,500
Estimated Present Worth (7%): $1,140,000

Alternative DZ-2 utilizes SVE wells to induce air flow that will carry and remove vapor-phase COCs from the deeper unsaturated zone of the Chicot aquifer by inducing a vacuum. Soil gas collected by the vacuum will be treated prior to discharge to the atmosphere. The treatment option for the soil vapor includes Granulated Activated Carbon (GAC). This alternative will address the contamination in the deeper unsaturated zone by mitigating the source and preventing further migration of COCs into the deep WBZ.

Evaluation of Alternatives

Nine criteria are used to evaluate the different remedial alternatives individually and against each other in order to select a remedy. The nine evaluation criteria are (1) overall protection of human health and the environment; (2) compliance with ARARs; (3) long-term effectiveness and permanence; 4) reduction of toxicity, mobility, or volume of contaminants through treatment; (5) short-term effectiveness; (6) implementability; (7) cost; (8) State/support agency acceptance; and (9) community acceptance. This section of the Proposed Plan profiles the relative performance of each alternative against the nine criteria, noting how it compares to the other options under consideration. The nine evaluation criteria are discussed below. The comparison of Criteria 1-7 are detailed in **Table 4 Evaluation for Shallow Source Area Soil Remedial Alternatives** and **Table 5 Evaluation for Deeper Unsaturated Zone of the Chicot Aquifer Remedial Alternatives**. Criteria 8 and 9 are presented below.

1. **Overall Protection of Human Health and the Environment** addresses whether each alternative provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled, through treatment, engineering controls, and/or institutional controls.

2. **Compliance with Applicable or Relevant and Appropriate Requirements ("ARAR").** Section 121(d) of CERCLA, 42 U.S.C. § 9621(d), and 40 CFR §300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate Federal and State requirements, standards, criteria, and limitations which are collectively referred to as ARARs, unless such ARARs are waived under CERCLA section 121(d)(4), 42 U.S.C. §9621(d)(4).

3. **Long-term Effectiveness and Permanence** refers to expected residual risk and the ability to maintain reliable protection of human health over time, once cleanup levels have been met.

4. **Reduction of Toxicity, Mobility, or Volume of Contaminants through Treatment** refers to the anticipated performance of the treatment technologies that may be included as part of a remedy.

5. **Short-term Effectiveness** addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community, and the environment during implementation.

6. **Implementability** considers the technical and administrative feasibility of a remedy such as relative availability of goods and services and coordination with other governmental entities.

7. **Cost** includes estimated capital and operation and maintenance costs as well as present worth costs. Present worth cost is the total cost of an alternative over time in terms of today's dollar value. Cost estimates are expected to be accurate within a range of +50 to -30 percent.
8. **State/Support Agency Acceptance** considers whether the State agrees with U.S.EPA's analyses and recommendations of the RI/FS and the Proposed Plan.

   The TCEQ has been provided the opportunity to review the RI/FS reports and Proposed Plan. The TCEQ was also a key participant in the Optimization Review technical discussions and conclusions to support the actions and preferred alternative evaluated in this Proposed Plan.

9. **Community Acceptance** considers whether the local community agrees with U.S. EPA's analyses and preferred alternative. Comments received on the Proposed Plan are an important indicator of community acceptance.

   Community acceptance of the Preferred Alternatives will be evaluated after the public comment period ends and will be described in the ROD Amendment for the Site.

Preferred Remedy

Based on the **Table 4** and **Table 5** comparisons of alternatives for Criterion 1-7 and Criterion 8 (State/Support Agency Acceptance) and Criterion 9 (Community Acceptance), EPA proposes Alternatives S-2 and DZ-2 as the Preferred Alternative to address the remedial action objective of source control. The use of soil vapor extraction is a presumptive remedy for VOCs in sandy soils (Deep Unsaturated Chicot Sand) as it will sustain an air flow for effective reduction in the mobility and volume of the contaminants. The SVE application was also shown to be effective for the Shallow Source Area Soil, a principal threat waste, through a 2016 field Pilot Test. Both Alternatives select soil vapor extraction (SVE).

Based on information currently available, the EPA believes the Preferred Alternatives S-2 and DZ-2 for SVE meet the threshold criteria and provide the best balance of tradeoffs among the other alternatives with respect to the balancing and modifying criteria. The EPA expects the Preferred Alternatives to satisfy the following statutory requirements of CERCLA §121(b), 42 U.S.C. §9621(b): 1) be protective of human health and the environment; 2) comply with ARARs (or justify a waiver); 3) be cost-effective; 4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and 5) satisfy the preference for treatment as a principal element.
In the event EPA selects a remedy that results in hazardous substances remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review will need to be conducted pursuant to 40 CFR § 300.430(f)(4)(ii) within 5 years after initiation of the remedial action to ensure that the remedy is, or will be, protective of human health and the environment. All alternatives presented in this FFS will potentially result in hazardous substances remaining on-site above levels that allow for unlimited use and unrestricted exposure. During statutory reviews, EPA will evaluate monitoring data collected prior to the review period and assess the effectiveness of the remedy. In the event that EPA determines that the RAO is not being met or the remedy is no longer protective, the remedy will be

reevaluated and an Explanation of Significant Differences document or ROD Amendment may be required.

Glossary

Administrative Record – All documents which the EPA considered or relied upon in selecting the response action at a Superfund site, culminating in the Record of Decision for a Remedial Action.

Aquifer - An underground geological formation, or group of formations, containing water. Are sources of groundwater for wells and springs.

Applicable, or Relevant, and Appropriate Requirements (ARARs) – Generally, any Federal, State, or local requirements or regulations that would apply to a remedial action if it were not being conducted under CERCLA, or that while not strictly applicable, are relevant in the sense that they regulate similar situations or actions and are appropriate to be followed in implementing a particular remedial action.

Bioaugmentation - The introduction of microorganisms and other materials to treat contaminated soil or water.

Chemical of Concern (COC) - Those chemicals that are identified as a potential threat to human health or the environment, are evaluated further in the baseline risk assessment, and are identified in the **RI/FS** as needing to be addressed by the response action proposed in the ROD or ROD Amendment.

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) – Also known as Superfund. CERCLA is a Federal law passed in 1980 and modified in 1986 by the Superfund Amendments and Reauthorization Act. Under CERCLA, the EPA can either pay for the site cleanup or take legal action to force parties responsible for site contamination to clean up the site or pay back the Federal government for the cost of the cleanup.

Dense Non-aqueous Phase Liquids (DNAPL) – A DNAPL is an organic substance that is relatively insoluble in water and denser than water. DNAPLs tend to sink vertically through sand and gravel aquifers to the underlying layer.

Feasibility Study (FS) – Identifies and evaluates the appropriate technical approaches and technologies to address contamination at the site.

Five-Year Reviews – A review generally required by statute or program policy when hazardous substances remain at a site above levels which permit unrestricted use and unlimited exposure. Five-year reviews provide an opportunity to evaluate the implementation and performance of a remedy to determine whether it remains protective of human health and the environment. Reviews are performed five years after completion of the remedy construction at Superfund-financed sites, and are repeated every succeeding five years so long as future uses at a site remain restricted.

Groundwater – Water found beneath the ground surface that fills pores between soil, sand, and gravel particles to the point of saturation. When it occurs in a sufficient quantity and quality, ground water can be used as a water supply.

In-Situ Chemical Oxidation (ISCO) - Technology that oxidizes contaminants dissolved in the soil or ground water, converting them into insoluble compounds. The reaction occurs underground within the contaminated area.

Institutional Controls (ICs) – Non-engineered instruments, such as administrative and/or legal controls, that help to minimize the potential for human exposure to contamination and/or protect the integrity of the remedy. **ICs** work by limiting land or ground water use and/or providing information that helps modify or guide a person's action at a site. Some common examples include restrictive covenants, deed notices, or local ordinances.

Maximum Contaminant Level (MCL) – MCLs are established under the Safe Drinking Water Act and are protective levels set for human exposure to a chemical in a drinking water source.

Micrograms per Cubic Meter (ug/m^3) – Concentrations of chemicals in air are typically measured in units of mass of chemical (i.e. micrograms) per volume of air, in this case, as cubic meters.

Micrograms per Liter (µg/L) – Equivalent to parts per billion (ppb); is a measurement of concentration used to measure how many micrograms of a contaminant are present in one liter of water. One µg/L is equal to 0.001 milligrams per liter (mg/L). One µg/L of PCE in water is like measuring one ounce of PCE in a billion ounces of water.

Milligrams per Liter (mg/L) – Equivalent to parts per million (ppm); is a measurement of concentration used to measure how many milligrams of a contaminant are present in one liter of water. One mg/L is equal to 1000 micrograms per liter (µg/L).

Operable Unit (OU) - An operable unit is a discrete action that comprises an incremental step toward comprehensively addressing site contamination.

National Priorities List (NPL) – EPA's list of the most serious uncontrolled or abandoned hazardous waste sites identified for possible long-term remedial response.

Plume - A measurable discharge of a contaminant from a given point of origin.

Present Worth Cost – A method of evaluation of expenditures that occur over different time periods. By discounting all costs to a common base year, the costs for different remedial action alternatives can be compared on the basis of a single figure for each alternative. When calculating present worth cost for Superfund sites, total operations and maintenance costs are to be included.

Proposed Alternative – Final remedial alternative that meets the NCP evaluation criteria and is supported by regulatory agencies and subject to review during a public comment period. Also referenced as the Preferred Alternative.

Principle Threat Waste - The NCP establishes an expectation that EPA will use treatment to address the principal threats posed by a Site wherever practicable. The "principal threat" concept is applied to the characterization of "source materials" at a Superfund site. A source material is material that includes or contains hazardous substances, pollutants or contaminants that act as a reservoir for migration of contamination to ground water, surface water or air, or acts as a source for direct exposure. Contaminated ground water generally is not considered to be a source material; however, non-aqueous Phase Liquids (NAPL) in ground water may be viewed as source material. Principal threat wastes are those materials considered to be highly toxic or highly mobile that generally cannot be reliably contained, or would present a significant risk to human health or the environment should exposure occur. Non-principal threat wastes are those source materials that generally can be reliably contained and that would present only a low risk in the event of exposure.

Record of Decision (ROD) - A public document that explains which cleanup alternative(s) will be used at Superfund (National Priorities List) sites.

Reductive Dechlorination – Biological process in which chlorinated solvents are transformed be sequential removal of chlorine atoms. Complete reductive dechlorination transforms Tetrachloroethene to trichloroethene to cis-1,2-dichloroethene to vinyl chloride to ethene

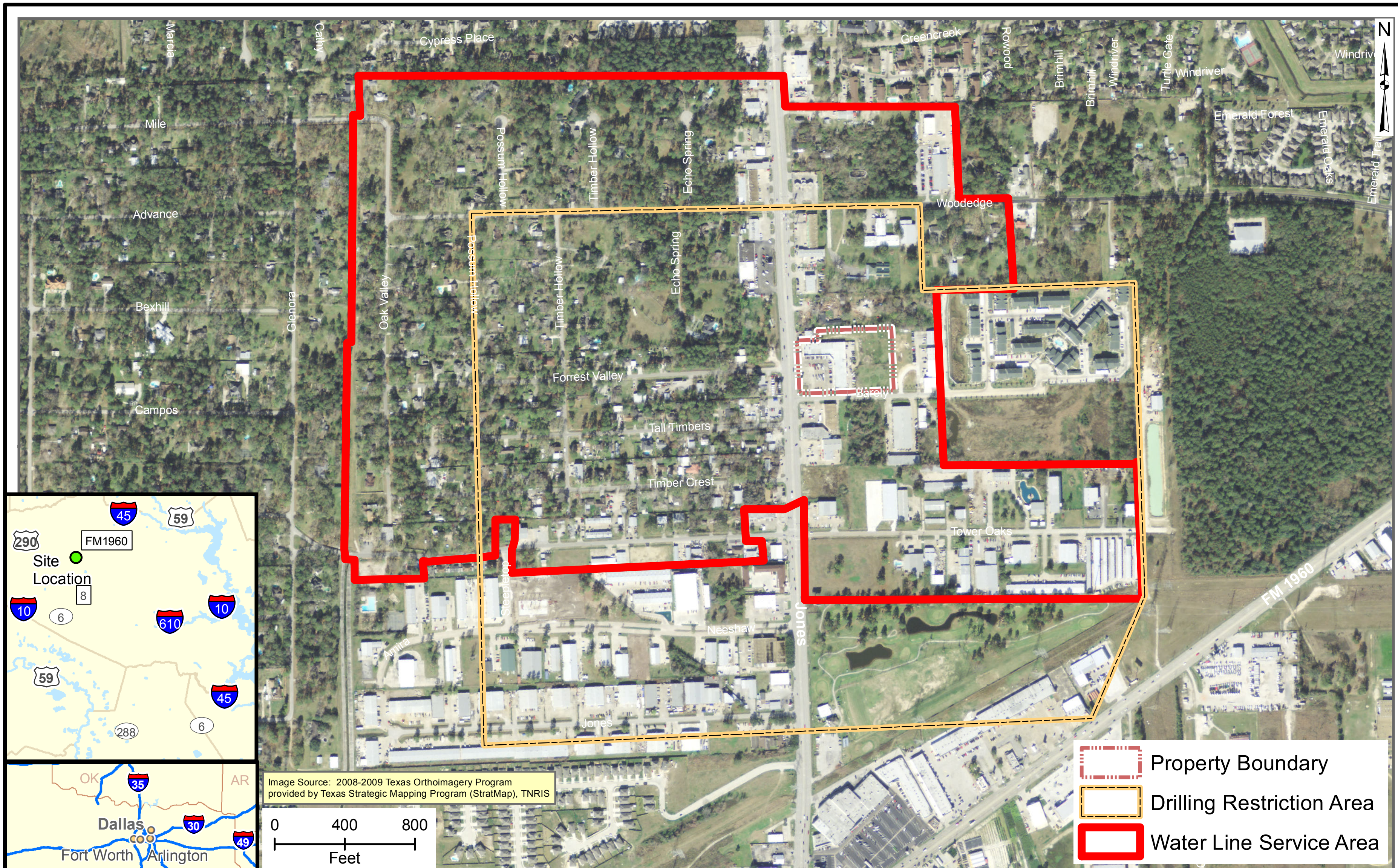
Remedial Action (RA) – Action(s) taken to correct or remediate contamination.

Remedial Action Objectives (RAO) - RAOs provide a general description of what the cleanup will accomplish (e.g., restoration of ground water to drinking water levels). These goals typically serve as the design basis for the remedial alternatives for a site.

Remedial Design - A phase of remedial action that follows the remedial investigation/feasibility study and includes development of engineering drawings and specifications for a site cleanup.

Remedial Investigation (RI) – The collection and assessment of data to determine the nature and extent of contamination at a site.

Figures



Focused Feasibility Study
Jones Road Ground Water Plume
Houston, Harris County, Texas

Figure 1
Site Location Map

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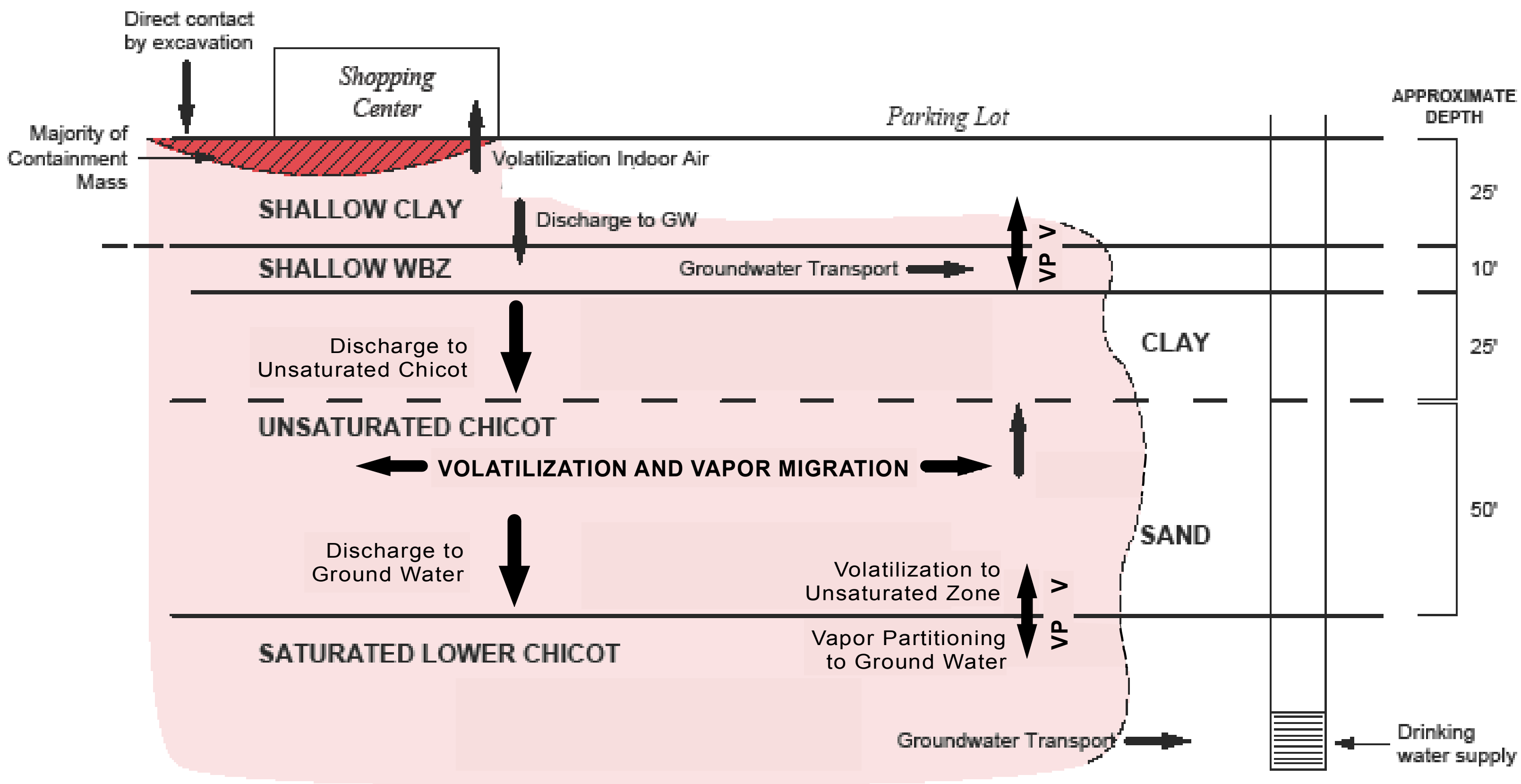

NOTE: Model from "Jones Road Conceptual Site Model", GSI Environmental, August 2013

Focused Feasibility Study
Jones Road Ground Water Plume
Houston, Harris County, Texas

Figure 2
Conceptual Site Model

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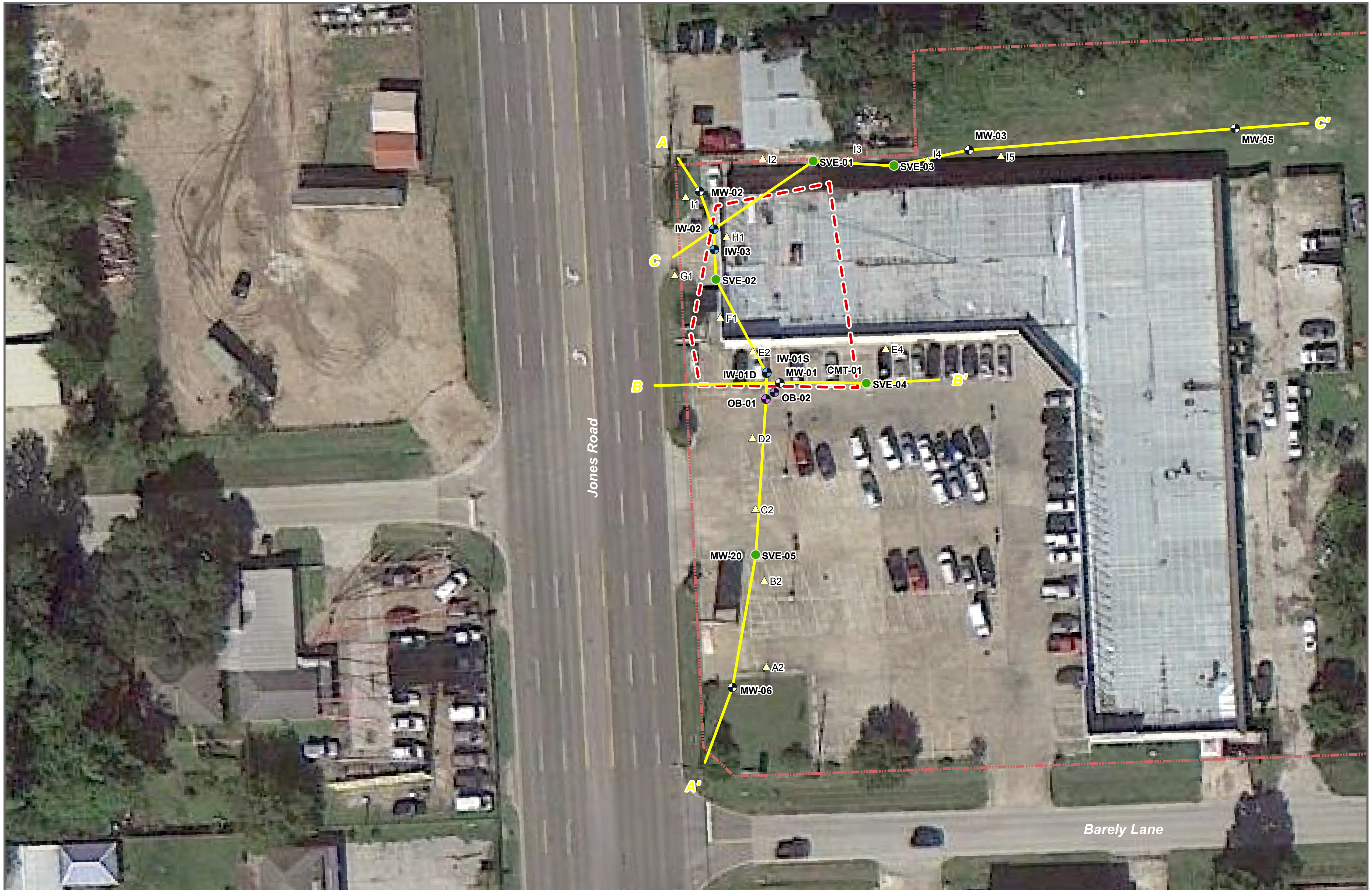

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Passive Soil Gas Locations
Injection Well
Observation Well
Monitoring Well
Deep Soil Vapor Extraction Well
Cross-Section
Fence Diagram of Source Area Conceptual Site Model
Property Boundary

0 25 50
Feet

Image Source: 2015 Texas Orthoimagery Program provided by Texas Strategic Mapping Program (StratMap), TNRIS

Focused Feasibility Study
Jones Road Ground Water Plume
Houston, Harris County, Texas

Figure 3 Cross-Section Location Map

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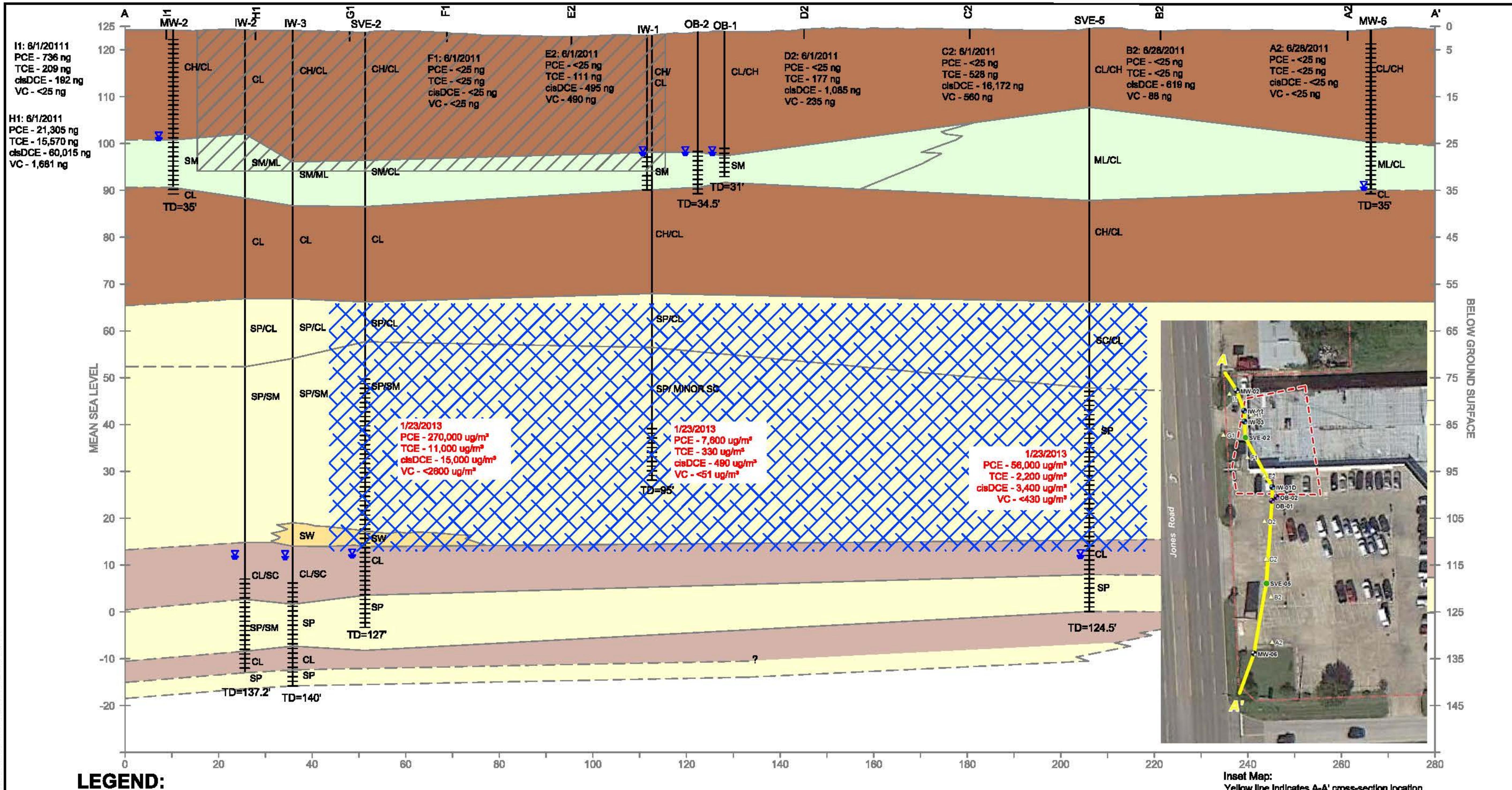

LEGEND:

CH/CL	FAT CLAY TO CLAY, BROWN TO GRAY, MOTTLED, STIFF, AREAS OF HIGH CALCIFICATION
CL/SC	SANDY CLAY TO CLAYEY SAND, PALE BROWN TO REDDISH YELLOW, SLIGHTLY PLASTIC TO PLASTIC, VERY FINE TO FINE GRAINED
SM/ML	SILTY SAND TO SANDY SILT, PALE TO YELLOW TO RED, VERY FINE GRAINED, MAY BE INTERBEDDED WITH SANDY CLAY AND CLAYEY SAND
SW	WELL GRADED SAND - REDDISH BROWN TO VERY PALE BROWN, LOOSE, VERY FINE TO MEDIUM GRAINED
SP - SP/CL/SC	POORLY GRADED SAND, WHITE TO PALE BROWN, VERY FINE TO FINE GRAINED, LOOSE, INTERBEDDED WITH SILTY AND SANDY CLAY AND CLAYEY SAND
(hatched)	EXTENT OF SOIL CONTAMINATION AS DETERMINED BY "FINAL SOURCE AREA CONCEPTUAL SITE MODEL", SHAW ENGINEERING, MAY 2008
(cross-hatched)	APPROXIMATE EXTENT OF SOIL VAPOR CONTAMINATION

MW-1 — WELL ID
SC — USCS SOIL CLASSIFICATION
BOREHOLE/WELL CASING
WELL SCREEN
GROUND WATER LEVEL
TD=30' — TOTAL DEPTH

AIR/GAS RESULTS :
SAMPLEDATE
PCE -
TCE -
cisDCE -
VC -

VERTICAL SCALE IN FEET (20 10 0 20)

HORIZONTAL SCALE IN FEET (20 10 0 20)

Focused Feasibility Study
Jones Road Ground Water Plume
Houston, Harris County, Texas

NOTES:

PCE = TETRACHLOROETHENE
TCE = TRICHLOROETHELENE
CISDCE = CIS-DICHLOROETHENE
VC = VINYL CHLORIDE

ug = MICROGRAMS
L = LITER
m³ = CUBIC METER

SOIL VAPOR RESULTS (u/m³)
PASSIVE SOIL GAS RESULTS (ng)

Figure 4

Cross-Section A-A'

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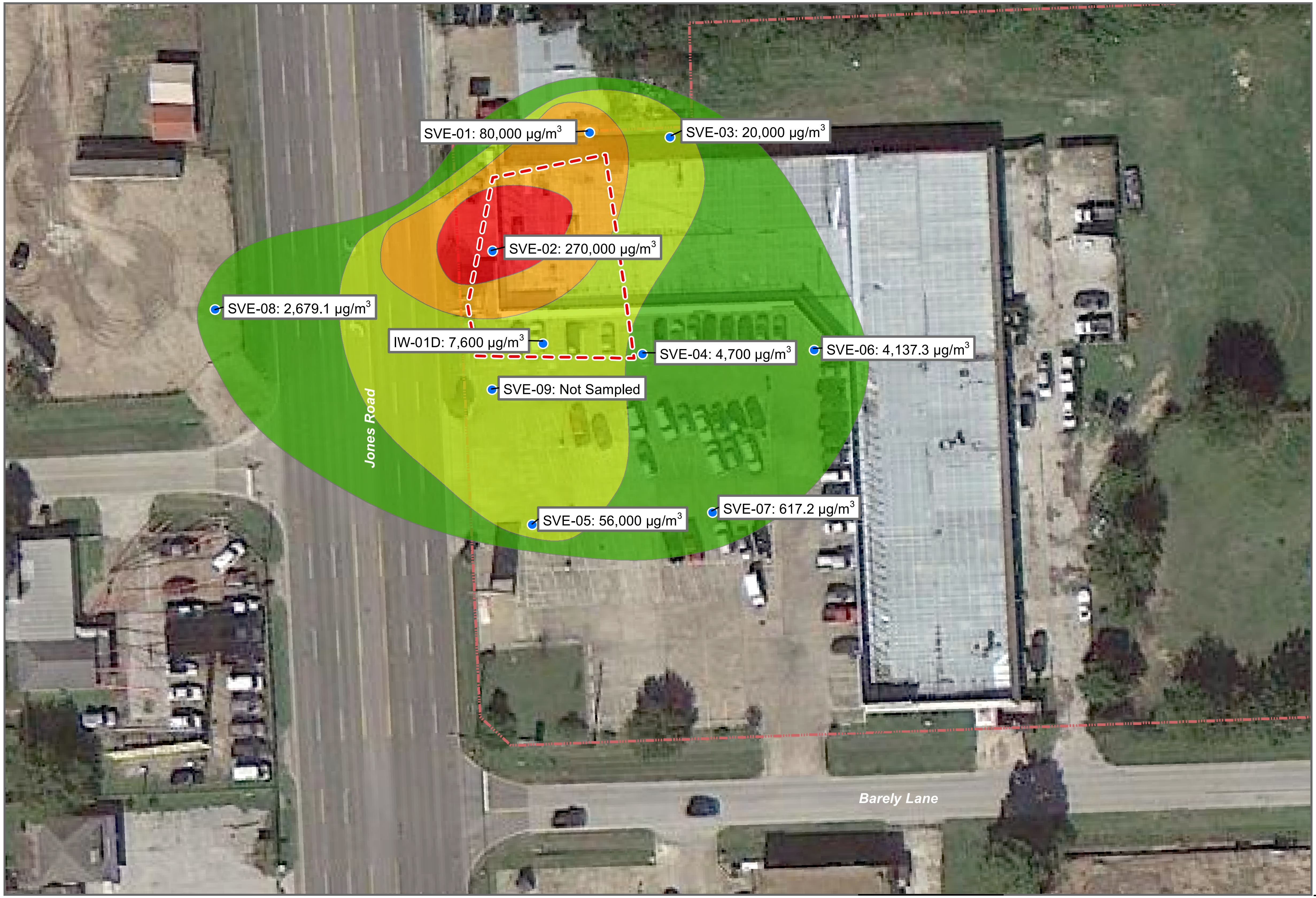

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Soil Vapor Extraction Well Location

Extent of Shallow Soil Contamination exceeding 5.0 ppb Tetrachloroethene in Soil as Determined by "Final Source Area Conceptual Site Model", Shaw Engineering, May 2008

Tetrachloroethene Contours

Soil Vapor Results

- 200,000 µg/m3
- 70,000 µg/m3
- 5,000 µg/m3
- 100 µg/m3

Property Boundary

Notes:

Sample Location: Tetrachloroethene Soil Vapor Results

Air Samples collected from SVE-06 through SVE-08 in March 2016. Samples collected from SVE-01 through SVE-05 collected in February 2013

0 25 50
Feet

Image Source: 2015 Texas Orthoimagery Program provided by Texas Strategic Mapping Program (StratMap), TNRIS

Feasability Study
Jones Road Ground Water Plume
Houston, Harris County, Texas

Figure 5
Approximate Treatment Area - Shallow Soil and Deeper Unsaturated Zone Soil Vapor

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Tables

TABLE 1
DESCRIPTION OF TECHNOLOGIES POTENTIALLY APPLICABLE FOR SHALLOW SOURCE AREA SOIL

General Response Action	Technology	Description
No Action	NA	No action is taken at the Site
Removal	Excavation	Contaminated material is collected and transported to an approved off-site disposal facility.
	Soil Vapor Extraction	A vacuum is applied to soil to induce a controlled flow of air to remove volatile contaminats through extraction wells. Water will be separated from the vapor stream and treated prior to discharge, disposal, or injection. Volatile compounds in the vapor are either directly discharged or treated prior to discharge to the atmosphere.
	Enhanced Soil Vapor Extraction with Hot Air Injection	Hot air is injected into the subsurface soil via injection wells to heat the contaminated zone in an effort to strip and recover subsurface contaminants. The contaminated vapors are captured with soil vapor extraction.
	Thermal Desorption	Contaminants are removed from soil through direct or indirect heat exchange that vaporize water and volatile organic compounds. The vapors are condensed or collected for further treatement or disposal.
Treatment	Bioventing	Aerobic degradation of contaminants are promoted by providing oxygen to existing soil microorganisms. Oxygen is supplied through direct air injection into contaminated soil.
	Chemical Oxidation	Contaminants are oxidized to inorganic chloride by introducing oxidizers such as permanganate, peroxide, or ozone into the soil.

Note:
NA = Not applicable

TABLE 2
TECHNOLOGY SCREENING: SHALLOW SOURCE AREA SOIL

General Response Action	Technology	Effectiveness	Implementability	Cost[1]	Status
No Action	NA	Will not address RAOs.	NA	NA	**Retained as required under the NCP**
Removal	Excavation	Will address RAOs.	Not implementable due to potential impacts to the overlying building.	NA	Not retained.
	Soil Vapor Extraction	Will address RAOs.	Implementable.	Medium	**Retained.**
	Enhanced Soil Vapor Extraction with Hot Air Injection	Will address RAOs.	Not implementable due to potential impacts to the overlying building.	NA	Not retained.
	Thermal Desorption	Will address RAOs.	Not implementable due to potential impacts to the overlying building.	NA	Not retained.
Treatment	Bioventing	Will not address RAOs. The typical biodegradation pathway for chlorinated solvents is anaerobic.	Implementable.	High	Not retained.
	in situ Chemical Oxidation	Will address RAOs.	Not implementable due to potential impacts to the overlying building.	NA	Not retained.
	ex situ Chemical Oxidation	Will address RAOs.	Not implementable due to potential impacts to the overlying building.	NA	Not retained.

Note:
[1] Cost estimates are relative within each General Response Action
Shaded cell denotes retained technology
NA = Not applicable
NCP = National Contingency Plan
PCE = Perchloroethene
RAO = Remedial action objective
TCE = Trichloroethene

TABLE 3
REMEDIAL ALTERNATIVES FOR SHALLOW SOURCE AREA SOIL

	Remedial Action Objectives
	Prevent or minimize further migration of contaminants from source materials to ground water (source control).
Alternative S-1: No Further Action	Does not address
Alternative S-2: Soil Vapor Extraction	Soil vapor extraction would address RAO. Source area soil contamination would be removed, mitigating the long-term source to the dissolved phase plume.

Notes:
COC = Contaminant of concern
MCL = Maximum contaminant level
RAO = Remedial action objective

TABLE 4
EVALUATION FOR SHALLOW SOURCE AREA SOIL REMEDIAL ALTERNATIVES

Evaluation Criteria	S-1 - No Action	S-2 - Soil Vapor Extraction
1. Overall Protection of Human Health and the Environment		
	No action is not protective since contaminants will continue to be sourced to the deep water bearing zone. Ground water migration pathway to human receptors will continue to exist.	SVE will remove contamination from the source area soil, thereby eliminating the soil leaching to ground water pathway.
2. Compliance with ARARs		
	No Action so no action- or location-specific requirements	Air quality permit by rule will be required. Will generate IDW from well drilling and moisture production from SVE operation that will require characterization and management. Construction permits will be filed, as appropriate.
3. Long Term Effectiveness and Permanence		
Magnitude of Residual Risk	Residual concentrations are not expected to decline in acceptable time period.	Magnitude of residual risk will decrease as pore volumes of soil vapor are extracted. VOC contamination can be physically removed and significant mass of residual waste or byproducts are not anticipated.
Adequacy and Reliability of Controls	No controls.	SVE is reliable as a control measure.
4. Reduction of Toxicity, Mobility, and Volume Through Treatment		
Treatment Process Used and Materials Treated	No reduction in mobility, toxicity, or volume of contaminated media.	Sorbed phase soil contaminants and soil vapors will be physically removed via extraction from the vadose zone with vacuum pumps. Extracted vapors and separated moisture will be treated using granular activated carbon adsorption. SVE will treat vapor phase and sorbed phase contamination.
Hazardous Materials Destroyed or Treated	None.	A significant volume of vadose zone contaminant mass will be removed and treated by this process.
Degree of Expected Reductions in Toxicity, Mobility, and Volume	Little to no reduction in toxicity, mobility, and volume.	Mobility and volume will be reduced to cleanup levels in soil.
Degree to Which Treatment is irreversible	No treatment. Not applicable.	Contaminants will be removed from the site. Irreversible.
Type of Residuals Remaining After Treatment	No treatment. Not applicable.	Low-level residuals in the vadose zone will be at concentrations that are protective of ground water migration pathway.

TABLE 4
EVALUATION FOR SHALLOW SOURCE AREA SOIL REMEDIAL ALTERNATIVES

Evaluation Criteria	S-1 - No Action	S-2 - Soil Vapor Extraction
5. Short Term Effectiveness		
Community Protection	The no-action alternative involves no disturbance of contaminated media and poses no short-term risk to human health or the environment.	Will require construction safety since construction will be performed and heavy equipment will transported to a commercial shopping center at the site.
Worker Protection	No remedial action. No risk to workers.	Standard Hazwoper controls, traffic control, and construction safety will provide adequate worker safety. There are no chemicals or processes that could expose workers other than site contaminants.
Environmental Impacts	The no action alternative may result in an expanded impact of the site ground water plume.	There are no anticipated environmental impacts related to this alternative. Adequate emission control will mitigate environmental impacts.
Time Until Remedial Action Objective is Achieved	Remedial action objective will not be achieved.	SVE is effective in source area soils, as demonstrated by a pilot test conducted in 2016. The target remediation time was estimated as 2 years.
6. Implementablility		
Ability to Construct and Operate the Technology	No Action.	Readily constructible using standard construction materials. Property access must be coordinated.
Technology Reliability	No Action.	Reliable and proven technology.
Ease of Undertaking Additional Remedial Actions, if Necessary	Easy to undertake additional remedial actions.	SVE systems can be readily expanded within reasonable flow rate increases. Large remedial actions may require more construction effort to accommodate modifications.
Monitoring Requirements	No Action.	SVE is easily monitored at several points in the extraction and treatment train and numerous guidance manuals exist regarding performance assessment.
Availability of Necessary Equipment and Specialists	Not applicable.	All equipment is standard and readily available. Disposal or regeneration of granular activated carbon is routine and the service is readily available.
Ability to Obtain Approvals from Other Agencies	Concurrence with other agencies not expected.	Ability to obtain approvals and coordinate with other agencies assumed to be possible.

TABLE 4
EVALUATION FOR SHALLOW SOURCE AREA SOIL REMEDIAL ALTERNATIVES

Evaluation Criteria	S-1 - No Action	S-2 - Soil Vapor Extraction
7. Cost		
a. Capital Costs	$0	$1.18M
b. Annual Operating and Maintenance Costs	$0	$178K
C. Total Present Value	$0	$1.54M

Notes:

ARAR	Applicable or Relevant and Appropriate Requirements
Hazwoper	Hazardous Waste Operations and Emergency Response
IDW	Investigation Derived Waste
SVE	Soil Vapor Extraction

TABLE 5
EVALUATION FOR DEEPER UNSATURATED ZONE OF THE CHICOT AQUIFER REMEDIAL ALTERNATIVES

Evaluation Criteria	DZ-1 - No Action	DZ-2 - Soil Vapor Extraction
1. Overall Protection of Human Health and the Environment		
	No action is not protective since contaminants will continue to be sourced to the deep water bearing zone. Ground water migration pathway to human receptors will continue to exist.	SVE will remove contamination from the deeper unstaruated zone, thereby eliminating the soil leaching to ground water pathway. This alternative will protect receptors from continued aquifer contamination.
2. Compliance with ARARs		
	No Action so no action- or location-specific requirements	Air quality permit by rule will be required. Will generate IDW from well drilling and moisture production from SVE operation that will require characterization and management. Construction permits will be filed, as appropriate.
3. Long Term Effectiveness and Permanence		
Magnitude of Residual Risk	Residual concentrations are not expected to decline in acceptable time period.	Magnitude of residual risk will decrease as pore volumes of soil vapor are extracted. VOC contamination can be physically removed and significant mass of residual waste or byproducts are not anticipated.
Adequacy and Reliability of Controls	No controls.	SVE is reliable as a control measure. Presumptive remedy for VOCs in soil.
4. Reduction of Toxicity, Mobility, and Volume Through Treatment		
Treatment Process Used and Materials Treated	No reduction in mobility, toxicity, or volume of contaminated media.	Sorbed phase soil contaminants and soil vapors will be physically removed via extraction from the vadose zone with vacuum pumps. Extracted vapors will be treated using granular activated carbon adsorption. SVE will treat vapor phase and sorbed phase contamination.
Hazardous Materials Destroyed or Treated	None.	A significant volume of vadose zone contaminant mass will be removed and treated by this process.
Degree of Expected Reductions in Toxicity, Mobility, and Volume	Little to no reduction in toxicity, mobility, and volume.	Mobility and volume will be reduced to cleanup levels in soil.
Degree to Which Treatment is irreversible	No treatment. Not applicable.	Contaminants will be removed from the site. Irreversible.
Type of Residuals Remaining After Treatment	No treatment. Not applicable.	Low-level residuals in the vadose zone will be at concentrations that are protective of ground water migration pathway.

TABLE 5
EVALUATION FOR DEEPER UNSATURATED ZONE OF THE CHICOT AQUIFER REMEDIAL ALTERNATIVES

Evaluation Criteria	DZ-1 - No Action	DZ-2 - Soil Vapor Extraction
5. Short Term Effectiveness		
Community Protection	The no-action alternative involves no disturbance of contaminated media and poses no short-term risk to human health or the environment.	Will require construction safety with conveyance piping installation under Jones Road, general construction activity, and heavy equipment transportation to a commercial shopping center at the site.
Worker Protection	No remedial action. No risk to workers.	Standard Hazwoper controls, traffic control, and construction safety will provide adequate worker safety. There are no chemicals or processes that could expose workers other than site contaminants.
Environmental Impacts	The no action alternative may result in an expanded impact of the site ground water plume.	There are no anticipated environmental impacts related to this alternative. Adequate emission control will mitigate environmental impacts.
Time Until Remedial Action Objective is Achieved	Remedial action objective will not be achieved.	SVE is effective in soils similar to the type encountered at Site. Permeability, air flow, and radius of influence are adequate for SVE. The target remediation time was estimated as 2.5 years.
6. Implementablility		
Ability to Construct and Operate the Technology	No Action.	Readily constructible using standard construction materials. Property access must be coordinated.
Technology Reliability	No Action.	Reliable and proven technology. Presumptive remedy for VOC in soil.
Ease of Undertaking Additional Remedial Actions, if Necessary	Easy to undertake additional remedial actions.	SVE systems can be readily expanded within reasonable flow rate increases. Large remedial actions may require more construction effort to accommodate modifications.
Monitoring Requirements	No Action.	SVE is easily monitored at several points in the extraction and treatment train and numerous guidance manuals exist regarding performance assessment.
Availability of Necessary Equipment and Specialists	Not applicable.	All equipment is standard and readily available. Disposal or regeneration of granular activated carbon is routine and the service is readily available.
Ability to Obtain Approvals from Other Agencies	Concurrence with other agencies not expected.	Ability to obtain approvals and coordinate with other agencies assumed to be possible.

TABLE 5
EVALUATION FOR DEEPER UNSATURATED ZONE OF THE CHICOT AQUIFER REMEDIAL ALTERNATIVES

Evaluation Criteria	DZ-1 - No Action	DZ-2 - Soil Vapor Extraction
7. Cost		
a. Capital Costs	$0	$790K
b. Annual Operating and Maintenance Costs	$0	$141K
c. Total Present Value	$0	$1.14M

Notes:

ARAR	Applicable or Relevant and Appropriate Requirements
Hazwoper	Hazardous Waste Operations and Emergency Response
IDW	Investigation Derived Waste
SVE	Soil Vapor Extraction