Letter Health Consultation

Reviewed Environmental Sampling Data Collected Between 2011 and 2015

R & H OIL COMPANY AND TROPICANA ENERGY COMPANY

SAN ANTONIO, TEXAS

EPA FACILITY ID: TXD057577579

EPA FACILITY ID: TX0002369072

SEPTEMBER 21, 2016

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Community Health Investigations
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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Prepared By:

U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry
Division of Community Health Investigations
Central Branch

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Agency for Toxic Substances
and Disease Registry
Atlanta GA 30333

September 21, 2016

Mr. Stephen Tzhone
Remedial Project Manager
USEPA Region 6
1445 Ross Avenue, Suite 1200
Dallas, Texas 75202

Dear Mr. Tzhone:

In response to your request, the Agency for Toxic Substances and Disease Registry (ATSDR) reviewed environmental sampling data collected between 2011 and 2015 for the R & H Oil Company and Tropicana Energy Company in San Antonio, Texas. Environmental sampling data were available for soil, surface water, groundwater, and soil gas.
The site has not been operational since the early 1990s and is fenced. Light non-aqueous phase liquids (LNAPLs) and volatile chemicals are present in groundwater and soil beneath the site. Overall, ATSDR found two primary exposure pathways of potential concern for this site for area residents: surface soil and indoor air (via vapor intrusion). Based on the available data, ATSDR reached three conclusions:

Conclusion 1: Current and future exposure to the chemicals detected in onsite surface soil is not expected to harm people's health. Because 1) exposure to onsite surface soil is not occurring every day, year after year, and 2) future land use of the site is restricted to commercial/industrial, ATSDR finds that current and future exposures to chemicals found in onsite surface soil are not at levels of health concern for area residents.

Conclusion 2: Future exposure to volatile chemicals in onsite indoor air is not expected to harm people's health because 1) soil gas chemical measurements at the currently abandoned onsite building were low or not detected, and 2) additional investigation and vapor intrusion controls are required prior to construction of onsite buildings. In the future, follow-up indoor air, sub-slab or crawlspace gas, and outdoor air monitoring would ensure contaminants are below levels of health concern for site occupants.

Conclusion 3: ATSDR cannot conclusively determine whether current and future exposure to volatile chemicals from vapor intrusion into offsite indoor air for nearby structures like buildings and homes could harm people's health. The limited soil gas measurements for areas downgradient of the dissolved groundwater plume provided inconsistent benzene results (i.e., some benzene measurements above screening levels and other measurements showing benzene was not found). Further, because offsite indoor air samples were not collected, the actual levels of volatile chemicals to which residents could be exposed to is unknown. Therefore, ATSDR cannot conclusively determine the vapor intrusion risks for people in homes and other nearby buildings in offsite areas.

Based on its evaluation, ATSDR recommends:

1. Continued monitoring of LNAPLs and dissolved volatile chemicals in the groundwater to ensure the plume does not migrate further offsite to residential areas.

2. Additional characterization of volatile and semi-volatile chemicals in soil gas southeast of the site to provide a clear understanding of soil gas migration. ATSDR generally recommends following U.S. Environmental Protection Agency (US EPA) approaches, including collecting soil gas samples no less than five feet below ground surface and investigating possible migration through sewer lines (see Chapter 6, USEPA 2015[1]).

3. Follow-up monitoring of onsite buildings in the future to ensure contaminants are below levels of health concern for site occupants. ATSDR recommends concurrent indoor air, sub-slab or crawlspace gas, and outdoor air monitoring.

4. Consider collecting offsite indoor air[2] samples in

    - commercial/industrial buildings northwest of the site near or above the dissolved groundwater plume, and
    - commercial/industrial buildings and homes southeast of the site downgradient of the plume to determine whether volatile chemicals are present in these structures.

Note that because people 1) are not expected to be in contact with subsurface soil, 2) are not expected to drink, swim, or wade in surface water intermittently found in the drainage ditch, 3) do not drink groundwater in the site's vicinity, 4) are not currently breathing indoor air in the onsite abandoned building, and 5) do not directly breathe soil gas, ATSDR does not consider these media to be primary exposure pathways of concern for this site. The following text provides information in support of ATSDR's findings and recommendations for the R & H Oil Company and Tropicana Energy Company site.

Site Background

The R & H Oil Company and Tropicana Energy Company (referred to hereafter as "the site") are situated on 7 acres of land, approximately 6 ½ miles southwest of downtown San Antonio, Texas. R & H Oil Company operated on the northern portion of the site, while Tropicana Energy Company operated on the southern portion (see Figure 1). The site has not been operational since the early 1990s.
The site operated as a fuel blending facility and crude oil refinery from 1934 until it was abandoned in the early 1990s. The facility primarily produced hydrocarbon products, reprocessed used oils, and blended and distributed gasoline. The reprocessed used oils, which were received from transmission and automotive shops, service stations, military installations, municipal/industrial generators and crude oil facilities, were collected and stored on site in 10,000 gallon aboveground storage tanks (ASTs). Before being processed and blended, the used oils were centrifuged to remove solids and sludge, and waste generated from this process remained on the site [TDH 2003; USEPA 2001]. Light non-aqueous phase liquids (LNAPLs) are present in the shallow groundwater beneath the site [Pastor, Behling & Wheeler, LLC 2016].

In 1998, removal assessment and sampling began. By late 2001, US EPA completed a removal and disposal of hazardous materials located in the ASTs, various containers, processing equipment, and piping. Some visibly contaminated soils were also removed. Additionally, US EPA demolished equipment, storage sheds, and tanks. By October 2001, new fencing was installed and there was no evidence of trespassing at that time [TDH 2003].

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[1] US Environmental Protection Agency (USEPA). June 2015. OSWER technical guide for assessing and mitigating the vapor intrusion pathway from subsurface vapor sources to indoor air. Available at: http://www2.epa.gov/vaporintrusion/technical-guide-assessing-and-mitigating-vapor-intrusion-pathway-subsurface-vapor.

[2] Concurrent with sub-slab or crawlspace gas and outdoor air.

Currently, about one-third of the site is gravel parking lots, paved road, and extensively re-worked soil and bare patches of soil. The remaining portion of the site is a routinely maintained grass lot with several grassy containment berms still present. Restrictive covenants that limit groundwater use, restrict future land use to commercial/industrial use, and require additional investigation and vapor intrusion controls prior to construction have been filed on the deed for the site [Pastor, Behling & Wheeler, LLC 2016].

Land Use in the Area

The site is bounded on the north, east, and south by commercial properties. Kelly Air Force Base (KAFB) is to the west of the site. The Union Pacific Railroad runs alongside the western side of the site. Most of the residential properties in the area lie to the south and east of the site, with the nearest residential property approximately 120 feet to the east (see Figure 2).

Groundwater use in the Area

The site area has both a shallow aquifer and a deeper, confined underground waterway known as the Edwards Aquifer. Groundwater flow direction at the site is typically toward the east or southeast. The shallow aquifer is at depths of about 12 to 30 feet below the surface. A layer of clay below the shallow aquifer ranges from 50 to 450 feet in thickness. Under the clay layer is about 300 feet of a loose, crumbly rock material known as marl and another 500 feet of limestone and shale. The Edwards aquifer is below about 1000 feet of clay, marl, limestone, and shale layers [ATSDR 2007].

Site investigations indicated the shallow groundwater is underlain by several feet of low permeability silty clay lenses that inhibit hydraulic communication with the deeper groundwater present in the alluvium above the Navarro Shale (approximately 45 feet below ground surface [bgs]). Vertical migration to deeper water-bearing units below the Navarro Formation shale is effectively precluded by the thickness and low vertical hydraulic conductivity of the shale [Pastor, Behling & Wheeler, LLC 2016].

Residences in this area receive drinking water from the San Antonio Water System [ATSDR 2007; Pastor, Behling, and Wheeling, LLC 2016]. The San Antonio Water System 2015 Water Quality Report indicates the area's drinking water currently meets US EPA standards [San Antonio Water System 2015]. No water supply wells have been identified in the site's vicinity[3]. Further, the site is subject to a June 2014 ordinance that the City of San Antonio implemented that established that the San Antonio Water System shall not issue a permit for any new well on a property to which water service is currently available or could be established to the property at a reasonable cost [Pastor, Behling & Wheeler, LLC 2016].

Previous ATSDR Site Activities

Through ATSDR's Cooperative Agreement Program, in 2003, the Texas Department of Health[4] (TDH) evaluated the environmental information available for the site and identified several exposure pathways through which people might come into contact with site contaminants. TDH evaluated contaminant data for surface water, air, soil, groundwater, and soil vapor. On the basis of available information at that time (i.e., 2003), TDH concluded that the site poses no apparent public health hazard. TDH noted that if site conditions change, particularly if contaminants migrate into the Edwards Aquifer, a re-evaluation of the public health significance of this site would be necessary.

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[3] KAFB investigations included an extensive water well survey of the area. The survey was conducted in several phases from 1988 to 2001, and included a records search, a field survey, and water well sample collection/analyses. The survey identified only two water supply wells completed in the uppermost groundwater bearing unit within approximately 2,000 feet of the R & H Oil Company and Tropicana Energy Company site. Both of those wells were identified as having been plugged [Pastor, Behling & Wheeler, LLC 2016].

[4] In 2004, TDH was renamed the Texas Department of State Health Services (DSHS).

Discussion

At the request of EPA, ATSDR reviewed additional environmental sampling data for soil, surface water, groundwater, and soil gas collected between 2011 and 2015. Soil and groundwater samples were analyzed for total petroleum hydrocarbons (TPHs), volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and metals. Surface water samples taken from the offsite drainage ditch were analyzed for VOCs, SVOCs, and metals. Soil gas samples were analyzed for VOCs.

To determine whether people are being exposed to contaminants in soil, surface water, groundwater, and soil gas at this site, ATSDR examined the path between a contaminant in these media and a person or group of people who could be exposed. If completed or potential exposure pathways were identified, sample results were screened using health-based comparison values (CVs). These CVs, as well as all other health-based screening criteria, represent conservative levels of protection; they are not thresholds of toxicity. Although concentrations at or below a CV may reasonably be considered low or no risk, concentrations above a CV will not necessarily be harmful. Instead, the results of the CV screening identify those contaminants that warrant a more detailed, site-specific evaluation to determine whether health effects may potentially occur.

TPH is the measurable amount of petroleum-based hydrocarbon in an environmental media. TPH is a measured, gross quantity without identification of its constituents. TPH itself is not a direct indicator of risk to people or to the environment [ATSDR 1999]. Thus, ATSDR did not evaluate the public health significance of the TPH measurements.

Soil

Exposure to soil occurs primarily through dermal contact with the top three inches of soil. In addition, people might incidentally ingest soil as well as dust that is generated from disturbing the surface soil, and inhale volatile chemicals released from the soil. Preschool age children tend to swallow more soil than do any other age group because they have more contact with surface soil through their play activities and they tend to exhibit mouthing of objects. Children in elementary school, teenagers, and adults tend to swallow much smaller amounts of surface soil.

Subsurface soil samples were collected from both onsite and offsite areas. Thirty-six onsite subsurface soil samples (2 feet to 25 feet bgs) were collected onsite during the installation of groundwater monitoring wells. Visible LNAPL was observed within the soil matrix in the soil cores for several locations, and the nature of the detected compounds observed in onsite deeper soil suggests that they are primarily associated with a smear zone resulting from the presence of the LNAPLs and water table fluctuations [Pastor, Behling & Wheeler, LLC 2016]. Offsite subsurface soil was sampled from two locations at three depths to support the soil gas investigation [Pastor, Behling & Wheeler, LLC 2016]. Because people are not typically exposed to subsurface soil, ATSDR does not consider subsurface soil to be a primary exposure pathway of concern for this site, and will not evaluate it further.

Because outdoor air is not contained within a structure like indoor air, ATSDR does not consider inhalation of VOCs and SVOCs from the soil to the outdoor air to be a primary exposure pathway of concern for this site, and will not evaluate it further.

Nineteen surface soil samples (0 to 6 inches bgs) were collected onsite; no offsite surface soil samples were collected. All but three samples (SB-1, SB-2, and SB-3) were collected inside the fenced area of the site. The three onsite samples outside the fenced area were collected from the western portion of the site, between the fence and a drainage ditch that runs adjacent to railroad tracks. ATSDR screened these data and found the

majority of chemicals were detected at levels below their most protective health-based CVs; these chemicals found below health-based CVs in onsite surface soil are not at levels of health concern.
Although the majority of chemicals were detected below health-based CVs, the maximum levels of few chemicals in onsite surface soil exceeded available health-based CVs based on long-term exposure. These maximum chemical levels were for arsenic at 7.9 milligrams per kilogram (mg/kg), lead at 430 mg/kg, thallium at 1.3 mg/kg, and several polycyclic aromatic hydrocarbons (PAHs) with a benzo(a)pyrene toxic equivalent (BaP-TE) at 4.7 mg/kg. The maximum levels of arsenic and BaP-TE exceeded ATSDR cancer risk evaluation guides of 0.47 ppm (arsenic) and 0.096 ppm (Bap-TE); however, the arsenic maximum level is below both its chronic and acute noncancer environmental media evaluation guides (15 ppm and 10 ppm, respectively). The maximum levels of thallium and lead exceed US EPA regional screening levels of 0.78 ppm (thallium) and 400 ppm (lead). But thallium was only detected one time in 19 samples. Lead's second highest detection was 160 ppm, with the median being 49 ppm. Note that long-term CVs assume daily exposure for years. Exposure doses calculated for a trespasser exposed to onsite surface soil were found to be well below the health guideline levels and are not expected to result in harm. Although an occasional trespasser might hop the fence to gain access to the site or walk along the drainage ditch and railroad track area, such trespassers are not expected to be in direct contact with the soil nor engaged in activities that disturb the soil to any great extent every day, year after year. Because 1) exposure to onsite surface soil is not occurring every day, year after year, and 2) future land use of the site is restricted to commercial/industrial, ATSDR finds that current and future exposures to these chemicals in onsite surface soil are not at levels of health concern for area residents.

Surface Water

Exposure to surface water occurs through dermal contact and incidental ingestion during activities such as swimming, wading, and fishing. A drainage ditch is located between the site's fence and the Union Pacific Railroad tracks. The ditch receives surface water runoff from an industrial area of San Antonio, and potentially from a small portion of the site draining to the ditch; however, the ditch is frequently dry except after rainfall events [Pastor, Behling & Wheeler, LLC 2016]. Five surface water samples were collected from the drainage ditch in October 2011 following a rainfall event. ATSDR would not expect people to swim, wade, or fish in the shallow surface water intermittently found in this ditch. Therefore, ATSDR does not consider drainage ditch surface water to be a primary exposure pathway of concern for this site, and will not evaluate it further.

Groundwater

Exposure to groundwater occurs when it is pumped to the surface to be used for domestic supply. Routes of exposure are ingestion, inhalation of vapors, and dermal contact. Groundwater exposures occur through drinking, showering, bathing, dishwashing, and other household activities.

Groundwater samples were collected from onsite and offsite monitoring wells in May 2012, April 2014, May 2015, and December 2015. Shallow groundwater is unconfined and the top of the water table was typically found from 12 to 22 feet bgs during the investigation. Monitoring wells were screened both in the deeper alluvium above the Navarro Shale and in the upper water-bearing zone [Pastor, Behling & Wheeler, LLC 2016].

Groundwater at the site contains elevated concentrations of contaminants, such as the VOCs benzene, ethylbenzene, toluene, and xylenes (called BTEX). Overall, site investigations indicated that

1. Based on the contaminant concentration gradient, the source area for the dissolved plume appears to be in the northwest portion of the site.
2. LNAPL has been observed in monitoring wells located within the dissolved plume; however, the dissolved contaminant concentrations within the plume do not appear to be influenced by the presence of this LNAPL.

3. The concentration of dissolved contaminants at the site exhibits a steadily decreasing trend across the site from the northwest to the southeast, and the dissolved plume does not extend under homes located to the southeast of the site.
4. The dissolved benzene concentration at the site decreases by five orders of magnitude over a distance of about 500 feet, indicating that significant natural attenuation of the dissolved plume is occurring.
5. The dissolved plume is undergoing aerobic and anaerobic biodegradation based on geochemical data.
6. The lateral extent of dissolved contaminants in groundwater is about 520 feet (from the primary source area in the northwest corner of the site to the southeast property boundary and limit of benzene plume) [Pastor, Behling & Wheeler, LLC 2016].

As stated previously, residences in this area receive drinking water from the San Antonio Water System and ATSDR is not aware of any private wells in the vicinity of the site. Therefore, ATSDR does not consider groundwater to be a primary exposure pathway of concern for this site, and will not evaluate it further. However, ATSDR provides groundwater screening information for BTEX under the soil gas section with regard to its evaluation of potential vapor intrusion risks.

Soil Gas

People are not directly exposed to soil gas; however, soil gas measurements can help public health officials make informed decisions about the potential for vapor intrusion. Vapor intrusion can occur when there is a migration of volatile chemicals from contaminated groundwater or soil into an overlying building. Volatile chemicals can emit vapors that can migrate through soils and into indoor air spaces of overlying buildings. Exposure occurs when people breathe in the volatile chemicals in indoor air.

On September 10, 2011, nine onsite soil gas samples were collected from inside the fenced area of the site. Seven of the samples were collected at 5–6 feet bgs, one at 3.5–4.5 feet bgs, and one at 3–4 feet bgs. Three sub-slab samples (SS-1, SS-2, and SS-3) were also collected at 1 foot bgs in the abandoned former office building located near the entrance of the site. The building is located on the downgradient boundary of the property directly over the groundwater containing dissolved contaminants [Pastor, Behling & Wheeler, LLC 2016]. Location SS-2 was sampled again on September 24, 2012. On February 21, 2014, three onsite soil gas samples (SG-23, SG-24 and SG-25) were collected at 4–5 feet bgs outside the fenced area along the eastern site boundary downgradient of the dissolved plume.

On September 24, 2012, two offsite soil gas samples, SG-21 and SG-22, were collected at 5–6 feet bgs. Location SG-21 was sampled again on January 16, 2013. On May 26, 2015, three offsite soil gas samples (SG-26, SG-27 and SG-28) were collected at 1.5 feet bgs from below the sidewalk on the east side of Somerset Road. Figure 1 shows the locations of the soil gas sampling locations.
Because people are not currently breathing indoor air in the onsite abandoned building, ATSDR does not consider the indoor air of this building to be a current exposure pathway of concern for this site. However, ATSDR considers future onsite vapor intrusion into indoor air for the current onsite building and any future onsite buildings, as well as current and future offsite vapor intrusion into indoor air for nearby structures like buildings and homes, to be primary exposure pathways of potential concern.

To reach firm conclusions about vapor intrusion risks, ATSDR requires multiple-lines-of-evidence that incorporate data from various sources, including indoor air measurements; however, no onsite or offsite indoor air samples were collected. ATSDR's evaluation of potential vapor intrusion risks is limited to the available groundwater and soil gas data.

ATSDR has not developed health-based screening values to specifically evaluate the potential for vapor intrusion from groundwater and soil gas sampling results. However, for chemicals with air CVs such as the ATSDR chronic

environmental media evaluation guide (cEMEG), ATSDR cancer risk evaluation guide (CREG), US EPA carcinogenic screening level (CSL), and US EPA noncarcinogenic screening level (NSL)[5], ATSDR uses these air CVs to calculate a target groundwater and soil gas concentration in order to evaluate the groundwater and soil gas results for potential vapor intrusion concerns.

Site investigations indicate the highest soil gas measurements were typically for BTEX related compounds (e.g., benzene at 620,000 micrograms per cubic meter [$\mu g/m^3$]) associated with LNAPL sources in shallow soil (typically less than five feet bgs) [Pastor, Behling & Wheeler, LLC 2016]. Table 1 provides the site's BTEX sampling results for onsite and offsite groundwater and soil gas and the calculated vapor intrusion screening levels (VISLs).

Table 1 shows the sub-slab measurements from the abandoned onsite building, which is above the dissolved groundwater plume, had relatively few chemicals detected, including benzene. Conversely, benzene, toluene, and xylene onsite soil gas results exceeded their respective VISLs, with benzene exceeding it soil gas VISL by over five orders of magnitude (see Table 1). BTEX results for onsite groundwater showed these contaminants exceeding their respective VISLs by about one to over four orders of magnitude. Based on these onsite soil gas and groundwater BTEX results, future vapor intrusion of volatile chemicals into onsite building indoor air could be of potential concern if preventative measures are not taken. US EPA states "it may be appropriate and cost-effective to design, install, operate, and monitor mitigation systems (including passive barrier systems) in newly constructed buildings (or buildings planned for future construction) that are located in areas of vapor-forming subsurface contamination, rather than allow vapor intrusion (if any) to occur and address vapor intrusion after the fact" [USEPA 2015]. Because restrictive covenants on the site's deed require additional investigation and vapor intrusion controls prior to construction of buildings, ATSDR finds that people, both workers and area residents, would not be expected to be exposed to volatile chemicals in onsite indoor air in the future.

Except for the BTEX results that are already provided in Table 1, Table 2 provides groundwater and soil gas measurements for VOCs found in offsite groundwater downgradient of the site, onsite site soil gas downgradient of the site (outside the fenced area), and offsite soil gas for chemicals that exceeded their VISLs and for those chemicals without VISLs. Benzene, bromodichloromethane, naphthalene, and vinyl chloride exceeded their respective groundwater VISLs by less than one order of magnitude. Benzene; 1,2-dichloroethane; naphthalene; and 1,2,4-trimethylbenzene exceeded their soil gas VISLs.

Focusing on the higher benzene measurements in soil gas, Table 1 shows that a maximum detected benzene concentration of 170,000 $\mu g/m^3$ in soil gas from a location downgradient of the dissolved plume (SG-23) is well above the VISL of 4.3 $\mu g/m^3$ calculated from ATSDR's CREG. This soil gas measurement is also above ATSDR's acute EMEG for benzene in air of 29 $\mu g/m^3$, which would result in a calculated acute VISL of 970 $\mu g/m^3$. However, SG-23 is not in the residential area and soil gas measurements taken just across Somerset Road from this location (i.e., SG-26, SG-27, and SG-28) did not find benzene. ATSDR is unclear whether this is because 1) the soil gas measurements were collected from different depths (SG-23 at 4–5 feet bgs and the others at 1.5 feet bgs), 2) the soil gas measurements were collected during different seasons (SG-23 in February and the others in May), 3) a preferential pathway exists, or 4) some other variable. Additionally, somewhat further downgradient of the dissolved plume at location SG-21, benzene exceeded its soil gas VISLs with a maximum concentration of 610 $\mu g/m^3$.

Overall, site groundwater investigations indicate a limited potential future migration of volatile chemicals to offsite residential areas [Pastor, Behling & Wheeler, LLC 2016]. However, based on these available soil gas data, ATSDR cannot conclusively determine whether current and future exposure to volatile chemicals from vapor

[5] US EPA carcinogenic and noncarcinogenic screening levels are posted in the "Regional Screening Level (RSL) Resident Ambient Air Table (TR=1E-06, HQ=1) November 2015" file found at https://semspub.epa.gov/work/03/2220589.pdf.

intrusion into offsite indoor air for nearby structures like buildings and homes could harm people's health. This is because the relatively few soil gas measurements for areas downgradient of the dissolved plume provided inconsistent results with some benzene measurements above VISLs and other measurements showing benzene was not found. Further, because offsite indoor air samples were not collected, the actual levels of benzene residents could be exposed to is unknown.

Conclusions and Recommendations

Based on the available data, ATSDR reached three conclusions:

Conclusion 1: Current and future exposure to the chemicals detected in onsite surface soil is not expected to harm people's health.

- **Basis for Conclusion 1:** The site has not been operational since the early 1990s and is fenced. The maximum levels of few chemicals (arsenic, lead, thallium, and several PAHs) in onsite surface soil exceeded available health-based CVs based on long-term exposure. Although an occasional trespasser might hop the fence to gain access to the site or walk along the drainage ditch and railroad track area, such trespassers are not expected to be in direct contact with the soil nor engaged in activities that disturb the soil to any great extent. Because 1) exposure to onsite surface soil is not occurring every day, year after year, and 2) future land use of the site is restricted to commercial/industrial, ATSDR finds that current and future exposures to these chemicals in onsite surface soil are not at levels of health concern for area residents. If site conditions or land use changes, a re-evaluation of the public health significance of the onsite surface soil exposure pathway would be necessary.

Conclusion 2: Future exposure to volatile chemicals in onsite indoor air is not expected to harm people's health.

- **Basis for Conclusion 2:** LNAPLs are present in the shallow groundwater beneath the site. Onsite groundwater, subsurface soil, and soil gas measurements confirm volatile chemicals exist in the groundwater and soil beneath the site. Because 1) soil gas chemical measurements at the currently abandoned onsite building were low or not detected, and 2) additional investigation and vapor intrusion controls are required prior to construction of onsite buildings, ATSDR finds that people, both workers and area residents, would not be expected to be exposed to volatile chemicals in onsite indoor air in the future. If the restrictive covenants on the site's deed are modified, a re-evaluation of the public health significance of this exposure pathway would be necessary. In the future, follow-up indoor air, sub-slab or crawlspace gas, and outdoor air monitoring would ensure contaminants are below levels of health concern for site occupants.

Conclusion 3: ATSDR cannot conclusively determine whether current and future exposure to volatile chemicals from vapor intrusion into offsite indoor air for nearby structures like buildings and homes could harm people's health.

- **Basis for Conclusion 3:** LNAPLs are present in the shallow groundwater beneath the site and this shallow groundwater contains elevated concentrations of contaminants, such as BTEX. However, the relatively few soil gas measurements for areas downgradient of the dissolved groundwater plume provided inconsistent results with some benzene measurements above VISLs and other measurements showing benzene was not found. Further, because offsite indoor air samples were not collected, the actual levels of benzene residents could be exposed to is unknown. Therefore, ATSDR cannot conclusively determine the vapor intrusion risks for offsite areas.

Based on its evaluation, ATSDR recommends:

1. Continued monitoring of LNAPLs and dissolved volatile chemicals in the groundwater to ensure the plume does not migrate further offsite to residential areas.

2. Additional characterization of volatile and semi-volatile chemicals in soil gas southeast of the site to provide a clear understanding of soil gas migration. ATSDR generally recommends following US EPA approaches, including collecting soil gas samples no less than five feet below ground surface and investigating possible migration through sewer lines (see Chapter 6, USEPA 2015[6]).

3. Follow-up monitoring of onsite buildings in the future to ensure contaminants are below levels of health concern for site occupants. ATSDR recommends concurrent indoor air, sub-slab or crawlspace gas, and outdoor air monitoring.

4. Consider collecting offsite indoor air[7] samples in
    - commercial/industrial buildings northwest of the site near or above the dissolved groundwater plume, and
    - commercial/industrial buildings and homes southeast of the site downgradient of the plume to determine whether volatile chemicals are present in these structures.

ATSDR notes that our evaluation of the potential exposure pathways for residents living near the site has several limitations, including that 1) no offsite surface soil samples were collected, 2) no offsite indoor air samples were collected, and 3) the relatively few soil gas measurements for areas downgradient of the dissolved plume provided inconsistent benzene results.

Thank you for contacting ATSDR. I hope you find the information provided in this letter useful to your work at the site. If you have any additional questions, please contact me at 770-488-0665 or DLangmann@cdc.gov.

Sincerely,

Danielle M. Langmann, MS
Environmental Health Scientist
Division of Community Health Investigations
Agency for Toxic Substances and Disease Registry

CC:
George Pettigrew, ATSDR Region 6 Director
Jennifer Lyke, ATSDR Region 6 Representative
Richard Gillig, ATSDR Central Branch Chief

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[6] US Environmental Protection Agency (USEPA). June 2015. OSWER technical guide for assessing and mitigating the vapor intrusion pathway from subsurface vapor sources to indoor air. Available at: http://www2.epa.gov/vaporintrusion/technical-guide-assessing-and-mitigating-vapor-intrusion-pathway-subsurface-vapor.

[7] Concurrent with sub-slab or crawlspace gas and outdoor air.

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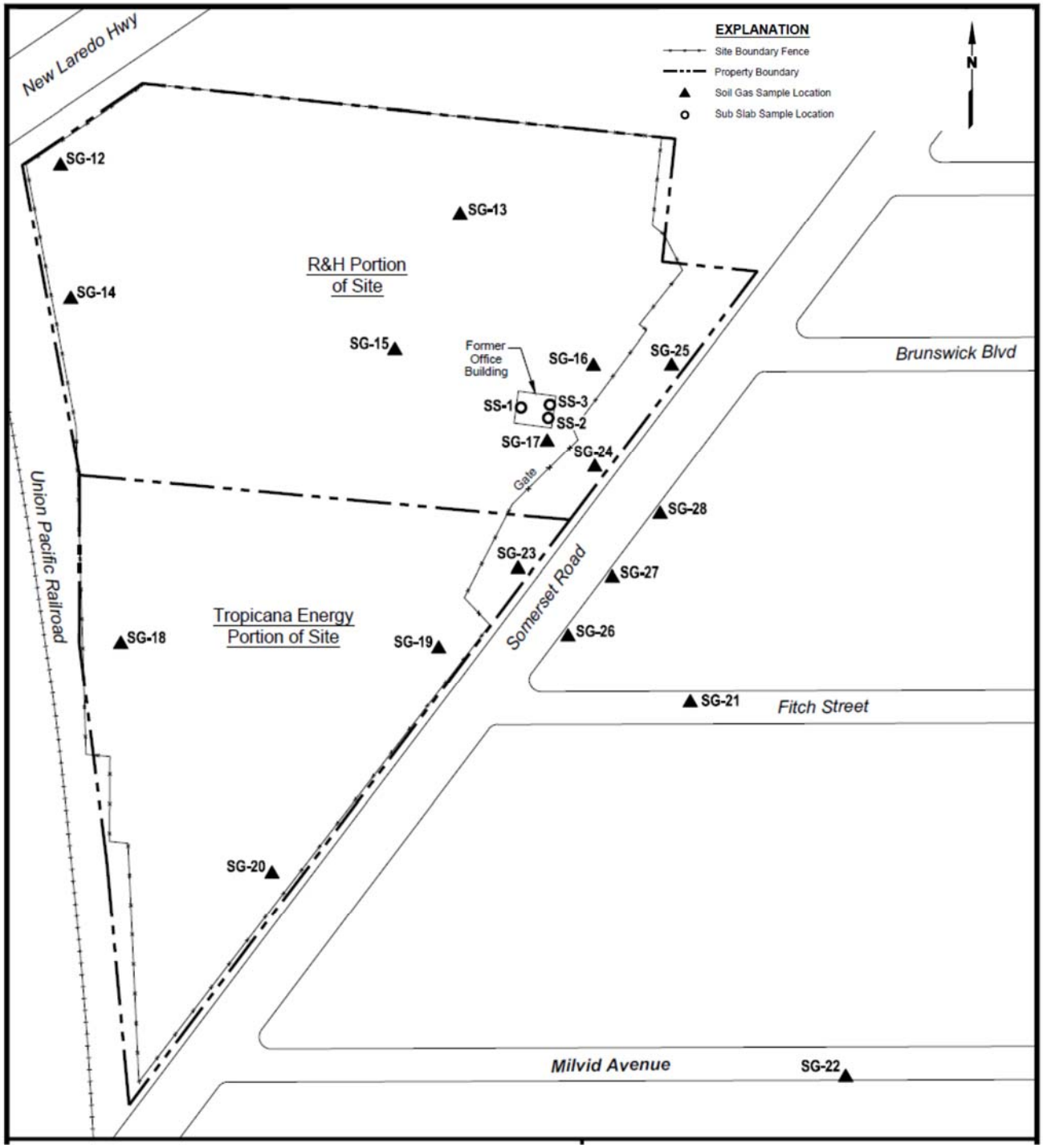
Figure 1. R & H Oil Company and Tropicana Energy Company Soil Gas Sample Location Map, San Antonio, TX



* Source: Adapted from Figure 6 in Pastor, Behling & Wheeler, LLC 2016.

Figure 2. R & H Oil Company and Tropicana Energy Company Google Satellite Image, San Antonio, TX

* Source: Adapted from Google Maps 2016.

— Approximate site boundary.

Table 1. R & H Oil Company and Tropicana Energy Company Groundwater and Soil Gas BTEX Results, San Antonio, TX

Contaminant	Onsite Ground-water Results	Offsite Ground-water Up-gradient Results	Offsite Ground-water Down-gradient Results	Ground-water VISL*	Sub-Slab Results†	Onsite Soil Gas Results‡ (inside fenced area)	Onsite Soil Gas Results¶ (down-gradient, outside fenced area)	Offsite Soil Gas Results§ (along Somerset Road)	Offsite Soil Gas Results**	Soil Gas VISL††	Air CV (basis)	Henry's Law Constant
	µg/L	µg/L	µg/L	µg/L	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	ug/m³	unitless‡‡
Benzene	ND–**31,000**¶¶	ND–**14,000**	ND–**1.5**	0.57	ND	**33J–620,000**	**230–170,000**	ND	ND–**610**	4.3	0.13 (CREG)	0.227
				42						320	9.6 (cEMEG)	
Toluene	ND–**29,000**	ND–14J	ND; 0.18J	1,100	ND	50J–**16,000**	58–2,200	4.1–210	ND; 100J	10,000	300 (cEMEG)	0.271
Ethylbenzene	ND–**1,700**	ND–**2,200**	ND–6.6	810	ND	ND–8,500	92–7,900	ND–46	ND–2,300	8,700	260 (cEMEG)	0.322
Xylenes, total	ND–**15,000**	ND–**1,800**	ND	1,000	ND; 19	ND–**24,000**	NR	21.4–95	ND–570J+	7,300	220 (cEMEG)	0.212

Data Source: Pastor, Behling & Wheeler, LLC 2016.

* Groundwater VISL = Air CV / [(Henry's Law Constant × Groundwater Attenuation Factor × Unit Conversion Factor)], where the Groundwater Attenuation Factor is 0.001 and the Unit Conversion Factor is 1,000 L/m³.

† Sub-slab results for locations SS-1, SS-2, and SS-3 (see Figure 1).

‡ Onsite soil gas results (inside the fenced area) for locations SG-12, SG-13, SG-14, SG-15, SG-16, SG-17, SG-18, SG-19, and SG-20 (see Figure 1).

¶ Onsite soil gas results (downgradient, outside fenced area) for locations SG-23, SG-24, and SG-25 (see Figure 1).

§ Offsite soil gas results (along Somerset Road) for locations SG-26, SG-27, and SG-28 (see Figure 1).

** Offsite soil gas results for locations SG-21 and SG-22 (see Figure 1).

†† Soil Gas VISL = Air CV / Soil Gas Attenuation Factor, where the Soil Gas Attenuation Factor is 0.03.

‡‡ Henry's Law Constant from the "Chem Props" worksheet at https://www.epa.gov/sites/production/files/2016-01/visl-calculator_v_346.xlsm.

¶¶ Bolded results exceed one or more vapor intrusion screening level.

BTEX benzene, ethylbenzene, toluene, xylenes
cEMEG chronic environmental media evaluation guide
CREG cancer risk evaluation guide
CV comparison value
J estimated value
J+ estimated value with a potentially high bias
L/m³ liters per cubic meter
µg/m³ microgram per cubic meter
µg/L microgram per liter
ND not detected
NR not reported
VISL vapor intrusion screening level

Table 2. R & H Oil Company and Tropicana Energy Company Groundwater and Soil Gas VOC Results, San Antonio, TX (page 1 of 2)

Contaminant	Offsite Ground-water Downgradient Results	Ground-water VISL*	Onsite Soil Gas Results† (downgradient, outside fenced area)	Offsite Soil Gas Results‡ (along Somerset Road)	Offsite Soil Gas Results¶	Soil Gas VISL§	Air CV (basis)	Henry's Law Constant
	µg/L	µg/L	µg/m³	µg/m³	µg/m³	µg/m³	ug/m³	Unitless**
Bromodichloromethane	ND; **1.2††**	0.88	ND	ND	ND	2.5	0.076 (CSL)	0.0867
n-Butylbenzene	ND–0.95J	NA	--	--	--	NA	NA	0.65
sec-Butylbenzene	ND–0.89J	NA	--	--	--	NA	NA	0.72
tert-Butylbenzene	ND–0.63J	NA	--	--	--	NA	NA	0.54
Chloroform	ND–0.38J	0.29	ND	ND	ND	1.4	0.043 (CREG)	0.15
		650				3,300	98 (cEMEG)	
1,2-Dichloroethane	ND; 0.72J	0.79	ND	ND	ND; **40J+**	1.3	0.038 (CREG)	0.0482
		50,000				80,000	2,400 (cEMEG)	
cis-1,2-Dichloroethene	ND–0.82J	NA	ND	ND	ND; 61J+	NA	NA	0.167
4-Ethyltoluene	--	NA	ND–58	ND	ND	NA	NA	NA
Isopropylbenzene	ND–13	NA	--	--	--	NA	NA	NA
Naphthalene	ND–**42J-**	4.6	ND; **36J-**	ND	ND	2.8	0.083 (CSL)	0.018
		210				120	3.7 (cEMEG)	
Trichloroethene	ND–2	0.60	ND	ND	ND	8.0	0.24 (CREG)	0.403
		5.0				67	2 (cEMEG)	
Trichlorofluoromethane	ND	NA	ND	ND; 35	ND	NA	NA	3.97
1,2,4-Trimethylbenzene	ND	29	ND–59J	ND; 16	ND; **500J+**	240	7.3 (NSL)	0.252
1,3,5-Trimethylbenzene	ND	NA	ND–19	ND; 4.6	ND; 60J+	NA	NA	0.359
Vinyl chloride	ND; **0.12J**	0.10	ND	ND	ND	3.7	0.11 (CREG)	1.14

Data Source: Pastor, Behling & Wheeler, LLC 2016

* Groundwater VISL = Air CV / [(Henry's Law Constant × Groundwater Attenuation Factor × Unit Conversion Factor)], where the Groundwater Attenuation Factor is 0.001 and the Unit Conversion Factor is 1,000 L/m³.

Table 2. R & H Oil Company and Tropicana Energy Company Groundwater and Soil Gas VOC Results, San Antonio, TX (page 2 of 2)

†	Onsite soil gas results (downgradient, outside fenced area) for locations SG-23, SG-24, and SG-25 (see Figure 1).
‡	Offsite soil gas results (along Somerset Road) for locations SG-26, SG-27, and SG-28 (see Figure 1).
¶	Offsite soil gas results for locations SG-21 and SG-22 (see Figure 1).
§	Soil Gas VISL = Air CV / Soil Gas Attenuation Factor, where the Soil Gas Attenuation Factor is 0.03.
**	Henry's Law Constant from the "Chem Props" worksheet at https://www.epa.gov/sites/production/files/2016-01/visl-calculator_v_346.xlsm.††
††	Bolded results exceed one or more vapor intrusion screening level.

--	chemical not analyzed
cEMEG	chronic environmental media evaluation guide
CREG	cancer risk evaluation guide
CSL	carcinogenic screening level
CV	comparison value
J	estimated value
J+	estimated value with a potentially high bias
J-	estimated value with a potentially low bias
L/m^3	liters per cubic meter
$\mu g/m^3$	microgram per cubic meter
µg/L	microgram per liter
NA	none available
ND	not detected
NSL	noncarcinogenic screening level
VISL	vapor intrusion screening level
VOC	volatile organic compounds