Texas Commission on Environmental Quality
Monitoring Division

Region 12 Pearland Area Monitoring Project June 6-10, 2016

Strategic Monitoring Support Team

Document Number
PL1606-FR

Region 12 Pearland Area Monitoring Project, June 6-10, 2016

Project Summary

The Texas Commission on Environmental Quality (TCEQ) Strategic Sampling Work Group (SSWG) conducted an air monitoring project in the Pearland, Texas (TX) area, June 6-10, 2016. The air monitoring project was designed to assist and support regional staff investigations related to odor complaints in the Shadow Creek Ranch neighborhood located in Pearland, TX. Objectives for this project were to coordinate with Region 12 staff, to collect ambient air data, and to collect quality air monitoring data to measure potential hydrogen sulfide (H2S) and the target compounds listed Tables 1 and 2 to be used in a health effects evaluation by the Toxicology Division. Region 12 air investigators coordinated with SSWG staff to conduct odor surveys during the air monitoring activities.

Facilities surrounding the Shadow Creek Ranch area were assessed as potential odor sources (see Attachment B for location information). SSWG staff surveyed the Republic Services Blue Ridge Landfill located to the west of the Shadow Creek Ranch neighborhood and the Lone Star Disposal and Recycling facility located to the northwest. The following facilities were also surveyed.

- Nalco Champion Chemical Company
- Stericycle Warehouse
- Technisand, Incorporated (Inc.)
- Pittsburgh Corning Corporation
- Cherry Crushed Concrete
- Flexicore of Texas
- Akzo Nobel Surface Chemistry
- Reflection Bay Waste Water Treatment Plant
- Honghua America
- Brenntag Southwest Chemical Plant
- Syntech Chemicals, Inc.
- Centerpoint Energy odorizing station

Technical information, including sample sites and maps (Attachments A and B), volatile organic compounds (VOC) real-time gas chromatography (RTGC) data (Attachment C), VOC canister data (Attachment D), H_2S Picarro G1104 data (Attachment E), meteorological data (Attachment F), and the Toxicology Division human health evaluation (Attachment G) are attached. Key findings and observations from the Region 12 Pearland Area Monitoring Project include the following.

- Times during which notable odors and instrument measurements occurred were primarily from 01:00 to 06:00 during all sample periods. Wind conditions were mainly light and variable during these time frames.
- In the Shadow Creek Ranch neighborhood, at the intersection of Laurel Loch Lane and Lost Creek Drive (site 5), toxic vapor analyzer (TVA) surveys measured total VOCs up to a maximum concentration of 450 parts per million (ppm).
- Canister sample PL1606-C002, collected at the intersection of Laurel Loch Lane and Lost Creek Drive (site 5) on June 8, 2016, from 01:08 to 02:08, measured the following VOC concentrations in the Shadow Creek Ranch area above compound specific laboratory sample detection and quantitation limits defined and listed in

Attachment D:
  - isobutane with a 1-hour average concentration of 13 parts per billion by volume (ppbv);
  - propane with a 1-hour average concentration of 12 ppbv;
  - isopentane with a 1-hour average concentration of 9.9 ppbv; and
  - n-butane with a 1-hour average concentration of 7.8 ppbv.
- Optical gas imaging camera (OGIC) surveys showed no emissions from any of the facilities surveyed. As a result, no OGIC images were recorded.
- Jerome surveys measured TRS up to a maximum concentration of 200 part per billion (ppb) in the area near the Lone Star Disposal and Recycling facility along Bluebonnet Drive (site 9). Surveys in the area near the Republic Services Blue Ridge Landfill, at the intersection of Trinity Bay Drive and Arcadia Bay Drive (site 3), measured TRS concentrations ranging from 6 to 25 ppb.
- Maximum 30-minute average H_2S concentrations measured by the Picarro G1104 cavity ring down spectrometer (CRDS) were:
  - 0.011 parts per million by volume (ppmv) at the intersection of McHard Road and West Drive (site 2) on June 7, 2016, from 04:45 to 05:15;
  - 0.098 ppmv at the intersection of Bluebonnet Drive and Feld Drive (site 7) on June 8, 2016, from 03:05 to 03:35; and
  - 0.107 ppmv along Bluebonnet Drive, approximately 0.3 mile west of Almeda Road (site 9) on June 9, 2016, from 03:50 to 04:20.
- No target VOCs were detected in the RTGC samples collected.

Monitoring survey activities included frequency, intensity, duration, and offensiveness (FIDO) odor surveys, hand-held instrument surveys using a TVA for VOCs, and a Jerome J605 for H_2S. OGIC surveys were conducted to locate specific VOC emission sources. In locations where odors and survey results indicated notable VOC concentrations, one-hour time integrated canister samples were collected. Canisters were analyzed by the Austin Air Laboratory for the target compounds listed in Table 1.

Table 1: Canister Target Analytes with Corresponding Air Monitoring Comparison Values (AMCVs)

Target Analyte Compound Name	Chemical Abstracts Service (CAS) Number	Short-Term AMCV Health (ppb)	Odor AMCV[1] (ppb)
ethane	74-84-0	simple asphyxiant*	
ethylene	74-85-1	500,000	
acetylene	74-86-2	25,000	
propane	74-98-6	simple asphyxiant*	
propylene	115-07-1	simple asphyxiant*	
dichlorodifluoromethane	75-71-8	10,000	
methyl chloride (chloromethane)	74-87-3	500	
isobutane	75-28-5	33,000	
vinyl chloride	75-01-4	26,000	
1-butene	106-98-9	27,000	
1,3-butadiene	106-99-0	1700	230
n-butane	106-97-8	92,000	
t-2-butene	624-64-6	15,000	
bromomethane	74-83-9	30	
c-2-butene	590-18-1	15,000	
3-methyl-1-butene	563-45-1	8000	100
isopentane	78-78-4	68,000	
trichlorofluoromethane	75-69-4	10,000	
1-pentene	109-67-1	12,000	100

Target Analyte Compound Name	Chemical Abstracts Service (CAS) Number	Short-Term AMCV Health (ppb)	Odor AMCV[1] (ppb)
n-pentane	109-66-0	68,000	
isoprene (2-methyl-1,3-butadiene)	78-79-5	20	
t-2-pentene	646-04-8	12,000	
1,1-dichloroethylene	75-35-4	180	
c-2-pentene	627-20-3	12,000	
methylene chloride (dichloromethane)	75-09-2	3500	
2-methyl-2-butene	513-35-9	12,000	
2,2-dimethyl butane	75-83-2	1000	
cyclopentene	142-29-0	2900	
4-methyl-1-pentene	691-37-2	500	
1,1-dichloroethane	75-34-3	1000	
cyclopentane	287-92-3	5900	
2,3-dimethylbutane	79-29-8	990	
2-methylpentane	107-83-5	850	
3-methylpentane	96-14-0	1000	
2-methyl-1-pentene+1-hexene	763-29-1 592-41-6	500	
n-hexane	110-54-3	1800	
chloroform	67-66-3	20	
t-2-hexene	4050-45-7	500	
c-2-hexene	7688-21-3	500	
1,2-dichloroethane	107-06-2	550	
methylcyclopentane	96-37-7	750	
1,1,1-trichloroethane	71-55-6	1700	
2,4-dimethylpentane	108-08-7	850	
benzene	71-43-2	180	
carbon tetrachloride	56-23-5	20	
cyclohexane	110-82-7	1000	
2-methylhexane	591-76-4	750	
2,3-dimethylpentane	565-59-3	850	
3-methylhexane	589-34-4	750	
1,2-dichloropropane	78-87-5	100	
trichloroethylene	79-01-6	100	
2,2,4-trimethylpentane (isooctane)	540-84-1	750	
2-chloropentane	625-29-6	240	
n-heptane	142-82-5	850	
c-1,3-dichloropropylene	10061-01-5	10	
methylcyclohexane	108-87-2	4000	
t-1,3-dichloropropylene	10061-02-6	10	
1,1,2-trichloroethane	79-00-5	100	
2,3,4-trimethylpentane	565-75-3	750	
toluene	108-88-3	4000	
2-methylheptane	592-27-8	750	
3-methylheptane	589-81-1	750	
1,2-dibromoethane	106-94-3	0.5	
n-octane	111-65-9	750	
tetrachloroethylene (perchloroethylene)	127-18-4	1000	
chlorobenzene	108-90-7	100	
ethylbenzene	100-41-4	20,000	
m+p-xylenes	108-38-3 106-42-3	1700	
styrene	100-42-5	5100	25
1,1,2,2-tetrachloroethane	79-34-5	10	
o-xylene	95-47-6	1700	
n-nonane	111-84-2	2000	

Target Analyte Compound Name	Chemical Abstracts Service (CAS) Number	Short-Term AMCV Health (ppb)	Odor AMCV[1] (ppb)
isopropylbenzene (cumene)	98-82-8	500	130
n-propylbenzene	103-65-1	500	
m-ethyltoluene	620-14-4	250	
p-ethyltoluene	622-96-8	250	
1,3,5-trimethylbenzene	108-67-8	3000	
o-ethyltoluene	611-14-3	250	
1,2,4-trimethylbenzene	95-63-6	3000	
n-decane	124-18-5	1750	
1,2,3-trimethylbenzene	526-73-8	3000	
m-diethylbenzene	141-93-5	460	
p-diethylbenzene	105-05-5	460	
n-undecane	1120-21-4	550	

Odor values are included for those compounds in which the odor number is smaller than the health-based number.
ppb – parts per billion
*A simple asphyxiant displaces air, lowering the partial pressure of oxygen and causing hypoxia at sufficiently high concentrations.

RTGC sampling was performed when TVA surveys indicated sustained total VOC concentrations above 10 ppm. RTGC analysis was based on a 19 compound VOC standard. Compounds listed in Table 2 were used for RTGC calibration.

Table 2: Gas Chromatograph Target Compounds with Corresponding Air Monitoring Comparison Values (AMCVs)

Target Analyte Compound Name	Chemical Abstracts Service (CAS) Number	Short-Term AMCV Health (ppb)	Odor AMCV[1] (ppb)
ethane	74-84-0	simple asphyxiant*	
ethylene	74-85-1	500,000	
acetylene	74-86-2	250,000	
propane	74-98-6	simple asphyxiant*	
propylene	115-07-1	simple asphyxiant*	
isobutane	75-28-5	33,000	
n-butane	106-97-8	92,000	
1-butene	106-98-9	27,000	
1,3-butadiene	106-99-0	1700	230
n-hexane	110-54-3	1800	
cyclohexane	110-82-7	1000	
benzene	71-43-2	180	
n-octane	111-65-9	750	
toluene	108-88-3	4000	
ethylbenzene	100-41-4	20,000	
styrene	100-42-5	5100	25
m+p-xylenes	108-38-3 106-42-3	1700	
o-xylene	95-47-6	1700	

[1]Odor values are included for those compounds in which the odor number is smaller than the health-based number.
ppb – parts per billion
*A simple asphyxiant displaces air, lowering the partial pressure of oxygen and causing hypoxia at sufficiently high concentrations.

When Jerome J605 surveys indicated TRS concentrations, a Picarro G1104 CRDS was used to detect and confirm the presence of H2S as a target compound.

A datalogger malfunction did not allow the SSWG to record data for the Teledyne 101E analyzer for TRS. However, during periods when the Picarro G1104 CRDS measured H2S concentrations, SSWG staff observed correlating readings between the Teledyne

101E and Picarro G1104 analyzers. This correlation confirmed that any measured sulfur was H2S, and readings were not due to other TRS compounds.

Sampling and Analysis

Staff used TVAs to determine maximum total ambient VOC concentrations. Jerome J605 analyzers were used to determine maximum ambient TRS concentrations. Survey instrument measurements were used for screening and were not site specific. Compound specific ambient air VOC samples were collected using an Agilent 6890 GC with dual flame ionization detectors (FIDs) located in sampling vehicle 0940. Target compounds are listed in Table 2.

During the monitoring project, three 60-minute passivated canister samples were collected. These samples were submitted to the TCEQ Austin Air Laboratory where they were analyzed for 84 VOC compounds using a gas chromatograph/mass spectrometer (GC/MS). Target compounds are listed in Table 1.

SSWG staff used a Picarro G1104 CRDS located in sampling vehicle 0439 for continuous air monitoring to determine H_2S concentrations. All H_2S data are reported as 30-minute averages in ppmv. The state regulatory standard for H_2S is a 30-minute average of 0.080 ppmv with both upwind and downwind measurements. Only downwind measurements were collected for this project due to resource limitations.

A Climatronics All-in-One (AIO) Compact Weather Station, located in sampling vehicle 0439, was used to collect real-time temperature, wind speed, and wind direction data. The sample collection locations were documented using global positioning system (GPS) coordinates. Attachment A lists sample site locations for RTGC, Picarro G1104 CRDS, canister samples, and meteorological data collection.

Quality Control (QC) Summary

QC samples were analyzed, along with the field samples, to assess data quality (method, precision, and accuracy) and data limitations. Data quality objectives are outlined in the method or project-specific standard operating procedures.

Data completeness is measured as a percentage of valid target compound data that meets the established accuracy and precision acceptance criteria divided by the total amount of target compound data collected. In cases where the analysis data qualifiers included concentrations below the limit of detection (J qualifier), additional data qualifiers are not considered in data completeness calculations. Canister field quality control (QC) samples, including one trip blank (TB), one time-integrated field blank, and one time-integrated duplicate were collected. The analytical data capture was expected to be 75 percent for all SSWG sampling and analytical techniques. Data completeness for RTGC, Picarro G1104 H_2S, and canister sampling was 100 percent.

Observations and Field Activities

Sample Period One - 20:00 June 6, 2016 – 08:00 June 7, 2016

Roadside conditions, wind direction, and potential sample locations were surveyed by SSWG staff in the Shadow Creek Ranch neighborhood. SSWG staff completed RTGC quality control checks at 04:00. Region 12 staff met with the SSWG to assess the area and determine the best locations for surveys. Winds were light and southerly. TVA, Jerome, and odor surveys along McHard Road (FM 2234) indicated strong odors with traces of sulfur. Continuous air monitoring for H_2S was conducted along McHard Road (site 1). Further air monitoring for H_2S along McHard Road was conducted at site 2. A one-hour canister sample (PL1606-C003) was also collected at site 2. Results for air monitoring and sampling are listed in Table 3.

Winds became light and variable at approximately 02:00 on June 7, 2016. TVA surveys indicated total VOC concentrations ranging from 95 ppm to 300 ppm along North Ripple Ridge Drive and Hiram Clarke Road. A one hour canister sample (PL1606-C004) was collected at the intersection of FM 521 and McHard Road (site 6). In addition, a regional FIDO odor log was recorded and collocated with TVA survey data. The regional FIDO survey (investigation report number 1337792) noted a strong odor for the duration of canister PL1606-C004, and TVA readings ranged between 98 and 210 ppmv. Canister sample results are listed in Table 3.

SSWG and regional staff surveys between 04:00 and 06:30 noted strong odors in the Shadow Creek Ranch area along Trinity Bay Drive and Arcadia Bay Drive. Winds were light and northwesterly to north. RTGC and H_2S sampling vehicles were collocated and collected samples at Trinity Bay Drive and Arcadia Bay Drive (site 3). Continuous air monitoring for H_2S was also conducted at this site. TVA readings in the area ranged from 100 to 120 ppm. Results for air monitoring and sampling are listed in Table 3.

Table 3: Sample Period One Data Summary

Sampling Method	Date	Time	Location[1]	Results
Real-Time Gas Chromatography	6/7/16	04:48–05:37	site 3	VOC target analytes not detected
Continuous Air Monitoring for H_2S using a Picarro G1104 Analyzer	6/6/16	22:40–23:10	site 1	Maximum 30-minute H_2S concentration: 0.003 ppmv
	6/7/16	00:20–00:50	site 2	Maximum 30-minute H_2S concentration: 0.009 ppmv
	6/7/16	04:45–05:15	site 3	Maximum 30-minute H_2S concentration: 0.011 ppmv
One-Hour Canister PL1606-C003	6/7/16	02:25–03:25	site 2	VOC target analytes not detected above laboratory sample detection and quantitation limits
One-Hour Canister PL1606-C004	6/7/16	02:51–03:51	site 6	VOC target analytes not detected above laboratory sample detection and quantitation limits

[1]See Attachments A and B for site location information.
H_2S – hydrogen sulfide
ppmv – parts per million by volume

Sample Period Two - 20:00 June 7, 2016 – 08:00 June 8, 2016

While Region 12 investigators conducted odor surveys near the Blue Ridge landfill (investigation report number 1337777), the SSWG surveyed facilities surrounding the Shadow Creek Ranch area. Odor, TVA, Jerome, and OGIC surveys did not indicate the presence of ambient VOC or H_2S concentrations near the following facilities (see Attachment B for location information).

- Cherry Crushed Concrete
- Flexicore of Texas
- Akzo Nobel Surface Chemistry
- Reflection Bay Waste Water Treatment Plant
- Honghua America
- Centerpoint Energy odorizing station
- Pittsburgh Corning Corporation

Winds were light and primarily from the north, northwest, and west-northwest for the duration of the sample period. In the Shadow Creek Ranch neighborhood, at Laurel Loch Lane and Lost Creek Drive, TVA measurements showed a maximum total VOC concentration of 450 ppm at 00:51. Jerome J605 measurements showed a maximum TRS concentration of 5 ppb. RTGC samples were collected at Laurel Loch Lane and Lost Creek Drive (site 5). A one-hour canister sample (PL1606-C002) was also collected at site 5. Results for air monitoring and sampling are listed in Table 4.

Jerome surveys from 01:00 to 06:00 to the southeast of both the Republic Services Blue Ridge Landfill and Lone Star Disposal and Recycling facilities measured TRS concentrations ranging from approximately 100 ppb to 200 ppb. Continuous air monitoring for H_2S was conducted at the intersection of Broadway Street and FM 521 (site 4) near the Blue Ridge Landfill and the Lone Star Disposal and Recycling facility located at Bluebonnet Drive and Feld Drive (site 7). Region 12 investigators documented a strong sulfur smell during the same time period (investigation report number 1337777). Results for air monitoring are listed in Table 4.

Table 4: Sample Period Two Data Summary

Sampling Method	Date	Time	Location[1]	Results
Real-Time Gas Chromatography	6/8/16	01:01–02:49	site 5	VOC target analytes not detected
Continuous Air Monitoring for H_2S using a Picarro G1104 Analyzer	6/8/16	01:35–02:05	site 4	Maximum 30-minute H_2S concentration: 0.025 ppmv
	6/8/16	01:50–02:20	site 4	Maximum 30-minute H_2S concentration: 0.025 ppmv
	6/8/16	03:05–03:35	site 7	Maximum 30-minute H_2S concentration: 0.098 ppmv
One-Hour Canister PL1606-C002	6/8/16	01:08–02:08	site 5	Compounds detected above laboratory sample detection and quantitation limits • isobutane at 13 ppbv • propane at 12 ppbv • isopentane at 9.9 ppbv • n-butane at 7.8 ppbv

[1]See Attachments A and B for site location information.
H_2S – hydrogen sulfide
ppbv – part per billion by volume
ppmv – parts per million by volume

Sample Period Three - 20:00 June 8, 2016 – 08:00 June 9, 2016

Odor, TVA, Jerome, and OGIC surveys did not indicate the presence of ambient VOCs or H_2S near the following facilities (see Attachment B for location information).

- Nalco Champion Chemical Company
- Stericycle Warehouse
- Technisand, Inc.
- Cherry Crushed Concrete
- Flexicore of Texas
- Akzo Nobel Surface Chemistry
- Reflection Bay Waste Water Treatment
- Honghua America
- Brenntag Southwest Chemical Plant
- Syntech Chemicals, Inc.
- Centerpoint Energy odorizing station

Winds were light and primarily from the west and northwest for the entire sample period. Jerome surveys continued to measure H_2S concentrations in the Shadow Creek Ranch area and along Bluebonnet Drive adjacent to the Lone Star Disposal and Recycling facility. TVA surveys showed no detection of VOCs for the duration of the sample period. Continuous air monitoring for H_2S was conducted along Biscayne Bay Drive (site 8). Further air monitoring for H_2S was conducted along Bluebonnet Drive (site 9). Results for air monitoring and sampling are listed in Table 5.

Table 5: Sample Period Three Data Summary

Sampling Method	Date	Time	Location[1]	Results
Continuous Air Monitoring for H_2S using a Picarro G1104 Analyzer	6/9/16	02:05–02:35	site 8	Maximum 30-minute H_2S concentration: 0.004 ppmv
	6/9/16	02:10–02:40	site 8	Maximum 30-minute H_2S concentration: 0.004 ppmv
	6/9/16	02:10–02:40	site 8	Maximum 30-minute H_2S concentration: 0.004 ppmv

[1]See Attachments A and B for site location information.
H_2S – hydrogen sulfide
ppmv – parts per million by volume

Sample Period Four - 21:00 June 9, 2016 – 06:30 June 10, 2016

At 22:00 on June 9, 2016, SSWG staff met with a representative of the City of Pearland Public Works department as arranged by regional staff. The public works representative gave SSWG staff access to the Republic Services Blue Ridge landfill wastewater pipeline (off-property) along Highway 521. Jerome surveys were taken near and at a roadside manhole access point, and total reduced sulfur (TRS) measurements ranged from 0 ppb to 5.6 ppb. Continuous air monitoring for H_2S was not conducted at this location due to limitations of the sampling vehicle's sample inlet (located approximately 10 feet above ground) to measure potential emissions at ground level.

Winds were calm and variable during the entire sample period. SSWG staff continued to survey around all facilities near the Shadow Creek Ranch area. Odor, TVA, Jerome, and OGIC surveys did not indicate the presence of ambient VOCs or H_2S near any of the following facilities (see Attachment B for location information).

- Nalco Champion Chemical Company

- Stericycle Warehouse
- Technisand, Inc.
- Cherry Crushed Concrete
- Flexicore of Texas
- Akzo Nobel Surface Chemistry
- Reflection Bay Waste Water Treatment Plant
- Honghua America
- Brenntag Southwest Chemical Plant
- Syntech Chemicals, Inc.
- Centerpoint Energy odorizing station

TVA surveys did not detect any total VOC concentrations, therefore, no canister or RTGC samples were collected. Although Jerome J605 measurements showed TRS concentrations ranging from approximately 100 ppb to 300 ppb near the Lone Star Disposal and Recycling facility, variable wind directions did not allow for continuous H_2S monitoring. SSWG survey and air monitoring activities concluded at 06:30 on June 10, 2016.

Summary

The coordinated efforts of Region 12 staff and the SSWG determined the following.

- Weather conditions were consistent with those documented during the majority of citizen complaints. It did not rain, and winds were calm and primarily from the west, northwest, and north during sample periods one through three. Winds during sample period four were calm and variable.
- Sampling was conducted between 20:00 and 08:00 on June 6, 2016, through June 10, 2016, and bracketed times when the majority of citizen complaints were received; 01:00 to 06:00.
- Quantifiable levels of H_2S above the state regulatory standard of 0.080 ppmv were measured in the Shadow Creek Ranch during periods of noticeable odors and odors documented by Region 12 staff. Upwind samples were not collected.
- RTGC and canister samples collected did not measure any target VOCs above the associated AMCVs.
- H_2S was consistently measured with the Picarro and Jerome downwind of Republic Services Blue Ridge Landfill and Lone Star Disposal and Recycling.
- The following facilities were surveyed and no target compounds were detected downwind of the facilities:
  - Nalco Champion Chemical Company
  - Stericycle Warehouse
  - Technisand, Inc.
  - Pittsburgh Corning Corporation
  - Cherry Crushed Concrete
  - Flexicore of Texas
  - Akzo Nobel Surface Chemistry
  - Reflection Bay Waste Water Treatment Plant
  - Honghua America
  - Brenntag Southwest Chemical Plant
  - Syntech Chemicals, Inc.
  - Centerpoint Energy odorizing station

The Toxicology Division human health evaluation determined the following.

- Based on the one-hour canister and RTGC data reported, adverse health effects from target VOCs would not be expected.
- Reported H_2S concentrations were below levels that would contribute to direct adverse health effects, however, the reported concentrations could contribute to perceptible odors. The odors are consistent with citizen complaints.
- The Toxicology Division encourages H_2S reductions necessary to prevent odor nuisance conditions in this area. Strong odors may cause indirect, odor-related health effects such as headache or nausea.

For detailed toxicological information see Attachment G.

For any other information concerning the project, please contact the following.

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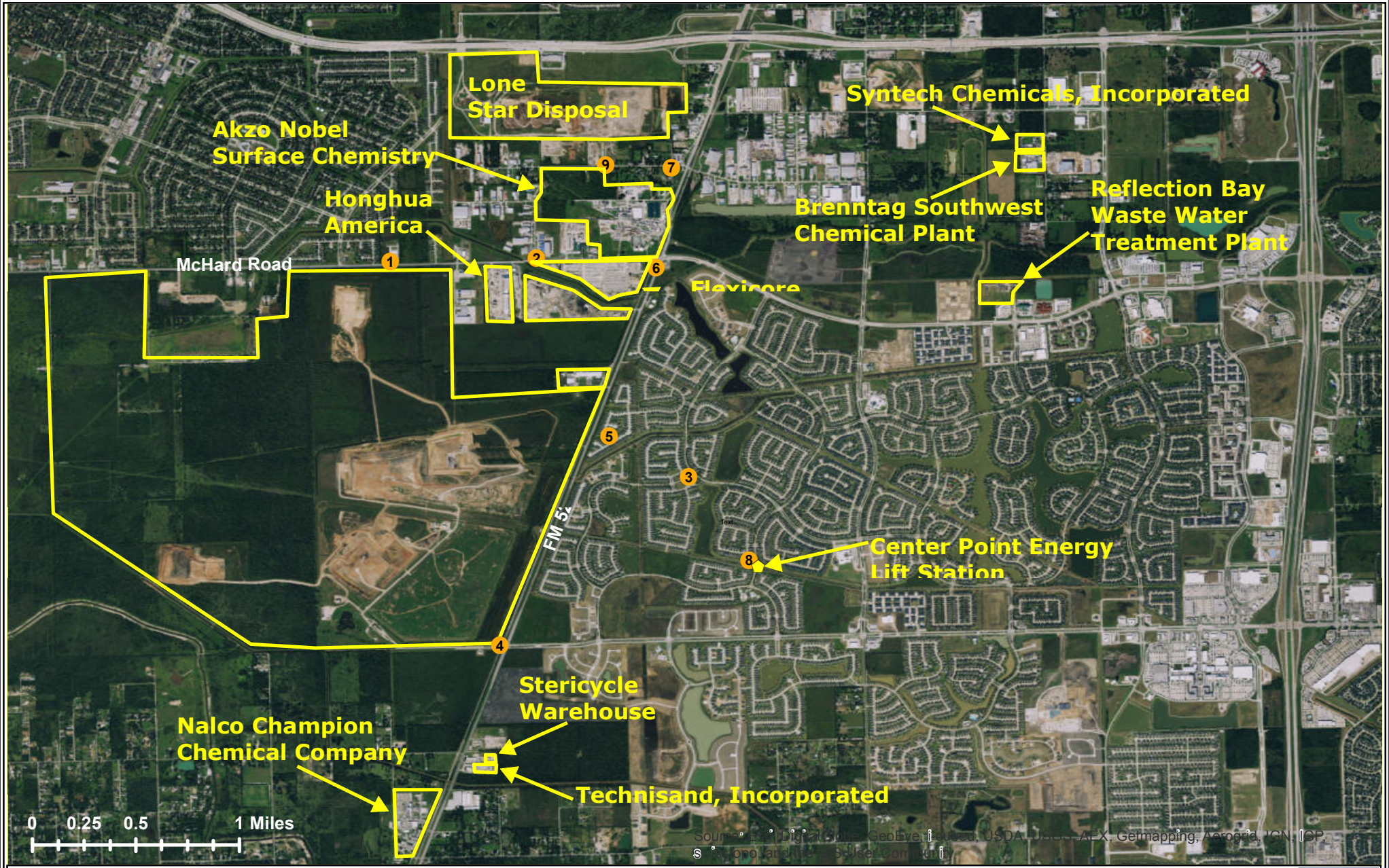
Sample Sites
Region 12 Pearland Area Monitoring Project
Pearland, TX
June 6-10, 2016

Sample Site	Location	GPS Coordinates	
		North Latitude	West Longitude
1	Along McHard Road, approximately 0.05 mile east of Ripple Ridge Drive	29.5814328	-95.4505721
2	Intersection of McHard Road and West Drive	29.5816452	-95.4403607
3	Intersection of Arcadia Bay Drive and Trinity Bay Drive	29.5663094	-95.4296742
4	Intersection of Farm-to-Market (FM) 521 and Broadway Street	29.5545330	-95.4429117
5	Intersection of Laurel Loch Lane and Lost Creek Drive	29.5691719	-95.4352695
6	Intersection of FM 521 and McHard Road	29.5809916	-95.4319591
7	Intersection Bluebonnet Drive and Feld Drive	29.5880202	-95.4309011
8	Along Biscayne Bay Drive, approximately 0.1 mile south of Eagle Cove Drive	29.5604294	-95.4249454
9	Along Bluebonnet Drive, approximately 0.3 mile west of Almeda Road	29.5881971	-95.4355029

GPS - global positioning system

Attachment B



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Bend County
Brazoria County

Sample Sites
Region 12 Pearland Area Monitoring Project
Pearland, Texas
June 6-10, 2016

Texas Commission on Environmental Quality
Monitoring Division
Strategic Sampling Work Group
Mail Code 165
P.O. Box 13087
Austin, TX 78711-3087
Source: DOQQs are Texas Natural Resources Information System 2004 (1m) data
Created On: 6/22/16
Created By: TR
Revised On: 7/15/16
Revised By: TR

TCEQ

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Real-Time Gas Chromatography (RTGC) Volatile Organic Compound (VOC) Data
Region 12 Pearland Area Monitoring Project
Pearland, Texas
June 6-10, 2016

Agilent 6890N GC with Flame Ionization Detector (FID)

Site 3 Samples

	Sample Date		6/7/16		6/7/16		6/7/16	
	Sample Time		04:48		05:13		05:37	
	Sample Site		3		3		3	
Compound Name	**LOD**	**LOQ**	**ppbv**	**Data Flag**	**ppbv**	**Data Flag**	**ppbv**	**Data Flag**
ethane	4.4	25	ND	T	ND	T	ND	T
ethylene	8.5	25	ND	T	ND	T	ND	T
acetylene	9.6	47	ND	T	ND	T	ND	T
propane	3.6	26	ND	T	ND	T	ND	T
propylene	4.8	25	ND	T	ND	T	ND	T
isobutane	5.2	26	ND	T	ND	T	ND	T
n-butane	5.3	27	ND	T	ND	T	ND	T
1-butene	4.6	26	ND	T	ND	T	ND	T
1,3-butadiene	5.3	26	ND	T	ND	T	ND	T
n-hexane + cyclohexane	7.2	50	ND		ND		ND	
benzene	7.9	24	ND		ND		ND	
n-octane	6.9	24	ND		ND		ND	
toluene	3.6	25	ND		ND		ND	
ethylbenzene	4.5	26	ND		ND		ND	
styrene	3.2	24	ND		ND		ND	
o-xylene	8.7	49	ND		ND		ND	

Site 3 Averages and Maximum Values

Compound Name	**LOD**	**LOQ**	**Site Average**	**Data Flag**	**High 1-Hour Average**	**Data Flag**	**Maximum Value**	**Data Flag**
ethane	4.4	25	ND		ND		ND	T
ethylene	8.5	25	ND		ND		ND	T
acetylene	9.6	47	ND		ND		ND	T
propane	3.6	26	ND		ND		ND	T
propylene	4.8	25	ND		ND		ND	T
isobutane	5.2	26	ND		ND		ND	T
n-butane	5.3	27	ND		ND		ND	T
1-butene	4.6	26	ND		ND		ND	T
1,3-butadiene	5.3	26	ND		ND		ND	T
n-hexane + cyclohexane	7.2	50	ND		ND		ND	
benzene	7.9	24	ND		ND		ND	
n-octane	6.9	24	ND		ND		ND	
toluene	3.6	25	ND		ND		ND	
ethylbenzene	4.5	26	ND		ND		ND	
styrene	3.2	24	ND		ND		ND	
o-xylene	8.7	49	ND		ND		ND	

Real-Time Gas Chromatography (RTGC) Volatile Organic Compound (VOC) Data
Region 12 Pearland Area Monitoring Project
Pearland, Texas
June 6-10, 2016

Agilent 6890N GC with Flame Ionization Detector (FID)

Site 5 Samples

	Sample Date		6/8/16		6/8/16		6/8/16	
	Sample Time		01:01		01:25		01:50	
	Sample Site		5		5		5	
Compound Name	**LOD**	**LOQ**	**ppbv**	**Data Flag**	**ppbv**	**Data Flag**	**ppbv**	**Data Flag**
ethane	4.4	25	ND	T	ND	T	ND	T
ethylene	8.5	25	ND	T	ND	T	ND	T
acetylene	9.6	47	ND	T	ND	T	ND	T
propane	3.6	26	ND	T	ND	T	ND	T
propylene	4.8	25	ND	T	ND	T	ND	T
isobutane	5.2	26	ND	T	ND	T	ND	T
n-butane	5.3	27	ND	T	ND	T	ND	T
1-butene	4.6	26	ND	T	ND	T	ND	T
1,3-butadiene	5.3	26	ND	T	ND	T	ND	T
n-hexane + cyclohexane	7.2	50	ND		ND		ND	
benzene	7.9	24	ND		ND		ND	
n-octane	6.9	24	ND		ND		ND	
toluene	3.6	25	ND		ND		ND	
ethylbenzene	4.5	26	ND		ND		ND	
styrene	3.2	24	ND		ND		ND	
o-xylene	8.7	49	ND		ND		ND	

Site 5 Samples (continued)

	Sample Date		6/8/16		6/8/16	
	Sample Time		02:05		02:49	
	Sample Site		5		5	
Compound Name	**LOD**	**LOQ**	**ppbv**	**Data Flag**	**ppbv**	**Data Flag**
ethane	4.4	25	ND	T	ND	T
ethylene	8.5	25	ND	T	ND	T
acetylene	9.6	47	ND	T	ND	T
propane	3.6	26	ND	T	ND	T
propylene	4.8	25	ND	T	ND	T
isobutane	5.2	26	ND	T	ND	T
n-butane	5.3	27	ND	T	ND	T
1-butene	4.6	26	ND	T	ND	T
1,3-butadiene	5.3	26	ND	T	ND	T
n-hexane + cyclohexane	7.2	50	ND		ND	
benzene	7.9	24	ND		ND	
n-octane	6.9	24	ND		ND	
toluene	3.6	25	ND		ND	
ethylbenzene	4.5	26	ND		ND	
styrene	3.2	24	ND		ND	
o-xylene	8.7	49	ND		ND	

Real-Time Gas Chromatography (RTGC) Volatile Organic Compound (VOC) Data
Region 12 Pearland Area Monitoring Project
Pearland, Texas
June 6-10, 2016

Agilent 6890N GC with Flame Ionization Detector (FID)

Site 5 Averages and Maximum Values

Compound Name	LOD	LOQ	Site Average	Data Flag	High 1-Hour Average	Data Flag	Maximum Value	Data Flag
ethane	4.4	25	ND		ND		ND	T
ethylene	8.5	25	ND		ND		ND	T
acetylene	9.6	47	ND		ND		ND	T
propane	3.6	26	ND		ND		ND	T
propylene	4.8	25	ND		ND		ND	T
isobutane	5.2	26	ND		ND		ND	T
n-butane	5.3	27	ND		ND		ND	T
1-butene	4.6	26	ND		ND		ND	T
1,3-butadiene	5.3	26	ND		ND		ND	T
n-hexane + cyclohexane	7.2	50	ND		ND		ND	
benzene	7.9	24	ND		ND		ND	
n-octane	6.9	24	ND		ND		ND	
toluene	3.6	25	ND		ND		ND	
ethylbenzene	4.5	26	ND		ND		ND	
styrene	3.2	24	ND		ND		ND	
o-xylene	8.7	49	ND		ND		ND	

*See Attachments A and B for site location information.
All concentrations reported in parts per billion by volume (ppbv).
ND - not detected
T - tentatively identified compound. Site averages and high one-hour averages are not qualified with a T.

Canister Volatile Organic Compound Data
Region 12 Pearland Area Monitoring Project
Pearland, Texas
June 6-10, 2016

Lab ACL Number	1606006			1606006			1606006		
Lab Sample ID	1606006-003			1606006-004			1606006-005		
SSWG Sample Number	PL1606-C002			PL1606-C003			PL1606-C004		
Sample Date	6/8/16			6/7/16			6/7/16		
Sample Time	01:08-02:08			02:25-03:25			02:51-03:51		
General Sample Information	1-Hour OFC			1-Hour OFC			1-Hour OFC		
Sample Site	5			2			6		
Compound Name	ppbv	Data Flag	SDL	ppbv	Data Flag	SDL	ppbv	Data Flag	SDL
ethane	5.3	T, D1	1.0	6.0	T, D1	1.0	6.0	T, D2	1.0
ethylene	3.3	T, D1	1.0	1.1	L, T, D1	1.0	1.4	L, T, D2	1.0
acetylene	ND	T, D1	1.0	ND	T, D1	1.0	2.6	T, D2	1.0
propane	12	T, D1	1.0	5.9	T, D1	1.0	7.4	T, D2	1.0
propylene	2.7	T, D1	1.0	0.39	J, T, D1	1.0	1.2	L, T, D2	1.0
dichlorodifluoromethane	0.51	L, D1	0.40	0.46	L, D1	0.40	0.46	L, D2	0.40
methyl chloride	0.89	L, D1	0.40	0.80	L, D1	0.40	0.74	L, D2	0.40
isobutane	13	D1	0.46	3.5	D1	0.46	5.0	D2	0.46
vinyl chloride	0.25	J, D1	0.34	0.06	J, D1	0.34	0.07	J, D2	0.34
1-butene	0.36	J, D1	0.40	ND	D1	0.40	ND	D2	0.40
1,3-butadiene	ND	D1	0.54	ND	D1	0.54	ND	D2	0.54
n-butane	7.8	D1	0.40	2.4	D1	0.40	3.2	D2	0.40
t-2-butene	ND	D1	0.36	ND	D1	0.36	ND	D2	0.36
bromomethane	0.01	J, D1	0.54	0.01	J, D1	0.54	0.01	J, D2	0.54
c-2-butene	0.02	J, D1	0.54	ND	D1	0.54	ND	D2	0.54
3-methyl-1-butene	0.05	J, D1	0.46	ND	D1	0.46	0.02	J, D2	0.46
isopentane	9.9	D1	0.54	2.2	L, D1	0.54	3.9	L, D2	0.54
trichlorofluoromethane	0.40	J, D1	0.58	0.25	J, D1	0.58	0.27	J, D2	0.58
1-pentene	0.05	J, D1	0.54	ND	D1	0.54	ND	D2	0.54
n-pentane	3.6	L, D1	0.54	0.75	L, D1	0.54	1.7	L, D2	0.54
isoprene	0.14	J, D1	0.54	0.11	J, D1	0.54	0.15	J, D2	0.54
t-2-pentene	0.03	J, D1	0.54	ND	D1	0.54	ND	D2	0.54
1,1-dichloroethylene	ND	D1	0.36	ND	D1	0.36	0.01	J, D2	0.36
c-2-pentene	ND	D1	0.50	ND	D1	0.50	ND	D2	0.50
methylene chloride	0.95	L, D1	0.28	0.27	J, D1	0.28	0.41	L, D2	0.28
2-methyl-2-butene	0.03	J, D1	0.46	0.01	J, D1	0.46	ND	D2	0.46
2,2-dimethylbutane	0.08	J, D1	0.42	0.03	J, D1	0.42	0.04	J, D2	0.42
cyclopentene	0.01	J, D1	0.40	ND	D1	0.40	ND	D2	0.40
4-methyl-1-pentene	ND	D1	0.44	ND	D1	0.44	ND	D2	0.44
1,1-dichloroethane	ND	D1	0.38	ND	D1	0.38	ND	D2	0.38
cyclopentane	0.24	J, D1	0.54	0.07	J, D1	0.54	0.16	J, D2	0.54
2,3-dimethylbutane	0.09	J, D1	0.56	0.03	J, D1	0.56	0.05	J, D2	0.56
2-methylpentane	0.32	J, D1	0.54	0.12	J, D1	0.54	0.18	J, D2	0.54
3-methylpentane	0.25	J, D1	0.46	0.10	J, D1	0.46	0.14	J, D2	0.46
2-methyl-1-pentene + 1-hexen	ND	D1	0.40	ND	D1	0.40	ND	D2	0.40
n-hexane	0.37	J, D1	0.40	0.14	J, D1	0.40	0.19	J, D2	0.40
chloroform	0.05	J, D1	0.42	0.03	J, D1	0.42	0.04	J, D2	0.42
t-2-hexene	ND	D1	0.54	ND	D1	0.54	ND	D2	0.54
c-2-hexene	ND	D1	0.54	ND	D1	0.54	ND	D2	0.54
1,2-dichloroethane	0.10	J, D1	0.54	0.04	J, D1	0.54	0.06	J, D2	0.54
methylcyclopentane	0.14	J, D1	0.54	0.06	J, D1	0.54	0.08	J, D2	0.54
2,4-dimethylpentane	0.05	J, D1	0.54	0.02	J, D1	0.54	0.02	J, D2	0.54
1,1,1-trichloroethane	0.04	J, D1	0.52	0.02	J, D1	0.52	0.03	J, D2	0.52
benzene	0.38	J, D1	0.54	0.25	J, D1	0.54	0.26	J, D2	0.54
carbon tetrachloride	0.09	J, D1	0.54	0.09	J, D1	0.54	0.09	J, D2	0.54
cyclohexane	0.43	J, D1	0.48	0.17	J, D1	0.48	ND	D2	0.48
2-methylhexane	0.48	J, D1	0.54	0.11	J, D1	0.54	0.20	J, D2	0.54
2,3-dimethylpentane	0.14	J, D1	0.52	ND	D1	0.52	ND	D2	0.52
3-methylhexane	0.48	L, D1	0.40	0.14	J, D1	0.40	0.23	J, D2	0.40
1,2-dichloropropane	ND	D1	0.34	ND	D1	0.34	ND	D2	0.34
trichloroethylene	0.09	J, D1	0.58	0.02	J, D1	0.58	0.04	J, D2	0.58

Canister Volatile Organic Compound Data
Region 12 Pearland Area Monitoring Project
Pearland, Texas
June 6-10, 2016

Lab ACL Number	1606006			1606006			1606006		
Lab Sample ID	1606006-003			1606006-004			1606006-005		
SSWG Sample Number	PL1606-C002			PL1606-C003			PL1606-C004		
Sample Date	6/8/16			6/7/16			6/7/16		
Sample Time	01:08-02:08			02:25-03:25			02:51-03:51		
General Sample Information	1-Hour OFC			1-Hour OFC			1-Hour OFC		
Sample Site	5			2			6		
Compound Name	ppbv	Data Flag	SDL	ppbv	Data Flag	SDL	ppbv	Data Flag	SDL
2,2,4-trimethylpentane	0.20	J, D1	0.48	0.08	J, D1	0.48	0.09	J, D2	0.48
2-chloropentane	ND	D1	0.54	ND	D1	0.54	ND	D2	0.54
n-heptane	0.53	L, D1	0.50	0.13	J, D1	0.50	ND	D2	0.50
c-1,3-dichloropropylene	ND	D1	0.40	ND	D1	0.40	ND	D2	0.40
methylcyclohexane	0.30	J, D1	0.52	0.09	J, D1	0.52	0.14	J, D2	0.52
t-1,3-dichloropropylene	ND	D1	0.40	ND	D1	0.40	ND	D2	0.40
1,1,2-trichloroethane	ND	D1	0.42	0.01	J, D1	0.42	0.01	J, D2	0.42
2,3,4-trimethylpentane	0.09	J, D1	0.48	0.03	J, D1	0.48	0.04	J, D2	0.48
toluene	3.3	D1	0.54	0.73	L, D1	0.54	1.3	D2	0.54
2-methylheptane	0.09	J, D1	0.40	0.02	J, D1	0.40	0.04	J, D2	0.40
3-methylheptane	ND	D1	0.46	ND	D1	0.46	ND	D2	0.46
1,2-dibromoethane	ND	D1	0.40	ND	D1	0.40	ND	D2	0.40
n-octane	0.21	J, D1	0.38	0.06	J, D1	0.38	0.09	J, D2	0.38
tetrachloroethylene	0.13	J, D1	0.48	0.04	J, D1	0.48	0.07	J, D2	0.48
chlorobenzene	0.01	J, D1	0.54	0.01	J, D1	0.54	ND	D2	0.54
ethylbenzene	0.74	L, D1	0.54	0.20	J, D1	0.54	0.26	J, D2	0.54
m & p-xylene	1.5	L, D1	0.54	0.44	J, D1	0.54	0.55	L, D2	0.54
styrene	0.15	J, D1	0.54	0.12	J, D1	0.54	0.08	J, D2	0.54
1,1,2,2-tetrachloroethane	ND	D1	0.40	ND	D1	0.40	ND	D2	0.40
o-xylene	0.42	J, D1	0.54	0.13	J, D1	0.54	0.16	J, D2	0.54
n-nonane	0.30	J, D1	0.44	0.05	J, D1	0.44	0.09	J, D2	0.44
isopropylbenzene	0.04	J, D1	0.48	ND	D1	0.48	0.02	J, D2	0.48
n-propylbenzene	ND	D1	0.54	0.02	J, D1	0.54	ND	D2	0.54
m-ethyltoluene	ND	D1	0.22	ND	D1	0.22	ND	D2	0.22
p-ethyltoluene	ND	D1	0.32	0.07	J, D1	0.32	0.08	J, D2	0.32
1,3,5-trimethylbenzene	0.06	J, D1	0.50	ND	D1	0.50	0.03	J, D2	0.50
o-ethyltoluene	ND	D1	0.26	0.01	J, D1	0.26	ND	D2	0.26
1,2,4-trimethylbenzene	ND	D1	0.54	ND	D1	0.54	ND	D2	0.54
n-decane	0.35	J, D1	0.54	ND	D1	0.54	0.09	J, D2	0.54
1,2,3-trimethylbenzene	ND	D1	0.54	ND	D1	0.54	ND	D2	0.54
m-diethylbenzene	ND	D1	0.54	ND	D1	0.54	ND	D2	0.54
p-diethylbenzene	0.03	J, D1	0.54	ND	D1	0.54	ND	D2	0.54
n-undecane	0.12	J, D1	0.54	ND	D1	0.54	0.04	J, D2	0.54

D1 - Sample concentration was calculated using a dilution factor of 4.01.
D2 - Sample concentration was calculated using a dilution factor of 4.
J - reported concentration is below the SDL.
L - reported concentration is greater than or equal to the SDL but less than the LOQ.
LOD - limit of detection
LOQ - limit of quantitation
ND - not detected
SDL - sample detection limit (LOD adjusted for dilutions).
T - data was not confirmed by a confirmational analysis. Data is tentatively identified.

Continuous Emission Monitor
Hydrogen Sulfide (H_2S*) Data
Region 12 Pearland Area Monitoring Project
Pearland, Texas
June 6-10, 2016
Van 5416

These data were collected using a Picarro G1104 Cavity Ringdown Spectrometer H_2S Analyzer.

Sample Period 1

Date	Time	Site[a]	H_2S 5-Minute Average (ppmv)	Data Flag	H_2S 30-Minute Average (ppmv)	Data Flag
6/6/2016	22:45	1	0.007	L	NA	
6/6/2016	22:50	1	0.008	L	NA	
6/6/2016	22:55	1	0.002	J	NA	
6/6/2016	23:00	1	ND		NA	
6/6/2016	23:05	1	ND		NA	
6/6/2016	23:10	1	0.002	J	0.003	J
6/6/2016	23:15	1	ND		0.002	J
6/6/2016	23:20	1	ND		ND	
6/6/2016	23:25	1	ND		ND	
6/6/2016	23:30	1	ND		ND	
6/6/2016	23:35	1	ND		ND	
6/6/2016	23:40	1	ND		ND	
6/6/2016	23:45	1	ND		ND	
6/6/2016	23:50	1	ND		ND	
6/6/2016	23:55	1	ND		ND	
6/7/2016	00:25	2	0.012	L	NA	
6/7/2016	00:30	2	0.010	L	NA	
6/7/2016	00:35	2	0.012	L	NA	
6/7/2016	00:40	2	0.012	L	NA	
6/7/2016	00:45	2	0.007	L	NA	
6/7/2016	00:50	2	0.002	J	0.009	L
6/7/2016	00:55	2	0.003	J	0.008	L
6/7/2016	01:00	2	0.002	J	0.006	J
6/7/2016	01:05	2	0.002	J	0.005	J
6/7/2016	01:10	2	ND		0.003	J
6/7/2016	01:15	2	ND		0.002	J
6/7/2016	04:35	3	ND		NA	
6/7/2016	04:40	3	ND		NA	
6/7/2016	04:45	3	0.006	J	NA	
6/7/2016	04:50	3	0.011	L	NA	
6/7/2016	04:55	3	0.013	L	NA	
6/7/2016	05:00	3	0.012	L	0.007	L
6/7/2016	05:05	3	0.011	L	0.009	L
6/7/2016	05:10	3	0.009	L	0.010	L
6/7/2016	05:15	3	0.007	L	0.011	L
6/7/2016	05:20	3	0.005	J	0.010	L
6/7/2016	05:25	3	0.005	J	0.008	L
6/7/2016	05:30	3	0.004	J	0.007	L
6/7/2016	05:35	3	0.003	J	0.006	J
6/7/2016	05:40	3	0.003	J	0.005	J
6/7/2016	05:45	3	0.002	J	0.004	J
6/7/2016	05:50	3	0.002	J	0.003	J
6/7/2016	05:55	3	0.002	J	0.003	J

Continuous Emission Monitor
Hydrogen Sulfide (H_2S*) Data
Region 12 Pearland Area Monitoring Project
Pearland, Texas
June 6-10, 2016
Van 5416

Sample Period 2

Date	Time	Site[a]	H_2S 5-Minute Average (ppmv)	Data Flag	H_2S 30-Minute Average (ppmv)	Data Flag
6/8/2016	01:40	4	0.027	L	NA	
6/8/2016	01:45	4	0.019	L	NA	
6/8/2016	01:50	4	0.025	L	NA	
6/8/2016	01:55	4	0.023	L	NA	
6/8/2016	02:00	4	0.026	L	NA	
6/8/2016	02:05	4	0.028	L	0.025	L
6/8/2016	02:10	4	0.017	L	0.023	L
6/8/2016	02:15	4	0.025	L	0.024	L
6/8/2016	02:20	4	0.029	L	0.025	L
6/8/2016	02:25	4	0.013	L	0.023	L
6/8/2016	02:30	4	0.006	J	0.020	L
6/8/2016	03:10	7	0.127		NA	
6/8/2016	03:15	7	0.108		NA	
6/8/2016	03:20	7	0.113		NA	
6/8/2016	03:25	7	0.090		NA	
6/8/2016	03:30	7	0.094		NA	
6/8/2016	03:35	7	0.057		0.098	
6/8/2016	03:40	7	0.043	L	0.084	
6/8/2016	03:45	7	0.043	L	0.073	
6/8/2016	03:50	7	0.029	L	0.059	
6/8/2016	03:55	7	0.024	L	0.048	L
6/8/2016	04:00	7	0.023	L	0.037	L
6/8/2016	04:05	7	0.017	L	0.030	L
6/8/2016	04:10	7	0.018	L	0.026	L
6/8/2016	04:15	7	0.020	L	0.022	L
6/8/2016	04:20	7	0.018	L	0.020	L
6/8/2016	04:25	7	0.017	L	0.019	L
6/8/2016	04:30	7	0.022	L	0.019	L
6/8/2016	04:35	7	0.044	L	0.023	L
6/8/2016	04:40	7	0.056		0.030	L
6/8/2016	04:45	7	0.061		0.036	L
6/8/2016	04:50	7	0.059		0.043	L
6/8/2016	04:55	7	0.051		0.049	L
6/8/2016	05:00	7	0.032	L	0.051	
6/8/2016	05:05	7	0.025	L	0.047	L
6/8/2016	05:10	7	0.024	L	0.042	L
6/8/2016	05:15	7	0.025	L	0.036	L
6/8/2016	05:20	7	0.018	L	0.029	L
6/8/2016	05:25	7	0.022	L	0.024	L
6/8/2016	05:30	7	0.018	L	0.022	L
6/8/2016	05:35	7	0.023	L	0.022	L
6/8/2016	05:40	7	0.022	L	0.021	L
6/8/2016	05:45	7	0.016	L	0.020	L

Continuous Emission Monitor
Hydrogen Sulfide (H_2S*) Data
Region 12 Pearland Area Monitoring Project
Pearland, Texas
June 6-10, 2016
Van 5416

Sample Period 3

Date	Time	Site[a]	H_2S 5-Minute Average (ppmv)	Data Flag	H_2S 30-Minute Average (ppmv)	Data Flag
6/9/2016	00:45	8	ND		NA	
6/9/2016	00:50	8	0.003	J	NA	
6/9/2016	00:55	8	0.004	J	NA	
6/9/2016	01:00	8	ND		NA	
6/9/2016	01:05	8	0.002	J	NA	
6/9/2016	01:10	8	ND		0.002	J
6/9/2016	01:15	8	ND		0.002	J
6/9/2016	01:20	8	0.003	J	0.002	J
6/9/2016	01:25	8	ND		ND	
6/9/2016	01:30	8	ND		ND	
6/9/2016	01:35	8	ND		ND	
6/9/2016	01:40	8	ND		ND	
6/9/2016	01:45	8	0.004	J	0.002	J
6/9/2016	01:50	8	ND		ND	
6/9/2016	01:55	8	ND		ND	
6/9/2016	02:00	8	ND		ND	
6/9/2016	02:05	8	ND		ND	
6/9/2016	02:10	8	ND		ND	
6/9/2016	02:15	8	0.007	L	ND	
6/9/2016	02:20	8	ND		ND	
6/9/2016	02:25	8	ND		ND	
6/9/2016	02:30	8	0.012	L	0.003	J
6/9/2016	02:35	8	ND		0.004	J
6/9/2016	02:40	8	ND		0.004	J
6/9/2016	02:45	8	ND		0.002	J
6/9/2016	02:50	8	0.003	J	0.003	J
6/9/2016	02:55	8	0.004	J	0.003	J
6/9/2016	03:00	8	ND		0.002	J
6/9/2016	03:05	8	ND		0.002	J
6/9/2016	03:10	8	ND		0.002	J
6/9/2016	03:15	8	ND		0.002	J
6/9/2016	03:20	8	ND		0.002	J
6/9/2016	03:25	8	ND		ND	
6/9/2016	03:55	9	0.223		NA	
6/9/2016	04:00	9	0.188		NA	
6/9/2016	04:05	9	0.127		NA	
6/9/2016	04:10	9	0.046	L	NA	
6/9/2016	04:15	9	0.021	L	NA	
6/9/2016	04:20	9	0.039	L	0.107	
6/9/2016	04:25	9	0.023	L	0.074	
6/9/2016	04:30	9	0.024	L	0.047	L
6/9/2016	04:35	9	0.024	L	0.030	L
6/9/2016	04:40	9	0.021	L	0.025	L
6/9/2016	04:45	9	0.015	L	0.024	L
6/9/2016	04:50	9	0.018	L	0.021	L
6/9/2016	04:55	9	0.028	L	0.022	L

*H_2S regulatory level is a 30-minute average of 0.080 ppmv, however data did not include upwind sampling equipment.

[a] See Attachments A and B for site location information.

All concentrations reported in parts per million by volume (ppmv).

The H_2S limit of detection is 0.007 ppmv.

J - reported concentration is below the limit of detection (LOD).

L - reported concentration is greater than or equal to LOD but less than the lowest concentration standard of 0.050 ppmv.
ND - not detected

Meteorological Data
Region 12 Pearland Area Monitoring Project
Pearland, Texas
June 6-10, 2016
Van 5416

These data were collected using a Climatronics All-In-One (AIO) Compact Weather Station with a folded-path, low power sonic anemometer, internal flux-gate compass, and triple element thermistor.

Date	Time	Sample Site[a]	Average Wind Speed (mph)	Average Wind Direction (degrees)[b]	Average Temperature (degrees F)
Sample Period 1					
Mast Down June 06, 2016 19:30-22:35					
06/06/16	22:35	1	Calm	287	78
06/06/16	22:40	1	Calm	196	78
06/06/16	22:45	1	Calm	195	78
06/06/16	22:50	1	Calm	110	78
06/06/16	22:55	1	3	31	78
06/06/16	23:00	1	3	46	78
06/06/16	23:05	1	3	69	78
06/06/16	23:10	1	Calm	102	78
06/06/16	23:15	1	Calm	137	79
06/06/16	23:20	1	Calm	96	79
06/06/16	23:25	1	Calm	198	79
06/06/16	23:30	1	EM	EM	EM
06/06/16	23:35	1	EM	EM	EM
06/06/16	23:40	1	EM	EM	EM
06/06/16	23:45	1	EM	EM	EM
06/06/16	23:55	1	Calm	217	78
Mast Down June 06-07, 2016 23:55-00:15					
06/07/16	00:15	2	Calm	307	76
06/07/16	00:20	2	Calm	192	77
06/07/16	00:25	2	Calm	174	77
06/07/16	00:30	2	Calm	129	77
06/07/16	00:35	2	Calm	144	77
06/07/16	00:40	2	Calm	154	77
06/07/16	00:45	2	Calm	144	78
06/07/16	00:50	2	Calm	156	78
06/07/16	00:55	2	Calm	188	78
06/07/16	01:00	2	Calm	191	78
06/07/16	01:05	2	Calm	170	77
06/07/16	01:10	2	Calm	139	77
06/07/16	01:15	2	Calm	112	77
Sample Period 1 (continued)					

Date	Time	Sample Site[a]	Average Wind Speed (mph)	Average Wind Direction (degrees)[b]	Average Temperature (degrees F)
Mast Down June 07, 2016 01:15-04:25					
06/07/16	04:25	3	Calm	326	75
06/07/16	04:30	3	Calm	356	74
06/07/16	04:35	3	Calm	352	74
06/07/16	04:40	3	Calm	9	75
06/07/16	04:45	3	Calm	343	75
06/07/16	04:50	3	Calm	341	75
06/07/16	04:55	3	Calm	14	75
06/07/16	05:00	3	Calm	16	75
06/07/16	05:05	3	Calm	5	75
06/07/16	05:10	3	Calm	5	75
06/07/16	05:15	3	Calm	9	75
06/07/16	05:20	3	Calm	8	75
06/07/16	05:25	3	Calm	337	75
06/07/16	05:30	3	Calm	6	75
06/07/16	05:35	3	Calm	19	74
06/07/16	05:40	3	Calm	359	74
06/07/16	05:45	3	Calm	336	74
06/07/16	05:50	3	Calm	18	74
06/07/16	05:55	3	Calm	6	74
Mast Down June 07, 2016 05:55-07:30					

Sample Period 2					
Mast Down June 07-08, 2016 19:30-01:35					
06/08/16	01:35	4	Calm	310	76
06/08/16	01:40	4	Calm	315	75
06/08/16	01:45	4	Calm	1	74
06/08/16	01:50	4	Calm	347	75
06/08/16	01:55	4	Calm	35	75
06/08/16	02:00	4	Calm	8	75
06/08/16	02:05	4	Calm	355	74
06/08/16	02:10	4	Calm	300	74
06/08/16	02:15	4	Calm	273	74
06/08/16	02:20	4	Calm	269	73
06/08/16	02:25	4	Calm	277	73
06/08/16	02:30	4	Calm	283	73

Date	Time	Sample Site[a]	Average Wind Speed (mph)	Average Wind Direction (degrees)[b]	Average Temperature (degrees F)
Sample Period 2 (continued)					
Mast Down June 08, 2016 02:30-03:05					
06/08/16	03:05	7	Calm	314	73
06/08/16	03:10	7	Calm	271	73
06/08/16	03:15	7	Calm	292	74
06/08/16	03:20	7	Calm	300	75
06/08/16	03:25	7	Calm	303	74
06/08/16	03:30	7	Calm	314	74
06/08/16	03:35	7	Calm	316	74
06/08/16	03:40	7	Calm	318	74
06/08/16	03:45	7	Calm	338	74
06/08/16	03:50	7	Calm	18	74
06/08/16	03:55	7	Calm	9	74
06/08/16	04:00	7	Calm	310	74
06/08/16	04:05	7	Calm	322	74
06/08/16	04:10	7	Calm	313	74
06/08/16	04:15	7	Calm	332	74
06/08/16	04:20	7	Calm	329	74
06/08/16	04:25	7	Calm	315	74
06/08/16	04:30	7	Calm	325	74
06/08/16	04:35	7	Calm	345	74
06/08/16	04:40	7	Calm	3	74
06/08/16	04:45	7	Calm	336	74
06/08/16	04:50	7	Calm	327	74
06/08/16	04:55	7	Calm	344	74
06/08/16	05:00	7	Calm	358	74
06/08/16	05:05	7	Calm	343	74
06/08/16	05:10	7	Calm	335	74
06/08/16	05:15	7	Calm	328	74
06/08/16	05:20	7	Calm	335	74
06/08/16	05:25	7	Calm	340	74
06/08/16	05:30	7	Calm	351	74
06/08/16	05:35	7	Calm	348	74
06/08/16	05:40	7	Calm	350	74
06/08/16	05:45	7	Calm	339	74
Mast Down June 08, 2016 05:45-07:30					

Date	Time	Sample Site[a]	Average Wind Speed (mph)	Average Wind Direction (degrees)[b]	Average Temperature (degrees F)
Sample Period 3					
Mast Down June 08-09, 2016 19:30-00:35					
06/09/16	00:35	8	Calm	158	80
06/09/16	00:40	8	Calm	117	80
06/09/16	00:45	8	Calm	117	79
06/09/16	00:50	8	Calm	116	79
06/09/16	00:55	8	Calm	127	79
06/09/16	01:00	8	Calm	127	79
06/09/16	01:05	8	Calm	127	79
06/09/16	01:10	8	Calm	123	79
06/09/16	01:15	8	3	123	79
06/09/16	01:20	8	3	114	79
06/09/16	01:25	8	Calm	115	79
06/09/16	01:30	8	Calm	122	79
06/09/16	01:35	8	Calm	129	78
06/09/16	01:40	8	Calm	127	78
06/09/16	01:45	8	Calm	132	78
06/09/16	01:50	8	Calm	151	78
06/09/16	01:55	8	Calm	150	78
06/09/16	02:00	8	Calm	140	78
06/09/16	02:05	8	Calm	130	78
06/09/16	02:10	8	Calm	143	78
06/09/16	02:15	8	Calm	116	78
06/09/16	02:20	8	Calm	71	78
06/09/16	02:25	8	Calm	144	78
06/09/16	02:30	8	Calm	80	78
06/09/16	02:35	8	Calm	349	78
06/09/16	02:40	8	Calm	322	77
06/09/16	02:45	8	Calm	322	77
06/09/16	02:50	8	Calm	26	77
06/09/16	02:55	8	Calm	38	77
06/09/16	03:00	8	Calm	34	77
06/09/16	03:05	8	Calm	22	77
06/09/16	03:10	8	Calm	345	77
06/09/16	03:15	8	Calm	322	77
06/09/16	03:20	8	Calm	321	76
06/09/16	03:25	8	Calm	335	77
06/09/16	03:30	8	Calm	354	77

Date	Time	Sample Site[a]	Average Wind Speed (mph)	Average Wind Direction (degrees)[b]	Average Temperature (degrees F)
Sample Period 3 (continued)					
Mast Down June 09, 2016 03:30-03:45					
06/09/16	03:45	9	Calm	306	76
06/09/16	03:50	9	Calm	5	76
06/09/16	03:55	9	Calm	247	76
06/09/16	04:00	9	Calm	357	76
06/09/16	04:05	9	Calm	2	76
06/09/16	04:10	9	Calm	34	76
06/09/16	04:15	9	Calm	41	76
06/09/16	04:20	9	Calm	55	76
06/09/16	04:25	9	Calm	139	75
06/09/16	04:30	9	Calm	126	75
06/09/16	04:35	9	Calm	159	75
06/09/16	04:40	9	Calm	180	75
06/09/16	04:45	9	Calm	181	75
06/09/16	04:50	9	Calm	172	75
06/09/16	04:55	9	Calm	175	75
06/09/16	05:00	9	Calm	178	75
Mast Down June 09, 2016 05:00-07:30					

[a] See Attachments A and B for sample site information

[b] All wind direction data based on magnetic north

EM - equipment malfunction

F - Fahrenheit

mph - miles per hour

TCEQ Interoffice Memorandum

To: Ashley Wadick, Director, Region 12
Daniel O'Brien, Assistant Regional Director, Region 12
Nicole Bealle, Special Assistant to the Regional Director, Region 12

Thru: Michael Honeycutt, Ph.D, Director MH
Toxicology Division, Office of the Executive Director

From: Joseph "Kip" Haney, M.S. KH
Toxicology Division, Office of the Executive Director

Date: August 16, 2016

Subject: Toxicological Evaluation of the Pearland Area Monitoring Project, June 6-10, 2016, Region 12, Document Number PL1606-FR.

Key Points

- Reported concentrations of target volatile organic compounds (VOCs) in 1-hour canister samples were either not detected or were detected below levels of short-term health and/or welfare concern, and no real-time gas chromatography (RTGC) VOC analytes were detected.
- Adverse health or welfare effects would not be expected to occur based on the 1-hour canister and RTGC data reported.
- Considering canister and RTGC sampling results, that these sampling methods cannot capture and/or analyze for all chemicals, the toxic vapor analyzer readings, and reports of odors by TCEQ staff suggests that canister and RTGC sampling may not be well suited for investigation of the cause(s) and/or source(s) of odor complaints in this area as the odors experienced may be due to non-target VOCs and/or sulfur compounds, especially given the hydrogen sulfide (H_2S) data collected.
- Two 30-minute H_2S concentrations measured at Site 7 (84 and 98 ppb_v) and one 30-minute concentration measured at Site 9 (107 ppb_v) exceeded the state regulatory standard numerical value (80 ppb_v).
- Although adverse health effects would not be expected due to exposure to the reported 30-minute (or 5-minute) H_2S concentrations, the range of concentrations detected at the seven H_2S sampling sites (e.g., 30-minute averages of 2-107 ppbv) could result in the perception of odors if exposure were to occur, which is consistent with citizen odor complaints.
- As most of the H_2S sampling sites were located in close proximity to homes (e.g., Sites 1, 3, 7, 8, 9, with Sites 4 and 2 being somewhat more distant), the Toxicology Division encourages any H_2S reductions necessary to prevent odor nuisance conditions in this area and

preclude persistent, strong odors with the potential to cause indirect, odor-related health effects (e.g., headache, nausea).

Background

On June 6-10, 2016, the Texas Commission on Environmental Quality (TCEQ) Strategic Sampling Work Group (SSWG) conducted an air monitoring project in the Pearland, Texas (TX) area. The objectives for this project were to coordinate with Region 12 staff, to collect quality air monitoring data to measure potential hydrogen sulfide (H_2S) as well as target volatile organic compounds (VOCs) via summa canister and real-time gas chromatography (RTGC) to be used in a health effects evaluation by the Toxicology Division (TD). Weather conditions and sampling times were reported to be consistent with those during the majority of citizen complaints. In this memorandum, the TD evaluates the reported air concentration data from a health effects perspective.

Furthermore, the air monitoring project was designed to assist and support regional staff investigations related to odor complaints in the Shadow Creek Ranch neighborhood located in Pearland, TX. Region 12 air investigators coordinated with SSWG staff to conduct odor surveys during the air monitoring activities (i.e., frequency, intensity, duration, and offensiveness (FIDO) odor surveys). Facilities surrounding the Shadow Creek Ranch area were assessed as potential odor sources. SSWG staff surveyed the Republic Services Blue Ridge Landfill located to the west of the Shadow Creek Ranch neighborhood, the Lone Star Disposal and Recycling facility located to the northwest, as well as multiple other facilities. One-hour time integrated summa canister samples were collected in locations where odors and hand-held toxic vapor analyzer (TVA) survey results indicated notable VOC concentrations.

Additional details on the sampling/surveys conducted (e.g., optical gas imaging camera and Jerome total reduced sulfur surveys, facilities surveyed), meteorological conditions, and sampling locations can be found in the TCEQ report entitled, "Region 12 Pearland Area Monitoring Project, June 6-10, 2016, Document Number PL1606-FR."

Results and Evaluation

<u>One-Hour Canister Samples</u>

Three 1-hour summa canister samples were collected during the air monitoring project. Canister samples were analyzed by the Austin Air Laboratory for 84 target VOCs (see Attachment A for the list of canister VOCs evaluated for this review), and air concentrations of detected VOCs were reported in parts per billion by volume (ppb_v). Note that available canister technology and analysis methodology cannot capture and/or analyze for all chemicals. One canister sample was collected at each of three sampling sites (Sites 2, 5, and 6). Site 2 was at the intersection of McHard Road and West Drive, which does not fall on the border of a residential area but essentially lies between two large residential areas. The nearest facilities are Flexicore of Texas, Cherry Crushed Concrete, Honghua America, and Akzo Nobel Surface Chemistry (see Attachment B). Site 5 was at the intersection of Laurel Loch Lane and Lost Creek Drive, on the western edge of the Shadow Creek Ranch neighborhood just across FM 521 from the Blue Ridge Landfill to the immediate west. Several other facilities are located within a mile of Site 5 to the

north/northwest, including Pittsburg Corning Corporation as well as the four facilities mentioned above. Site 6 was at the intersection of FM 521 and McHard Road, which is just northwest of the northwestern edge of the Shadow Creek Ranch neighborhood. Flexicore of Texas and Akzo Nobel Surface Chemistry are located at this intersection (see Attachment B), and other facilities are located within a mile of this site as well (e.g., Lone Star Disposal, Blue Ridge Landfill, as well as the other facilities mentioned above).

Reported VOC concentrations in 1-hour canister samples were compared to the TCEQ's short-term, health- and/or welfare-based air monitoring comparison values (AMCVs) (see Table 1 in Attachment A). Short-term AMCVs are guideline levels used to evaluate ambient air concentrations to determine their potential to result in acute adverse health effects, vegetation effects, or odors. Health-based AMCVs provide a margin of safety and are set at concentrations well below levels at which adverse health effects have been reported in the scientific literature. If a chemical concentration in ambient air is less than its AMCV, no adverse health effects are expected to occur. If a chemical concentration exceeds its health-based AMCV, it does not necessarily mean that adverse effects will occur, but rather that further evaluation is warranted. All reported 1-hour VOC concentrations detected in canisters were less than their respective health- and/or welfare-based AMCVs. *Therefore, adverse health or welfare effects would not be expected if exposure were to occur to the reported 1-hour canister concentrations.*

Although canister VOC analytes were either not detected (ND) or detected below their respective short-term AMCVs, as mentioned above, canister sampling cannot capture and/or analyze for all chemicals. Considering this limitation, it is important to note that TCEQ staff reported experiencing odors. For example, during sampling period 1 (from 20:00 June 6, 2016 to 08:00 June 7, 2016), although TVA readings were reported to range between 98 and 210 parts per million by volume (ppm_v) and a regional FIDO survey (investigation report number 1337792) noted a strong odor for the duration of the 1-hour canister collected at Site 6 (essentially at the northwest corner of the Shadow Creek Ranch neighborhood), no odorous concentrations were reported for the 84 VOCs analyzed. Because Site 6 was at the intersection of FM 521 and McHard Road, it is further noted that during the same sampling period (sampling period 1), odor and Jerome J605 instrument surveys along McHard Road (FM 2234) indicated strong odors with traces of sulfur. *Together, this information suggests that canister sampling may not be well suited for investigation of the cause(s) and/or source(s) of odor complaints in this area as the odors experienced may be due to non-target VOCs and/or sulfur compounds, especially considering the H_2S data collected.* For example, Site 1 (essentially on the southeast corner of a residential area) and Site 2 were on McHard Road west of Site 6 during sampling period 1, and data reported for these sites indicate H_2S concentrations (e.g., 5-minute averages of ND-8 ppb_v for Site 1 and ND-12 ppb_v for Site 2) that can result in the perception of odors if exposure occurs as odor thresholds are reported to range from 0.5 to 300 ppb_v (ATSDR 2014) (see the H_2S sampling section below).

<u>RTGC Sampling</u>

RTGC was used to analyze for 17 target VOCs at two sampling sites (Sites 3 and 5). Note that n-hexane and cyclohexane are reported together as "n-hexane + cyclohexane" (see the Attachment A list of the RTGC VOCs evaluated as footnoted by "*"). Site 3 was at the intersection of Trinity Bay Drive and Arcadia Bay Drive, in the Shadow Creek Ranch neighborhood east of the Blue Ridge Landfill (see Attachment B). Site 5 was located northwest of Site 3 at the intersection of

Laurel Loch Lane and Lost Creek Drive, on the western edge of the Shadow Creek Ranch neighborhood and closer to the Blue Ridge Landfill just across FM 521. No RTGC VOC analytes were detected. *Thus, adverse health or welfare effects would not be expected based on the RTGC data reported.*

However, as mentioned above for canister samples, it is important to note that RTGC sampling cannot capture and/or analyze for all chemicals and non-target compounds could have been present, especially considering the H_2S data collected (see the H_2S sampling section below). For example, at Site 3 during sampling period 1 on June 7, while no RTGC target VOCs were detected at 05:13, the 5-minute H_2S averages reported at 05:10 and 05:15 were 9 and 7 ppb_v, respectively. In addition to the lack of VOC detections at 05:13, no target VOCs were detected by RTGC at 04:48, whereas the 30-minute H_2S averages reported at 05:10 and 05:15 were 10 and 11 ppb_v, respectively. Exposure to these concentrations (e.g., 7-11 ppb_v) can result in the perception of odors as odor thresholds are reported to range from 0.5 to 300 ppb_v (ATSDR 2014). *Similar to canister sampling, this information suggests that RTGC sampling may not be well suited for investigation of the cause(s) and/or source(s) of odor complaints in this area as the odors experienced may be due to non-target compounds (e.g., H_2S).*

<u>H_2S Sampling</u>

H_2S was detected at all sites (i.e., Sites 1, 2, 3, 4, 7, 8, and 9) where sampling occurred during the three sampling periods from June 6th to 9th. Sites 1, 2, 3, 4, 7, 8, and 9 had reported 30-minute H_2S averages ranging from ND-3 ppb_v, 2-9 ppb_v, 3-11 ppb_v, 20-25 ppb_v, 19-98 ppb_v, ND-4 ppb_v, and 21-107 ppb_v, respectively. Although only downwind measurements were collected for this project due to resource limitations, reported 30-minute H_2S averages were compared to the state regulatory 30-minute, net H_2S standard of 80 ppb_v. Two 30-minute concentrations measured at Site 7 during sampling period 2 (84 and 98 ppb_v) and one 30-minute concentration measured at Site 9 during sampling period 3 (107 ppb_v) exceeded the state regulatory standard numerical value (80 ppb_v). Site 7 was located at Bluebonnet Drive and Feld Drive, which appears to be near some homes primarily on the west side of Feld Drive, with the closest facilities being Lone Star Disposal to the north/northwest and Akzo Nobel Surface Chemistry to the south/southwest (see Attachment B). Site 9 was to the west of Site 7 on Bluebonnet Drive, and appears to have been near some homes on Bluebonnet Drive between Sites 7 and 9, with the closest facilities being Lone Star Disposal to the north and Akzo Nobel Surface Chemistry to the south (see Attachment B). See the first paragraph below on 5-minute averages for a limited discussion of wind direction at the times of the highest H_2S averages for these sites. As these 30-minute H_2S concentrations exceeded the state regulatory standard numerical value, especially considering that homes are located nearby, further evaluation was warranted. *Adverse health effects would not be expected due to exposure to these 30-minute H_2S concentrations as they are significantly lower than levels at which direct adverse effects (e.g., irritation) have been reported in the scientific literature* (e.g., margin of exposure (MOE) > 18 times lower than the 30-minute, minimal lowest-observed-adverse-effect-level (LOAEL) of 2,000 ppb_v associated with changes suggestive of bronchial obstruction in asthmatics and used as the point of departure by ATSDR (2014) for the acute minimal risk level; MOE > 12 times lower than even the subchronic $LOAEL_{HEC}$ of ≈1,370 ppb_v for nasal effects based on Brenneman et al. 2000).

In regard to odor potential, as odor thresholds are reported to range from 0.5 to 300 ppb_v (ATSDR 2014), the range of 30-minute concentrations detected at these seven sites (2-107 ppb_v)

could result in the perception of odors if exposure were to occur, which is consistent with citizen odor complaints. In this regard, it is noted that most of the H_2S sampling sites were located in close proximity to homes (e.g., Sites 1, 3, 7, 8, 9, with Sites 4 and 2 being somewhat more distant) (see Attachment B). *Consequently, the TD encourages any H_2S reductions necessary to prevent odor nuisance conditions in this area.* Lastly, while persistent, strong odors have the potential to cause indirect, odor-related health effects (e.g., headache, nausea), the reported concentrations are significantly lower than levels at which indirect, acute adverse effects have been reported in the scientific literature (e.g., headache occurred in 3/10 humans exposed to 2,000 ppb_v for 30 minutes in Jappinen et al. 1990, a concentration > 18 times the maximum 30-minute concentration reported).

In regard to 5-minute H_2S averages, Sites 1, 2, 3, 4, 7, 8, and 9 had reported concentrations ranging from ND-8 ppb_v, ND-12 ppb_v, ND-13 ppb_v, 6-29 ppb_v, 16-127 ppb_v, ND-12 ppb_v, and 15-223 ppb_v, respectively. The sites with the highest 5-minute H_2S averages had the highest reported 30-minute averages (e.g., Sites 9, 7, and 4). Sites 9 and 7 were located on Bluebonnet Drive and near some homes, whereas Site 4 was located somewhat more distant from homes but near the southwest corner of the Shadow Creek Ranch neighborhood (see Attachment B). For Site 9, the highest 5-minute averages (127-223 ppb_v) were reported on June 9th at 03:55, 04:00, and 04:05. While source attribution is beyond the scope of this health effects review, it is noted that 5-minute wind direction averages were reported from 247, 357, and 2 degrees at these respective times. Lone Star Disposal was located to the north of Site 9 (e.g., 357 and 2 degrees), with Akzo Nobel Surface Chemistry and then the Blue Ridge Landfill property being located to the southwest at 247 degrees. For Site 7, the highest 5-minute averages (84-127 ppb_v) were reported on June 8th at 03:10-3:30, when 5-minute wind direction averages were reported from 271-314 degrees. Lone Star Disposal was located to the northwest of Site 7. Although the reported highest 5-minute H_2S averages for Site 4 were significantly lower than those for Sites 7 and 9, the highest 5-minute averages (17-29 ppb_v) were reported on June 8th at 01:40-02:20. It is noted that 5-minute wind direction averages were reported from 269-35 degrees at these times. The Blue Ridge Landfill was located to the north/northwest to slightly northeast of Site 4, which was located near the southwest corner of the Shadow Creek Ranch neighborhood. Region 12 investigators have reported odors around the Blue Ridge Landfill consistent with citizen complaints previously (e.g., see the May 4, 2016 memorandum from Tracie Phillips, Ph.D. to Ashley Wadick entitled, "Toxicological Evaluation of Results from an Ambient Air Sample for Volatile Organic Compounds Collected North of Blue Ridge Landfill in Fresno, Fort Bend County, Texas"), and in the current instance investigators were reported to document a strong sulfur smell during the same time period that sampling was being conducted at Sites 7 and 4. Site 1 (essentially on the southeast corner of a residential area) had the lowest reported maximum 5-minute H_2S concentration (range of ND-8 ppb_v), with 7 and 8 ppb_v being reported on June 6th at 22:45 and 22:50 and respective 5-minute wind direction averages being from 195 and 110 degrees. The Blue Ridge Landfill was to the south/southeast/southwest of Site 1, which was located just north and across McHard Road from the Blue Ridge Landfill (see Attachment B). These examples are consistent with the TCEQ report (Document Number PL1606-FR) statement, "H_2S was consistently measured with the Picarro and Jerome downwind of Republic Services Blue Ridge Landfill and Lone Star Disposal and Recycling." *Despite these simple examples and general observations, source attribution is beyond the scope of this health effects review, and the TD defers source attribution to TCEQ staff with expertise in that area.*

Conclusions regarding the odor potential of reported 5-minute H_2S averages are similar to those for 30-minute data. As odor thresholds are reported to range from 0.5 to 300 ppb_v (ATSDR 2014), the range of 5-minute concentrations detected at the seven sites where H_2S sampling occurred (8-223 ppb_v) could result in the perception of odors if exposure were to occur, which is consistent with citizen odor complaints. In this regard, it is noted that most of the H_2S sampling sites were located in close proximity to homes (e.g., Sites 1, 3, 7, 8, 9, with Sites 4 and 2 being somewhat more distant) (see Attachment B). *As mentioned above, the TD encourages any H_2S reductions necessary to prevent odor nuisance conditions in this area.*

Conclusions

Reported concentrations of target VOCs were either ND or were detected below levels of short-term health and/or welfare concern in 1-hour canister samples, and no RTGC VOC analytes were detected. Consequently, adverse health or welfare effects would not be expected to occur based on the 1-hour canister and RTGC data reported. Considering the canister and RTGC sampling data, that canister and RTGC sampling cannot capture and/or analyze for all chemicals, the TVA readings reported, and reports of odors by TCEQ staff suggests that canister and RTGC sampling may not be well suited for investigation of the cause(s) and/or source(s) of odor complaints in this area as the odors experienced may be due to non-target VOCs and/or sulfur compounds, especially considering the H_2S data collected.

Two 30-minute H_2S concentrations measured at Site 7 (84 and 98 ppb_v) and one 30-minute concentration measured at Site 9 (107 ppb_v) exceeded the state regulatory standard numerical value (80 ppb_v). Although adverse health effects would not be expected due to exposure to the reported 30-minute (or 5-minute) H_2S concentrations, the range of concentrations detected at the seven H_2S sampling sites (e.g., 30-minute averages of 2-107 ppbv) could result in the perception of odors if exposure were to occur, which is consistent with citizen odor complaints. In this regard, it is noted that most of the H_2S sampling sites were located in close proximity to homes (e.g., Sites 1, 3, 7, 8, 9, with Sites 4 and 2 being somewhat more distant) (see Attachment B). Consequently, the TD encourages any H_2S reductions necessary to prevent odor nuisance conditions in this area and preclude persistent, strong odors with the potential to cause indirect, odor-related health effects (e.g., headache, nausea). Nausea, for example, has been reported previously by citizens, and TCEQ investigators have also reported nausea following prolonged exposure to strong to very strong and/or offensive odors while collecting samples in the vicinity of the Blue Ridge Landfill (e.g., see the June 20, 2016 and August 1, 2016 memoranda from Tracie Phillips, Ph.D. to Ashley Wadick entitled, "Toxicological Evaluation of Results from an Ambient Air Sample for Volatile Organic Compounds Collected at Various Locations in Fresno, Fort Bend County, Houston, Harris County, and Pearland, Brazoria County, Texas" and "Toxicological Evaluation of Results from an Ambient Air Sample for Volatile Organic Compounds Collected Northwest of Blue Ridge Landfill in Fresno, Fort Bend County, Texas").

Please call me at (512) 239-5691 if you have any questions regarding this evaluation.

References

Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological profile for hydrogen sulfide and carbonyl sulfide, draft. U.S. Department of Health and Human Services, Public Health Service. Available at: http://www.atsdr.cdc.gov/toxprofiles/tp114.pdf

Brenneman KA, James RA, Gross EA, et al. 2000. Olfactory neuron loss in adult male CD rats following subchronic inhalation exposure to hydrogen sulfide. Toxicol Pathol 28(2):326-333.

Jappinen P, Vilkka V, Marttila O, et al. 1990. Exposure to hydrogen sulphide and respiratory function. Br J Ind Med 47:824-828.

Attachment A

List of Target Analytes for Canister Samples

ethane *
ethylene *
acetylene *
propane *
propylene *
dichlorodifluoromethane
methyl chloride
isobutane *
vinyl chloride
1-butene *
1,3-butadiene *
n-butane *
t-2-butene
bromomethane
c-2-butene
3-methyl-1-butene
isopentane
trichlorofluoromethane
1-pentene
n-pentane
isoprene
t-2-pentene
1,1-dichloroethylene
c-2-pentene
methylene chloride
2-methyl-2-butene
2,2-dimethylbutane
cyclopentene
4-methyl-1-pentene
1,1-dichloroethane
cyclopentane
2,3-dimethylbutane
2-methylpentane
3-methylpentane
2-methyl-1-pentene + 1-hexene
n-hexane *,[1]
chloroform
t-2-hexene
c-2-hexene
1,2-dichloroethane
methylcyclopentane
2,4-dimethylpentane
1,1,1-trichloroethane
benzene *
carbon tetrachloride
cyclohexane *,[1]
2-methylhexane
2,3-dimethylpentane
3-methylhexane
1,2-dichloropropane
trichloroethylene
2,2,4-trimethylpentane
2-chloropentane
n-heptane
c-1,3-dichloropropylene
methylcyclohexane
t-1,3-dichloropropylene
1,1,2-trichloroethane
2,3,4-trimethylpentane
toluene *
2-methylheptane
3-methylheptane
1,2-dibromoethane
n-octane *
tetrachloroethylene
chlorobenzene
ethylbenzene *
m & p-xylene
styrene *
1,1,2,2-tetrachloroethane
o-xylene *
n-nonane
isopropylbenzene
n-propylbenzene
m-ethyltoluene
p-ethyltoluene
1,3,5-trimethylbenzene
o-ethyltoluene
1,2,4-trimethylbenzene
n-decane
1,2,3-trimethylbenzene
m-diethylbenzene
p-diethylbenzene
n-undecane

* Real-time gas chromatography (RTGC) analyte.
[1] Analyzed by RTGC as n-hexane + cyclohexane.

Table 1. Short-Term AMCVs for Target Analytes

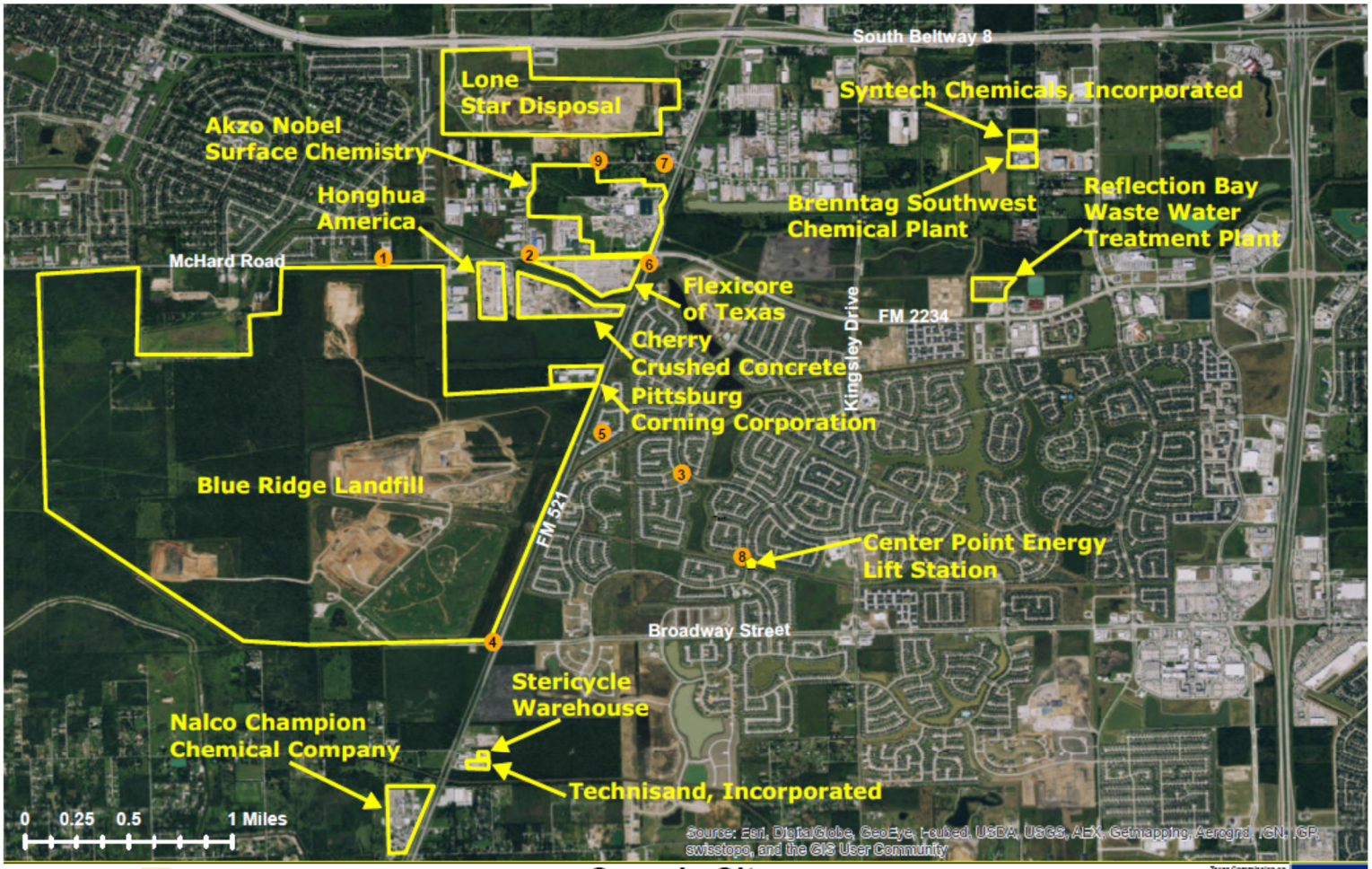
Target Analyte	CAS No.	Short-Term Health-Based AMCV (ppb_v)	Short-Term Odor-Based AMCV (ppb_v)
1,1,1-trichloroethane	71-55-6	1700	--
1,1,2,2-tetrachloroethane	79-34-5	10	--
1,1,2-trichloroethane	79-00-5	100	--
1,1-dichloroethane	75-34-3	1000	--
1,1-dichloroethylene	75-35-4	180	--
1,2,3-trimethylbenzene	526-73-8	3000	--
1,2,4-trimethylbenzene	95-63-6	3000	--
1,2-dichloropropane	78-87-5	100	--
1,3,5-trimethylbenzene	108-67-8	3000	--
1,3-butadiene	106-99-0	1700	230
1-butene	106-98-9	27000	--
1-hexene and 2-methyl-1-pentene	--	500	--
1-pentene	109-67-1	12000	100
2,2,4-trimethylpentane	540-84-1	750	--
2,2-dimethylbutane	75-83-2	1000	--
2,3,4-trimethylpentane	565-75-3	750	--
2,3-dimethylbutane	79-29-8	990	--
2,3-dimethylpentane	565-59-3	850	--
2,4-dimethylpentane	108-08-7	850	--
2-chloropentane	625-29-6	240	--
2-methyl-2-butene	513-35-9	12000	--
2-methylheptane	592-27-8	750	--
2-methylhexane	591-76-4	750	--
2-methylpentane	107-83-5	850	--
3-methyl-1-butene	563-45-1	8000	100
3-methylheptane	589-81-1	750	--
3-methylhexane	589-34-4	750	--
3-methylpentane	96-14-0	1000	--
4-methyl-1-pentene	691-37-2	500	--
acetylene	74-86-2	25000	--
benzene	71-43-2	180	--
bromomethane	74-83-9	30	--
carbon tetrachloride	56-23-5	20	--
chlorobenzene	108-90-7	100	--

Target Analyte	CAS No.	Short-Term Health-Based AMCV (ppb_v)	Short-Term Odor-Based AMCV (ppb_v)
chloroform	67-66-3	20	--
chloromethane	74-87-3	500	--
cis-1,3-dichloropropene	10061-01-5	10	--
cis-2-butene	590-18-1	15000	--
cis-2-hexene	7688-21-3	500	--
cis-2-pentene	627-20-3	12000	--
cumene	98-82-8	500	130
cyclohexane	110-82-7	1000	--
cyclopentane	287-92-3	5900	--
cyclopentene	142-29-0	2900	--
dichlorodifluoromethane	75-71-8	10000	--
ethane	74-84-0	simple asphyxiant [1]	--
ethylbenzene	100-41-4	20000	--
ethylene [2]	74-85-1	500000	--
ethylene dibromide	106-93-4	0.5	--
ethylene dichloride	107-06-2	550	--
isobutane	75-28-5	33000	--
isopentane	78-78-4	68000	--
isoprene	78-79-5	20	48
m/p-xylene	179601-23-1	1700	--
m-diethylbenzene	141-93-5	460	--
methylcyclohexane	108-87-2	4000	--
methylcyclopentane	96-37-7	750	--
methylene chloride	75-09-2	3500	--
m-ethyltoluene	620-14-4	250	--
n-butane	106-97-8	92000	--
n-decane	124-18-5	1750	--
n-heptane	142-82-5	850	--
n-hexane	110-54-3	1800	--
n-nonane	111-84-2	2000	--
n-octane	111-65-9	750	--
n-pentane	109-66-0	68000	--
n-propylbenzene	103-65-1	500	--
n-undecane	1120-21-4	550	--
o-ethyltoluene	611-14-3	250	--
o-xylene	95-47-6	1700	--

Target Analyte	CAS No.	Short-Term Health-Based AMCV (ppb_v)	Short-Term Odor-Based AMCV (ppb_v)
p-diethylbenzene	105-05-5	460	--
p-ethyltoluene	622-96-8	250	--
propane	74-98-6	simple asphyxiant [1]	--
propylene	115-07-1	simple asphyxiant [1]	--
styrene	100-42-5	5100	25
tetrachloroethylene	127-18-4	1000	--
toluene	108-88-3	4000	--
trans-1,3-dichloropropene	10061-02-6	10	--
trans-2-butene	624-64-6	15000	--
trans-2-hexene	4050-45-7	500	--
trans-2-pentene	646-04-8	12000	--
trichloroethylene	79-01-6	100	--
trichlorofluoromethane	75-69-4	10000	--
vinyl chloride	75-01-4	26000	--

[1] A simple asphyxiant displaces air, lowering the partial pressure of oxygen and causing hypoxia at sufficiently high concentrations.
[2] Vegetation-based AMCV for ethylene is 1,200 ppb_v.
ppb_v - parts per billion by volume
AMCV - Air Monitoring Comparison Value

Attachment B



Sample Sites
Region 12 Pearland Area Monitoring Project
Pearland, Texas
June 6-10. 2016