

# TCEQ Interoffice Memorandum

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**To:** Ashley Wadick, Regional Director, R12  
Daniel O'Brien, Assistant Regional Director, R12  
Nicole Bealle, Special Assistant to the Regional Director, R12

**From:** Joseph T. Haney, Jr., M.S.  
Tracie Phillips, Ph.D.  
Heather Reddick Schaefer, Dr.PH  
Toxicology Division

**Date:** September 20, 2016

**Subject:** Health Effects Review of 2015 Ambient Air Network Monitoring Data in Region 12, Houston

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## Key Points

- Notably, annual averages for all chemicals and metals were below their respective long-term air monitoring comparison values (AMCVs) for the sixth consecutive year over many years of sampling.
- Only approximately 0.0001% of measured hourly concentrations exceeded an odor-based AMCV. A few hourly levels (e.g., styrene) at two Region 12 sites could result in the perception of odors if people were exposed. Assuming exposure, the monitored concentrations would not be expected to cause direct, short-term adverse health effects (e.g., eye irritation), and the infrequency and generally low magnitude of the exceedances are not indicative of persistent, strong odors with the potential to cause odor-related health effects (e.g., nausea, headache).
- All of the 24-hour measurements, for which there are 24-hour AMCVs available, were below their health-based AMCVs in Region 12 in 2015. Only one of the measured 24-hour concentrations exceeded its odor-based AMCV, which was at Mustang Bayou. This monitored concentration would not be expected to cause acute health effects.
- In August 2016, propionaldehyde was removed from the Air Pollutant Watch List (APWL) (Site# 1202) for Texas City based on improvements in available monitoring data, the updated propionaldehyde odor-based AMCV, and the significant changes Dow has made to its facility to reduce propionaldehyde emissions. Galena Park monitoring site data meeting annual data completeness objectives from recent years (2008-2013, 2015) have shown representative annual benzene concentrations less than those of concern for potential long-term (i.e., lifetime), adverse health effects. Therefore, the Toxicology Division recommends removal of benzene at Galena Park from the APWL (Site# 1206).

## Background

The primary purpose of this memorandum is to convey the Toxicology Division's (TD) evaluation of ambient air toxics sampling conducted at monitoring sites in Region 12-Houston during 2015. The TD reviewed summary results for volatile organic compounds (VOCs) from 24-hour canister samples, 1-hour automated gas-chromatography (autoGC) VOC samples, 24- and 3-hour carbonyl samples, 24-hour polycyclic aromatic hydrocarbon (PAH)/semivolatile

organic compound (SVOC) samples, 30-minute rolling averages of 1-hour hydrogen sulfide samples, 24-hour metals samples from filters designed to collect particulate matter with an aerodynamic diameter of 2.5 microns or less (PM<sub>2.5</sub>) and from filters collecting particulate matter with an aerodynamic diameter of 10 microns or less (PM<sub>10</sub>), and 24-hour lead total suspended particulate (TSP) samples.

Historically, this memorandum has evaluated data from the TCEQ and Enhanced Industry-Sponsored Monitoring (EISM) sites, which are reported to the TCEQ on a regular basis. For this memorandum, industry-sponsored air monitoring networks that are not routinely reported to the TCEQ are also included. The TD requested these data from the respective industry groups and included it in our evaluation, as detailed below. Except for lead, data for criteria pollutants (i.e., compounds having National Ambient Air Quality Standards (NAAQS)) were not evaluated for this memorandum. Appendix 1 contains a list of the target analytes evaluated for this review.

Information regarding monitoring sites and target analyte data reviewed by the TD is presented in Table 1 and summarized below:

- 24-hour canister VOC sampling at:
  - 12 TCEQ sites
  - 1 EISM site,
  - 6 Houston Regional Monitoring (HRM) sites outside of the EISM sites, and
  - 3 Texas City/La Marque Community Air Monitoring Network (TCLAMN) sites.
- 24-hour carbonyl sampling at 2 sites.
- 24-hour metals sampling at 4 sites.
- 24-hour PAH/SVOC sampling at 1 site.
- 1-hour autoGC VOC sampling at:
  - 5 TCEQ sites,
  - 9 EISM sites,
  - 1 Harris County Health and Environmental Services site,
  - 1 TCLAMN site, and
  - 1 HRM site.
- 5-minute hydrogen sulfide (H<sub>2</sub>S) sampling at:
  - 1 TCEQ site,
  - 2 EISM sites.

**Table 1. Monitoring Sites Located in TCEQ Region 12**

County	EPA Site ID	Site Name and Location	Network	Monitored Compounds
Galveston	N/A	2nd Avenue Monitoring Station (29.386981, -94.91912)	TCLAMN <sup>1</sup>	VOC (24-hour canister, 1/12 days <sup>2</sup> ; autoGC)
Galveston	N/A	Avenue A Monitoring Station (29.37435, -94.96364)	TCLAMN	VOC (24-hour canister)
Harris	48-201-0058	<a href="#">Baytown</a> 7201 ½ Bayway Dr	TCEQ	VOC (24-hour canister)
Harris	48-201-6000	<a href="#">Cesar Chavez</a> 4829A Galveston Rd	TCEQ	VOC (autoGC)
Harris	48-201-0026	<a href="#">Channelview</a> 1405 Sheldon Rd	TCEQ	VOC (autoGC)
Harris	48-201-1035	<a href="#">Clinton</a> 9525 ½ Clinton Dr	TCEQ/City of Houston Health Department <sup>3</sup>	VOC (autoGC), Carbonyls <sup>4</sup> / Metals (PM <sub>10</sub> )
Brazoria	48-039-1003	<a href="#">Clute</a> 426 Commerce St	TCEQ	VOC (24-hour canister)
Brazoria	48-039-0618	<a href="#">Danciger</a> Along US Hwy 1459 in Brazoria County	EISM <sup>5</sup> - SI Group <sup>6</sup>	VOC (autoGC)
Brazoria	48-039-1012	<a href="#">Freeport South Ave I</a> 207 South Avenue I	TCEQ	Metals (PM <sub>2.5</sub> )
Harris	48-201-0057	<a href="#">Galena Park</a> 304 Stewart St	Harris County HES <sup>7</sup> / TCEQ	VOC (autoGC / 24-hour canister)

<sup>1</sup> TCLAMN – Texas City/La Marque Community Air Monitoring Network.

<sup>2</sup> The typical schedule for 24-hour canisters is to collect one 24-hour sample every six days. This sampler is collecting one 24-hour sample every twelve days.

<sup>3</sup> City of Houston Health Department owns and is responsible for the PM<sub>10</sub> metals monitor at this site.

<sup>4</sup> This carbonyl sampler collects one 24-hour sample every six days from January through June and October through December. From July through September, this sampler switches to a more intensive sampling schedule where it collects eight 3-hour samples every three days.

<sup>5</sup> EISM – Enhanced Industry-Sponsored Monitoring, this acronym is followed by the industry group responsible for the sampling.

<sup>6</sup> Sweeny Industry Group.

<sup>7</sup> Harris County Health and Environmental Services site; data from this site is reported directly to TCEQ.

County	EPA Site ID	Site Name and Location	Network	Monitored Compounds
Harris	48-201-0024	<a href="#">Houston Aldine</a> 4510 ½ Aldine Mail Rd	TCEQ	Metals (PM <sub>2.5</sub> )
Harris	48-201-0055	<a href="#">Houston Bayland Park</a> 6400 Bissonnet St	TCEQ	VOC (24-hour canister)
Harris	48-201-1039	<a href="#">Houston Deer Park #2</a> 4514 ½ Durant St	TCEQ	VOC (autoGC, 24-hour canister), Carbonyls, Metals (PM <sub>2.5</sub> , PM <sub>10</sub> , Lead TSP) , PAHs/SVOCs
Harris	48-201-0803	<a href="#">HRM #3 Haden Rd</a> 1504 ½ Haden Dr	TCEQ/EISM - HRM <sup>8</sup>	VOC (24-hour canister)/VOC (autoGC)
Harris	N/A	HRM 1 Central Street 1501 Central Street, Houston	HRM	VOCs (24-hour canister)
Harris	N/A	HRM 4 Sheldon Rd 16200 Miller Road 1, Channelview	HRM	VOC (24-hour canister)
Harris	N/A	HRM 7 W Baytown 4606 W. Baker Rd, Baytown	HRM	VOC (24-hour canister)
Harris	N/A	HRM 8 LaPorte 11426 Fairmont Pkwy, La Porte	HRM	VOC (24-hour canister)
Chambers	N/A	HRM 10 Mont Belvieu 13618 Hatcherville Rd, Mont Belvieu	HRM	VOC (24-hour canister)
Chambers	N/A	HRM 11 E Baytown 8620 West Bay Rd, Baytown	HRM	VOC (24-hour canister)
Harris	N/A	HRM 16 Deer Park 601 East 8th Street, Deer Park	HRM	VOC (autoGC)
Harris	48-201-0036	<a href="#">Jacinto Port</a> 1st St and Elsbeth St	TCEQ	VOC (24-hour canister)
Brazoria	48-039-1016	<a href="#">Lake Jackson</a> 109-B Brazoria Hwy 332-W	EISM – FI Group <sup>9</sup>	VOC (autoGC)

<sup>8</sup> HRM – Houston Regional Monitoring.

<sup>9</sup> Freeport Industry Group.

County	EPA Site ID	Site Name and Location	Network	Monitored Compounds
Harris	48-201-1015	<a href="#">Lynchburg Ferry</a> 1001 B Lynchburg Rd	TCEQ/EISM - HRM	VOC (24-hour canister)/VOC (autoGC)
Harris	48-201-0307	<a href="#">Manchester/Central</a> 9401 ½ Manchester Rd	TCEQ	VOC (24-hour canister)
Harris	48-201-0069	<a href="#">Milby Park</a> 2201-a Central St	TCEQ	VOC (autoGC)
Brazoria	48-039-0619	<a href="#">Mustang Bayou</a> FM 2917 @ County Road 169	EISM - Chocolate Bayou Industry Group	VOC (24-hour canister) <sup>10</sup>
Galveston	N/A	North Site (29.429228, - 94.971503)	TCLAMN	VOC (24-hour canister, 1/12 days)
Harris	48-201-1049	<a href="#">Pasadena North</a> 702 Light Company Rd	TCEQ	VOC (24-hour canister)
Harris	48-201-0061	<a href="#">Shoreacres</a> 3903 ½ Old Hwy 146	TCEQ	VOC (24-hour canister)
Galveston	48-167-0683	<a href="#">Texas City 11th St</a> <a href="#">569 11<sup>th</sup> Street South</a>	EISM - Marathon Petroleum Co.	Benzene (autoGC)
Galveston	48-167-0056	<a href="#">Texas City 34th St</a> 2212 North 34th St	EISM - TCLAMN	VOC (autoGC)
Galveston	48-167-0005	<a href="#">Texas City Ball Park</a> 2516 ½ Texas Ave	TCEQ	H <sub>2</sub> S, VOC (24-hour canister)
Galveston	48-167-0615	<a href="#">Texas City BP 31st Street (Site 1)</a> 302 31st Street South	EISM – Marathon Petroleum Co.	H <sub>2</sub> S, 4 VOCs (autoGC)
Galveston	48-167-0621	<a href="#">Texas City BP Logan Street (Site 3)</a> 303 Logan Street	EISM – Marathon Petroleum Co.	H <sub>2</sub> S, 4 VOCs (autoGC)
Harris	48-201-0617	<a href="#">Wallisville Rd</a> 4727 Wallisville Rd	EISM - HRM	VOC (autoGC)

<sup>10</sup> Mustang Bayou was de-activated on 11/18/2016.

All data collected at TCEQ monitors are analyzed by the TCEQ laboratory and should meet a 75% data completeness objective. At EISM monitors, data are collected by a third party contractor and should also meet a 75% data completeness objective. One-hour autoGC VOC and 3-hour carbonyl data were evaluated for potential acute health (e.g., irritation), odor, and vegetation concerns, as were any 24-hour sample results (e.g., VOCs, carbonyls, metals) that exceeded short-term air monitoring comparison values (AMCVs). Twenty-four-hour air samples collected every 6<sup>th</sup> day for a year are designed to provide representative long-term average concentrations. In order to be able to evaluate 24-hour monitoring data more fully, the TCEQ has developed 24-hour AMCVs for specific chemicals. As such, 24-hour samples were compared to the available TCEQ 24-hour AMCVs for formaldehyde, acrolein, 1,3-butadiene, benzene, and ethylene dichloride. However, because short-term or peak concentrations may be significantly different than 24-hour sample concentrations, daily concentrations have limited use in evaluating the potential for acute health effects. The annual averages from 1-hour autoGC and 24-hour samples (VOCs, carbonyls, and metals) were evaluated for potential chronic health and vegetation concerns. Measured chemical concentrations were compared to appropriate comparison values (e.g., the National Ambient Air Quality Standards (NAAQS) value, TCEQ health-, odor-, and vegetation-based AMCVs). Information on AMCVs may be obtained via the internet (<http://www.tceq.texas.gov/toxicology/AirToxics.html#list>) or by contacting the TD (512-239-3900).

## **Evaluation**

### **1-Hour and 3-hour Concentrations**

The vast majority of the 1-hour autoGC VOC concentrations were below their respective TCEQ short-term, health-, odor-, and/or vegetation-based AMCVs. For example, about 99.99995% of the approximately 3,974,173 1-hour VOC measurements from the TCEQ, EISM, Harris County Health and Environmental Services, and TCLAMN network autoGC monitors in Region 12 in 2015 were below their short-term AMCVs (total valid samples were not provided for HRM 16). Only two (approximately 0.00005%) hourly autoGC measurements collected at these Region 12 monitors in 2015 exceeded a TCEQ short-term, health-based AMCV (see discussion below). Four hourly measurements (approximately 0.0001%) exceeded an odor-based AMCV, with no more than two exceedances for a chemical at any one site. For HRM 16, two isoprene measurements exceeded the short-term, health-based AMCV and one measurement also exceeded the odor-based AMCV for isoprene. Additionally, 100% of the approximately 3,927 3-hour carbonyl concentrations measured in Region 12 in 2015 were below their respective AMCVs. Therefore, the TD would not expect short-term, adverse health effects, vegetation effects, or odors to be associated with the vast majority of 1-hour or 3-hour measurements monitored in Region 12 in 2015.

Further evaluation was conducted for the monitored concentrations that exceeded their respective short-term, health- and/or odor-based AMCVs to determine the potential for adverse health effects or odors. Four concentrations of isoprene were the only instances in which any of the monitored 1-hour concentrations exceeded their respective short-term, health-based AMCVs in 2015. Two of these exceedances occurred at the Lynchburg Ferry site monitor, where hourly isoprene concentrations of 27.2 and 29.1 ppb<sub>v</sub> were above the current interim short-term, health-

based AMCV of 20 ppb<sub>v</sub>. The other two isoprene exceedances occurred at the HRM 16 monitor, with a maximum of 78.8 ppb<sub>v</sub>. However, this short-term AMCV was simply designed to help ensure that the long-term average at a site remains low (i.e., < 2 ppb<sub>v</sub>) as opposed to being a short-term concentration of actual potential health concern. The TCEQ is currently in the final stages of assessing the health hazards/risks of isoprene, including deriving a final health-protective, short-term AMCV more representative of the actual potential for short-term, adverse health effects. Using the latest scientific assessment methods, the final short-term, health-based AMCV will likely be at least an order of magnitude higher than the current interim value. In addition, these monitored hourly exceedances are significantly below isoprene levels attributable to short-term, adverse health effects. Therefore, exposure to these hourly concentrations would not be expected to cause short-term, adverse health effects.

The monitored 1-hour autoGC VOC concentrations that exceeded their respective odor-based comparison levels in 2015 are shown below in Table 2. The total number of odor-based AMCV autoGC exceedances in Region 12 in 2015 (5 exceedances) is equivalent to the number of exceedances in 2014 (5 exceedances), 38% lower than in 2013 (8 exceedances), 64% lower than in 2012 (14 exceedances), 74% lower than in 2011 (19 exceedances), and 93% lower than in 2010 (75 exceedances). Additionally, it is significantly lower compared to 2009 (37 exceedances), 2008 (82 exceedances), and 2007 (103 exceedances).

**Table 2. Odor-Based AMCV Exceedances by 1-Hour AutoGC VOC Concentrations**

Site	Chemical	Number of 1-Hour Concentrations above Odor-Based AMCV	Maximum Measured Concentration (ppb <sub>v</sub> )	Odor-Based AMCV (ppb <sub>v</sub> )
Milby Park	Styrene	1	41.1	25
	1,3-butadiene	1	842.4	230
Lynchburg Ferry	Styrene	2	26.8	25
HRM 16	Isoprene	1	78.8	48

The monitored odor-based AMCV exceedances in 2015 would not be expected to cause direct acute adverse health effects (e.g., eye irritation). Additionally, the infrequency and generally low magnitude of the exceedances (e.g., < 2 times the odor-based AMCV except for 1,3-butadiene, which has a mild aromatic odor) are not indicative of persistent, strong odors with the potential to cause odor-related health effects (e.g., nausea, headache).

### 24-Hour Concentrations

All of the 24-hour measurements, for which there are 24-hour AMCVs available, were below

their health-based AMCVs in Region 12 in 2015. At the Mustang Bayou site, one acetaldehyde concentration (69 ppb<sub>v</sub>) measured in the canister sampler slightly exceeded its respective odor-based AMCV (67 ppb<sub>v</sub>).

### **Annual Average Concentrations**

In 2015, all annual averages were below their respective long-term AMCVs for the sixth consecutive year in many years of sampling in Region 12:

- Based on the approximately 6,586 24-hour metals measurements, all monitored annual average concentrations of metals were below their respective long-term comparison values (e.g., long-term AMCVs);
- Based on the approximately 1,683 24-hour measurements, all annual average concentrations of carbonyls were also below their respective long-term AMCVs;
- Based on approximately 1,840 24-hour measurements, all annual average concentrations for PAHs/SVOCs were below long-term AMCVs; and
- Based on averages from approximately 78,015 24-hour canister measurements and approximately 3,974,173 hourly autoGC measurements (TCEQ, EISM, Harris County Health and Environmental Services, and TCLAMN network autoGC sites), all annual VOC concentrations were also less than their respective long-term AMCVs.

In conclusion, 100% of all annual averages were below their respective long-term AMCVs and no long-term, adverse health or vegetation effects would be expected due to exposure to those concentrations.

### *Galena Park APWL Area for Annual Benzene Concentrations*

Although the Galena Park site did not meet the data completeness objective (75%) in 2014 due to monitoring site equipment issues, based on the available every 6<sup>th</sup> day 24-hour canister data (36 samples, 59% completeness) the 2014 annual average benzene concentration was 1.09 ppb<sub>v</sub>. The benzene annual average for 2015 based on every 6<sup>th</sup> day 24-hour canister data that did meet the data completeness objective (56 samples, 93% completeness) was 0.91 ppb<sub>v</sub>, well below the long-term AMCV (1.4 ppb<sub>v</sub>). This concentration (0.91 ppb<sub>v</sub>) is similar to the partial-year averages (0.80 and 0.84 ppb<sub>v</sub>) reported for two Galena Park autoGC monitors that operated for different periods during 2015 (one TCEQ monitor that was installed in May 2015, and one that replaced the TCEQ monitor operated by Harris County as part of a Supplemental Environmental Project). Although benzene in the Galena Park area is currently on the APWL (Site# [1206](#)), Galena Park monitoring site data meeting annual data completeness objectives from recent years (2008-2013, 2015) have shown representative annual benzene concentrations less than those of concern for potential long-term (i.e., lifetime), adverse health effects. Therefore, the TD recommends removal of benzene at Galena Park from the APWL due to the improvement in available ambient monitoring data.

### *Delisting of Texas City APWL Area for Propionaldehyde Concentrations Exceeding the 1-hour Odor-based AMCV.*

As of August 2016, propionaldehyde was removed from the APWL (Site# [1202](#)) for Texas City. Several factors supported the delisting of propionaldehyde from the Texas City area. This APWL



area was listed based on mobile monitoring, where concentrations of propionaldehyde were detected above the historical (i.e., prior to September 2015) odor-based AMCV (then 9 ppb<sub>v</sub>) downwind of Dow Chemical. The AMCVs for many odorous pollutants, including propionaldehyde, have been recently updated to more appropriately assess odor nuisance conditions rather than mere potential detection of an odor. The odor-based AMCV for propionaldehyde was updated from 9 ppbv to 40 ppbv. In addition, Dow has made significant changes to its facility to reduce propionaldehyde emissions and reduce the potential for odor nuisance conditions from existing propionaldehyde sources. Moreover, Dow's 2014 ambient monitoring study did not measure any concentrations at or above the current odor-based AMCV. Furthermore, there were no complaint incidents or complaint investigations related to Dow Chemical in Texas City from 2010 through 2015. Based on the available monitoring data, the updated AMCVs (e.g., odor-based AMCV), and other information (e.g., reductions by Dow, complaint history), propionaldehyde was delisted from the APWL.

*Freeport APWL Area for Arsenic, Cobalt, Nickel, & Vanadium Concentrations Exceeding Short-Term, Health-based AMCVs.*

Elevated short-term nickel, arsenic, vanadium, and cobalt levels exceeding their respective AMCVs were measured near Gulf Chemical and Metallurgical Corporation in Freeport during yearly mobile monitoring trips conducted 2005-2010. Due to the elevated metals concentrations, the Freeport area (Site# [1201](#)) was added to the APWL in 2005. In May of 2011, the Freeport South Avenue I monitoring site was activated. This site is located northeast of the facility of concern, within a residential area, and monitors for speciated PM<sub>2.5</sub> metals. Since this site's activation in May of 2011, 100% of all speciated PM<sub>2.5</sub> metals short-term and annual averages have been below their respective AMCVs; no adverse health effects would be expected due to exposure to these concentrations.

If you have any questions regarding this memorandum, please contact Tracie Phillips, Ph.D. by phone at (512) 239-2269 or by email at [Tracie.Phillips@tceq.texas.gov](mailto:Tracie.Phillips@tceq.texas.gov), Joseph T. Haney, Jr., M.S. by phone at (512) 239-5691 or by email at [Joseph.Haney@tceq.texas.gov](mailto:Joseph.Haney@tceq.texas.gov), or Heather Reddick Schaefer, Dr.PH by phone at (512) 239-0154 or by email at [Heather.Reddick@tceq.texas.gov](mailto:Heather.Reddick@tceq.texas.gov). For questions regarding the APWL, you may visit the TCEQ website at <https://www.tceq.texas.gov/toxicology/apwl/apwl-index.html>.

## Appendix 1. Monitored Air Toxics in Region 12 in 2015

### List 1. Target VOC Analytes in Canister Samples\*

1,1,2,2-Tetrachloroethane	Acrolein – Verified <sup>a</sup>	m-Diethylbenzene
1,1,2-Trichloroethane	Benzene	Methyl Chloroform (1,1,1-Trichloroethane) <sup>c</sup>
1,1-Dichloroethane	Bromomethane	Methylcyclohexane
1,1-Dichloroethylene	cis-1,3-Dichloropropylene	Methylcyclopentane
1,2,3-Trimethylbenzene	cis-2-Butene	m-Ethyltoluene
1,2,4-Trimethylbenzene	cis-2-Hexene	n-Butane
1,2-Dichloropropane	cis-2-Pentene	n-Decane
1,3,5-Trimethylbenzene	Carbon Tetrachloride	n-Heptane
1,3-Butadiene	Chlorobenzene	n-Hexane
1-Butene <sup>b</sup>	Chloroform	n-Nonane
1-Hexene & 2-Methyl-1-Pentene <sup>b</sup>	Chloromethane (Methyl Chloride)	n-Octane
1-Pentene	Cyclohexane	n-Pentane
2,2,4-Trimethylpentane	Cyclopentane	n-Propylbenzene
2,2-Dimethylbutane (Neohexane) <sup>c</sup>	Cyclopentene	n-Undecane
2,3,4-Trimethylpentane	Dichlorodifluoromethane	o-Ethyltoluene <sup>c</sup>
2,3-Dimethylbutane	Dichloromethane (Methylene Chloride)	o-Xylene
2,3-Dimethylpentane	Ethane	p-Diethylbenzene
2,4-Dimethylpentane	Ethyl Benzene	p-Ethyltoluene
2-Chloropentane <sup>b</sup>	Ethylene	Propane
2-Methyl-2-Butene <sup>d</sup>	Ethylene Dibromide (1,2-Dibromoethane) <sup>c</sup>	Propylene
2-Methylheptane	Ethylene Dichloride (1,2-Dichloroethane) <sup>c</sup>	Styrene
2-Methylhexane <sup>c</sup>	Isobutane	trans-1,3-Dichloropropylene
2-Methylpentane (Isohexane) <sup>c</sup>	Isopentane (2-Methylbutane)	trans-2-Butene
3-Methyl-1-Butene	Isoprene	trans-2-Hexene
3-Methylheptane	Isopropylbenzene (Cumene) <sup>c</sup>	trans-2-Pentene
3-Methylhexane	m/p Xylene	Tetrachloroethylene <sup>c</sup>
3-Methylpentane		Toluene <sup>c</sup>
4-Methyl-1-Pentene		Trichloroethylene
Acetylene		Trichlorofluoromethane
		Vinyl Chloride

\* See Lists 6 and 7 for additional canister analytes monitored only at the Mustang Bayou and HRM 1, 4, 7, 8, 10 and 11 sites.

<sup>a</sup> Only measured at Houston Deer Park #2 monitoring site.

<sup>b</sup> Not monitored at the Mustang Bayou Site and HRM 1, 4, 7, 8, 10 and 11 sites.

<sup>c</sup> Not monitored at the HRM 1, 4, 7, 8, 10 and 11 sites.

<sup>d</sup> Not monitored at the Mustang Bayou Site.

**List 2. Target Carbonyl Analytes**

2,5-Dimethylbenzaldehyde	Crotonaldehyde	Methacrolein
Acetaldehyde	Formaldehyde	o-Tolualdehyde
Acetone	Heptanal	Propionaldehyde
Acrolein - Unverified	Hexanaldehyde	Valeraldehyde
Benzaldehyde	Isovaleraldehyde	m & p-Tolualdehyde
Butyraldehyde	Methyl Ethyl Ketone (MEK)	

**List 3. Target Metal Analytes**

Aluminum (PM <sub>2.5</sub> , PM <sub>10</sub> )	Cobalt (PM <sub>2.5</sub> , PM <sub>10</sub> )	Selenium (PM <sub>2.5</sub> , PM <sub>10</sub> )
Antimony (PM <sub>2.5</sub> , PM <sub>10</sub> )	Copper (PM <sub>2.5</sub> , PM <sub>10</sub> )	Tin (PM <sub>2.5</sub> , PM <sub>10</sub> )
Arsenic (PM <sub>2.5</sub> , PM <sub>10</sub> )	Lead (PM <sub>2.5</sub> , PM <sub>10</sub> , TSP <sup>a</sup> )	Vanadium (PM <sub>2.5</sub> )
Barium (PM <sub>2.5</sub> , PM <sub>10</sub> )	Manganese (PM <sub>2.5</sub> , PM <sub>10</sub> )	Zinc (PM <sub>2.5</sub> , PM <sub>10</sub> )
Cadmium (PM <sub>2.5</sub> , PM <sub>10</sub> )	Molybdenum (PM <sub>2.5</sub> , PM <sub>10</sub> )	
Chromium (PM <sub>2.5</sub> , PM <sub>10</sub> )	Nickel (PM <sub>2.5</sub> , PM <sub>10</sub> )	

<sup>a</sup> Only monitored at the Houston Deer Park #2 monitoring site; TSP = total suspended particulate.

PM<sub>2.5</sub> metals are monitored at the Freeport South Avenue I, Houston Aldine, and Houston Deer Park #2 monitoring sites.

PM<sub>10</sub> metals are monitored at the Clinton and Houston Deer Park #2 monitoring sites.

**List 4. Target PAH Analytes**

Acenaphthene	Benzo(g,h,i)perylene	Indeno(1,2,3-cd)pyrene
Acenaphthylene	Benzo(k)fluoranthene	Naphthalene
Anthracene	Chrysene	Phenanthrene
Benzo(a)anthracene	Dibenzo(a,h)anthracene	Pyrene
Benzo(a)pyrene	Fluoranthene	
Benzo(b)fluoranthene	Fluorene	

**List 5. Target VOC Analytes in AutoGC**

1-Butene <sup>a</sup>	Acetylene	n-Decane
1-Pentene	Benzene <sup>c, e, f</sup>	n-Heptane
1,2,3-Trimethylbenzene <sup>b</sup>	c-2-Butene	n-Hexane <sup>e</sup>
1,2,4-Trimethylbenzene	c-2-Pentene	n-Nonane
1,3-Butadiene <sup>c</sup>	Cyclohexane	n-Octane
1,3,5-Trimethylbenzene	Cyclopentane	n-Pentane <sup>e</sup>
2-Methyl-2-Butene <sup>d</sup>	Ethane	n-Propylbenzene
2-Methylheptane	Ethylbenzene	n-Undecane <sup>d</sup>
2-Methylhexane <sup>a</sup>	Ethylene	o-Xylene
2,2-Dimethylbutane <sup>a</sup>	Isobutane	m/p Xylene
2,2,4-Trimethylpentane <sup>b</sup>	Isopentane	Propane
2,3-Dimethylpentane	Isoprene	Propylene
2,3,4-Trimethylpentane	Isopropylbenzene <sup>a</sup>	Styrene
2,4-Dimethylpentane	Methylcyclohexane	t-2-Butene
3-Methylheptane	Methylcyclopentane	t-2-Pentene
3-Methylhexane	n-Butane	Toluene <sup>a, e</sup>

<sup>a</sup> Not monitored at the HRM 16 Deer Park monitoring site.

<sup>b</sup> Not monitored at the Texas City 34th Street monitoring site.

<sup>c</sup> 2nd Avenue Monitoring Station only monitored for these compounds, in addition to those listed in List 8.

<sup>d</sup> Only monitored at the Danciger, Lake Jackson, Texas City 34th St., Wallisville Rd., HRM #3 Haden Rd., Lynchburg Ferry, HRM 16 Deer Park monitoring sites.

<sup>e</sup> These are the only compounds monitored at the TX City BP Logan and TX City BP 31st sites.

<sup>f</sup> This is the only compound monitored at the TX City 11th St site.

**List 6. Additional Canister Analytes Monitored at Mustang Bayou**

1,2,4-Trichlorobenzene	2,5-Dimethylhexane	Bromoform
1,2-Dichlorobenzene	2-2-3-Trimethylpentane	Butyl Benzene
1,3-Dichlorobenzene	2-Ethyl-1-Butene	Butyraldehyde
1,4-Dichlorobenzene	2-Methyl-2-Pentene	Chlorodifluoromethane
1,4-Dioxane	2-Propanol	Chloroethane
1-Decene	Acetaldehyde	Chloroprene
1-Heptene	Acetone	cis-1,2-Dichloroethene
1-Methylcyclohexene	Acetonitrile	cis-2-Octene
1-Nonene	Acrylonitrile	cis-3-Hexene
1-Octene	alpha-Pinene	cis-3-Methyl-2-Pentene
1-Undecene	Benzaldehyde	cis-4-Methyl-2-Pentene
2,2,5-Trimethylhexane	Benzyl Chloride	Cyclohexene
2,2-Dimethylpropane	beta-Pinene	Dichlorofluoromethane
2,4,4-Trimethyl-1-Pentene	Bromochloromethane	Diethyl Ether
2,4,4-Trimethyl-2-Pentene	Bromodichloromethane	Ethyl Alcohol

Freon 113	Isobutylbenzene	n-Butyl Alcohol
Freon 114	Methanol	n-Propyl Alcohol
Heptanal	Methyl Ethyl Ketone	p-Chlorotoluene
Hexachlorobutadiene	Methyl Isobutyl Ketone	p-Isopropyltoluene
Hexanal	Methyl Tert-Butyl Ether	tert-Butylbenzene
Indan	Methylcyclopentene	trans-1,2-Dichloroethylene
Indene	Naphthalene	Vinyl Acetate
Isobutene & 1-Butene	n-Butyl Acrylate	Vinyl Bromide

**List 7. Additional Canister Analytes Monitored at HRM 1, 4, 7, 8, 10 and 11 sites**

1-Hexene	Butyl Acrylate	Naphthalene
1-Methylcyclohexene	Butyraldehyde	

**List 8. Additional AutoGC Analytes Monitored at 2<sup>nd</sup> Avenue Monitoring Station**

Vinyl Chloride	Acrylonitrile
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