

Texas Commission on Environmental Quality

INTEROFFICE MEMORANDUM

To: Donna Phillips, Regional Director, R12
Marsha Hill, Assistant Region Director, R12
Linda Vasse, Air Section Manager, R12
Joel Anderson, Air Section Manager, R12
Rebecca Rentz, Air Quality Director, R12
David Bower, Coastal Texas Area Director
Richard Hyde, Air Permits Division Director
John Sadlier, Enforcement Division Director
Susana Hildebrand, Air Quality Division Director

Date: December 18th, 2006

From: Bernard Kadlubar, M.S.
Toxicology Section, Chief Engineer's Office

Subject: Health Effects Review of Ambient Air Monitoring Data Collected in TCEQ Region 12 during 2005

Conclusions

- The 2005 reported annual average benzene concentration near the Texas City-34th St. site (0.78 ppb_v) represents a 52% reduction in benzene concentrations when compared to 2004.
- The reported 2005 annual average benzene concentrations near the Baytown-Lynchburg Ferry, BP-sponsored, and Galena Park sites are of concern regarding potential long-term adverse health effects and emission reductions are recommended.
- The reported 2005 annual average benzene concentrations near the Texas City Ball Park and Shoreacres sites are higher than the 2004 reported averages, and emission reductions are encouraged.
- The reported 2005 annual average 1,3 butadiene concentration at Milby Park (1.52 ppb_v) is the lowest reported concentration at Milby Park since the agency began monitoring in 1999. The reduction can be attributed to emissions reduction agreements entered into by Texas Petrochemical (TPC) and Goodyear in 2004. While the 1,3-butadiene levels have significantly decreased, further reductions are encouraged in order to attain the interim long-term goal of 1ppb_v.
- The 2005 reported annual average formaldehyde concentrations near the Clinton Dr., Deer Park, and Channelview sites represented approximate reductions of 95%, 41%, and 13%, respectively, when compared to 2004. The 2005 reported annual average formaldehyde concentration near all three sites are not of concern regarding potential for long-term adverse health effects based on EPA's recent re-evaluation of formaldehyde toxicity.
- Hourly levels of several VOCs (most notably, styrene at the Baytown-Lynchburg Ferry site) would be odorous to people if exposed. Direct health effects such as eye irritation would not be expected; however, odor-related health effects such as headaches and nausea may occur.

Background

This memorandum's primary purpose is to convey the Toxicology Section's (TS) evaluation of ambient air toxics sampling conducted at monitoring network sites in Region 12-Houston during 2005. To provide a more complete picture in one document, this memorandum also highlights investigations and emission reductions made in the areas discussed below. Please note, however, that many investigations

are still ongoing and not appropriate for discussion in this memorandum. We reviewed summary results for volatile organic compounds (VOCs) from 1- and 24-hour canister samples, 1-hour automated gas-chromatography (autoGC) VOC samples, 1- and 24-hour carbonyl samples, and 24-hour metals samples (from PM_{2.5}, PM₁₀, and TSP filters). Criteria pollutant data were not evaluated. Appendix 1 is a list of the target analytes that were evaluated for this review. Information regarding monitoring sites and target analytes is summarized below and presented in Table 1:

- 1-hour canister VOC sampling at 3 sites
- 24-hour canister VOC sampling at 17 sites
- 1- and 24-hour carbonyl sampling at 3 sites
- 24-hour metals sampling at 8 sites
- 1-hour autoGC VOC monitoring at
 - 4 TCEQ sites, and
 - 7 Enhanced Industry-Sponsored Monitoring (EISM) sites
 - 1 TCEQ-Industry Agreed Order Monitoring site (AOM)

County	EPA Site ID	City and Site Location	Network	Monitored Compounds
Brazoria	48-039-1003	Clute 426 Commerce Street	TCEQ	VOC (24-hour canister)
Brazoria	48-039-0618	Danciger Along U.S. Hwy. 1459 in Brazoria County	EISM	VOC (autoGC)
Brazoria	48-039-1016	Lake Jackson 109-B Brazoria Hwy 332-W	EISM	VOC (autoGC)
Brazoria	48-039-0619	Mustang Bayou Liverpool	EISM	VOC (autoGC)
Galveston	48-167-0014	Galveston, Airport 8715 Cessna Street	TCEQ	VOC (1- & 24-hour canister)
Galveston	48-167-0053	Texas City, Nessler Pool 17th and 5th Ave	TCEQ	VOC (24-hour canister)
Galveston	48-167-0005	Texas City, Ball Park 2516 1/2 Texas Ave.	TCEQ	VOC (24-hour canister)
Galveston	48-167-0056	Texas City, 34th St. 2212 North 34th St.	EISM	VOC (autoGC)
Harris	48-201-1039	Deer Park 4514 1/2 Durant St.	TCEQ	VOC (24-hour canister), Carbonyls, Metals
Harris	48-201-0024	Houston, Aldine 4510 1/2 Aldine Mail Rd	TCEQ	VOC (1- & 24-hour canister), Metals
Harris	48-201-1034	Houston, East 1262 1/2 Mae Drive	TCEQ	Metals
Harris	48-201-1035	Houston, Clinton 9525 1/2 Clinton Drive	TCEQ	VOC (24-hour canister), Carbonyls, Metals VOC (autoGC)
Harris	48-201-0803	Houston, Haden Rd. 1504 1/2 Haden Rd.	TCEQ	VOC (24-hour canister)
			EISM	VOC (autoGC)
Harris	48-201-0057	Galena Park 304 Stewart St.	TCEQ	VOC (24-hour canister)
Harris	48-201-0026	Houston, Channelview 1405 Sheldon Rd.	TCEQ	VOC (24-hour canister), Carbonyls, Metals
Harris	48-201-0061	La Porte, Shoreacres 3903 1/2 Old Hwy 146	TCEQ	VOC (24-hour canister)
Harris	48-201-0069	Houston, Milby Park 2201-a Central Street	TCEQ	VOC (24-hour canister)* VOC (autoGC)
Harris	48-201-6000	Houston, Cesar Chavez 4829A Galveston Rd.	TCEQ	VOC (autoGC)

Harris	48-201-1015	Baytown, Lynchburg Ferry 1001 B Lynchburg Rd.	EISM	VOC (24-hour canister)
				VOC (autoGC)
Harris	48-201-0617	Baytown, Wallisville Rd. 4727 Wallisville Rd.	EISM	VOC (autoGC)
Harris	48-201-0307	Houston, Manchester/Central 9401 1/2 Manchester Rd.	TCEQ	VOC (24-hour canister)
Harris	48-201-0029	Tomball, NW Harris County 16822 Kitzman St.	TCEQ	VOC (1- & 24-hour canister)
Harris	48-201-0030	Houston, Channelview North US90/Sheldon Rd.	TCEQ	VOC (24-hour canister)
Harris	48-201-0055	Houston, Bayland Park 6400 Bissonnet St.	TCEQ	VOC (24-hour canister), Metals
Harris	48-201-0058	Baytown 7201 1/2 Bayway Dr.	TCEQ	VOC (24-hour canister)
Galveston	N/A	BP North America Products, Inc. 31 st St. (Between Texas Ave. and 5 th Ave.)	AOM	VOC (autoGC)
Montgomery	48-339-0078	Conroe 9472A Highway 1484	TCEQ	Metals

* - Data available from January through mid February

One-hour canister VOC, autoGC VOC, and carbonyl data were evaluated for potential acute health and odor concerns. The annual averages from one-hour autoGC and 24-hour samples were evaluated for potential chronic health concerns. Measured chemical concentrations were compared to TCEQ health-based and odor-based Effects Screening Levels (ESLs). Information on the ESLs can be obtained by contacting the TCEQ Toxicology Section (512-239-1795) or visiting the TCEQ website: (www.tceq.state.tx.us/implementation/tox/esl/ESLMain.html).

Evaluation

One-hour Concentrations

Most of the one-hour canister VOC, autoGC VOC, and carbonyl concentrations were below their respective short-term health- and odor-based ESLs. Therefore, short-term adverse health effects and odors would not be expected due to exposure to those reported concentrations. For the one-hour concentrations that exceeded their respective short-term ESL, further evaluation to determine potential for health effects or odors is discussed below.

The few reported concentrations of chemicals that exceeded their respective short-term, health-based ESLs included: benzene, formaldehyde, 1,3-butadiene, methyl ethyl ketone (MEK)/methacrolein, styrene, and acrolein. Further examination determined that acute health effects (e.g. eye irritation, headaches, etc.) would not be expected as a result of exposure to these reported one-hour concentrations. The magnitude and frequency of hourly benzene concentrations were of note at: the Lynchburg Ferry site in Baytown, the Texas City autoGC on 34th St., and the BP Products North America, Inc.(BP)-sponsored autoGC in Texas City are further discussed. There were 117 hourly benzene exceedances with a maximum concentration of 770 ppb_v at the Baytown-Lynchburg Ferry site. At the Texas City, 34th St. site, there were 18 hourly benzene exceedances (maximum concentration of 179.24 ppb_v), which is significantly less than the 118 hourly benzene exceedances reported in 2004. There were 88 hourly benzene exceedances in 2005 at the BP-sponsored site with a maximum concentration of 116.72 ppb_v. The maximum concentrations at these sites are significantly below levels attributable to short-term adverse health effects; however the frequency and magnitude of the reported elevated benzene concentrations contributed to the long-term concentrations. The long-term or annual concentrations are addressed under the *Annual Average Concentration* section of this document.

The highest reported 1-hour formaldehyde concentrations reported at the Channelview, Clinton Dr., and Deer Park sites (14.20 ppb_v, 18.83 ppb_v, and 16.23 ppb_v respectively) were above the short-term ESL of 12 ppbv. These levels are significantly below levels that cause eye and upper respiratory tract irritation, therefore no acute health effects would be expected. Evaluation of the long-term, or annual, concentration is discussed later.

The reported one-hour autoGC VOC concentrations that exceeded their respective odor-based ESLs are shown below in Table 2. Although these styrene concentrations would not be expected to cause direct acute health effects such as eye and skin irritation, exposure to strong unpleasant odors can cause odor-related health effects such as headache and nausea. At the Lynchburg Ferry site, there were 92 hourly styrene concentrations reported above the odor-based ESL of 25 ppb_v, with a maximum concentration of 432.97 ppb_v. Although these styrene concentrations would not be expected to cause direct acute health effects such as eye and skin irritation, exposure to strong unpleasant odors can cause odor-related health effects such as headache and nausea. To identify potential sources near the Lynchburg Ferry site, TS evaluated hourly wind directional data compiled from hourly autoGC data were evaluated and indicated that higher styrene concentrations were reported when the winds were from the north and northwest (Figure 1).

Site	Chemical	Number of hourly concentrations above the odor-based ESL	Maximum measured concentration (ppb_v)
Milby Park	Styrene	4	46.87
	Isoprene	2	6.34
	Isobutene	3	2657.50
	t-2-pentene	1	35.06
Lynchburg Ferry	Styrene	92	432.97
	Isoprene	21	91.17
	t-2-pentene	2	41.72
	c-2-pentene	1	45.47
	2-Methyl-2-butene	1	307.76
Danciger	Isoprene	26	11.14
Haden Rd.	Styrene	1	40.55
	Isoprene	9	8.22
	t-2-pentene	2	72.80
	c-2-pentene	1	49.68
	1-butene	5	101.43
Channelview	Isoprene	1	5.59
Texas City	Isobutane	1	2799.75
Cesar Chavez	Isoprene	1	5.10
	Styrene	1	25.70

Annual Average Concentrations

All annual average concentrations of metals (from PM_{2.5} and PM₁₀ filters) based on 24-hour samples and most of the annual average concentrations evaluated from 24-hour canister VOC, one-hour autoGC VOC, and 24-hour carbonyl data were below their respective long-term health-based ESLs. Therefore, no long-term adverse health effects are expected from those concentrations. For the annual average concentrations that exceeded their respective long-term ESL, further evaluation of the potential for adverse health effects is discussed below.

Texas City

In Texas City, the 2004 reported annual average benzene concentration based on hourly autoGC samples at the Texas City-34th St. site (1.62 ppb_v) was above the long-term, health-based ESL of 1 ppb. Significantly, the 2005 reported annual average benzene concentration (0.78 ppb_v) is below the long-term, health-based ESL. The comparison of the 2005 and 2004 annual average concentrations identified a 52% reduction in benzene concentrations at the Texas City-34th St. site. As shown in Figure 2, evaluation of source direction using the hourly 2005 autoGC data at this site indicated that higher benzene concentrations were associated with winds blowing from the northeast. In addition, the Galveston County Health District completed an investigation on April 21st, 2006, and a Notice of Enforcement was issued against Black Marlin Pipeline Company that outlines strict monitoring of flare activities. It is possible that emissions reductions from this facility led to the reduction in benzene levels at the Texas City-34th St. monitor.

The 2005 reported annual average benzene concentrations reported near the Texas City Ball Park site (1.06 ppb_v), and BP-sponsored site (2.70 ppb_v) are above the long-term, health-based ESL of 1 ppb_v. The comparison of the 2005 and 2004 annual average concentrations indicated an increase at both sites, with an approximate 35% increase at the BP-sponsored site. An evaluation of source identification near the BP-sponsored site was performed using the hourly autoGC data from the BP-sponsored site (Figure 3) indicates that higher benzene concentrations were associated with winds blowing from the south. The 2005 annual averages reported near both the BP-sponsored site and the Texas City Ball Park site were attributed to frequent episodes of elevated benzene concentrations stemming from an onsite explosion on March 21st, 2005 and a power outage due to Hurricane Rita on October 3, 2005. The preliminary 2006 reported benzene concentrations near both sites show a continued downward trend. The benzene concentrations reported near the Texas City Ball Park monitoring site are at a level such that this area of Texas City will remain on the TCEQ Air Pollutant Watch List (APWL). Benzene emissions reductions are encouraged in this area.

Lynchburg Ferry

At the Baytown-Lynchburg Ferry site, the 2005 reported annual average benzene concentration based on every sixth-day 24-hour canister samples was 9.17 ppb_v, while the annual average concentration based on hourly autoGC samples at the co-located autoGC was 3.17 ppb_v. Both are above the long-term, health-based ESL of 1 ppb_v. Further examination found that the average from the 24-hour canister samples were driven by two significantly elevated samples (193 ppb_v and 159.28 ppb_v), and these 24-hour samples coincide with multiple elevated hourly benzene levels detected at the co-located autoGC on the reporting days. The annual average based on the hourly autoGC samples is more appropriately representative of a long-term exposure, therefore this average was used in our assessment. As shown in Figure 4, evaluation of source direction using the hourly 2005 autoGC data at this site indicated that higher benzene concentrations were associated with winds blowing from the northeast as well as the southwest. In 2005 and into 2006 TCEQ has taken action, including enforcement and additional permit restrictions, at Channel Shipyard, a facility that had been identified as a source of benzene during mobile monitoring

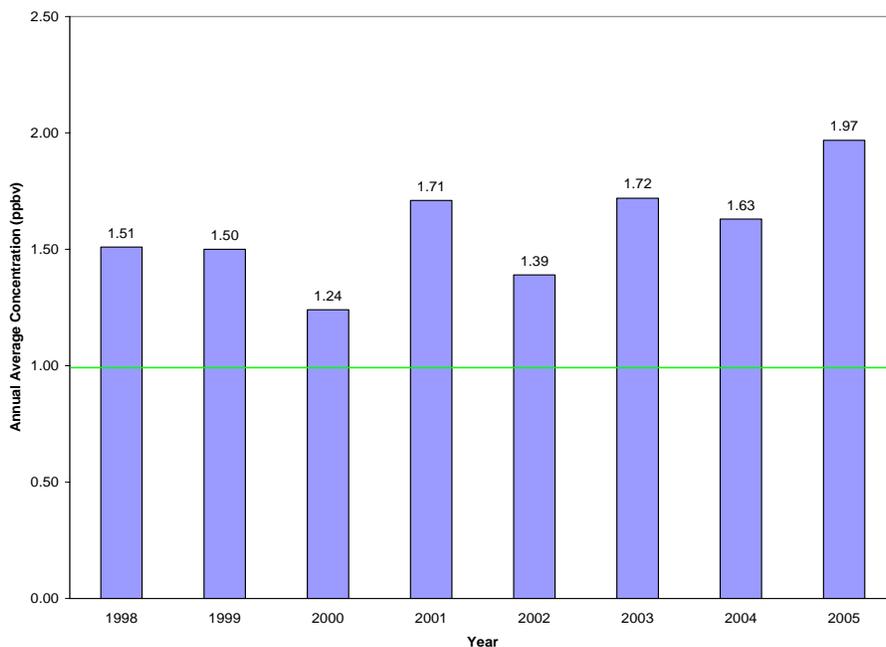
trips conducted in both 2004 and 2005. TCEQ has entered into Emission Reduction Agreements to reduce VOC emissions, including benzene emissions, with Oiltanking, Vopak, and Intercontinental Terminals Company, all facilities are located southwest of the monitor. In addition, barges in transit and barge lightering activities in the ship channel have recently been identified as a possible source of the benzene concentrations reported at the Baytown-Lynchburg Ferry site, and further investigative activities are ongoing. The 2006 benzene levels appear to exhibit a downward trend when compared to 2005. However the reported levels are of concern for potential long-term adverse health effects, and benzene emission reductions are recommended.

In order to better address the concerns regarding long-term benzene concentrations in the Jacintoport neighborhood that is located northwest of the Lynchburg Ferry site, a 24-hour canister sampler was established at the Corner of 1st and Elsbeth Streets. This site began collecting data on July 19th, 2006; therefore, data from this site was not available for this evaluation.

Galena Park

The 2005 reported annual average benzene concentration based on every sixth-day 24-hour canister samples at the Galena Park site was 1.97 ppb_v, which is higher than the 2004 annual average of 1.63 ppb_v. Elevated benzene concentrations have been reported near the Galena Park site since 1998, and a trend analysis indicates an upward pattern in the area surrounding the monitor in recent years (see Figure 5). While preliminary 2006 benzene levels appear to be lower than 2005, the reported levels are of concern for potential long-term adverse health effects, and emission reductions are recommended. In 2006, the TCEQ negotiated a voluntary 50% reduction in VOC emissions with Kinder Morgan Liquids Terminals, L.L.C., including 49% reduction in annual benzene emissions. This facility is located to the southeast of the Galena Park site.

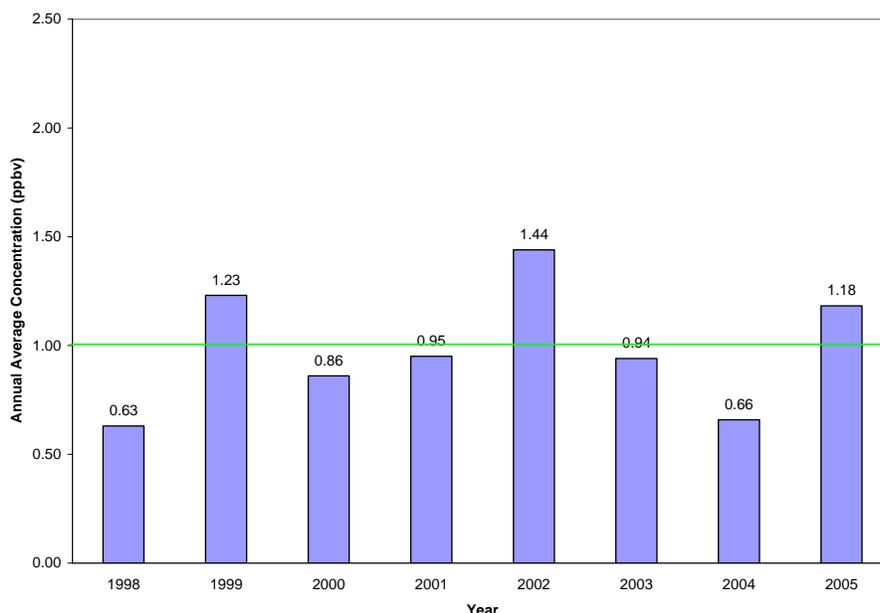
Figure 5. Trend Analysis of Benzene Concentrations Near Galena Park



Shoreacres

The 2005 reported annual average benzene concentration based on every sixth-day 24-hour samples at the Shoreacres site was 1.18 ppb_v and is above the long-term, health-based ESL of 1 ppb_v. Comparison to the 2004 annual average concentration of 0.66 ppb_v indicates an approximate 44% increase in benzene concentrations at this site. As shown in Figure 6, benzene levels in this area have fluctuated in recent years. Investigative activities and mobile monitoring conducted by regional personnel are ongoing in order to identify culpable sources. Benzene emission reductions in this area are encouraged.

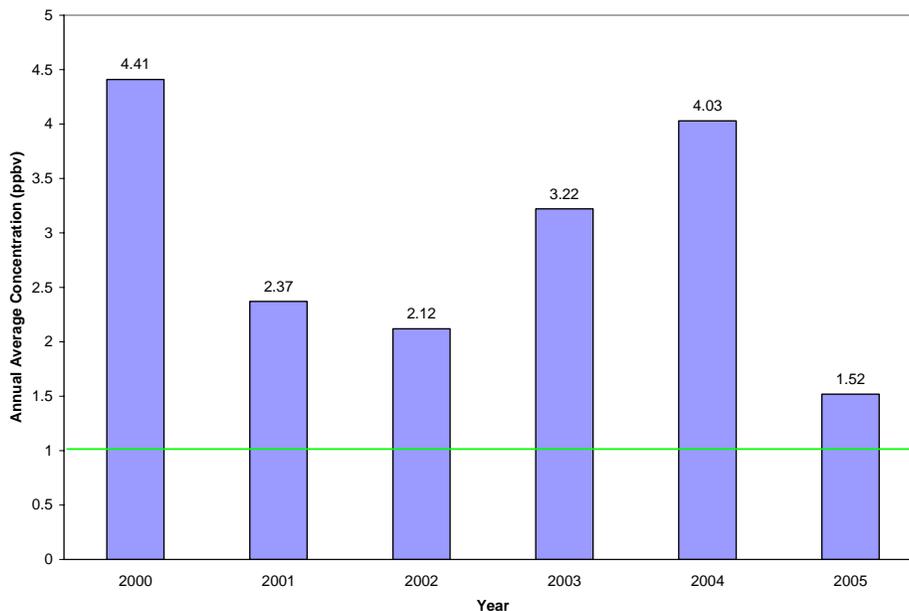
Figure 6. Trend Analysis of Benzene Concentrations Near Shoreacres



Milby Park

The 2005 reported annual average 1,3-butadiene concentration at the Milby Park site was 1.52 ppb_v, which is the lowest level reported at this site since monitoring began in 1999 (see Figure 7). While it is significantly lower than the 2004 annual average concentration of 4 ppb_v, it is still above the interim long-term goal of 1 ppb_v. The 2005, the every sixth-day 24-hour canister sampler at the Milby Park monitoring site was replaced with an autoGC, which began reporting data on February 20th, 2005. Therefore, the 2005 annual average used in this evaluation was an appropriately weighted composite average of both 24-hour and hourly autoGC samples. The reduction in the annual average concentration can be attributed to emissions reduction agreements entered into by Texas Petrochemical (TPC) and Goodyear in 2004 (see Figure 8). We note the reductions in 1,3-butadiene levels at Milby Park and this area will remain on the APWL.

Figure 7. Trend Analysis of 1,3 Butadiene Concentrations Near Milby Park



In order to better address questions regarding long-term 1,3-butadiene and other chemical concentrations in the Manchester neighborhood, an every sixth-day 24-hour canister sampler was established at 9401 1/2 Manchester Rd., and this site began collecting data on May 25th, 2005. At the Manchester site, the 2005 reported annual average 1,3-butadiene concentration based on nine months of valid data (0.35 ppb_v) and is below the long-term goal of 1 ppb_v.

Formaldehyde

The 2005 reported annual average formaldehyde concentration based on 24-hour seasonal samples near the Clinton Dr. site was 0.15 ppb_v, which represents an approximate 95% reduction when compared to 2004. The 2005 reported annual average formaldehyde concentrations based on 24-hour samples near the Deer Park site (2.71 ppb_v) and the Channelview site (2.57 ppb_v) and were above the current long-term ESL of 1.2 ppb_v. When compared to the 2004 levels at the respective sites, there was a 41% reduction at the Deer Park site and a 13% reduction at the Channelview site. However, the United States Environmental Protection Agency has recently revised their toxicity assessment of formaldehyde. Based on this new information, the reported annual average concentrations at all three sites are not of concern regarding their potential to cause long-term adverse health effects.

If you have any questions regarding this memorandum, please contact me by phone at (512) 239-1075 or by email at BKadluba@tceq.state.tx.us. For questions regarding the APWL, you may visit the TCEQ website at http://www.tceq.state.tx.us/implementation/tox/AirPollutantMain/APWL_index.html

Appendix 1. Monitored air toxics in TCEQ Region 12 for year 2005			
Canister & AutoGC Target Analytes		Additional Canister Target Analytes	Additional AutoGC Target Analytes
1,2,3-Trimethylbenzene	Methylcyclopentane	1,1,1-Trichloroethane	1-Hexene
1,2,4-Trimethylbenzene	m-Ethyltoluene	1,1,2,2-tetrachloroethane	2-Methyl-1-Pentene
1,3,5-Trimethylbenzene	n-Butane	1,1,2-Trichloroethane	3-Methyl-1-Butene+Cyclopentene
1,3-Butadiene	n-Decane	1,1-Dichloroethane	a-Pinene
1-Butene	n-Heptane	1,1-Dichloroethylene	b-Pinene
1-Pentene	n-Hexane	1,2-Dibromoethane	Isobutene
2,2,4-Trimethylpentane	n-Nonane	1,2-Dichloroethane	
2,3,4-Trimethylpentane	n-Octane	1,2-Dichloropropane	
2,3-Dimethylbutane	n-Pentane	1-Hexene+2-methyl-1-pentene	
2,3-Dimethylpentane	n-Propylbenzene	2-Butanone	
2,4-Dimethylpentane	n-Undecane	2-Chloropentane	
2-Methyl-2-Butene	o-Ethyltoluene	2-Methyl-3-hexanone	
2-Methylheptane	o-Xylene	3-Hexanone	
2-Methylhexane	p-Diethylbenzene	3-Pentanone	
3-Methyl-1-Butene	p-Ethyltoluene	Bromomethane	
3-Methylheptane	Propane	Butyl Acetate	
3-Methylhexane	Propylene	Carbon Tetrachloride	
3-Methylpentane	p-Xylene + m-Xylene	Chlorobenzene	
4-Methyl-1-Pentene	Styrene	Chloroform	
Acetylene	t-2-Butene	Chloroprene	
Benzene	t-2-Hexene	CIS 1,3-dichloropropylene	
c-2-Butene	t-2-Pentene	Dichlorodifluoromethane	
c-2-Hexene	Toluene	Ethyl Acetate	
c-2-Pentene		Isobutyraldehyde	
Cyclohexane		Methyl Butyl Ketone (MBK)	
Cyclopentane		Methyl chloride	
Cyclopentene		Methyl t-Butyl ether	
Ethane		Methylene Chloride	
Ethyl Benzene		Methylisobutylketone	
Ethylene		n-Propyl Acetate	
Isobutane		Tetrachloroethylene - Perchloroethylene	
Isopentane		trans-1-3-Dichloropropylene	
Isoprene		Trichloroethylene	
m-Diethylbenzene		Trichlorofluoromethane	
Methylcyclohexane		Vinyl Chloride	
Carbonyls		Metals	
2,5-Dimethylbenzaldehyde	p-Tolualdehyde	Aluminum (PM 2.5)	Aluminum (PM 10)
Acetaldehyde	Propanal - Propionaldehyde	Antimony (PM 2.5)	Antimony (PM 10)
Acetone	Valeraldehyde	Arsenic (PM 2.5)	Arsenic (PM 10)
Acrolein		Barium (PM 2.5)	Barium (PM 10)
Benzaldehyde		Cadmium (PM 2.5)	Cadmium (PM 10)
Butylaldehyde		Chromium (PM 2.5)	Chromium (PM 10)
Crotonaldehyde - 2-Butenal		Cobalt (PM 2.5)	Cobalt (PM 10)
Formaldehyde		Copper (PM 2.5)	Copper (PM 10)
Heptaldehyde		Manganese (PM 2.5)	Manganese (PM 10)
Hexanaldehyde		Molybdenum (PM 2.5)	Molybdenum (PM 10)
Isovaleraldehyde		Nickel (PM 2.5)	Nickel (PM 10)
m-Tolualdehyde		Selenium (PM 2.5)	Selenium (PM 10)
MEK/Methacrolein		Tin (PM 2.5)	Tin (PM 10)
o-Tolualdehyde		Zinc (PM 2.5)	Zinc (PM 10)

Figure 1. Source Direction Evaluation of 2005 Styrene autoGC Data Near Lynchburg Ferry

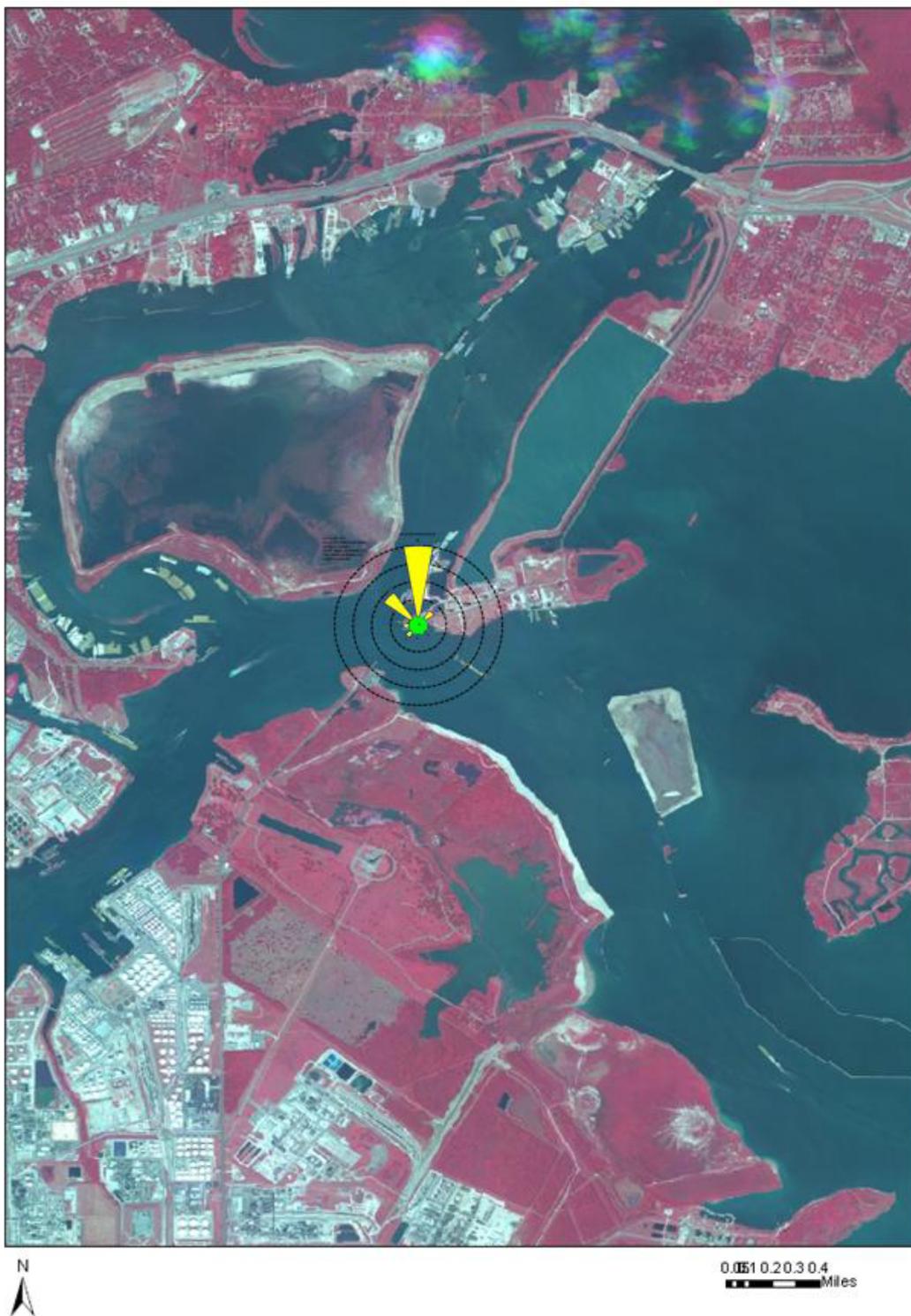


Figure 2. Source Direction Evaluation of 2005 Benzene autoGC Data near Texas City-34th St.



Figure 3. Source Direction Evaluation of 2005 autoGC Data near BP North America Products, Inc.

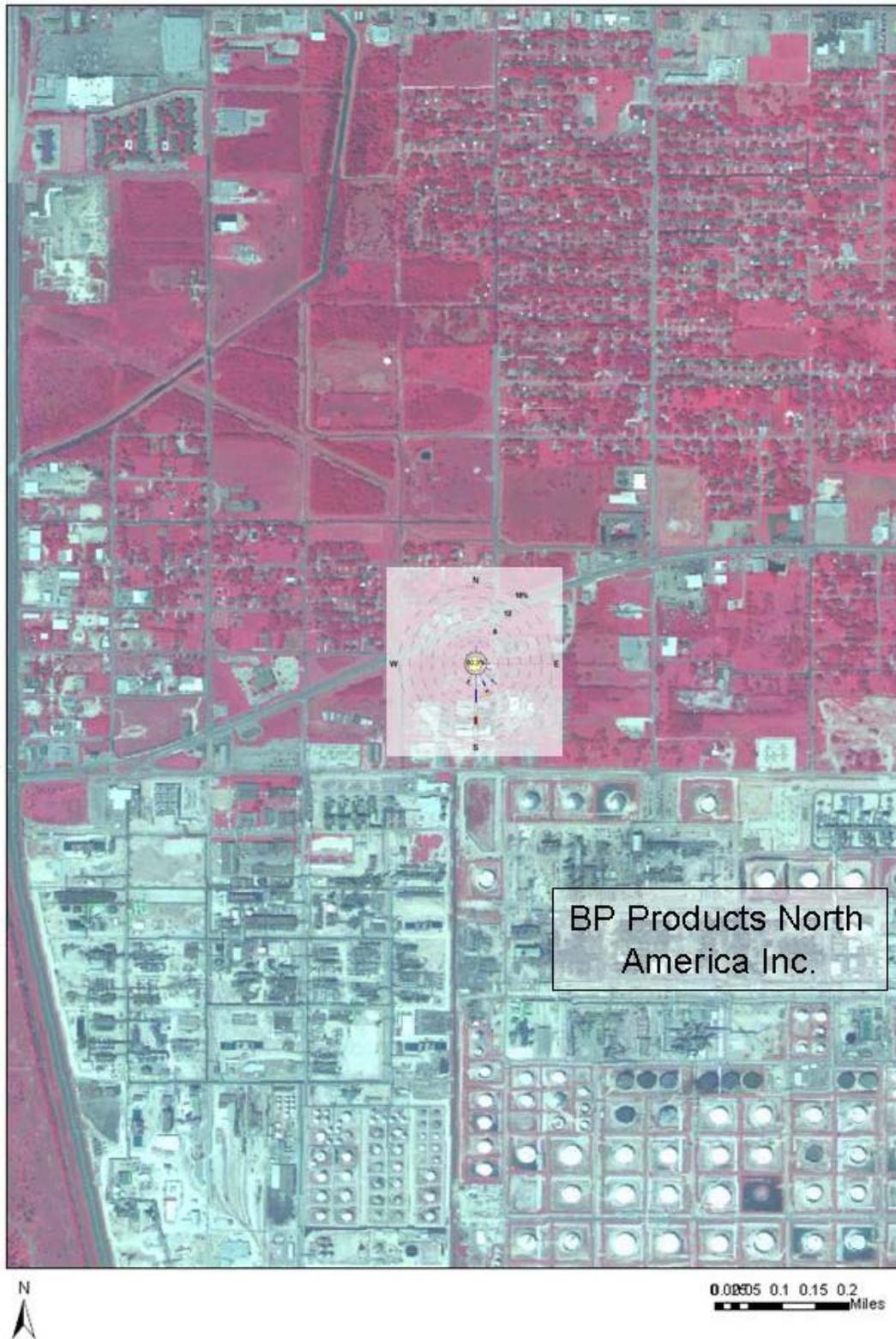


Figure 4. Source Direction Evaluation of 2005 Benzene autoGC Data Near Lynchburg Ferry

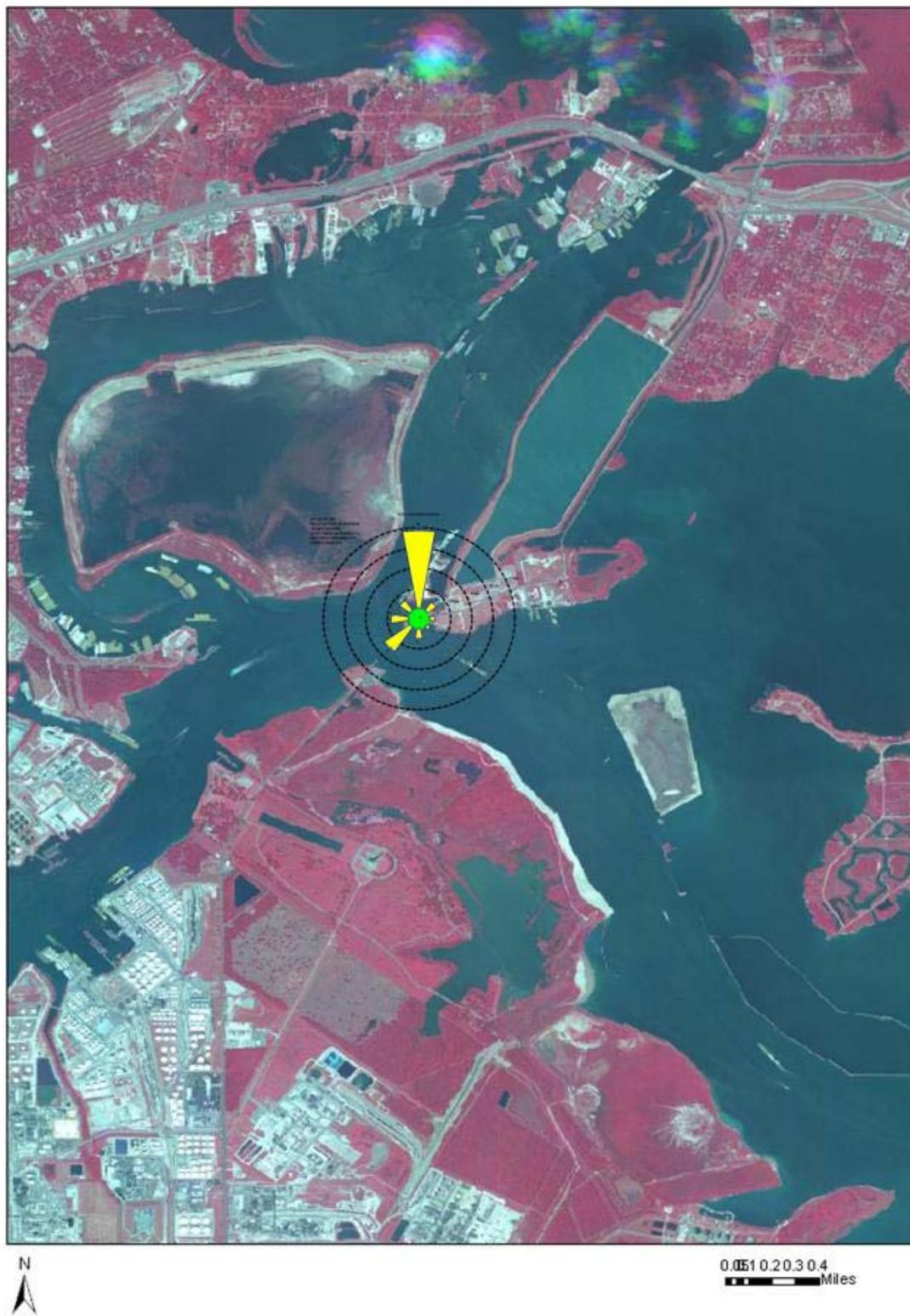


Figure 8. Source Direction Evaluation of 2005 1,3-Butadiene autoGC Data Near Milby Park



D. Phillips, M. Hill, L. Vasse, J. Anderson, R. Rentz, D. Bower, R. Hyde, J. Sadlier, S. Hildebrand

December 18th, 2006

Page 15

cc:

Susan Prosperie, Dept. of State Health Services

Arturo Blanco, City of Houston

Bob Allen, Harris County

B. Z. Karachiwala, Harris County

Ronnie Schultz, Galveston County Health Dept

Ruben Casso, Region 6 EPA

Kuenja Chung, Region 6 EPA