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ASSESSMENT OF CHANGES TO THE AIR POLLUTANT WATCH LIST (APWL) IN TEXAS

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Executive Summary

The Texas Commission on Environmental Quality (TCEQ) continually monitors air quality in areas among the 16 TCEQ regions and generally adds areas with concentrations of pollutants that exceed state-based screening level guidelines to the Air Pollutant Watch List (APWL). Specifically, areas are added to the APWL when pollutant levels exceed either state regulatory standards (in the case of sulfur dioxide and hydrogen sulfide) or pollutant-specific air monitoring comparison values (AMCVs). According to the TCEQ, it will remove a pollutant and/or area from the APWL only when the area has shown a consistent decrease in monitored concentrations of the pollutant of concern.

Since 2007, a total of 14 pollutants in 10 areas have been delisted by the TCEQ as shown in Table 1 (TCEQ, 2015b) and Figure 1 below.

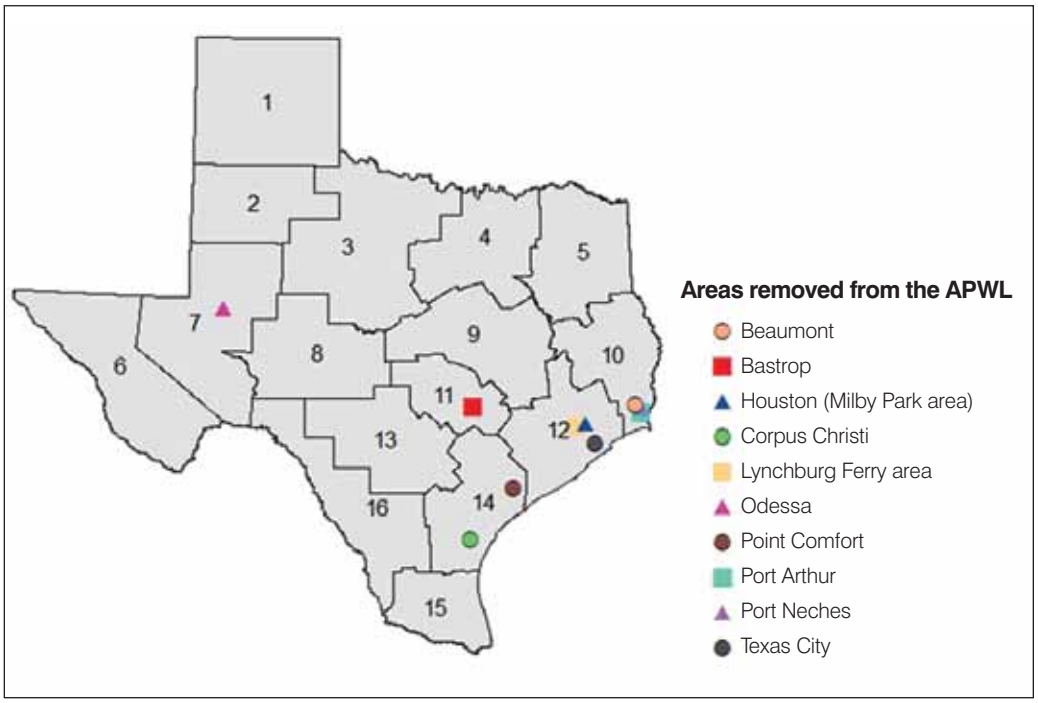

FIGURE 1. Areas that have been removed from the APWL within the 16 TCEQ regions. Source: TCEQ Air Monitoring Site Data. Map created using ArcGIS

This report analyzes and compares air monitoring data from the 14 delisted cases to the applicable AMCVs or regulatory standards for each pollutant, to determine whether air quality improvements have persisted since the year each case was removed from the APWL. In addition to analytical results, the report includes several recommendations as to how the TCEQ could improve the management of air toxics in the state. These recommendations are summarized below:

- **Ensure that all monitoring equipment is reporting data accurately and consistently.**
- If any monitoring data exceed short-term and/or long-term AMCVs, **conduct further investigation, including a meteorological analysis, to identify the source of the exceedance and determine appropriate measures to address it.**
- **Improve transparency of the TCEQ's investigative and enforcement actions,** in order to share information with the public about the measures that are taken in response to violation of AMCVs.
- **Ensure that air monitoring data from all air monitoring sites are available to the public and that these data are up to date.** These data should include not only 24-hour monitoring data collected every sixth day, but also hourly monitoring data.
- **Collect monitoring data for hydrogen sulfide, which is based on hourly readings, on the same scale as the state standard, which is based on 30-minute readings.**
- **Assess data collection protocols** to ensure that the TCEQ's reports and database adequately report and evaluate the hourly data that are needed to make informed decisions regarding acute health effects.
- **Include more robust statistical analyses in the TCEQ's APWL annual reports,** such as providing standard deviations, quartiles, and maximum values. Providing more detailed statistical information will increase the agency's and the public's ability to understand the high variability in concentration levels for many pollutants, as well as the persistence of short-term exceedances in some areas with annual mean concentrations below long-term AMCVs.
- **Improve the validity of the annual average concentration estimates that the TCEQ uses in listing and delisting decisions** by justifying the soundness and appropriateness of using specific types of monitors for chronic measurement of pollutants.
- **Respond promptly to public comments regarding APWL delistings.**

TABLE 1.

Areas removed from the APWL since start of APWL program

APWL	CITY/ REGION	POLLUTANT	YEAR ADDED	YEAR REMOVED
1402	Corpus Christi	Benzene	1998	2010
1004	Port Neches	1,3-Butadiene	1996	2009
1002	Beaumont	Hydrogen Sulfide	2002	2009
1002	Beaumont	Benzene	2004	2009
1207	Milby Park	1,3-Butadiene	1999	2009
1204	Lynchburg Ferry Area	Benzene	2002	2010
1203	Texas City	Benzene	2004	2007
1202	Texas City	Benzene Hydrogen Sulfide	2003 2004	2014
1202	Texas City	Acrolein Butyraldehyde Valeraldehyde	2001	2010
0701	Odessa	Ethylene	2001	2007
1401	Point Comfort	1,2-Dichloroethane	2004	2007
1101	Bastrop	Hydrogen Sulfide	2007	2012
1003	Port Arthur	Benzene	2001	2014
1204	Lynchburg Ferry Area	Styrene	2003	2014
1002	Beaumont	Sulfur Dioxide	2003	2016

Source: (TCEQ, 2015b)

Introduction

While the Environmental Protection Agency (EPA) sets federal health-based standards for six different criteria air pollutants that include ozone, particulate matter, nitrogen dioxide, sulfur dioxide, lead, and carbon monoxide, there are many other air pollutants, such as benzene, for which there are no federal standards. As Texas is home to some of the nation's largest refining and petrochemical facilities, the TCEQ is responsible for monitoring the concentrations of many of the air toxics that are associated with the operation of the hundreds of such industrial facilities. The TCEQ reviews ambient air monitoring data collected across the state and compares monitored concentrations of pollutants to AMCVs or state regulatory standards.

AMCVs are chemical-specific air concentrations, defined according to their known short- and long-term health effects, as well as odor and effects on vegetation. Short-term AMCVs were developed to take into account acute health effects, potential for odors to be a nuisance, and acute effects on vegetation, while long-term AMCVs are based on data concerning chronic effects on health or vegetation (TCEQ, 2015d)[1]. The TCEQ considers that exposure to an air pollutant with a concentration at or below its AMCV is not expected to cause adverse human health or welfare effects[2]. The TCEQ treats AMCVs as guidelines rather than standards, and does not necessarily take enforcement action in response to exceedances. One exception where the state has established a legally enforceable standard for an air toxic is in the case of hydrogen sulfide, for which the state has set a 30-minute regulatory standard[3].

When an air toxic has long-term monitored concentrations above its long-term AMCV, or has frequent short-term monitored concentrations exceeding the short-term AMCV/ state regulatory standard, the TCEQ may recommend adding the pollutant and its potential source areas to an Air Pollutant Watch List (APWL). Once an area is listed on the APWL with the pollutant of concern, the TCEQ has an established policy to work with local industry in the area to reduce ambient air toxic concentrations below the AMCV or state regulatory standard for that pollutant (TCEQ, 2010).

Two primary types of monitors are used in the state's air monitoring network: Automated Gas Chromatographs (Auto-GCs) and canister monitors. Auto-GCs collect data on pollutant concentrations, generating readings at hourly intervals. Canister monitors accumulate and store ambient air samples over a period of 24 hours, and are collected every sixth day for analysis (Texas Natural Resource Conservation Commission, 2001).

[1] Toxicologists define acute health effects as harmful effects resulting from a single or short-term exposure, while chronic health effects are defined as the ability of a substance to cause harmful effects over an extended period, and usually as a result of repeated or continuous exposure. TCEQ considers short-term to be a one-hour average and a long-term to be an annual average. www.tceq.texas.gov/toxicology/esl/

[2] The agency claims that exposure to an air concentration of a pollutant above its AMCV does not necessarily indicate the presence of adverse health effects, but it does indicate that further review is needed (TCEQ, 2013).

[3] For text of the state regulatory standard, see Texas Administrative Code Title 30, Chapter 112 – Regulation of Sulfur Compounds, Subchapter B – Control of Hydrogen Sulfide.

The TCEQ states that a listed area may be removed from the APWL when monitoring data for the pollutant of concern shows a decreasing trend, and monitored concentrations no longer exceed the AMCV or state regulatory standard. Since 2007, the TCEQ has delisted a total of 14 cases in 10 areas. Table 2 shows both AMCVs and state regulatory standards (where applicable) for pollutants that have been removed from the APWL.

TABLE 2.

AMCVs and state regulatory standard for pollutants removed from the APWL – (parts per billion by volume – ppbv)

POLLUTANT	ODOR-BASED (ppbv)	SHORT-TERM HEALTH (ppbv)	LONG-TERM HEALTH (ppbv)
Benzene	2700	180	1.4
1,3-Butadiene	230	1700	9.1
Styrene	25	5100	110
Ethylene	--	1200 (Vegetation)*	30 (Vegetation)*
1,2-Dichloroethane	--	40	1
Acrolein	3.6	4.8	1.2
Butyraldehyde	1.4	3800	34
Valeraldehyde	30	500	50
POLLUTANT	**30-MINUTE STATE REGULATORY STANDARD**		
Hydrogen sulfide	80		

**The AMCV for ethylene is based on its effects on vegetation, which is a more sensitive endpoint for this pollutant.*

Unit: Parts per billion by volume (ppbv)

Source: (TCEQ, 2013)

The purpose of this study was to evaluate the monitored concentrations of air toxics in these delisted areas after they were removed from the APWL, and further, to determine whether improved air quality has persisted since the year the area was removed.

Summary of Methodology

We used air monitoring data as reported by the TCEQ for annual average concentrations and standard deviations of pollutants in each delisted APWL area. Additionally, we prepared boxplots of the data for each area showing the variation in air concentrations throughout each year and extreme values at each monitor. Some of these air monitoring data are publicly available through the TCEQ's TAMIS database, and others were obtained by filing Public Information Requests (PIR) with the TCEQ.

We analyzed all data that were made available to us for each delisted APWL area as of September 2016. For consistency, tables and graphs only include data through December 2015, allowing comparison between readings from complete years where available[4]. In a few cases, however, we refer to potential health concerns using specific examples from 2016 data.

[4] In the case of 4 monitors, only partial data were available for the year 2015. Additionally, as we note in our recommendations, as of September 2016 no data were available at all for five additional monitors in Texas City. For these cases, we present the most recent monitoring data that we were able to obtain at any point during this analysis, including some data sets that were previously made available to us but were since withdrawn.

Common Terms

This section defines a list of common terms that are used in this report., compiled from various sources (TCEQ, 2013, 2015a; U.S. EPA, 2015).

- **Acrolein**. Acrolein is a chemical used as an intermediate in the chemical industry, primarily for the synthesis of many organic substances. In the oil and gas industry, it is used as a biocide in drilling waters, as well as a scavenger for hydrogen sulfide (used to cause a chemical reaction that results in a more inert substance). It can also be found in the air due to the burning of organic matter, such as tobacco. Depending on the concentration, exposure to acrolein can result in eye, nasal, and respiratory tract irritations.
- **Air Monitoring Comparison Values (AMCV)**. Air Monitoring Comparison Values are a set of chemical-specific air concentration levels that are developed and used by the TCEQ to review ambient air monitoring data in protection of human health and welfare. Short-term AMCVs are based on data concerning acute health effects, potential for odors to be a nuisance, and acute vegetation effects, while long-term AMCVs are based on data concerning chronic health or vegetation effects (TCEQ, 2015d). The agency expects that exposure to a pollutant of concern with concentrations below its AMCV would not be expected to cause adverse health or welfare effects.
- **Air Pollutant Watch List (APWL)**. The Air Pollutant Watch List is a program implemented by the TCEQ to address areas in Texas where air pollutants have been monitored at or above AMCVs.
- **Ambient Air Quality**. Ambient air quality refers to the quality of outdoor air in the surrounding environment.
- **Benzene**. Benzene is a natural constituent of crude oil and is used primarily as a precursor in the manufacture of chemicals with more complex structure. Sources of benzene include emissions from combustion of coal and oil, gasoline service stations, and motor vehicle exhaust. Benzene is classified by the EPA as a known human carcinogen. Both short- and long-term human exposure to benzene can cause adverse health effects, including toxicity to the liver, kidney, lung, heart, and the brain. Benzene exposure can result in DNA strand breaks and chromosomal damage, leading to cancer.
- **1,3-Butadiene**. 1,3-Butadiene is an industrial chemical used in the production of synthetic rubber. It is also a pollutant found in motor vehicle exhaust. The chemical is classified by the EPA as carcinogenic to humans through inhalation, and short-term exposure to 1,3-butadiene can cause irritation of lungs, throat, nasal passages, and eyes.

- **Butyraldehyde**. Butyraldehyde, also referred to as butanal, is a naturally occurring compound in several plants. Butyraldehyde is used in industrial facilities that make plasticizers, rubber accelerators, and synthetic resins. Humans may be exposed to butyraldehyde through workplace air or in the environment when the chemical is released into the air, water, or groundwater, resulting in eye damage or skin irritation.
- **1,2-Dichloroethane**. 1,2-dichloroethane is used primarily in the production of vinyl chloride, and used to make a variety of plastic and vinyl products including polyvinyl chloride (PVC) pipes, furniture and automobile upholstery, wall coverings, housewares, and automobile parts. Humans can be exposed to 1,2-dichloroethane, also called ethylene dichloride, by inhalation in the ambient or workplace air. Inhalation of concentrated 1,2-dichloroethane may affect the human nervous system, liver, kidney, or result in respiratory distress or other symptoms. The chemical has been classified by the International Agency for Research on Cancer (IARC) as a Group B2, probable human carcinogen.
- **Ethylene**. Ethylene is an organic compound widely used in the chemical industry to make polyethylene, a plastic. Exposure to high concentrations of ethylene may cause headache, dizziness, anesthesia, drowsiness, or other central nervous system effects.
- **Hydrogen sulfide**. Hydrogen sulfide is a colorless gas with a strong odor similar to rotten eggs. Hydrogen sulfide is formed from the breakdown of organic matter in the absence of oxygen and is a component of natural gas. Exposure to high concentrations of hydrogen sulfide can result in death due to toxicity of the central nervous system.
- **PPBV**. PPBV stands for parts per billion by volume. It is a unit based on volume-to-volume ratio and is used in gas measurements.
- **TCEQ**. The Texas Commission on Environmental Quality (TCEQ) is the lead environmental agency for the state of Texas.
- **Styrene**. Styrene is a primary chemical used in the production of resins and polystyrene plastics. Short- term exposure to styrene can cause eye irritation and gastrointestinal effects, and long-term exposure can cause adverse effects on the central nervous system (CNS), including headache, fatigue, hearing loss, etc.
- **Sulfur Dioxide (SO2)**. SO2 is emitted into the air by the burning of fossil fuels that contain sulfur. Coal, metal extraction and smelting, ship engines, and heavy equipment diesel equipment burn fuels that contain sulfur. Sulfur dioxide causes eye irritation, worsens asthma, increases susceptibility to respiratory infections, and impacts the cardiovascular system. When SO2 combines with water, it forms sulfuric acid; this is the main component of acid rain, a known contributor to deforestation.
- **Valeraldehyde**. Valeraldehyde is a volatile organic compound (VOC) and is both naturally occurring and synthetically produced. Potential sources of valeraldehyde include emissions from building materials, gasoline, diesel and turbine engines, and wastewater and waste gases from industrial waste disposal sites. Exposure to valeraldehyde liquid and vapor can cause irritation of the skin, eyes, nose, and respiratory tract.

Areas and Pollutants Removed from the Air Pollutant Watch List

APWL 1402 – Benzene in Corpus Christi (Removed 2010)

The TCEQ decided to remove this region from the list in 2010 because annual average benzene concentrations monitored at the Huisache monitoring site showed a seven-year downward trend beginning in 2002, and the 2008 benzene concentration of 0.86 parts per billion by volume (ppbv) was below the agency's long-term AMCV of 1.4 ppbv (TCEQ, 2010). Figure 2 below shows annual average benzene concentrations from 2006 to September of 2015. While annual average benzene concentrations from 2008 to September of 2015, based on 24-hour readings taken once every six days, were below the AMCV, the standard deviation for all years was relatively large, indicating potential anomalous large-scale emissions events leading to concentrations above the AMCV.

In addition, the boxplot in Figure 3 shows that after the region was delisted in 2010, in 2011 and 2014, more than 25% of air monitoring data were actually above the long-term AMCV of 1.4 ppbv, while in 2012 and 2013, nearly 25% of readings were above the AMCV. From January to September 2015, around 10% of readings were above the AMCV. Figure 3 further indicates that large spikes occurred during almost every year from 2006 to 2015. For instance, a benzene concentration of 9.65 ppbv was detected on January 30, 2015, a concentration that is much larger than the average and long-term AMCV. It is recommended that the TCEQ conduct more investigation into these large spikes to minimize human health risks.

TABLE 3.

Maximum 24-hour benzene concentrations at Corpus Christi Huisache (ppbv)*.

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
7.68	9.86	3.28	5.99	8.88	7.18	6.97	4.43	7.6	9.65

** Note that these 24-hour concentrations collected every sixth day cannot be compared to hourly concentrations collected at other sites (Short-term AMCV: 180 ppbv)*

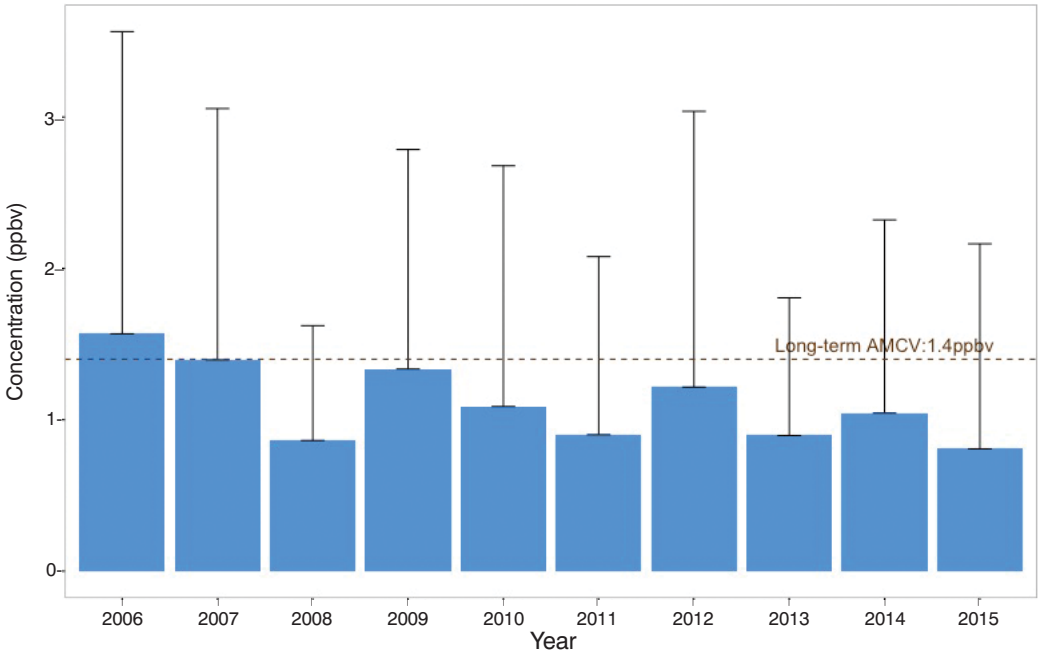

Figure 2. Annual average benzene concentrations (+/- standard deviation (SD)) at the Corpus Christi Huisache monitoring site (Air Quality System (AQS): 483550032), 2006 – 2015. Annual averages are based on 24-hour data collected every sixth day.

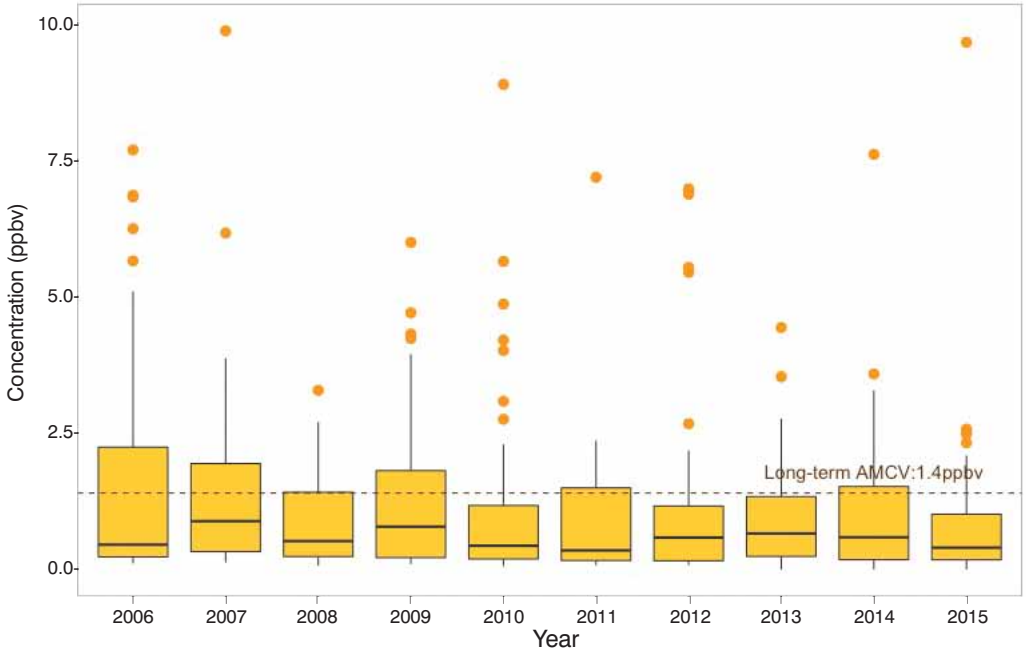

Figure 3. Boxplot of benzene measurements at the Huisache monitoring site (AQS: 483550032), 2006 – 2015. Dots represent outliers[5].

[5] Outliers for all boxplots in this paper are defined as concentrations that are 1.5 times the inter-quartile range (IQR) above quartile 3 or higher for a given data set.

APWL 1004 – 1,3-Butadiene in Port Neches (Removed 2009)

Port Neches was placed on the APWL due to elevated annual averages of 1,3-Butadiene from 1994 to 1998 monitored at the Port Neches Merriman Street monitoring site, which were above a previously adopted AMCV of 5 ppbv. In August 2008, the TCEQ changed the AMCV from 5 ppbv to a less health-protective AMCV of 9.1 ppbv. As a result, annual average concentrations of 1,3-butadiene have remained below the revised AMCV (TCEQ, 2010). As shown in Figure 4 and Figure 5, annual averages of 1,3-butadiene concentrations based on every-sixth-day 24-hour data were below 9.1 ppbv between 2006 and 2015. No single air monitoring data reading exceeded the long-term AMCV established in 2008, suggesting that Port Neches has continued to maintain concentrations of 1,3-butadiene below the AMCV since the pollutant was removed from the APWL.

TABLE 4.

Maximum 24-hour 1,3 butadiene concentrations at Port Neches Merriman Street (ppbv) *

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
8.08	7.26	4.25	5.67	3.61	6.53	9.08	8.08	8.25	5.61

**Note that these 24-hour concentrations collected every sixth day cannot be compared directly to hourly concentrations collected at other sites. (Long-term AMCV: 9.1 ppbv)*

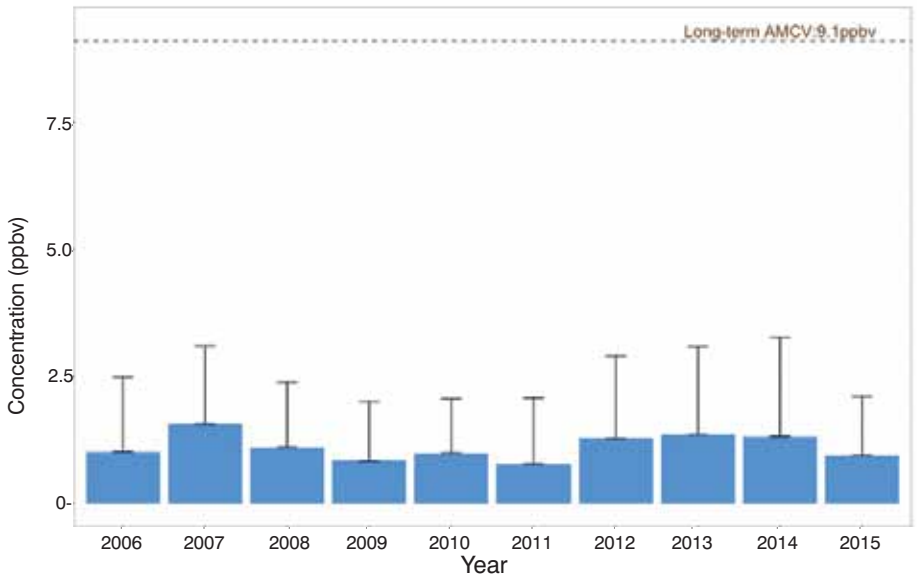

Figure 4. Annual average 1,3-butadiene concentrations (+/- SD) at the Port Neches Merriman Street monitor (AQS: 482450017), 2006 – 2015. Annual averages are based on 24-hour data collected every sixth day.

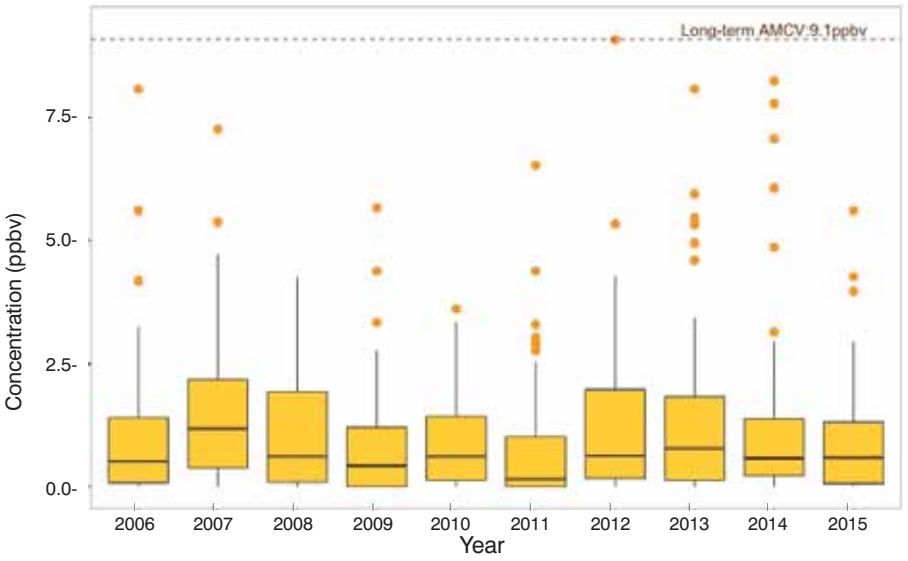

Figure 5. Boxplot of 1,3-butadiene measurements at the Port Neches Merriman Street monitor, 2006 – 2015. Data in 2015 only include January to September. Dots represent outliers.

APWL 1002 – Hydrogen Sulfide in Beaumont (Removed 2009)

Hydrogen sulfide in Beaumont was listed on the APWL due to detected concentrations at the former Carroll Street Park monitoring site above the 30-minute state regulatory standard of 80 ppbv (TCEQ, 2010). Although the TCEQ regulatory standard for hydrogen sulfide is based on 30-minute readings, the TCEQ's online Texas Air Monitoring Information System (TAMIS) database includes only hourly monitoring data (see Table 5). This raises a concern, because the hourly air quality data provided by the monitoring network cannot be compared to the state regulatory standard, which is set at 30 minutes, making it difficult to use these data to verify compliance with the state standard. It is also important to note that the Carroll Street Park monitoring site was relocated in 2008, and there are no data available at this monitoring site after 2008. As a result, data shown in table 5 below were collected at the Beaumont Mary monitoring site, which is located approximately 0.9 miles from the prior location and further away from local stationary emissions sources. Additionally, it is worth noting that the Beaumont Mary monitor did not collect complete hourly data in several of the years we analyzed. For example, in 2011 the monitor was operational less than 70% of the time, and in 2013 it was operational only 80% of the time. The TCEQ should take steps to ensure that this and other monitors are fully operational and collect complete data.

TABLE 5.

Maximum and average hourly hydrogen sulfide concentrations at Beaumont Mary*.

YEAR	MAXIMUM HOURLY CONCENTRATION (ppbv)	AVERAGE HOURLY CONCENTRATION (ppbv)	TOTAL HOURS COLLECTED
2010	15.54	0.81	1704
2011	28.05	0.77	5839
2012	23.85	0.79	8298
2013	22.59	1.03	6965
2014	48.90	1.11	8138
2015	36.97	0.63	6033

** Data shown in the table above were collected from 10/13/2010 to 9/21/2015, the most recent date for which data were publicly available. (30-minute regulatory standard: 80 ppbv):*

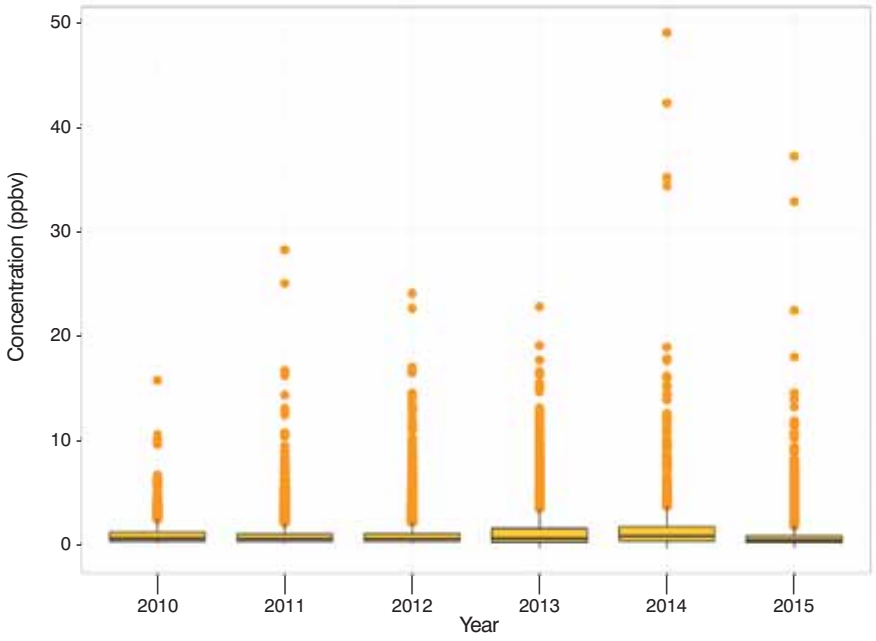

Figure 6. Boxplot of hydrogen sulfide measurements at the Beaumont Mary monitoring site (AQS: 482451050), 2006 – 2015. Data in 2015 only include January 1 to September 21, the most recent date for which data were publicly available as of September 2016. Because these hourly readings cannot be evaluated using the 30-minute state regulatory standard of 80 ppbv, the standard is not included on this chart. Dots represent outliers.

APWL 1002 – Benzene in Beaumont
(Removed 2009)

In multiple years prior to 2006, the annual average benzene concentrations at the Beaumont Carroll Street Park monitor exceeded the long-term AMCV of 1 ppbv. In October 2007, the TCEQ changed the long-term comparison value from 1 ppbv to a less protective value of 1.4 ppbv. Since the adoption of this less protective AMCV, average concentrations of benzene have been below 1.4 ppbv (TCEQ, 2010). Because the Carroll Street Park monitoring site was relocated in 2008, data for this area were collected from the Beaumont Downtown monitoring site. From 2006 to 2015, average concentrations based on 24-hour readings taken every sixth day were below the most recently adopted long-term AMCV (see Figure 7 and Figure 8), and maximum hourly monitoring data were below the short-term AMCV of 180 ppbv as shown in Table 6.

TABLE 6.

Maximum hourly benzene concentrations at Beaumont Downtown (ppbv) (Short-term AMCV: 180 ppbv)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
11.16	14.00	14.00	6.46	23.98	9.04	28.93	8.24	7.47	9.62

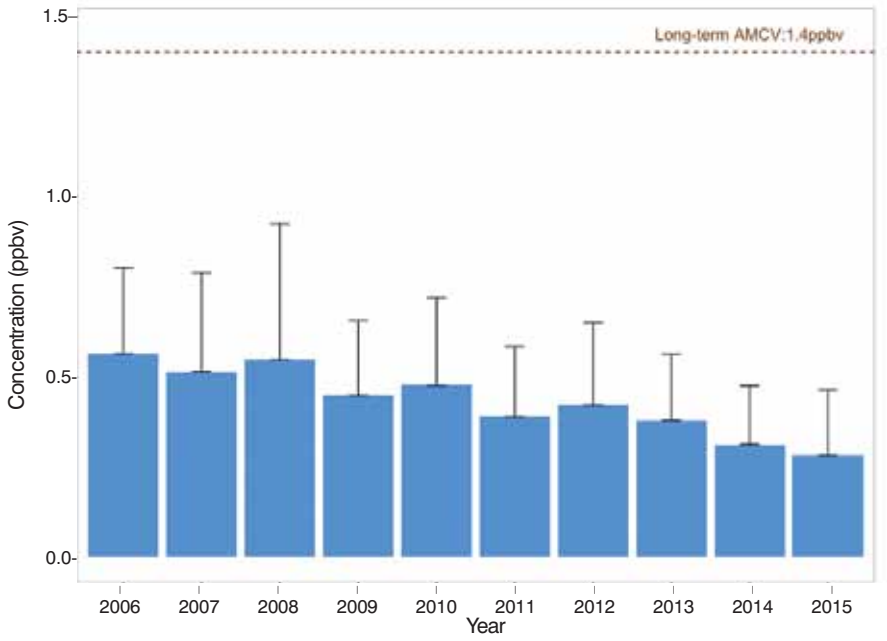

Figure 7. Annual average benzene concentrations (+/- SD) at the Beaumont Downtown monitor (AQS: 482450009), 2006 – 2015. Annual averages are based on 24-hour data taken every sixth day.

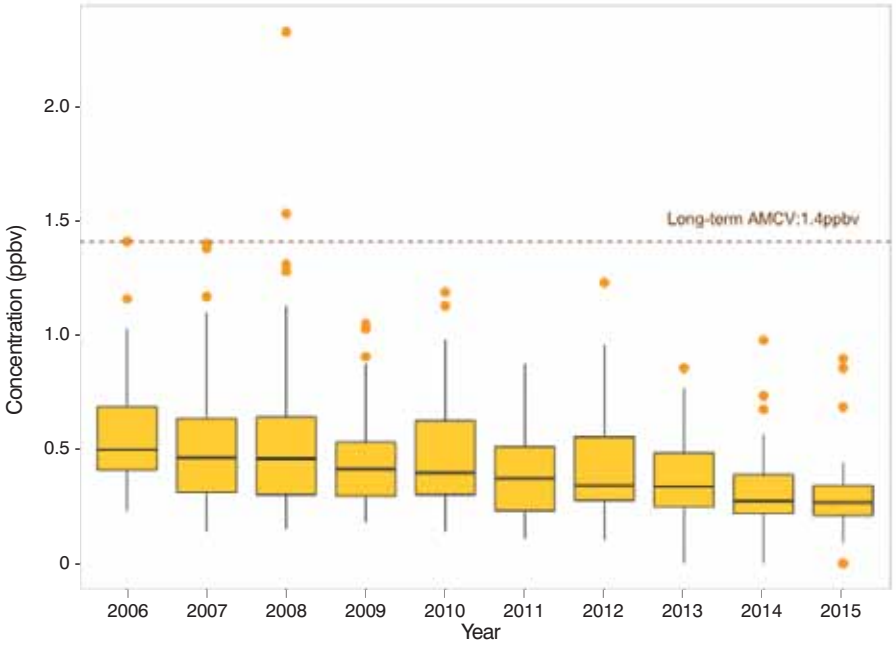

Figure 8. Boxplot of benzene measurements at the Beaumont Downtown monitor (AQS: 482450009), 2006 – 2015. Dots represent outliers.

APWL 1207 – 1,3-Butadiene in Milby Park (Removed 2009)

Prior to 2008, the annual average 1,3-butadiene concentrations were well above the recommended long-term average concentration of 1 ppbv from the EPA's 2002 health assessment, and therefore were considered to be elevated (TCEQ, 2010). The TCEQ revised the AMCV for 1,3- butadiene in August 2008, changing the long-term AMCV from 1 ppbv to a less protective value of 9.1 ppbv[6]. While the annual averages were below the less protective AMCV for several years, the annual average concentrations of 1,3-butadiene (based on hourly concentrations collected at the Milby Park monitor) were above the AMCV of 9.1 ppbv in 2014 and 2015 (see Figure 9). In addition, after several years of relatively low maximum hourly concentrations, there were concerning spikes in 2014 and 2015 (Table 7). We recommend that TCEQ relist Milby Park for 1,3-butadiene to address these concerns.

Although hourly monitoring data of 1,3-butadiene were all below the short-term AMCV of 1700 ppbv (see Table 7), it is worth noting that after several years of relatively low maximum concentrations registered from 2007-2013, maximum 1,3-butadiene hourly concentrations spiked to 1,208 ppbv in 2014 and 842 ppbv in 2015 (see Table 7), potentially indicating short-term emissions events. To safeguard the public against potential health risks from short-term exposures, the TCEQ should do more research to determine why these high concentrations occurred in 2014 and 2015.

TABLE 7.

Maximum hourly 1,3-butadiene concentrations at Milby Park (ppbv) (Short-term AMCV: 1700 ppbv)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
1611.25	73.93	29.32	36.62	107.31	62.50	56.85	58.17	1207.88	842.40

[6]: More information available here: https://www.tceq.texas.gov/toxicology/esl/ESLMain.html/#elevels

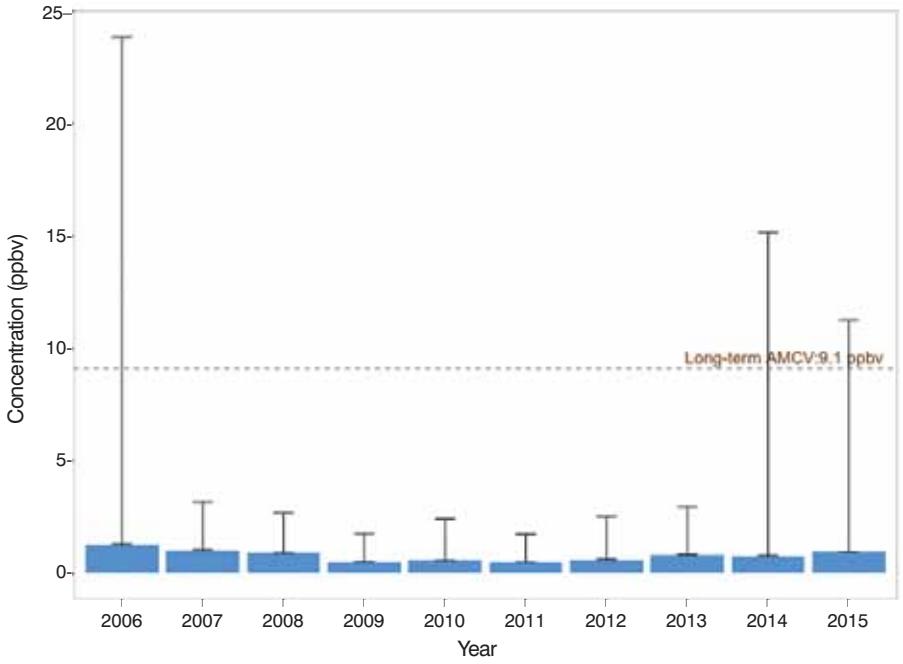

Figure 9. Annual average 1,3-butadiene concentrations (+/- SD) at the Milby Park monitor (AQS: 482010069), 2006 – 2015. Annual averages are based on hourly concentrations of 1,3-butadiene.

APWL 1204 – Benzene in Lynchburg Ferry Area of Houston (Removed 2010)

Although annual benzene concentrations in the Lynchburg Ferry area have been elevated above a level of health concern since 2003, detected concentrations at the Lynchburg monitoring site reported an overall decrease of benzene concentrations from 2005 to 2009 (TCEQ, 2010). In this study, annual averages of benzene concentrations based on hourly data collected between 2006 and 2015 were compared to the long-term AMCV. Hourly data were compared to the short-term AMCV as presented in Figure 10 and Figure 11. No annual average since delisting exceeded the long-term AMCV, and through 2015, only one hourly data reading exceeded the short-term AMCV since the area was removed from the APWL in 2010. However, available monitoring data for 2016 showed a concerning spike in benzene concentrations to 276.03 ppbv, well above the AMCV of 180 ppbv, indicating a likely emissions event and underlining the need for vigilance to ensure that exceedances do not continue to occur in this area[7].

TABLE 8.

Maximum hourly benzene concentrations at Lynchburg Ferry (ppbv) (Short-term AMCV: 180 ppbv)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
418.98	912.74	777.09	209.35	246.49	94.84	57.19	102.55	62.30	69.17

[7] We analyzed publicly available data through July 31, 2016.

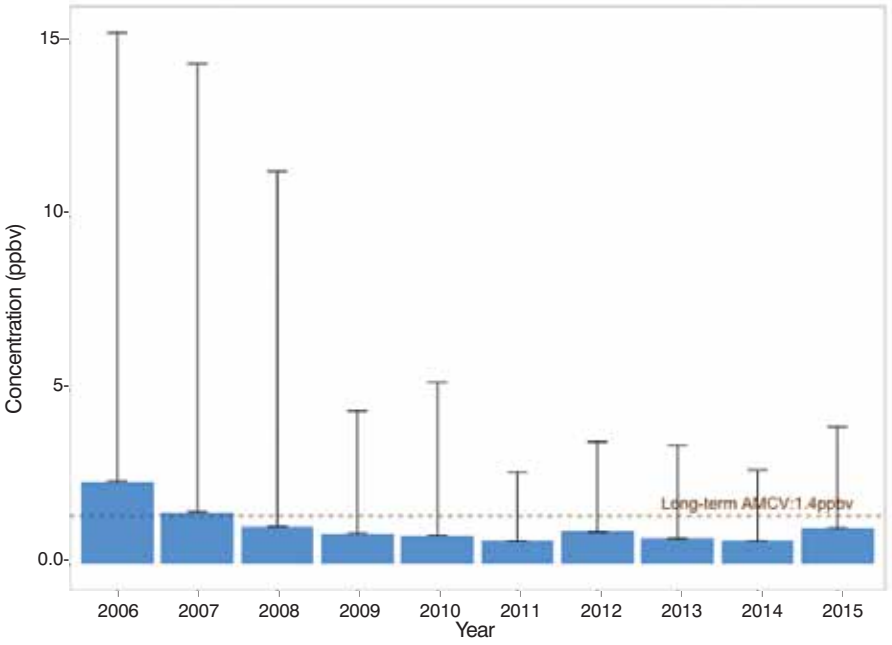

Figure 10 Annual average benzene concentrations (+/- SD) at the Lynchburg Ferry monitor (AQS: 482011015), 2006 – 2015. Annual averages are based on hourly benzene concentrations.

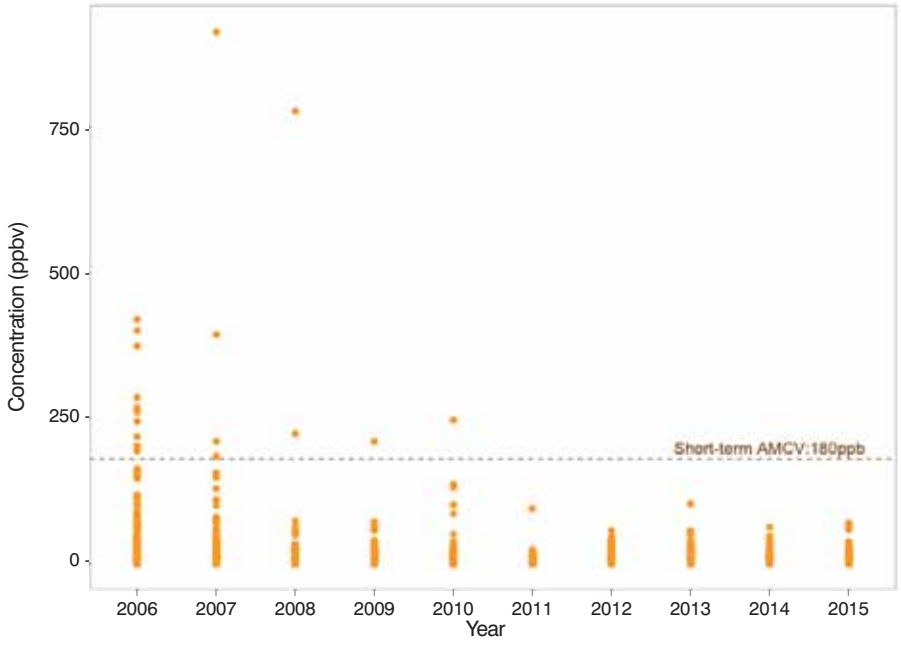

Figure 11. Hourly benzene measurements at the Lynchburg Ferry monitor (AQS: 482011015), 2006 – 2015.

APWL 1203 – Benzene in Texas City
(Removed 2007)

The TCEQ reported that annual benzene concentrations detected using Auto-GC monitors at the Texas City 34th Street monitoring site were above the AMCV in 2003 and 2004. Since 2005, average benzene concentrations have been below the long-term AMCV, and in 2007, the TCEQ determined that benzene concentrations at the Texas City 34th Street monitoring site were no longer a concern and removed benzene from the area's APWL listing (TCEQ, 2009d). EDF submitted a Public Information Request (PIR) dated July 13, 2015, to obtain monitoring data for this area, as the data at this site are not available to the public. The results are presented in Figure 12 and Table 9. From 2007 to March 2015 (the last date for which data was available at the time of the PIR), neither annual average benzene concentrations nor hourly benzene concentrations exceeded the long- or short-term AMCVs. However, as shown in Table 9, the maximum hourly benzene concentration in 2012 was more than 9 times larger than the average of maximum values from the five preceding years. We recommend that the TCEQ conduct more investigation into these large spikes to minimize potential human health risks to the public.

TABLE 9.

Maximum hourly benzene concentrations at Texas City 34th Street monitor (Short-term AMCV: 180 ppbv)*.

2007	2008	2009	2010	2011	2012	2013	2014	2015
14.14	8.43	13.84	6.51	16.00	110.32	3.84	11.20	4.10

** Data shown in the table above were collected from 01/01/2007 to 03/31/2015.*

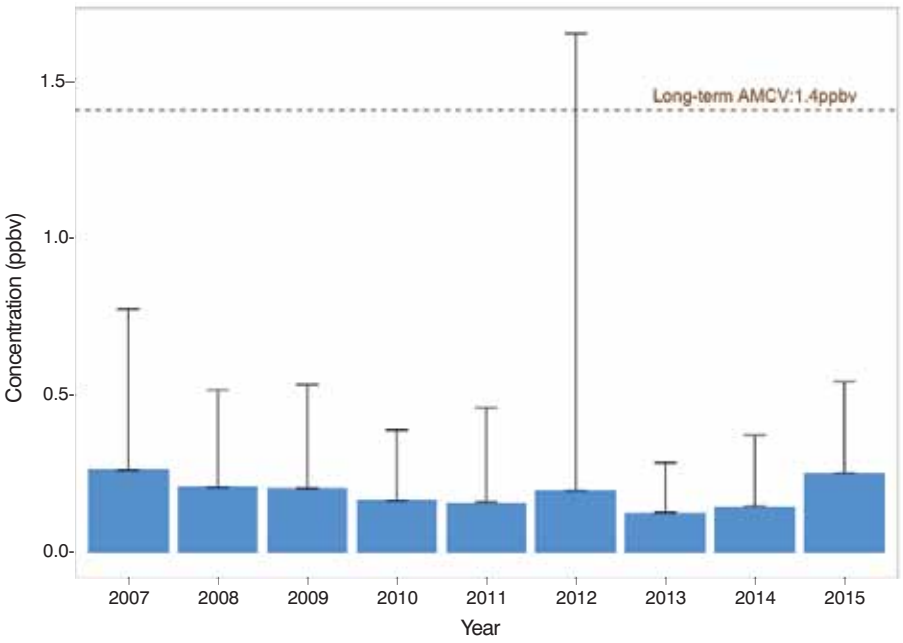

Figure 12. Annual average benzene concentrations (+/- SD) at the Texas 34th Street Monitor (AQS: 481670056), 2007 – 2015. Annual averages are based on hourly benzene concentrations. Data in 2015 only include January to March.

APWL 1202 – Benzene and hydrogen sulfide in Texas City (Removed 2014)

The removal of benzene and hydrogen sulfide from the Texas City APWL 1202 in 2014 was the subject of substantial public debate. EDF submitted comments to the TCEQ on May 10, 2013 arguing that existing monitoring data was insufficient to justify the delisting decision[8]. EDF's comments also identified considerable deficiencies with monitor siting and data analysis by the TCEQ and presented a differential analysis, which indicated that benzene emissions may have actually increased in some areas of Texas City from 2010 to 2012, and that communities downwind of certain emissions sources might experience annual average benzene concentrations higher than the long-term AMCV of 1.4 ppbv. The analysis found similar issues with the TCEQ's decision to delist hydrogen sulfide, recommending additional monitoring in areas downwind of identified sources of hydrogen sulfide emissions in Texas City.

Benzene

Benzene in Texas City was listed on the APWL because several stationary monitors in the Texas City area detected annual ambient concentrations of benzene above the long-term AMCV (TCEQ, 2010). There are six active monitors in this area, the names and locations of which are presented in Figure 13 (TCEQ, 2015c). Except for the monitoring data at Texas City 34th Street monitor, which is presented above and is located in APWL 1203, monitoring data collected at the other five monitors are presented in Figure 14 and Table 10. As of August 2015, monitoring data for the 11th Street, 31st Street, BP Onsite, and BP Logan Monitors from 2010 to March of 2015 were available to the public; however, these data and subsequent readings for these monitors were no longer publicly accessible as of September 2016. Monitoring data for the Ball Park monitor extending through July 31, 2016 were available publicly as of September 2016. In order to present data from all monitors in a comparable manner, Figure 14 and Tables 10 and 11 below include monitoring data from all 5 monitors from 2010 through March 2015.

Although no annual average benzene concentration exceeded the long-term AMCV between 2010 and March 2015, standard deviations for the data are relatively large, particularly in 2010 and 2011 at the BP Onsite monitor, indicating the persistence of short-term exceedances of the AMCV. Furthermore, Table 10 shows that maximum hourly benzene concentrations at the BP Onsite monitor exceeded the short-term AMCV of 180 ppbv for two consecutive years. In 2010, the maximum hourly concentration of 1329.05 ppbv was especially high – more than seven times larger than the short-term AMCV of 180 ppbv. Even for the year after benzene was removed from the APWL for this area in 2014, the maximum hourly benzene concentration at the Texas City 11th Street monitor in 2015 was nearly three times larger than the maximum values at other monitors.

[8] EDF submitted joint comments together with the organization Air Alliance Houston (AAH), available at https://www.tceq.texas.gov/toxicology/apwl/list.html.

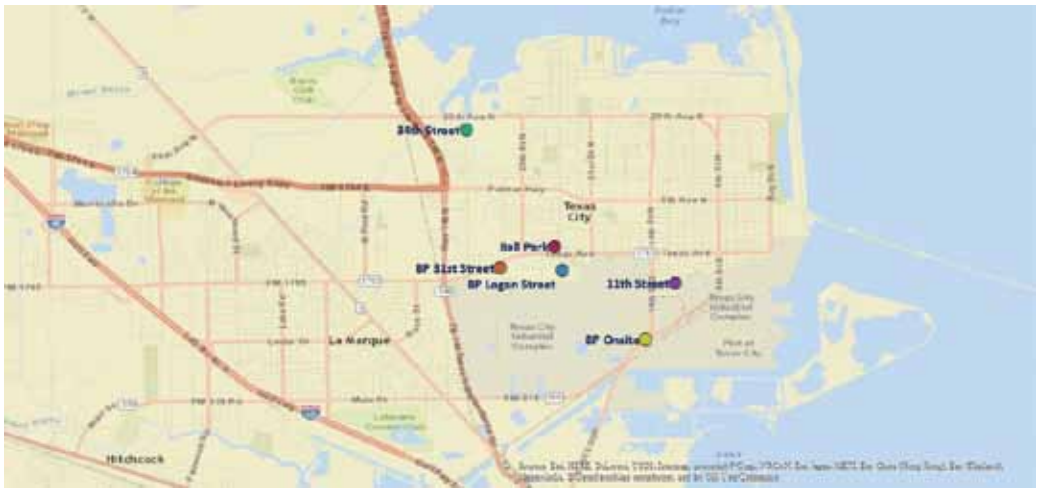

Figure 13. Monitoring locations in Texas City. Source: (TCEQ, 2015c)

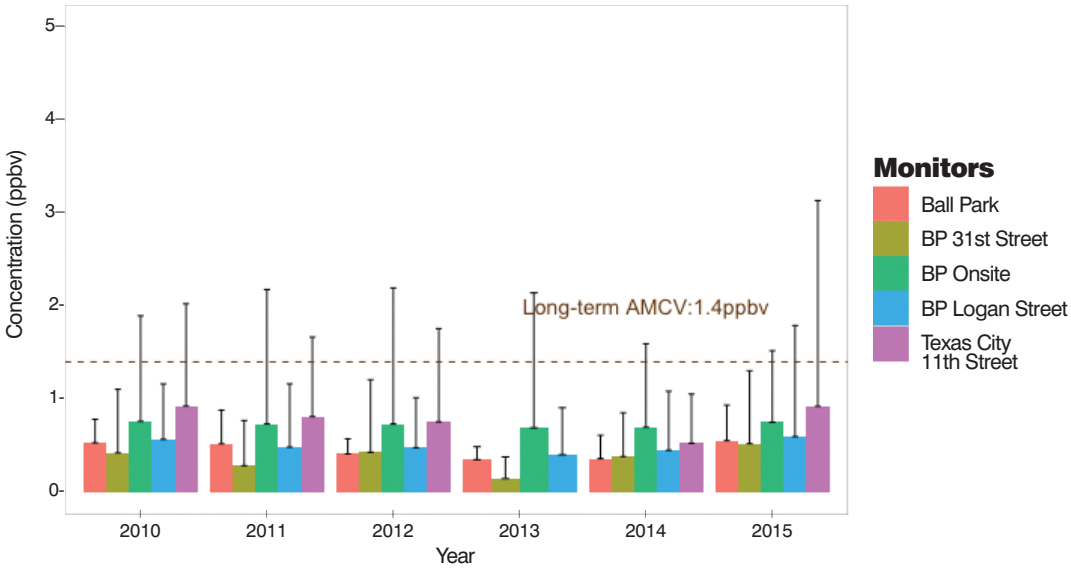

Figure 14. Annual average benzene concentrations (+/- SD) at five monitors in Texas City, 2010 – 2015. While illustrated on the same graph for convenience, data from these individual monitors should not be compared directly. With the exception of the Ball Park monitor (AQS: 481670005), for which annual averages are based on 24-hour data collected every sixth day, annual averages are calculated based on hourly concentrations recorded at the other monitors. Data for 2015 only include January 1 to March 31. In 2010, 2 extreme readings at the BP 31st Street monitor are excluded from this figure because they are so large that they distort the scale of the figure. Information about these readings – which are both more than 6 times as large as the short-term AMCV of 180 ppbv - is provided in table 10 below.

TABLE 10:

Extreme benzene concentrations at the BP 31st Street monitor, excluded from Figure 14 above (Short-term AMCV: 180 ppbv).

DATE	TIME	VALUE (PPBV)
6/1/2010	12:00	1158.69
6/1/2010	14:00	1329.05

TABLE 11.

Maximum hourly benzene concentrations in Texas City, 2010 – 2015 (Short-term AMCV: 180 ppbv)*.

YEAR	BP 31ST STREET (AQS: 481670615)	BP ONSITE (AQS: 481670616)	BP LOGAN STREET (AQS: 481670621)	TEXAS CITY 11TH STREET (AQS: 481670683)
2010	21.69	1329.1	12.08	25.2
2011	10.25	220.82	21.77	25.97
2012	12.63	37.49	12.02	22.02
2013	4.01	26.98	27.4	--
2014	7.99	18.39	18.74	8.55
2015	11.08	13.76	15.88	57.89

** Unit: ppbv. Data shown in the table above were collected from 01/01/2007 to 03/31/2015..*

Hydrogen sulfide

Hydrogen sulfide was placed on the Texas City APWL due to a 2004 mobile monitoring trip that detected hydrogen sulfide levels above the 30-minute state regulatory standard of 80 ppbv. Stationary monitoring data from the Texas City Ball Park monitor also indicated 69 exceedances of the state standard in 2004 and 16 exceedances in 2009 (TCEQ, 2012). However, as mentioned above, instead of 30-minute monitoring data for comparability with the state standard, only hourly data for hydrogen sulfide is available on the TCEQ's online TAMIS database (Table 12). Between 2008 and February 2016, the year 2009 represented the highest maximum hourly concentration of hydrogen sulfide, almost reaching the 30-minute state regulatory standard. After 2009, recorded maximum concentrations decreased dramatically, ranging from 15.93 to 35.11 ppbv between 2010 and 2014. The maximum hourly concentration of hydrogen sulfide in 2015 was substantially higher than in other years, indicating a potential large-scale emissions event.

TABLE 12.

Maximum and average hourly hydrogen sulfide concentrations at Texas City Ball Park Monitor.*

YEAR	MAXIMUM HOURLY CONCENTRATION (ppbv)	AVERAGE OF HOURLY CONCENTRATION (ppbv)	TOTAL HOURS COLLECTED
2008	32.61	1.34	7718
2009	71.93	1.03	7678
2010	27.40	0.85	8381
2011	35.11	0.74	8035
2012	15.93	1.36	7524
2013	16.88	0.43	7762
2014	19.32	0.70	8126
2015	51.10	1.14	8245

**The 30-minute state regulatory standard for hydrogen sulfide is 80 ppbv. However, these hourly concentrations cannot be compared to the 30-minute standard.*

APWL 1202 – Acrolein, butyraldehyde and valeraldehyde (Removed 2010)

According to a report on APWL1202 by the TCEQ, concentrations of acrolein, butyraldehyde, and valeraldehyde were detected above the odor-based AMCV during mobile monitoring investigations in 2001. Follow-up mobile monitoring investigations indicated an apparent decrease in the frequency of exceedances, and thus the TCEQ removed these three pollutants from the Texas City APWL in 2010 (TCEQ, 2009a). However, monitoring data for these three pollutants are not available to the public, and the TCEQ did not provide monitoring data after a PIR was submitted dated July 13, 2015.

APWL 0701 – Ethylene in Odessa (Removed 2007)

Prior to 2005, hourly ethylene concentrations detected at the Hays Elementary School monitor had exceeded the short-term vegetation AMCV of 1200 ppbv, and therefore were potentially damaging to certain plant species (TCEQ, 2009c). Between 2006 and January 2014, one hourly concentration above the AMCV was observed in 2007 (see Table 13). The TCEQ has reported that there has been no hourly concentration exceeding the AMCV since 2006 (TCEQ, 2009c). No monitoring data are publicly available for this site after January 2014, and the TCEQ has not provided up-to-date ethylene monitoring data, even following a PIR request dated July 13, 2015.

TABLE 13.

Dates of ethylene hourly concentration above short-term vegetation AMCV of 1200 ppbv. Data collected at the Hays Elementary School monitor (AQS: 481350003), 2006 – 2014*.

DATE	TIME (CENTRAL STANDARD TIME)	CONCENTRATION (ppbv)
10/05/2007	11:00 p.m.	1632.5

** Data shown in the table above were collected from 01/01/2006 to 01/31/2014*

APWL 1401 – 1,2-Dichloroethane in Point Comfort (Removed 2007)

1,2-Dichloroethane concentrations are monitored using monitors sponsored by Formosa Plastics Corporation in Odessa. However, monitoring data at Formosa Plastics Corporation sites are not available to the public and require a PIR to obtain. Even after a PIR to the agency, the TCEQ has not provided monitoring data for 1,2-dichloroethane in Point Comfort, stating that they do not have these data.

APWL 1101 – Hydrogen Sulfide in Bastrop (Removed 2012)

The TCEQ listed Bastrop on the APWL in response to hydrogen sulfide concentrations above the state standard downwind of Griffin Industries in 2007. The region was delisted in 2012 (TCEQ, 2009b). Again, mobile monitoring data at Bastrop regarding Griffin Industries are not available to the public, and the TCEQ has not provided monitoring data, even after a PIR was submitted dated July 13, 2015.

APWL 1003 – Benzene in Port Arthur
(Removed 2014)

The TCEQ listed benzene in Port Arthur on the APWL in 2001 because annual average benzene concentrations were above the prior long-term AMCV of 1.0 ppbv and also exceeded the current long-term AMCV of 1.4 ppbv for the years 1999 through 2001 (TCEQ, 2012). Figure 15 presents the average benzene concentrations, and Figure 16 presents large spikes in concentrations from 2006 to 2015. No average annual benzene concentration has exceeded 1.4 ppbv. However, multiple spikes above the AMCV have occurred in almost every year since 2006, including a spike of 6.95 ppbv in 2015, the year after the area was removed.

TABLE 14:

Maximum 24-hour benzene concentrations at Port Arthur City Service Center. (Long-term AMCV: 1.4 ppbv)*

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
1.91	1.8	21.92	5.2	5.41	1.92	1.75	1.85	1.82	6.95

** Note that these 24-hour concentrations collected every sixth day cannot be compared to hourly concentrations collected at other sites.*

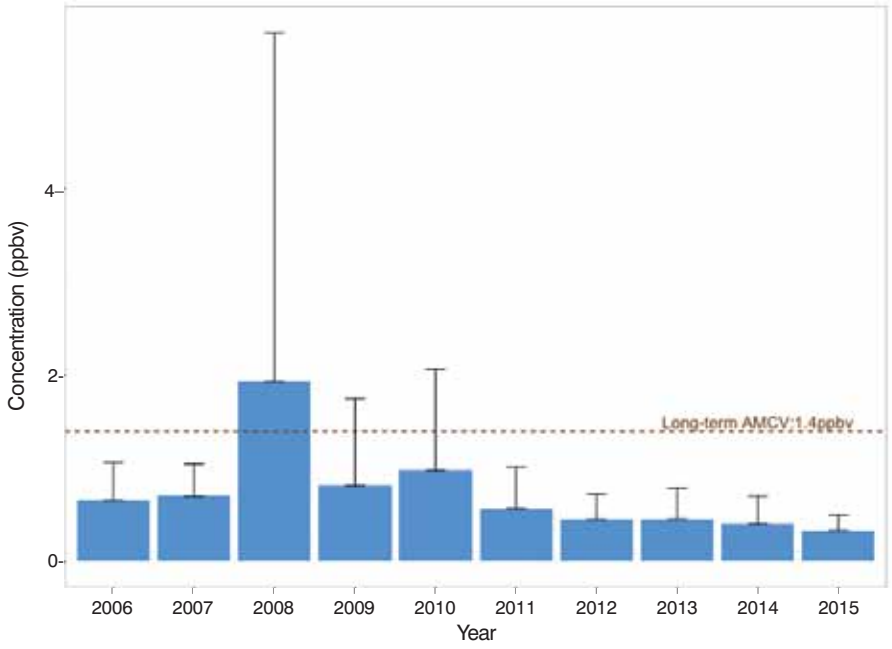

Figure 15. Annual average benzene concentrations (+/- SD) at the Port Arthur City Service Center monitor (AQS: 482450019), 2006 – 2015. Annual averages are based on 24-hour data collected every sixth day.

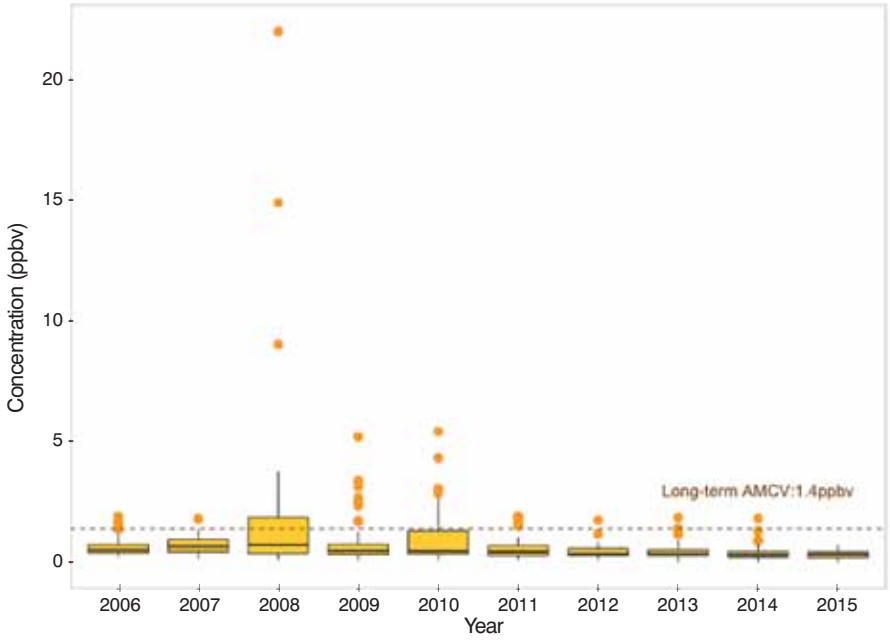

Figure 16. Boxplot of benzene measurements at the Port Arthur City Service Center monitor (AQS: 482450019), 2006 – 2015.

APWL 1204 – Styrene in Lynchburg Ferry Area of Houston (Removed 2014)

Styrene was placed on the Lynchburg Ferry Area APWL due to frequent odor-based AMCV exceedances in 2003. Beginning in 2006, TCEQ has reported hourly styrene concentrations detected at the Lynchburg Ferry monitor that appeared to be on a downward trend (TCEQ, 2010). Regardless, six hours of styrene concentrations were above the odor-based AMCV of 25 ppbv in 2012, and one exceedance was recorded in 2013 (see Table 15), as compared to 52 cases of exceedances in 2006 (presented in Table 16). As compared to the year the area was removed in 2014, when there were no exceedances, two exceedances were recorded in 2015, and two additional exceedances were recorded in April of 2016[9]. These 2016 exceedances are up to 5.6 times larger than the AMCV – 78.4 ppbv and 142.6 ppbv, respectively - and are substantially higher than any hourly concentration recorded from 2012 to 2014, suggesting that styrene emissions events appear to have become more frequent and more acute since the area was delisted in 2014.

TABLE 15:

Dates of styrene hourly data above odor-based AMCV of 25 ppbv at Lynchburg Ferry, 2012-2015

DATE	TIME (CENTRAL STANDARD TIME)	CONCENTRATION (ppbv)
05/01/2012	2:00 a.m.	47.51
13/06/2012	4:00 a.m.	29.61
18/07/2012	6:00 a.m.	37.82
28/08/2012	9:00 p.m.	38.59
28/09/2012	5:00 p.m.	56.58
16/11/2012	9:00 p.m.	39.91
18/11/2013	0:00 a.m.	43.25
10/02/2015	5:00 a.m.	26.41
12/11/2015	11:00 p.m.	26.80

[9] We examined publicly available 2016 data extending through July 31, 2016. Data in tables and figures are presented through December 31, 2015 for consistency.

TABLE 16:

Numbers of styrene odor-based AMCV exceedances at Lynchburg Ferry, 2006 – 2015 (Odor-based AMCV: 25 ppbv).

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
52	42	32	20	27	3	6	1	0	2

** Data shown in the table above were collected from 01/01/2006 to 12/31/2015*

APWL 1002 – Sulfur Dioxide in Beaumont (Removed 2016)

Sulfur Dioxide was placed on the Beaumont APWL in 2003 after the TCEQ detected air concentrations of sulfur dioxide above the 30-minute state regulatory standard of 320 ppbv. The 30-minute state regulatory standard of 320 ppbv is in addition to national ambient air quality standard (NAAQS) of 75 ppbv for sulfur dioxide set by the EPA. The additional state regulatory standard applies to Jefferson and Orange counties, and was adopted in 1992 as a measure to protect public health and welfare. As of August 1, 2016, which is the date the TCEQ published its proposal to delist sulfur dioxide from the Beaumont APWL, EPA classified Beaumont as "unclassifiable/ attainment" for the 1971 NAAQS (which preceded the 2010 standard)[10]. In its delisting document, the TCEQ cites a review of both monitors for sulfur dioxide located in this APWL area that found no exceedances of the state regulatory standard of 320 ppbv from 2012 through 2015. Since sulfur dioxide was added to the Beaumont APWL in 2003, at the Beaumont Downtown monitor, 21 exceedances of the state standard were recorded in 2004, 16 exceedances were recorded in 2009, and 16 exceedances were recorded in 2011. At the Carroll Street Park monitor, which was retired in July of 2008 and replaced by the Beaumont Mary monitor in 2010, 9 exceedances of the state standard were recorded in 2006 and 3 in 2007. No exceedances were recorded at the Beaumont Mary monitor from 2010 until its retirement in September 2015.

TABLE 17.

Average and maximum hourly sulfur dioxide concentrations at Beaumont SO_2 Downtown Monitor.*

YEAR	AVERAGE HOURLY CONCENTRATION (ppbv)	MAXIMUM HOURLY CONCENTRATION (ppbv)	TOTAL HOURS COLLECTED (ppbv)
2006	3.39	229.68	8553
2007	1.70	132.34	7763
2008	1.58	114.85	8063
2009	1.75	371.80	8431
2010	1.32	108.65	8567
2011	1.09	438.88	8489
2012	0.75	75.16	8683
2013	0.66	20.14	8533
2014	0.60	68.17	8641
2015	0.48	25.36	8592

**The 30-minute state regulatory standard for sulfur dioxide is 320 ppbv. However, these hourly data cannot be directly compared to this 30-minute standard.*

[10] The 1971 SO2 NAAQS set a 24-hour standard of 140 ppbv and an annual standard of 30 ppbv.

TABLE 18.

Average and maximum hourly concentrations at Beaumont Mary SO_2 monitor*

YEAR	AVERAGE HOURLY CONCENTRATION (ppbv)	MAXIMUM HOURLY CONCENTRATION (ppbv)	TOTAL HOURS COLLECTED (ppbv)
2010	1.75	66.60	1830
2011	1.33	92.67	5823
2012	1.01	95.91	8366
2013	1.03	100.49	7827
2014	0.76	22.78	8515
2015	0.61	53.83	5871

** Data for 2015 are only available through 09/21/2015, as the Beaumont Mary SO_2 monitor was retired on 9/22/2015. The 30-minute state regulatory standard for sulfur dioxide is 320 ppbv. However, these hourly data cannot be directly compared to this 30-minute standard.*

Discussion and Recommendations

The APWL program can be an important tool for protecting public health. The TCEQ explains that it "uses the APWL process to focus its resources, notify the public, engage stakeholders, and develop strategic actions to reduce emissions," and that it uses APWL designation as an important criterion for determining whether to apply additional scrutiny to air permit applications that would result in additional emissions of an APWL pollutant (TCEQ, 2015e). The importance of taking a precautionary approach to regulating air toxics is illustrated by the number of shelter in place events that occur in Texas every year. One example includes two fires within days of each other at industrial facilities in Texas, one of which triggered a "shelter in place" warning for a nearby school[11]. Accordingly, it is crucial to ensure that the air monitoring data the TCEQ uses for APWL listing and delisting decisions is collected and presented in a way that clearly and accurately represents both long-term and short-term risks to public health.

This analysis revealed shortcomings in the way that the TCEQ currently collects and reports these data. For some areas that have been delisted since 2007, a more detailed analysis of air monitoring data reveals continuing exceedances, suggesting that these areas should continue to be subject to additional scrutiny. Improving the rigor of the TCEQ's data analysis and making a more detailed rendering of these data available to the public would provide valuable information important in protecting public health.

A summary of key observations from our analysis of each APWL area is provided in Table 19 below:

TABLE 19:

Key Observations from analysis of areas removed from the APWL

APWL AREA	KEY OBSERVATIONS
APWL 1402 – Benzene in Corpus Christi (Removed 2010)	• While annual average concentrations have been below the AMCV since delisting, frequent emissions spikes persist that exceed the AMCV and could endanger public health.
APWL 1004 – 1,3-Butadiene in Port Neches (Removed 2009)	• Annual average concentrations have remained below the revised AMCV of 9.1 ppbv since delisting.

[11] The first of these fires occurred at an ExxonMobil refinery in Baytown on April 7, 2016. No employees were injured, and ExxonMobil stated that there was no need for the community to shelter in place. The second fire occurred on April 8 at a Lyondell Basell plant in southeast Houston. Students at a nearby middle school were instructed to stay indoors until further notified.

APWL AREA	KEY OBSERVATIONS
APWL 1002 – Hydrogen Sulfide in Beaumont (Removed 2009)	• Hourly air quality data provided by the monitoring network cannot be used to evaluate whether air concentrations comply with the 30-minute regulatory standard for hydrogen sulfide.
APWL 1002 – Benzene in Beaumont (Removed 2009)	• Annual average concentrations have remained below the revised AMCV of 1.4 ppbv since delisting.
APWL 1207 – 1,3-Butadiene in Milby Park (Removed 2009)	• Maximum hourly concentrations spiked in 2014 and 2015, potentially indicating a reemerging problem with short-term emissions events.
APWL 1204 – Benzene in Lynchburg Ferry Area of Houston (Removed 2010)	• Annual average concentrations from 2010-2015 were below the AMCV. However, an emissions spike in 2016 indicates a likely emissions event and underlines the need for vigilance in this area.
APWL 1203 – Benzene in Texas City (Removed 2007)	• While average and hourly benzene concentrations do not exceed AMCVs, a large emissions spike occurred in 2012, potentially posing a public health risk.
APWL 1202 Benzene and Hydrogen Sulfide in Texas City	• Monitoring data for benzene were no longer publicly accessible as of September 2016. • Short-term exceedances of the AMCV persisted in this area during the time period monitored, including one reading more than seven times larger than the short-term AMCV for benzene. • Hourly air quality data provided for hydrogen sulfide cannot be compared to the 30-minute state regulatory standard.
APWL 1202 –Texas City Acrolein, butyraldehyde and valeraldehyde (Removed 2010)	• The maximum hourly concentration of hydrogen sulfide in 2015 was substantially higher than in other years, indicating a potential large-scale emissions event.
APWL 0701 – Ethylene in Odessa (Removed 2007)	• Monitoring data for this site are not available to the public after January 2014, and the TCEQ has not provided up to date monitoring data in response to a PIR dated July 13, 2015.
APWL 1401 – 1,2-Dichloroethane in Point Comfort (Removed 2007)	• Monitoring data for this site are not available to the public and require a PIR. As of September 2016, TCEQ had not provided data for this area in response to a PIR, stating that they do not have these data.
APWL 1101 – Hydrogen Sulfide in Bastrop (Removed 2012)	• Mobile monitoring data regarding hydrogen sulfide in Bastrop are not available to the public, and as of September 2016 the TCEQ had not provided data in response to a PIR dated July 13, 2015.

APWL AREA	KEY OBSERVATIONS
APWL 1003 – Benzene in Port Arthur (Removed 2014)	• While annual average concentrations have not exceeded the AMCV since delisting, multiple spikes above the AMCV have occurred in almost every year since 2006, including in 2015, the year after the area was removed.
APWL 1204 – Styrene in Lynchburg Ferry Area of Houston (Removed 2014)	• Exceedances of the AMCV were recorded in 2015 and 2016, with concentrations substantially higher than any concentration recorded from 2012 to 2014, suggesting that styrene emissions events have become more frequent and more acute since the area was delisted in 2014.
APWL 1002 – Sulfur Dioxide in Beaumont (Removed 2016)	• Hourly air quality data provided by the monitoring network cannot be used to evaluate whether air concentrations comply with the 30-minute state regulatory standard for sulfur dioxide.

We believe that implementation of the recommendations discussed in detail below would result in significant improvements in the validity and transparency of APWL designations, as well as overall improvement in the air monitoring network:

- **The TCEQ should ensure that all monitoring equipment is reporting data accurately and consistently.** For example, in the case of benzene, the TCEQ used hourly data to calculate annual mean concentrations at six monitors located in three of the areas in this analysis, whereas it used 24-hour canister data collected every sixth day to calculate annual means at 4 monitors located in 4 areas in this analysis. Similarly, in the case of 1,3-butadiene, the TCEQ calculated annual mean concentrations based on hourly data in one area and on every sixth day 24-hour data in the other. The TCEQ should use consistent metrics in all APWL areas to ensure the appropriateness of its monitoring and listing decisions.
- This analysis detected multiple instances for which monitoring data exceeded AMCVs. One example of this is the large and repeated spikes in benzene emissions that occurred during almost every year from 2006 to 2015 in Corpus Christi, including a concentration of 9.65 ppbv detected on January 30, 2015, far exceeding the long-term AMCV of 1.4 ppbv. It is currently difficult to verify whether the TCEQ took appropriate follow-up measures in this case or others, as this information is not readily available to the public. **If any monitoring data exceed short-term and/or long-term AMCVs, the TCEQ should conduct further investigation, including a meteorological analysis, to identify the source of the exceedance and determine appropriate measures to address it.**
- Moreover, in light of the importance of its enforcement actions for public health, **the TCEQ should improve the transparency of its investigative and enforcement actions, in order to share information with the public about the measures that are taken in response to violation of AMCVs.**

- Both the TCEQ's APWL reports and its database for benzene and 1,3 butadiene lack evaluation of hourly data that is relevant for acute health effects, including maximum hourly concentrations and average hourly concentrations. **The TCEQ should assess its data collection protocols to ensure that its reports and database adequately report and evaluate hourly data that are needed to make informed decisions regarding acute health effects.**
- In 2013, the TCEQ proposed delisting benzene and hydrogen sulfide in APWL 1202 in Texas City. Air Alliance Houston and EDF submitted a public comment letter in July of 2013. The TCEQ did not issue a response until October of 2014. **The TCEQ should respond within 90 days to public comments regarding APWL delistings.**
- Air monitoring data for nine monitors located in the delisted APWL areas analyzed in this report are not currently available to the public, and as of September 2016 the TCEQ had not released complete monitoring data in response to Public Information Requests for four of these areas that were submitted on July 13, 2015. Moreover, in the case of Texas City, data from five monitoring sites that are analyzed in this paper and which were previously available to the public, have since been withdrawn from the TCEQ's published data and were unavailable as of September 2016. **The TCEQ should ensure that air monitoring data from all air monitoring sites are available to the public and that these data are up to date. These data should include not only 24-hour monitoring data collected every sixth day, but also hourly monitoring data.**
- The pollutant hydrogen sulfide is currently monitored on an hourly basis, while the state regulatory standard for hydrogen sulfide is specified on a 30-minute scale. Because monitoring concentration data are collected at a different scale, these data cannot be rigorously compared to the state standard. **The TCEQ should ensure that monitoring data for hydrogen sulfide are collected on a 30-minute scale to match the state regulatory standard, or provide a clear rationale for maintaining this difference.**

- In its APWL annual reports, the TCEQ included annual mean concentrations of pollutants as the only indicator to determine whether a pollutant is at a level of concern. However, EDF's analysis of TCEQ monitoring data shows substantial variability in concentration levels of monitored pollutants. Accordingly, while average annual concentrations for some delisted areas are below the relevant long-term AMCVs, these averages do not represent the variability of concentrations in these areas accurately, indicating persistence of short-term exceedances. In order to increase transparency regarding variability in concentration levels of pollutants and better protect public health, **the TCEQ should include more robust statistical analysis in its APWL annual reports. Among other items, the TCEQ should specify standard deviations, quartiles, and maximum values.** Currently, in order to fully assess and understand this important air quality information, members of the public must rely on raw data from TCEQ to conduct a full statistical analysis themselves.

[12] The EPA lists canister sampling as Toxic Organic method 15 (TO-15)

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