TCEQ Interoffice Memorandum

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Date: July 28, 2016

Subject: Toxicological Evaluation of 2015 Ambient Air Network Monitoring Data in Region 4, Dallas/Fort Worth

Conclusions

- All hourly and annual average concentrations of volatile organic compounds (VOCs) reported at Texas Commission on Environmental Quality (TCEQ) Region 4-Dallas/Fort Worth 1-hour automated gas chromatograph (autoGC) monitoring sites were below their respective short-term and long-term air monitoring comparison values (AMCVs), respectively, and would not be expected to cause acute or chronic adverse health effects, vegetation effects, or odor concerns.
- All 24-hour and annual average concentrations of VOCs and carbonyls from canister samples were below their respective TCEQ AMCVs and would not be expected to cause adverse health effects or vegetation effects.
- Reported concentrations of hydrogen sulfide (H_2S) were below the 30-minute state standard for residential areas.
- Annual average concentrations of all speciated metals were less than their respective TCEQ long-term AMCVs and would not be expected to cause chronic adverse health effects.
- At the Dallas-Morrell monitoring site, the annual average concentration of nickel, 0.0014 µg/m^3, reported as particulate matter with a diameter less than 10 micrometers in size (PM10), was below the long-term AMCV of 0.059 µg/m^3 for respirable carcinogenic forms of nickel (i.e., PM10) and would not be expected to cause chronic adverse health or vegetation effects. Additionally:
    - Although the Dallas-Morrell site currently remains on TCEQ's Air Pollutant Watch List (APWL0401) for nickel, the available data support removing this site from the APWL. This is based on information regarding the type of nickel detected as well as other site-specific data detailed below. This area is currently proposed for removal from the APWL.
- Air quality in the Barnett Shale area continues to be monitored. Detailed information is available on the TCEQ's Barnett Shale webpage.

Background

The Toxicology Division (TD) has reviewed ambient air sampling data collected from 32 network monitoring sites in TCEQ Region 4, Dallas/Fort Worth. The TD reviewed air monitoring summary results for VOCs and carbonyls from 1-hour and 24-hour samples collected continuously and every sixth-day, respectively. In addition, the TD evaluated the criteria

pollutant lead from a health perspective in this memorandum. For complete lists of all chemicals evaluated, please see Lists 1 through 4 in Attachment A. Table 1 lists the monitoring sites and provides a link to more information about the sites. A brief summary of the monitoring sites is provided below:

- 1-hour autoGC VOC monitoring at 15 sites
- Every sixth-day 24-hour canister VOC sampling at 13 sites
- Every sixth-day 24-hour carbonyl sampling at 2 sites
- H_2S sampling at 1 site
- Metals sampling at 8 sites ($PM_{2.5}$ speciation at the Dallas Convention Center monitor was deactivated on 12/31/2014, so it was not included in this evaluation)
    - Every sixth-day lead TSP sampling at 6 sites
    - Every sixth-day chromium and nickel PM_{10} or $PM_{2.5}$ sampling at 3 sites
    - Every third-day or sixth-day metals $PM_{2.5}$ sampling at 2 sites

Table 1. Monitoring Sites Located in TCEQ Region 4

Site Name and Location	County	EPA Site ID	Monitored Compounds
Arlington UT Campus, 1101 S. Pecan St.	Tarrant	48-439-1018	VOCs (autoGC)
Dallas Elm Fork, 2171 Manana Drive	Dallas	48-113-1505	VOCs (autoGC)
Dallas Hinton, 1415 Hinton Street	Dallas	48-113-0069	VOCs (autoGC, 24-hour canister), Carbonyl, Metals ($PM_{2.5}$), Lead (TSP)
Dallas Morrell, 3049 Morrell Street	Dallas	48-113-0018	Metals (PM_{10})
Decatur Thompson, 301 E Thompson Street	Wise	48-497-0088	VOCs (autoGC)
Denton Airport South, Denton Municipal Airport	Denton	48-121-0034	VOCs (24-hour canister)
DISH Airfield, 9800 Clark Airport Road	Denton	48-121-1013	VOCs (autoGC)
Eagle Mountain Lake, 14290 Morris Dido Newark Road	Tarrant	48-439-0075	VOCs (autoGC)
Everman Johnson Park, 633 Everman Parkway	Tarrant	48-439-1009	VOCs (autoGC)
Flower Mound Shiloh, 4401 Shiloh Road	Denton	48-121-1007	VOCs (autoGC)

Site Name and Location	County	EPA Site ID	Monitored Compounds
Fort Worth Benbrook Lake, 7001 Lakeside Drive	Tarrant	48-439-1503	VOCs (autoGC)
Fort Worth Joe B. Rushing Road, Road 2525 Joe B. Rushing Road	Tarrant	48-439-1065	VOCs (autoGC)
Fort Worth Northwest, 3317 Ross Avenue	Tarrant	48-439-1002	VOCs (autoGC, 24-hour canister), Carbonyls
Frisco 5th Street, 7471 South 5th Street	Collin	48-085-0003	Lead (TSP)
Frisco 7, 6931 Ash Street	Collin	48-085-0007	Lead (TSP)
Frisco Eubanks, 6601 Eubanks Street	Collin	48-085-0009	Lead (TSP)
Frisco Stonebrook, 7202 Stonebrook Parkway	Collin	48-085-0029	Lead (TSP)
Gainesville Doss Street, 1112 Doss Street	Cooke	48-097-1504	VOCs (24-hour canister)
Godley FM2331, 12404 FM2331	Johnson	48-251-1501	VOCs (autoGC)
Grapevine Fairway, 4100 Fairway Drive	Tarrant	48-439-3009	VOCs (24-hour canister)
Greenville, 824 Sayle Street	Hunt	48-231-1006	VOCs (24-hour canister)
Italy, 900 Farm to Market Road 667	Ellis	48-139-1044	VOCs (24-hour canister)
Johnson County Luisa, 2420 Luisa Lane	Johnson	48-251-1008	VOCs (24-hour canister)
Keller, FAA Site off Alta Vista Road	Tarrant	48-439-2003	VOCs (24-hour canister)
Kennedale Treepoint Drive, 5419 Treepoint Drive	Tarrant	48-439-1062	VOCs (autoGC)
Lancaster Cedardale, 1930 Cedardale Road	Dallas	48-113-1500	VOCs (24-hour canister)
Mansfield Flying L Lane, 1310 Flying L Lane	Johnson	48-251-1063	VOCs (autoGC)
Midlothian OFW, 2725 Old Fort Worth Road	Ellis	48-139-0016	VOCs (24-hour canister), Metals ($PM_{2.5}$), H_2S

Site Name and Location	County	EPA Site ID	Monitored Compounds
Mineral Wells 23rd Street, 2000 NE 23rd Street	Palo Pinto	48-363-1502	VOCs (24-hour canister)
Rhome Seven Hills Road, 639 CR 4651	Wise	48-497-1064	VOCs (autoGC)
Terrell Temtex, 2988 Temtex Boulevard	Kaufman	48-257-0020	Lead (TSP)
Weatherford Highway 180, 2253 Fort Worth Hwy	Parker	48-367-1506	VOCs (24-hour canister)

The TCEQ Monitoring Division reported the data for all chemicals evaluated in this memorandum. All data (84 VOCs (canister), 48 VOCs (autoGC), 17 carbonyls, H_2S, 16 metals ($PM_{2.5}$, PM_{10}, or TSP)) highlighted in this evaluation met TCEQ's data completeness objective of 75 percent data return except for the following:

- Arlington UT Campus (autoGC: 1,2,3-trimethylbenzene, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, n-decane, n-undecane)
- Dallas Hinton (autoGC: 1,2,3-trimethylbenzene, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, acetylene, n-decane)
- Everman Johnson Park (autoGC: 1,2,3-trimethylbenzene, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, n-decane, n-undecane)
- Fort Worth Benbrook Lake (autoGC: acetylene)
- Fort Worth Joe B Rushing Road (autoGC: 1,2,3-trimethylbenzene, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, acetylene, n-decane, n-undecane)
- Fort Worth Northwest (autoGC: 1,2,3-trimethylbenzene, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, acetylene, n-decane)
- Kennendale Treepoint Dr (autoGC: 1,2,3-trimethylbenzene, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, n-decane, n-undecane)
- Mansfield Flying L Lane (autoGC: acetylene)
- Rhome 7 Hills Road (autoGC: 1,2,3-trimethylbenzene, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, n-decane, n-undecane)

One-hour autoGC VOC samples were compared to TCEQ's short-term AMCVs. Twenty-four-hour air samples collected every third- or sixth-day for one year are designed to provide representative long-term average concentrations. In order to be able to evaluate 24-hour monitoring data more fully, TCEQ has developed 24-hour AMCVs for specific chemicals. As such, 24-hour samples were compared to the available TCEQ 24-hour AMCVs (1,3-butadiene, benzene, ethylene dichloride, acrolein, chromium, and formaldehyde). However, because short-term or peak concentrations are not necessarily captured by 24-hour samples, daily concentrations have limited use in evaluating the potential for acute health effects. Therefore, the TD evaluated the reported annual average concentrations from 1-hour autoGC and 24-hour

samples for each target analyte for potential chronic health and vegetation concerns by comparing measured chemical concentrations to their respective long-term AMCVs. More information about AMCVs is available on the Toxicology's AMCV webpage. H_2S samples were compared to the 30-minute state standard for H_2S.

As lead is a criteria pollutant, applicable lead TSP levels (i.e., rolling three-month averages) were compared to the appropriate comparison value (i.e., 0.15 µg/m^3); however, annual average lead TSP concentrations were also evaluated since they are more representative of long-term lead exposure from a health perspective.

Evaluation

VOCs

Short-Term Data

All hourly average concentrations of the 48 VOCs reported at the 15 autoGC sites were either not detected or below their respective short-term and 24-hour AMCVs. Therefore, acute adverse health effects, odorous conditions, or vegetation effects would not be expected to occur as a result of exposure to the reported levels of VOCs at these 15 autoGC monitoring sites.

Long-Term Data

The 2015 annual average concentrations of the 48 VOCs evaluated at the 15 autoGC monitoring sites and the 84 VOCs reported at each of the 13 every sixth-day 24-hour canister monitoring sites were well below their respective long-term AMCVs. Exposure to the reported annual average concentrations would not be expected to cause chronic adverse health or vegetation effects.

H_2S

All reported short-term H_2S concentrations measured at the Midlothian OFW site were below the 30-minute state residential standard of 80 ppb.

Carbonyls

The 2015 annual average concentrations of the 17 carbonyls reported at the Fort Worth Northwest and Dallas-Hinton sites were below their respective long-term AMCVs. Exposure to the reported annual average concentrations would not be expected to cause chronic adverse health or vegetation effects.

Metals

At the two sites reporting $PM_{2.5}$ metals data, annual average concentrations of all 16 metals were well below their respective long-term AMCVs. Exposures to the reported levels of these metals would not be expected to cause chronic adverse health and vegetation effects.

At the Dallas-Morrell site, only nickel and chromium were reported. The annual average concentrations of both nickel and chromium were below their respective long-term health-based

AMCVs. Exposure to the reported annual average concentrations of these two metals would not be expected to cause chronic, adverse health effects.

Nickel at the Dallas-Morrell Site

The City of Dallas Air Pollution Control Section operates the sampler located at the Morrell air monitoring site (AQS number 481130018), located at 3049 Morrell Avenue, Dallas, Texas. The monitoring site currently contains a high-volume sampler that collects particulate matter with diameter less than 10 micrometers in size (PM_{10}) trace metals on a filter over 24-hours, once every six days. A laboratory analysis is performed on each 24-hour sample to speciate the PM_{10} metal particles collected, enabling the TCEQ to determine the portion of the PM_{10} particulate matter that is nickel.

From 1987 to 2010, total suspended particulate (TSP) was collected and the nickel portion of the TSP was speciated and measured. For TSP data, the monitored nickel concentrations incorporated all particle size fractions less than 50 micrometers (and contained size fractions which are not in the respirable fraction). Due to consistently elevated TSP nickel concentrations, the TCEQ replaced the TSP sampler at the Morrell site with a PM_{10} sampler on August 17, 2010. The new sampler takes measurements that better represent the particle size fractions that could be inhaled (respirable particle size fractions) and are more directly comparable to the long-term nickel AMCV, which is also based on respirable particle size fractions of nickel particulate.

The long-term AMCV of 0.059 $\mu g/m^3$ for respirable nickel particles was derived based on risk of developing lung cancer following long-term, high-dose exposure to carcinogenic forms of nickel in occupational workers. Therefore, comparing nickel PM_{10} (post 2010) or TSP data (pre 2010) to the long-term AMCV for respirable nickel particles may be overly conservative for several reasons, including: differences in PM size fractions; differences in forms of nickel; and differences in health effects evaluated (i.e., non-carcinogenic and carcinogenic effects). Detailed information about the long-term AMCV and noncarcinogenic chronic AMCV for nickel is available in the nickel Development Support Document (DSD).

The air monitoring data from the Morrell site are representative of total nickel and do not specify the specific forms of nickel. However, DC Bumper, historically the most likely contributing nickel emissions source in the vicinity of the Morrell site, was known to emit mainly metallic nickel, based on the type of facility. The DC Bumper facility closed in November 2013.

Nickel TSP Monitoring, 1987-2010

Elevated annual nickel TSP levels were detected at the Morrell site from 1987-2010 (Figure 3, showing data from 1993-2010). Annual average nickel concentrations have decreased since 1995, and these reductions were attributed to actions taken by DC Bumper.

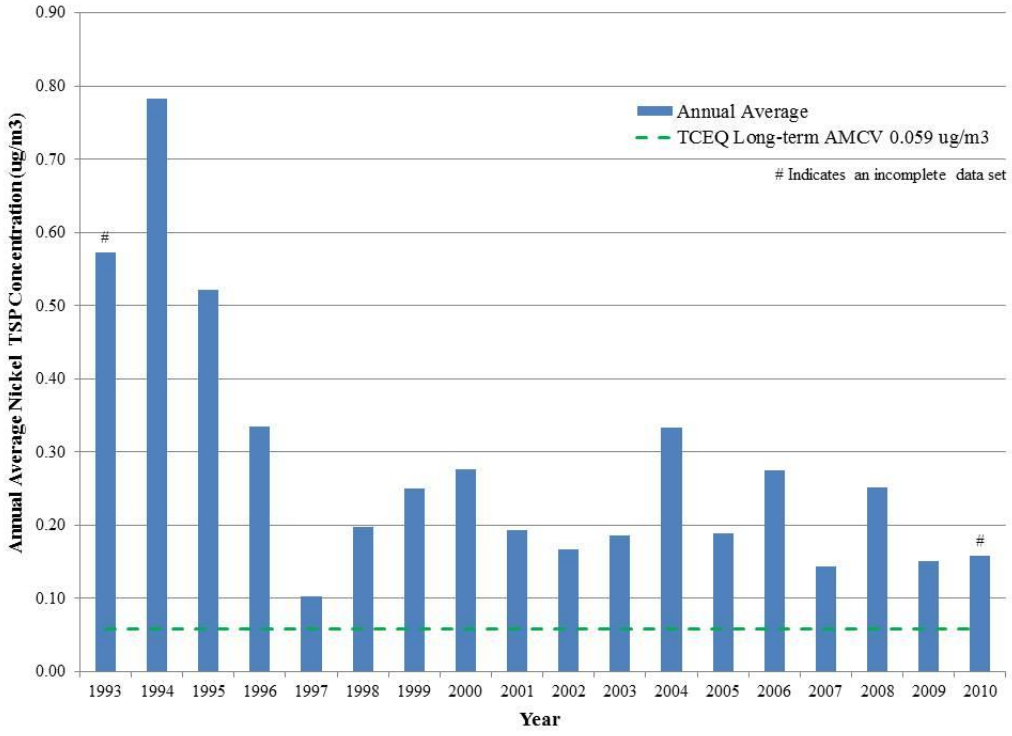

Figure 1. Nickel TSP trends from 1993 to 2010 as measured at the Morrell monitor

Collocated TSP and $PM_{2.5}$ Monitoring Study, 2009-2010

In order to address the issue of particle size at the Morrell site, and to better characterize the more toxicologically relevant nickel PM fraction for risk assessment of nickel exposure, a special monitoring study was conducted from April 2009 to August 2010 at the Morrell site. As mentioned above, only TSP samples have historically been collected at this site. During the special monitoring study, however, a new $PM_{2.5}$ monitor was collocated with the TSP monitor. $PM_{2.5}$ represents fine particulate, which is a more toxicologically relevant size fraction as it can be taken deep into the lungs.

The average reported nickel $PM_{2.5}$ concentration of 0.010 µg/m^3, collected at the Morrell site from April 1, 2009 to August 6, 2010, was below the long-term AMCV of 0.059 µg/m^3 for ambient nickel. Reported 24-hour nickel $PM_{2.5}$ levels ranged from non-detect to 0.065 µg/m^3. Based on 39 pairs of detected $PM_{2.5}$ and TSP levels, the TD determined that, on average, 9.49% of the total nickel in TSP was in the $PM_{2.5}$ fraction. The TD concluded that the annual $PM_{2.5}$ concentrations of nickel were likely below TCEQ's long-term AMCV of 0.059 µg/m^3 for nickel since 1996, as detailed in the 2010 Health Effects Review for Region 4, Dallas/Fort Worth.

Nickel PM_{10} Monitoring, 2010-present

In 2010, the TSP sampler was replaced with a PM_{10} sampler, and annual averages were then calculated based on the more appropriate respirable particle size (Figure 4). Annual average nickel PM_{10} concentrations were above the long-term AMCV in 2011, but these levels decreased in 2012 and decreased significantly after the primary source went out of business in 2013. The

2015 annual average nickel concentration of 0.0014 µg/m^3 was well below the long-term AMCV of 0.059 µg/m^3.

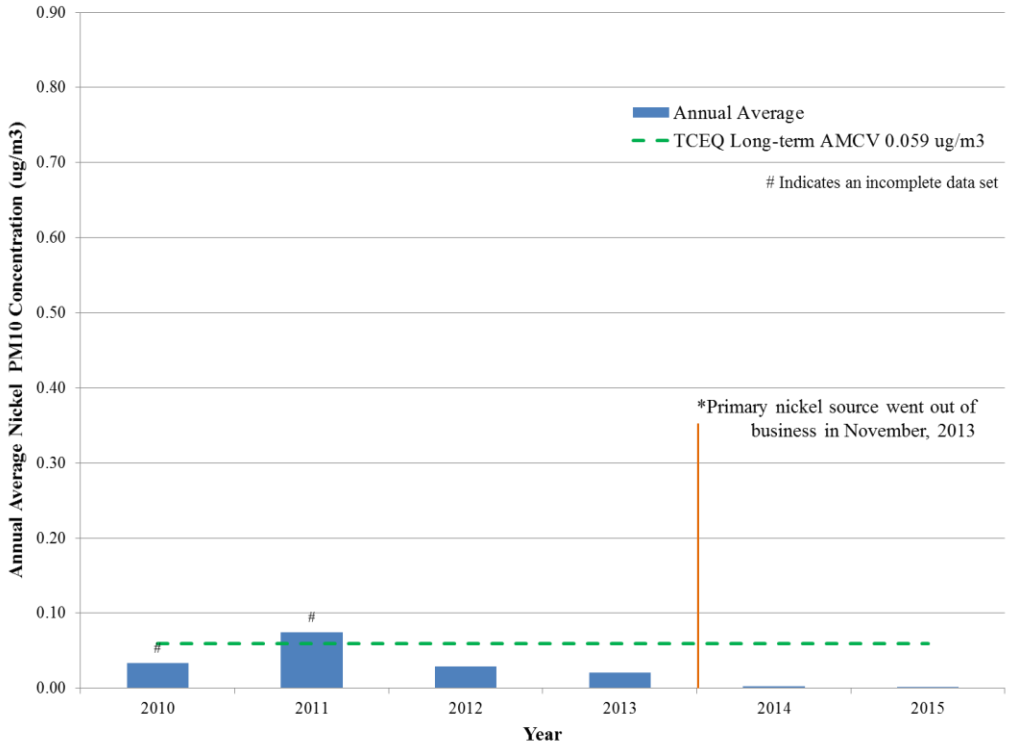

Figure 2. Nickel PM_{10} trends from 2010 to 2015 as measured at the Morrell monitor

Summary of Nickel Concentrations at the Dallas-Morrell Site

The 2015 annual average nickel concentration was below the long-term AMCV for respirable nickel particles. The air monitoring data from the Dallas-Morrell site are representative of total nickel concentrations and do not specify the specific forms of nickel, however this approach is very conservative, as described above. The TD recommends removal of nickel at the Dallas-Morrell site from the TCEQ's Air Pollutant Watch List (APWL0401), because the available ambient monitoring data, historical reviews detailed above, and the closure of the primary nickel emissions source in November of 2013 indicate that removal from the APWL is appropriate.

Lead

On November 12, 2008, the U.S. Environmental Protection Agency (EPA) finalized the new 0.15 µg/m^3 NAAQS for lead based on a rolling three-month average concentration (73 Federal Register 66964). In general, the rule requires source-oriented ambient air lead monitoring at sites with actual annual lead emissions of one or more tons per year. Based on their reported emissions, two lead-acid battery recycling facilities, namely Exide Technologies, Inc. and ECS Refining Texas LLC (hereafter called Exide and ECS, respectively), were subject to these source-oriented lead monitoring requirements in TCEQ Region 4. The 2015 rolling three-month averages of lead TSP at the Eubanks monitor near Exide were below the 0.15 µg/m^3 lead

NAAQS. The 2015 rolling 3-month averages of lead TSP at the Terrell Temtex site near ECS were also below the 0.15 µg/m^3 lead NAAQS.

Lead TSP Monitors around Exide

The Exide facility, a secondary lead smelter, was active from 1964 through November 2012. Three lead TSP monitors (Frisco 7, Frisco Eubanks, and Frisco 5th St.) were established in mid-1990 or earlier and an additional monitor (Frisco Stonebrook) was activated on January 7, 2011. Additional details about the Exide facility and surrounding area are available through the TCEQ websites for the remediation of the Exide site and the latest lead-related planning activities in the Dallas Fort Worth area. On November 30, 2012, Exide closed its doors, and clean up and demolition began in December of the same year.

Reported Lead TSP Concentrations from Monitors around Exide

Annual average concentrations of lead TSP from Frisco 7, Frisco Eubanks, and Frisco 5th St. monitors have been fairly consistent since 1995, with some variations (annual average lead TSP for 2002-2015 can be found in Figure 2). Higher concentrations have been reported from the Frisco Eubanks monitor and lower lead TSP concentrations were reported from all other monitors. While the NAAQS for lead was lowered ten-fold in 2008 from 1.5 to 0.15 µg/m^3, the ambient lead TSP concentrations around Exide did not change significantly at that time. However, since the closure of the facility in November of 2012, lead levels at the Eubanks monitor have fallen below the 0.15 µg/m^3 NAAQS. Lead concentrations, as measured by the three other ambient lead TSP monitors, have also continued to decline since that time.

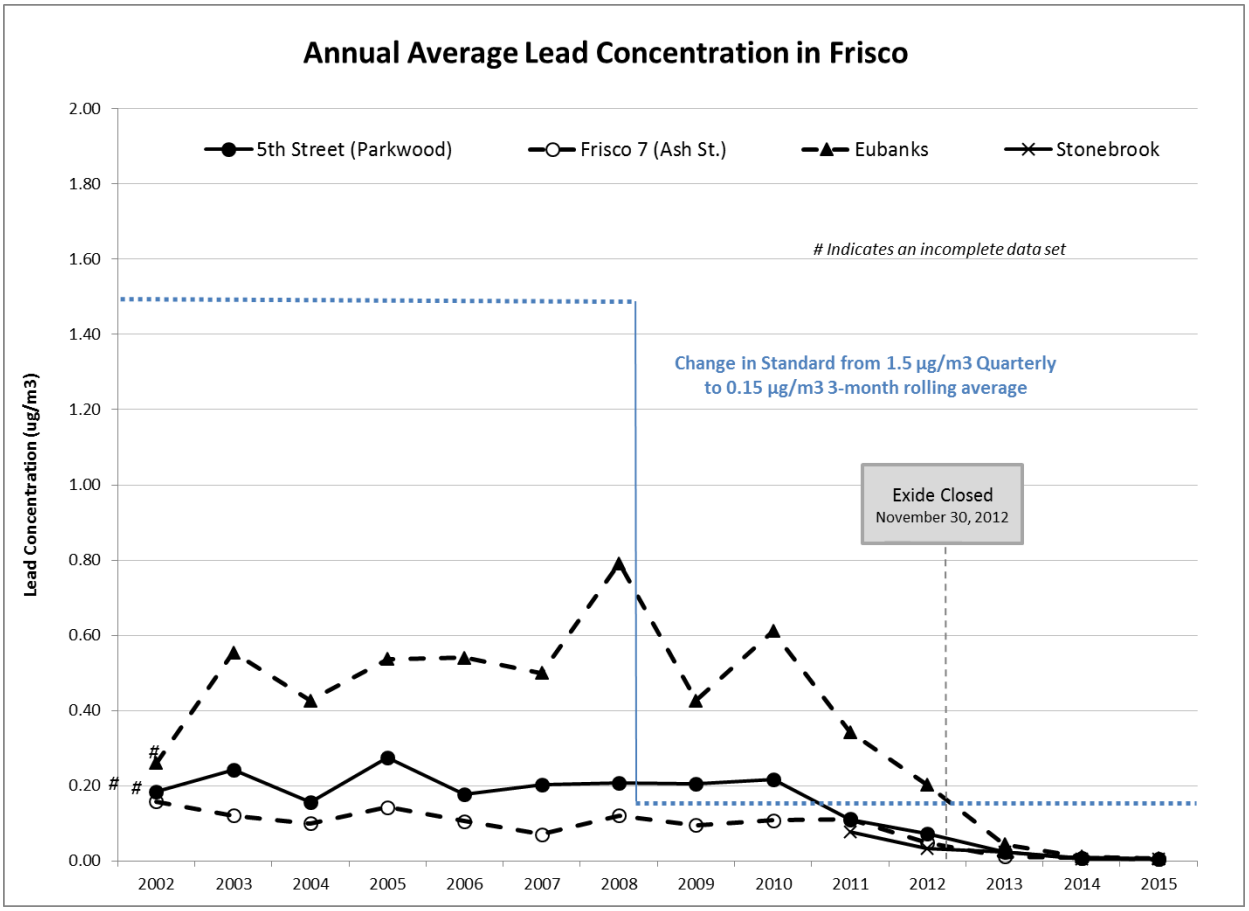

Figure 3. Annual Average Lead TSP Concentrations from Monitors around the Exide Facility from 2002 to 2015

Lead Summary

Although historical lead TSP concentrations at the Eubanks monitor near Exide exceeded the 0.15 µg/m^3 NAAQS, current air monitoring data indicate that lead concentrations are well below the NAAQS at all four monitor sites surrounding the facility and that the concentrations at the Eubanks monitor are now well below the 0.15 µg/m^3 NAAQS.

Investigations of Air Quality and Barnett Shale Activities

In response to concerns about air emissions from oil and gas operations in the Barnett Shale area, the TCEQ has performed extensive mobile monitoring and has significantly expanded the network of stationary samplers that measure VOCs. Based on the current complaint prioritization guidance updated on December 5, 2014, citizen complaints concerning odor from an oil or natural gas site with a TCEQ-documented odor nuisance condition in the previous 12 months will be given an "Expedited Response" priority for investigation. Complaints received that do not require dispatch of Emergency Response personnel, but that report human health effects are given an "Immediate Response" priority. For Expedited and Immediate Response complaints, an on-site investigation is conducted by the Dallas/Fort Worth Region staff within one working day

of receipt of the complaint by the regional office. All other oil and natural gas related complaints are given priority in accordance with the Field Operations Standard Operating Procedures. In addition, the Dallas/Fort Worth regional staff conducts periodic reconnaissance investigations in selected areas and the regional office also conducts monitoring, as time and resources permit, at the request of the public and other interested parties. Scheduled compliance investigations are also conducted at natural gas sites to determine compliance with applicable rules and regulations. Detailed information is available on the TCEQ's Oil and Gas Activities. For specific information about the Barnett Shale Area, click on the link for Barnett Shale Geological Area under the Air Quality section.

If you have any questions regarding the contents of this review, please do not hesitate to contact Shannon Ethridge by phone at (512) 239-1822 or via email at Shannon.Ethridge@tceq.texas.gov, or Jessica Myers by phone at (512) 239-3444 or via email at Jessica.Myers@tceq.texas.gov.

Attachment A

List 1. Target VOC Analytes in Canister Samples

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

List 2. Target Carbonyl Analytes

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

List 3. Target Metal Analytes

Aluminum ($PM_{2.5}$)	Chromium ($PM_{2.5}$, PM_{10} and TSP)	Molybdenum ($PM_{2.5}$)
Antimony ($PM_{2.5}$)	Cobalt ($PM_{2.5}$)	Nickel ($PM_{2.5}$, PM_{10} and TSP)
Arsenic ($PM_{2.5}$)	Copper ($PM_{2.5}$)	Selenium ($PM_{2.5}$)
Barium ($PM_{2.5}$)	Lead (TSP and $PM_{2.5}$)	Tin ($PM_{2.5}$)
Cadmium ($PM_{2.5}$)	Manganese ($PM_{2.5}$)	Zinc ($PM_{2.5}$)

List 4. Target VOC Analytes in AutoGC

1-Butene	Benzene	n-Decane
1-Pentene	c-2-Butene	n-Heptane
1,2,3-Trimethylbenzene	c-2-Pentene	n-Hexane
1,2,4-Trimethylbenzene	Cyclohexane	n-Nonane
1,3-Butadiene	Cyclopentane	n-Octane
1,3,5-Trimethylbenzene	Ethane	n-Pentane
2-Methylheptane	Ethyl Benzene	n-Propylbenzene
2-Methylhexane	Ethylene	o-Xylene
2,2-Dimethylbutane	Isobutane	p-Xylene + m-Xylene
2,2,4-Trimethylpentane	Isopentane	Propane
2,3-Dimethylpentane	Isoprene	Propylene
2,3,4-Trimethylpentane	Isopropyl Benzene - Cumene	Styrene
2,4-Dimethylpentane	Methylcyclohexane	t-2-Butene
3-Methylheptane	Methylcyclopentane	t-2-Pentene
3-Methylhexane	n-Butane	Toluene
Acetylene		