Health Consultation

Assessing the Public Health Implications of the Criteria
(NAAQS) Air Pollutants and Hydrogen Sulfide as part of the

MIDLOTHIAN AREA AIR QUALITY PETITION RESPONSE

MIDLOTHIAN, ELLIS COUNTY, TEXAS

APRIL 14, 2016

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Community Health Investigations
Atlanta, Georgia 30333

FOREWORD

Health Consultation: A Note of Explanation A health consultation is a verbal or written response from ATSDR or ATSDR's Cooperative Agreement Partners to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This health consultation is one of a series of six health consultations being prepared by ATSDR for this site. Completion of all six health consultations concludes the health consultation process for this site, and unless additional information is obtained by ATSDR or ATSDR's Cooperative Agreement Partner which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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Prepared By:

U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry (ATSDR)
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Abbreviations

ATSDR	Agency for Toxic Substances and Disease Registry
EPA	Environmental Protection Agency
HCV	Health Comparison Value
H_2S	hydrogen sulfide
MRL	Minimal Risk Level
NAAQS	National Ambient Air Quality Standard
NCDC	National Climatic Data Center
NEI	National Emissions Inventory
PM	particulate matter
PM_{10}	particulate matter with aerodynamic diameter of 10 microns or less
$PM_{2.5}$	particulate matter with aerodynamic diameter of 2.5 microns or less
ppb	parts per billion
ppm	parts per million
PSEI	Point Source Emissions Inventory
TCEQ	Texas Commission on Environmental Quality
TDSHS	Texas Department of State Health Services
TNRCC	Texas Natural Resources Conservation Commission
TRI	Toxics Release Inventory
TSP	total suspended particulate
$\mu g/m^3$	micrograms per cubic meter
UT-Arlington	University of Texas at Arlington
WHO	World Health Organization

Table of Contents

SUMMARY

INTRODUCTION

This Health Consultation documents the Agency for Toxic Substances and Disease Registry's (ATSDR) findings from the project: assessing the public health implications of exposures to the National Ambient Air Quality Standard (NAAQS) pollutants (particulate matter, ozone, sulfur dioxide, nitrogen oxides, carbon monoxide, and lead) and hydrogen sulfide (H_2S). This Health Consultation is part of a larger effort by ATSDR, with support from the Texas Department of State Health Services (TDSHS), to conduct an extensive review of environmental health concerns raised by community members in Midlothian, Texas. The goal of this review is to determine if chemical releases from local industrial facilities could affect or have affected the health of people and animals in the area. The facilities of concern are three cement manufacturing facilities and a steel mill. ATSDR plans to achieve this goal through a series of projects. All of the activities planned by ATSDR and the TDSHS can be found in the Public Health Response Plan for the site at: http://www.atsdr.cdc.gov/sites/midlothian/index.html.

ATSDR has already released a Health Consultation (ATSDR, 2015) to address community members' concerns about the various air pollution measurements that have been collected in Midlothian since 1981. The purpose of that Health Consultation was to take a careful look at the available monitoring data and determine which measurements are—and are not—suitable for use in ATSDR's health evaluations like this one. The previous Health Consultation identified pollutants, time frames, and locations for which the available data provide a sufficient basis for reaching health conclusions; it also identifies important gaps in the data. These findings are incorporated into this Health Consultation's evaluation of NAAQS pollutants and H_2S.

ATSDR used the Environmental Protection Agency's (EPA) National Ambient Air Quality Standards (NAAQS) and World Health Organization (WHO) guidelines only as a way to screen the environmental levels to determine which of the NAAQS air pollutants would be further evaluated in the Public Health Implications Section below—they were not used alone to determine if harmful effects were possible in the past or currently. ATSDR used the value of the current standards as health comparison values for screening purposes in relation to current and past exposures as they reflect the most updated information on our understanding of the possible harmful effects of the NAAQS air pollutants. Moreover, EPA has specific statistical approaches to evaluate environmental monitoring data for determining if a standard has been exceeded and whether an area is not in attainment of the standard. Moreover, for the years evaluated in this health consultation, ozone was the only NAAQS air pollutant that was above the EPA standards for attainment purposes but not for all years.

ATSDR released this health consultation for public comment on November 16, 2012 and accepted comments through February 14, 2013.
ATSDR's response to public comments can be found in Appendix D. ATSDR also conducted a peer review of this health consultation which included our draft responses to the public comments received (see Appendix E).

CONCLUSIONS

ATSDR reached six conclusions in this Health Consultation:

CONCLUSION 1—Sulfur Dioxide (SO_2 Exposures

In the past (1997–late 2008), breathing air contaminated with sulfur dioxide (SO_2) for short periods (5 minutes) could have harmed the health of sensitive individuals (e.g., people with asthma), particularly when performing an activity (such as exercising or climbing steps) that raised their breathing rate. *SO_2* levels that might have harmed sensitive individuals were infrequent and limited to areas primarily in Cement Valley and possibly areas east, south, and southeast of the TXI Operations, Inc. (TXI) fence line. Moreover, the frequency of exposures above levels of concern was the highest between late 1997-early 2005, not all sensitive individuals exposed while exercising would have experienced a harmful effect, and ATSDR would categorize any effects from these exposures to be less-serious.

Breathing air contaminated with SO_2 in the past (during the period 1997 to late 2008) was not expected to harm the health of the general population.

Reductions in SO_2 levels in Cement Valley have occurred since late 2008 resulting in exposures to both sensitive individuals and the general public that are not expected to be harmful. These reductions are likely a primary result of actions taken by TXI to reduce emissions and, in part, by declining production levels at local industrial facilities. The potential for future harmful exposures in Cement Valley from TXI have been greatly reduced by the actions taken by TXI to reduce emissions.

ATSDR cannot determine if past SO_2 exposures downwind of Ash Grove may have resulted in harmful effects. Although computer modeling of SO_2 emissions from Ash Grove indicated that persons who resided or recreated near the Ash Grove facility were not exposed

to harmful levels of SO_2, there is too much uncertainty to make a definitive conclusion. The primary uncertainty around the findings of ATSDR computer modeling relates to the available SO_2 emissions data from Ash Grove which had higher emissions as compared to Holcim. ATSDR attempted to obtain the needed emissions data to re-run the computer modeling but was unsuccessful.

Moreover, SO_2 emitted from Ash Grove should be substantially reduced as the Ash Grove facility has been upgraded with new kiln and emission control technology in 2014 which would reduce the likelihood of any off-site exposures of concern in the future—these SO_2 emission reductions need to be verified.

BASIS FOR DECISION

Past SO_2 exposures were **not** above the Environmental Protection Agency (EPA) standard in place at that time but were numerically above the current standard which ATSDR used as a health comparison value.

When SO_2 concentrations exceed 400 ppb (parts per billion), sensitive individuals may experience symptoms such as coughing, wheezing, and chest tightness. However, it is unlikely that sensitive persons would have experienced these health effects as the occurrence of levels above 400 ppb was extremely rare, the levels occurred late at night (around midnight), and, even if exposure occurred, ATSDR would not expect these effects in all sensitive persons (about 25-35% of exercising asthmatics show effects in clinical studies).

At lower SO_2 concentrations (200 ppb to 400 ppb), sensitive individuals functioning at elevated breathing rates may experience asymptomatic effects (e.g., mild constriction of bronchial passages). Moreover, in clinical studies of exercising asthmatics who were exposed to SO_2 in this range, about 5-30% showed the effects described. Adverse health effects from exposures to SO_2 concentrations less than 200 ppb are uncertain, but may occur in some people more sensitive or vulnerable than people participating in clinical studies because these studies were conducted on healthy volunteers (some with mild to moderate asthma) and the studies did not include children or people with severe asthma. Some people who live in Midlothian might be more sensitive to sulfur dioxide than were the volunteers who participated in these clinical studies. Moreover, ATSDR would consider any harmful effects of SO_2 exposures above 100 ppb (which is equal to the ATSDR Lowest-Observed-Adverse-Effect-Level) to 400 ppb to be less-serious in nature.

People with asthma, children, and older adults ($\geq$65 years) have been identified as groups susceptible to the health problems associated with breathing SO_2. Human scientific studies (clinical investigations and epidemiologic studies) have provided evidence of a causal relationship between SO_2 and respiratory disease (morbidity) in people with asthma and other more limited human studies (epidemiologic) have consistently reported that children and older adults may be at increased risk for SO_2-associated adverse respiratory effects. Groups potentially sensitive to air pollutants include the obese, people with preexisting cardiopulmonary disease, and people with a pro-inflammatory condition such as diabetes. However, there are no studies linking increased risk from SO_2 exposures to diabetes or obesity and studies linking SO_2 exposures to cardiopulmonary disease are limited.

For the computer modeling analysis using annual emissions data from Ash Grove and Holcim, the SO_2 predicted modeled values, for the years 2006-2010, indicated that levels approaching or exceeding the NAAQS standard may have occurred near the Ash Grove fence line or, in some cases, outside the fence line (although no residences, playgrounds or schools are located within this area based on an aerial evaluation of these off-site areas by ATSDR). However, computer modeling using annual emissions to predict shorter-term SO_2 levels is likely to result in large uncertainty. ATSDR attempted to obtain shorter-term emission data (i.e., 1-hour emissions data) in order to conduct the modeling to reduce this uncertainty. ATSDR was not able to obtain these data for Ash Grove (which is the primary emitter of SO_2 compared to Holcim for the years the modeling was performed). Therefore, ATSDR will not be able to make any firm health conclusions based on the SO_2 modeling results for past exposures to SO_2 emitted by Ash Grove and Holcim.

TCEQ provided ATSDR with several potential limitations of using the 5-minute data (TCEQ, 2012a) and clarifications of some of these limitations in a follow-up correspondence (Personal Communication, TCEQ e-mail from Tracie Phillips, 11/10/14). For various reasons (please see Appendix D, public comment B.3.32 and ATSDR's response), ATSDR believes that the 5-minute data are adequate for the purposes of this health consultation.

CONCLUSION 2—Particulate Matter Exposures	***Based on available data, breathing air contaminated with $PM_{2.5}$ (particulate matter with aerodynamic diameter of 2.5 microns or less) in Midlothian for one year or more is not likely to have harmed people's health. However, ATSDR is uncertain about downwind $PM_{2.5}$ exposures of Holcim because of a lack of data and information.*** ***Short-term potentially harmful levels of $PM_{2.5}$ have been infrequent in Midlothian. These infrequent exposures could have resulted in harmful cardiopulmonary effects, especially in sensitive individuals, but not the general public. However, the Midlothian area has been in compliance with the current EPA short-term standard for $PM_{2.5}$.*** Measured annual average $PM_{2.5}$ levels in Midlothian were not above EPA's current or past standard which was revised in 2012. $PM_{2.5}$ is both a local and regional air quality concern. Short- and long-term $PM_{2.5}$ levels observed in the Midlothian area are not considerably different from levels measured in multiple locations throughout the Dallas— Fort Worth metropolitan area. These $PM_{2.5}$ levels are caused by emissions from mobile (e.g., cars and trucks) and industrial sources in the Midlothian area and beyond. ATSDR noted several data gaps in relation to PM exposures. In general, monitoring stations in the Midlothian area have been placed near or at locations believed to have either high air-quality impacts from facility operations or a high potential for exposure. However, ambient air monitoring data are more limited for the residential neighborhoods in immediate proximity to the cement manufacturing facilities' limestone quarries. PM exposure is the primary concern for these localized residential areas.
BASIS FOR DECISION	Measured annual average $PM_{2.5}$ levels in the Midlothian area were not above EPA's past or current standard which was revised in 2012. Infrequent, short-term $PM_{2.5}$ levels in Midlothian have been in the range considered by the EPA (based on the Air Quality Index or AQI) to be a concern for sensitive populations, but not the general public. However, as defined by EPA, short-term levels of $PM_{2.5}$ in the Midlothian area have not exceeded the current standard. Although annual average $PM_{2.5}$ levels detected at the Holcim monitor indicate possible harmful levels, ATSDR is uncertain about what actual off-site exposures are occurring downwind of Holcim. Moreover, Holcim's recent request to amend their permit to reduce total hydrocarbons will likely increase their allowable $PM_{2.5}$ emissions by an estimated 103 tons per year.

CONCLUSION 3— Ozone Exposures	***Several of the levels of ozone detected in Midlothian since monitoring began in 1997 indicate that sensitive individuals have an increased likelihood of experiencing harmful respiratory effects (respiratory symptoms and breathing discomfort). This likelihood is primarily true for active children and adults and for people with respiratory diseases, such as asthma. The general population of Midlothian is not expected to experience harmful effects from ozone exposure except on rare occasions when ozone levels reach approximately 100 ppb or more. The highest frequency of ozone exposures of concern (to both sensitive persons and the general public) occurred in the 1997-2006 timeframe; however, from 2007-2012, the frequency of harmful exposures to sensitive persons has dropped and there have been no harmful exposures to the general public during this same timeframe.*** ***All of the above trends are based on the 2008 NAAQS standard. However, current science on what levels constitutes a harmful ozone exposure is evolving and scientists advising EPA have concluded that scientific evidence supports a standard within the range of 60-70 ppb (EPA, 2014). EPA revised the standard to 70 ppb in 2015. Therefore, although levels have been decreasing, they are still above levels of concern, especially for sensitive persons.***
BASIS FOR DECISION	Ellis County is one of 10 counties that make up the Dallas–Fort Worth ozone non-attainment area, which means that ozone levels in the metropolitan area occasionally exceed EPA's health-based standards. Ozone levels also have exceeded the World Health Organization (WHO) health guidelines. Emissions from industrial sources, mobile sources, and natural sources throughout the area contribute to this problem. Scientific studies indicate that breathing air containing ozone at concentrations similar to those detected in Midlothian can reduce lung function and increase respiratory symptoms, thereby aggravating asthma or other respiratory conditions. Ozone exposure also has been associated with increased susceptibility to respiratory infections, medication use by persons with asthma, doctor's visits, and emergency department and hospital admissions for individuals with respiratory disease. Ozone exposure also might contribute to premature death, especially in people with heart and lung disease. School absenteeism and cardiac-related effects may occur, and persons with asthma might experience greater and more serious responses to ozone that last longer than responses among people without asthma. Many of the 8-hour ozone levels reported in the Midlothian area, since monitoring began in late 1997, indicate that sensitive individuals have

an increased likelihood of respiratory symptoms and breathing discomfort. These reactions are primarily true for active children and adults and people with respiratory disease, such as asthma. On rare occasions during this period, levels reached 100 ppb or more, indicating that even non-sensitive individuals from the general population may have experienced harmful effects. For the period 2007-2012, the frequency of ozone 8-hour levels above levels of concern for sensitive persons has dropped from an average of about 18 events per year from 1997-2006 (range of 3-40 per year) to about 4 events per year (ranging from zero to 7 per year). Moreover, during the period 2007-2012, there have been no ozone exposures above levels of concern for the general public; whereas, there was an average of about 2 events per year from 1997-2006 (range of zero to 5 per year). ATSDR's ozone evaluation above is based on the previous EPA standard of 75 ppb. The number of potential events above levels of concern for sensitive persons have been larger if the new standard of 70 ppb is considered.

CONCLUSION 4— Mixture Exposures

ATSDR believes the severity of health effects from a mixture exposure is not likely to exceed those discussed for SO_2, $PM_{2.5}$, or ozone exposure alone. Moreover, ATSDR believes that sufficient information exists to warrant concern for multiple air pollutant exposures to sensitive individuals, especially in the past (during the period 1998 to 2002) when SO_2 levels were higher and more frequent and when these persons were breathing at higher rates (e.g., while exercising). Data also suggest that the number of potential co-exposures of concern were rare and any co-exposures were more likely between SO_2 and ozone, and to a lesser extent, between ozone and $PM_{2.5}$. Any mixtures exposures of concern would have likely occurred in the past for persons residing in Cement Valley because that is where the highest and most frequent sulfur dioxide exposures occurred.

Current science on what levels constitutes a harmful exposure to ozone is evolving and scientists advising EPA have concluded that scientific evidence supports a standard within the range of 60-70 ppb (EPA, 2014). Therefore, the number of possible co-exposures to SO_2 and ozone of concern in the past might have been higher given this new range of possible harmful ozone exposures.

For past SO_2 exposures, however, the number of sensitive individuals affected may have been greater because effects may have occurred at a lower SO_2 concentration when combined with exposure to ozone. Potential effects to a larger sensitive population, especially in the past, may be limited to the same locations but during the warmer months when ozone levels were usually the highest. In addition, potential effects to this larger sensitive population may also have resulted from multiple exposures that occurred during several consecutive days; however, the number of these potential occurrences was also rare.

BASIS FOR DECISION

Asthmatics are likely a sensitive population that when they are exposed to irritant gases (like ozone and sulfur dioxide) exacerbates their symptoms. The likely mechanism is that epithelial cells that line the airway passages in asthma (and other respiratory disorders) are damaged and these cells start shedding. The shedding of these cells exposures nerve endings allowing irritant gases access to free nerve endings, which in turn, aggravates asthma and allergy. A limited number of studies suggest that the evaluation of pulmonary changes to single pollutant exposure overlooks the interactive effect of common co-existing or sequentially occurring exposures to air pollutants. For example, sensitive persons first exposed to ozone and then to sulfur dioxide increased airway restriction such that the subjects responded to a concentration of sulfur dioxide that would not have produced an effect if exposed to sulfur dioxide alone.

Only 14 instances occurred when SO_2 and ozone levels occurred both in the same day and all of those occurred between 1998 and 2000. Moreover, these data indicate that there were only three days when $PM_{2.5}$ was above the NAAQS HCV and ozone was above 75 ppb, and all of these occurred in 2002. In addition, there were no observed days when a mixture, at levels of concern, occurred between SO_2 and $PM_{2.5}$ and, therefore, also for all three air pollutants. However, these types of mixture comparisons with $PM_{2.5}$ could not be made for the years when the frequency of elevated SO_2 and ozone levels were the greatest (1998-2000) because $PM_{2.5}$ data were not available. Please note that ATSDR's mixtures evaluation above is based on the previous EPA standard of 75 ppb for ozone. The number of potential co-exposures to ozone with either SO_2, or to a lesser extent $PM_{2.5}$, in the past, may be larger if the new EPA ozone standard of 70 ppb is considered.

CONCLUSION 5— Lead Exposures

Past lead air exposures during the period 1993 to 1998, in a localized area just north of the Gerdau Ameristeel fence line, could have harmed the health of children who resided or frequently played in this area. The estimated neurological health effect of these exposures would have been a slight lowering of IQ (Intelligence quotient) levels (1-2 points) for some children living in the area. Since 1998, air lead levels in this area decreased sharply. Monitoring data do not indicate

	that lead levels in air have occurred above EPA's current standard (0.15 $\mu g/m^3$) in other areas of Midlothian, either now or in the past.
BASIS FOR DECISION	Past lead air exposures were not above the EPA standard at that time but were above the current standard which ATSDR used as a health comparison value. EPA's 2008 standard for lead in air was developed to prevent a loss of 1-2 IQ points in young children. Some uncertainty exists with these findings given that we do not know what the lead levels in air were downwind of the Gerdau monitor (in more populated areas) and we do not know if small children were exposed at all in this sparsely populated area of Cement Valley. However, we do know that the closest possible receptors were about 450-500 feet west of the Gerdau Monitor (where elevated levels of lead were detected).
CONCLUSION 6-- Exposure to Other Contaminants	***ATSDR does not expect harmful effects in Midlothian from current or past exposures to the air pollutants carbon monoxide, nitrogen dioxide, or hydrogen sulfide***.
BASIS FOR DECISION	Based on available monitoring data and other information (emission reports, knowledge of what might be emitted from cement or steel operations, and worst-case computer air modeling), the levels of carbon monoxide, nitrogen dioxide, and hydrogen sulfide are below health-protective comparison values developed by EPA, WHO, or ATSDR.
NEXT STEPS—All Conclusions	***This health consultation is one of the several evaluations being conducted by ATSDR under the overall Public Health Response Plan developed to address community concern evaluations. The Public Health Response Plan and ATSDR's other evaluations can be found at: http://www.atsdr.cdc.gov/sites/midlothian/index.html.*** ***The following are public health actions taken, on-going or planned specifically related to the findings from this health consultation:*** ***Sulfur Dioxide Specific:*** Actions have been taken by TCEQ, TXI and Ash Grove to reduce SO2 emissions in Midlothian. Retirement of older cement kilns in Midlothian and the introduction of newer technology have resulted in lower emissions of SO_2 from TXI. Since 1999, the permitted SO_2 emission limits for TXI have been reduced by 90%. The retirement of two older kilns and the introduction of new kiln design and emission controls at Ash Grove should reduce SO_2 emission significantly; however, ATSDR

recommends that TCEQ review the 2015 annual emissions from Ash Grove to verify these reductions.

PM Specific:

ATSDR recommends appropriate ambient air monitoring to characterize exposures to persons located downwind of the Holcim facilities and take actions to reduce $PM_{2.5}$ emissions from these facilities if harmful exposures are indicated. In addition, particulate matter monitoring is needed in residential areas that are in immediate proximity to the facilities' limestone quarries.

ATSDR has or will issue two other Health Consultations that will further evaluate cement kiln dust (CKD): one document will consider the specific chemicals within CKD and whether those pose a health hazard when inhaled; another document will consider the extent to which CKD has contaminated soils and waterways through atmospheric deposition.

Ozone Specific: ATSDR supports reducing ozone concentrations to below levels of concern. The Midlothian area has been and currently is in compliance for all criteria pollutants except for ozone. Because Ellis County is included in the Dallas/Fort Worth non-attainment, it is also included in the ozone State Implementation Plan which includes measures for further reducing ozone. An attainment demonstration state implementation plan (SIP) revision will be developed for the Dallas-Fort Worth area to address the 2008 eight-hour ozone standard. The SIP revision will be developed with stakeholder input and will undergo separate notice and comment procedures. At that time, the TCEQ will develop rules and control measures as necessary to bring the area into attainment by the appropriate attainment deadline.

Mixtures Specific: ATSDR supports actions that have or will be taken by TCEQ, TXI or Ash Grove, as applicable, to reduce SO_2 and ozone exposures (see actions above) and, therefore, the potential for any harmful mixtures exposures in the future.

All Other Air Pollutants*:* No ATSDR recommendations at this time as measures are being taken by TCEQ to monitor carbon monoxide and nitrogen dioxide levels in the Midlothian area in order to maintain compliance with federal requirements.

All areas of the state are currently in attainment of the carbon monoxide and nitrogen dioxide standards. TCEQ will continue to monitor these and other pollutants in order to maintain compliance with federal requirements.

FOR MORE INFORMATION

If you have questions about this document or ATSDR's ongoing work on the Midlothian facilities, please call ATSDR at 1-800-CDC-INFO and ask for information about the "Midlothian, Texas evaluations." If you have concerns about your health, you should contact your health-care provider.

1. Purpose and Statement of Issues

In July 2005, a group of residents of Midlothian, Texas, submitted a petition to the Agency for Toxic Substances and Disease Registry (ATSDR). The petition expressed multiple concerns, but primarily that nearby industrial facilities were emitting air pollutants at levels that were affecting the health of residents. ATSDR accepted this petition, and the Texas Department of State Health Services (TDSHS), under a cooperative agreement with ATSDR, prepared a response.

Specifically, in December 2007, TDSHS, with ATSDR concurrence, issued a public comment draft Health Consultation that attempted to respond to concerns outlined in the original petition. Many comments were received on the draft Health Consultation.

During the process of evaluating these comments, ATSDR and National Center for Environmental Health Director requested that the ATSDR and TDSHS team take a more comprehensive look at the site. This new evaluation would review the initial petitioner's concerns, which questioned whether data generated by air monitors were being collected in a manner that could provide pertinent answers to the community health concerns. ATSDR and TDSHS are now looking at all available data to determine if there is a relationship between air emissions and health concerns in the community. As outlined in its Midlothian Public Health Response Plan (ATSDR, 2011a), ATSDR will complete this reevaluation in a series of projects.

The first ATSDR Health Consultation (ATSDR, 2015) assessed the utility of existing ambient air monitoring data for addressing Midlothian residents' concerns regarding air emissions from four industrial facilities, while also considering additional air quality impacts from other sources (e.g., motor vehicle traffic). To evaluate these concerns, ATSDR gathered relevant information on facility emissions, local meteorological conditions, and ambient air monitoring data. The findings of that document are based on all validated ambient air monitoring data and related information available to ATSDR as of late 2011 (SO_2 data ? became available in 2012). ATSDR accessed information from multiple parties, including the petitioner, local community groups, industry, and consultants; scientists from the University of

Purpose of this Document
This Health Consultation documents ATSDR's findings from the project: assessing the public health implications of exposures to the National Ambient Air Quality Standard (NAAQS) pollutants (particulate matter, ozone, sulfur dioxide, nitrogen oxides, carbon monoxide, and lead) and hydrogen sulfide (H_2S). The findings from ATSDR's first Health Consultation (ATSDR, 2015) are incorporated into this document's evaluation of the public health implications of potential exposures to the NAAQS pollutants and H_2S.

Readers should note that ATSDR's role in evaluating ambient air in Midlothian is as a *public health* agency, which is considerably different from the roles of other agencies, particularly those charged with addressing *environmental* issues. In this document, ATSDR evaluates the public health implications of the levels of air pollutants in the Midlothian area. These evaluations are not meant to address the region's compliance, or lack thereof, with state and federal standards, such as EPA's NAAQS, even though this Health Consultation uses the NAAQS as a means for the first step in evaluating the air monitoring data collected in the Midlothian area. State and federal environmental agencies are responsible for evaluating the area's compliance with the NAAQS and other environmental standards.

Texas at Arlington (UT-Arlington); TDSHS; the Texas Commission on Environmental Quality (TCEQ); and the U.S. Environmental Protection Agency (EPA).

This Health Consultation documents ATSDR's findings from the project: assessing the public health implications of exposures to the National Ambient Air Quality Standard (NAAQS) pollutants (particulate matter, ozone, sulfur dioxide, nitrogen oxides, carbon monoxide, and lead) and hydrogen sulfide (H_2S). The findings from the first Health Consultation (ATSDR, 2015) are incorporated into this document's evaluation of the public health implications of potential exposures to the NAAQS pollutants and H_2S.

2. Background

This section presents background information that ATSDR considered when evaluating the utility of the ambient air-monitoring studies previously conducted in the Midlothian area. Refer to Section 3 of this Health Consultation for ATSDR's interpretations of this background information and assessment of the ambient air monitoring conducted in the Midlothian area.

2.1. Air Emissions Sources

Air Emissions in Midlothian

The air exposure pathway begins with air emission sources—processes that release pollutants into the air. Once released, these pollutants move from their sources to locations where people may be exposed. This section presents background information on the air emission sources of interest in the Midlothian area: a steel mill and three cement manufacturing facilities that operate multiple kilns. Other local emission sources also are identified and discussed.

Midlothian is located in Ellis County, Texas, approximately 30 miles south of the Dallas-Fort Worth metropolitan area. Figure 1 shows the location of Midlothian and the four industrial facilities of interest. This section provides background information on the various emission sources that affect air quality in Midlothian, with a focus on the four industrial facilities shown in Figure 1.

Operations at all four facilities of interest have changed over the years. Some changes would have increased air emissions (e.g., increased production levels in certain years, use of different fuels in the kilns) whereas others would have decreased air emissions (e.g., installation of pollution control devices). In some cases, changes at the facilities might have simultaneously decreased emissions of certain pollutants and increased emissions of others. These changing operations are important to consider when evaluating the air quality concerns in the Midlothian area. Emissions also can change considerably from one hour to the next—a topic addressed later in this Health Consultation.

During some periods in the past, ,the four facilities of interest in Midlothian emit several pollutants at rates that have consistently ranked among the highest for industrial facilities in Ellis County that submit data to TCEQ's Point Source Emissions Inventory. Accordingly, this section presents detailed summaries of emission data for the four facilities. Other emission sources (e.g., motor vehicles) are briefly acknowledged and characterized for completeness.

2.2. Background on Relevant Industrial Processes

This section presents general information on the relevant manufacturing processes for the facilities of interest in Midlothian, with a focus on the types of air emissions commonly found at cement kilns and steel mills. Please refer to the ATSDR Health Consultation *Assessing the Adequacy of the Ambient Air Monitoring Database for Evaluating Community Health Concerns* for more details (ATSDR, 2015).

2.2.1. Air Emissions from Cement Kilns

Cement is a commercial product that is used to make concrete. Although cement manufacturing facilities employ various production technologies, most facilities share some common design features. A very simplified account of common elements of cement manufacturing follows.

Cement is typically manufactured by feeding crushed limestone, shale, and other ingredients into kilns that operate at high temperatures, typically at least 2,700º F (EPA, 1993). Facilities burn various fuels to sustain these kiln temperatures. Fuels used across industry include coal, oil, natural gas, hazardous waste, and tires. When the raw materials are heated to the temperatures achieved in the kilns, they form a material known as "clinker," which is the solid output from the kilns. The clinker is cooled and then ground [a process that produces particulate matter (PM) emissions and which is normally controlled]. The clinker is then mixed with gypsum and other materials to form the cement product. Combustion of fuels in the kilns may produce evaporative emissions of volatile organic compounds (VOC) and trace metals.

When the raw materials are heated to the temperatures achieved in the kilns, they form a material known as "clinker," which is the solid output from the kilns that is cooled and mixed with gypsum to form the cement product.

Many by-products also are formed and exit the kiln in air exhaust. The primary by-product is cement kiln dust, which is a highly alkaline dust of fine particle size. Air pollution control equipment, such as baghouses and electrostatic precipitators, are typically used to reduce emissions of cement kiln dust in the exhaust air from the kilns. Cement kiln dust not collected in the controls or otherwise captured for further processing is emitted by the stacks typically found at cement kilns, along with combustion by-products, which include carbon monoxide, nitrogen oxides, sulfur dioxide, and various volatile organic compounds (e.g., formaldehyde) and semi-volatile organic compounds (e.g., dioxins and furans).

In 2010, EPA promulgated and Texas Commission on Environmental Quality (TCEQ) adopted new Portland Cement maximum achievable control technology regulations (40 C.F.R. 63, Subpart LLL) and aggressive new limits for particulate matter, nitrogen oxides, sulfur dioxides in a revision of the New Source Performance Standards for Cement Plants (40 C.F.R. 60, Subpart F). Moreover, the four wet-process cement kilns at TXI's Midlothian plant were permanently shut down in 2008. For SO_2, since 1999, the permitted emission limits at TXI have been reduced by 90%. In 2014, two of the three wet-process cement kilns at Ash Grove's Midlothian plant were shut down and the third was converted to a more modern design. Retirement of older cement kilns at Midlothian continues to result in lower emissions of SO_2 and other air pollutants except for ammonia (Personal Communications, Tracie Phillips, TCEQ, 5/23/14 and 6/10/14). In addition to upgrades in the kilns and emission controls, the U.S. EPA's Portland Cement rules include additional in-stack monitoring requirements. Full year 2015 annual inventories of emissions from Ash Grove should provide evidence of the expected significant reductions in SO_2 emissions from Ash Grove due to changes in the kilns and emission controls (Personal Communications, Randy Hamilton, TCEQ, 9/30/2015).

Besides their kilns, cement manufacturing facilities have other operations that process materials. These operations might include mining for limestone at on-site quarries, crushing and blending raw materials, and other material handling processes. Air emissions from these and various other operations tend to occur at ground level and are not always vented through air pollution controls.

Detailed information specific to the Midlothian facilities is presented later in this section.

2.2.2. Air Emissions from Steel Mills

Most steel in the United States is manufactured in either basic oxygen furnaces or in electric arc furnaces (EPA, 2000a). Electric arc furnaces are the manufacturing technology of choice at facilities that manufacture steel from scrap metal, as occurs in Midlothian. With this technology, scrap metal and, if necessary, alloys are loaded into the furnace. Electrical energy is then used to melt the scrap metal. During the melting process, impurities in the steel react with the air in the furnace to form various by-products that are vented to the air, typically after passing through some form of air pollution control device. These emissions can include inorganics (i.e., metals and elements) originally found in the scrap and volatile organic compounds (VOCs) that can form from the impurities present in the melting process.

After each batch of scrap metal is melted, the electric arc furnace is tilted and the desired contents are poured into a mold, in which the molten steel gradually cools and takes its final form. The steel then usually undergoes additional finishing processes (e.g., rolling, beam straightening) to make the final product. Slag is a solid by-product from the melting process. Steel mills employ various strategies for managing slag, including disposal and beneficial reuse.

Pollutants typically emitted from steel mills that melt scrap in electric arc furnaces include particulate matter (PM) or dust, VOCs, carbon monoxide, nitrogen oxides, and sulfur dioxide. The PM emitted from these facilities contains various inorganic compounds.

2.3. Air Emissions Sources in Midlothian

- **Overview.** Information is provided on the facilities' history, ownership, location, and main production processes, including types and amounts of fuels used to power their furnaces and kilns.

- **Annual estimated air emissions.** The facilities' self-reported estimated annual air emissions are summarized, using data they submitted to TCEQ's Point Source Emissions Inventory.

  These data were accessed for *criteria pollutants* (e.g., carbon monoxide, lead, particulate matter [PM], sulfur dioxide, nitrogen oxides) and precursors to some criteria pollutants (e.g., VOCs). As with the Toxics Release Inventory (TRI) data, the criteria pollutant emission data in the Point Source Emissions Inventory are self-reported. However, annual emission data for some criteria pollutants are based on continuous emission monitoring data at the facilities of interest. Continuous emission monitors are devices that continuously measure air emissions inside stacks and other process areas. In other words, these devices directly measure emissions, so facilities do not need to estimate their emissions. This section also identifies whether any of the facilities' annual emissions rank among the state's top 25 emitters in the Point Source Emissions Inventory.

- **Short-term estimated air emissions.** This section summarizes the frequency and magnitude of certain short-term air contaminant releases, which annually averaged emission data do not characterize. TCEQ regulations require industrial facilities to disclose information associated with certain *scheduled* activities that lead to excess emissions (e.g., process maintenance, planned shutdowns) and *unscheduled* emission events (e.g., following process upsets or accidental releases). Whether reporting is required depends on several factors, such as the nature of the release and the amount of pollutants emitted.

  Facility-specific information on short-term estimated air emissions is based on data that facilities submitted to TCEQ's "Air Emission Event Reports" database. TCEQ subsequently makes these reports publicly available in summary form on its Web site. ATSDR accessed the entire history of online emission event data, which dates back to 2003 (TCEQ, 2010a). All information provided by the facilities (including the pollutant emission rates) is self-reported and typically estimated. Short term events may have occurred at the facilities of interest that were not reported to TCEQ. These events would likely have been confirmed by continuous emissions monitoring system (CEMS) data, and might have been detected by nearby off-site monitoring devices (provided that the wind direction was from the source to the off-site monitoring device). However, the most frequent wind patterns, duration of event, and extent of the event might preclude detection by off-site monitors.

  Understanding the short-term contaminant emissions is an important consideration for at least two reasons. First, several community members have voiced concern specific to acute (or short-term) exposures. Second, tabulations of annual average emissions and air pollution levels might mask important peaks in facility releases. Therefore, this document and ATSDR's other Health Consultations consider the implications of both short-term and long-term air pollution levels, where applicable.

Facility Profiles
The following pages in this document present brief profiles for the four facilities of interest. The purpose of this section is to document some of the most relevant background information that ATSDR collected. These profiles should not be viewed as comprehensive summaries of the individual facilities and their histories.

Although this section, by design, focuses on the individual facilities separately, this Health Consultation considers the combined air quality impacts from all four facilities and additional air emission sources throughout the Midlothian area.

2.3.1. Ash Grove Cement

- **Overview.** Ash Grove Texas L.P. is a business entity that operates a Portland cement manufacturing facility located north of Midlothian, referred to in this document as "Ash Grove Cement."[1] The parent company of this facility is Ash Grove Cement Co. From 1990 until 2003, the facility in Midlothian was owned and operated by another entity called North Texas Cement Company, L.P.; and before 1990, the facility was owned and operated

[1] This document primarily uses "Ash Grove Cement" to refer to the cement manufacturing facility located in Midlothian. Ash Grove Texas L.P. is the business entity that currently operates that facility. References to "the facility" throughout this document refer to the cement manufacturing plant, which was owned and operated by different entities over the years.

by Gifford Hill Cement Company. The facility was constructed in 1965 and began operating in 1966, and it currently operates three rotary kilns to manufacture cement. These kilns began operating in 1966, 1969, and 1972 (TNRCC, 1995a). Cement is manufactured by feeding limestone, shale, and other raw materials into the rotary kilns, which operate at temperatures reaching 4,000 degrees Fahrenheit (^oF). Most of the raw materials used in the process are from an onsite quarry, but some materials come from offsite sources via truck and rail. The solid product from the kilns is subsequently ground together with gypsum to make Portland cement.

Various fuels have been used at the facility over the years to fire its kilns. For example, only natural gas was used to fire the kilns after the facility was first built. In the 1970s, fuel oil handling equipment was added, and other fuels (e.g., coal, coke, wood chips) were added in subsequent years. As described further below, waste-derived fuel was burned in the mid-1980s into the early-1990s, and whole tires were allowed as a fuel starting in the 1990s. The facility is currently not able to use tire chips and has never used tire chips. The facility has not used wood chips extensively or used oil in the last decade. This facility employs a combination of coal, petroleum coke, and tires to fire its kilns; natural gas was typically used only for startup of the kilns but usage has expanded in recent years.

From 1986 to 1991, the facility also was authorized to burn waste-derived fuel in its kilns as a supplemental energy source. Starting in 1989, industrial facilities managing hazardous waste were required to submit biannual reports to EPA on the quantities of waste that were managed. In 1989, a total of 55,000 tons of hazardous waste were reportedly used for purposes of energy recovery; and in 1991, a total of 14,200 tons of hazardous waste were used for this purpose (EPA, 2010a). The practice of burning hazardous waste ceased in 1992.

At the time, hazardous waste combustion in cement kilns was regulated under an EPA regulation that addressed combustion of hazardous waste in boilers and industrial furnaces. That regulation required affected facilities to conduct compliance tests to determine allowable waste feed rates, use of automatic waste feed cutoffs to prevent feed rates from exceeding these limits, and other safeguards. In 1995, the facility received authorization to burn whole tires in its cement kilns and the facility is required to report to TCEQ its ongoing usage of tire-derived fuel (TCEQ, 2009). Annual statistics for the facility's usage of tire-derived fuel follow (Ash Grove Cement, 2010):

1996	5,500 tons	**2003**	39,400 tons
1997	18,400 tons	**2004**	43,300 tons
1998	33,400 tons	**2005**	43,000 tons
1999	37,100 tons	**2006**	43,400 tons
2000	38,200 tons	**2007**	42,400 tons
2001	38,200 tons	**2008**	44,800 tons
2002	37,400 tons	**2009**	29,300 tons

These data show varying annual usage of tire-derived fuel, including a substantial decrease in usage in 2009. According to Ash Grove Cement's air permit, the facility is currently allowed to fire its kilns with multiple fuels. Please see previous information regarding the shutdown or conversion of Ash Grove's three wet-process cement kilns in 2014.

Ash Grove Cement's production processes have numerous sources of air emissions. Exhaust air from the three kilns, for example, vents to the atmosphere through 150-foot tall stacks, after first passing through electrostatic precipitators designed to capture PM and other pollutants before being released to the air. Selective non-catalytic reduction technology has recently been implemented in all three kilns to reduce air emissions of nitrogen oxides. These air pollution controls collect a large portion of the kiln's emissions, including cement kiln dust, but are not 100% efficient, and every kiln at Ash Grove Cement emits various pollutants through its stacks. The facility is required to continuously monitor emissions of carbon monoxide, nitrogen oxides, and sulfur dioxide (and the facility was previously required to monitor emissions of VOCs), although many other pollutants are released from this source. These continuous monitors are placed directly in the kiln stacks.

Emissions also occur from the facility's quarry activities, physical processing of raw materials (e.g., crushing, grinding, milling), materials handling operations, stockpiles, and other storage areas. Many of these other emission sources are also equipped with air pollution controls to help reduce releases. For example, dust collectors capture PM from many of the materials handling operations. Facility-wide emissions can vary considerably with time, because Ash Grove Cement occasionally changed its fuel sources and the design of its unit operations; new equipment has been added over the years, and some older equipment has been taken out of service.

According to queries run on TCEQ's Web site, the agency received no complaints from residents about air emissions specifically from Ash Grove Cement between 2002 and 2010 (TCEQ, 2010b).

- **Annual estimated air emissions.** Section 3 below reviews the history of Ash Grove Cement's annual emissions for the pollutants considered in this Health Consultation.

- **Short-term estimated air emissions.** According to data ATSDR accessed in 2011, Ash Grove Cement submitted 257 air emission event reports to TCEQ dating back to 2003. Of these, 87 were scheduled maintenance, startup, or shutdown activities. The remaining 170 events were excess opacity events and emission events (opacity is an indicator of particulate matter emissions). Only one of these event reports included a pollutant-specific emission rate. On February 16, 2005, Ash Grove Cement experienced an hour-long emission event that released 106 pounds of carbon monoxide into the air; no other pollutants were identified in the excess emission event report. Some reports made by Ash Grove Cement were reportedly based on an expectation that there was a chance that the type of event (i.e., startup, shutdown, or maintenance) could result in emissions of one or more pollutants over a permit limit. However, reporting of such information should not be inferred to indicate that emissions above permitting limits automatically occurred.

2.3.2. Gerdau Ameristeel

Overview. Gerdau Ameristeel—sometimes referred to as Chaparral Steel—operates a secondary steel mill located southwest of Midlothian and adjacent to TXI Operations (see Section 2.3.4). The facility began operating in 1975 (TNRCC, 1995a) and currently uses two electric arc furnaces and three rolling mills to melt and recycle scrap steel. The scrap steel is obtained from an automobile shredder and junkyard, also located at the facility. The two electric arc furnaces melt scrap steel, and then casting operations form the material into structural steel beams, reinforcing bars, and other shapes and forms. The facility does not operate coke ovens to generate energy; therefore, coke oven emissions will not be considered in this investigation. Prior to 2007, Chaparral Steel was a wholly owned subsidiary of TXI; however, in 2007, Chaparral merged with Gerdau Ameristeel.

- Gerdau Ameristeel's production processes have multiple emission sources. Air emissions from the two furnaces are controlled through the use of positive and negative pressure baghouses, which collect airborne particles that would otherwise be released to the environment. Exhaust air from these baghouses vents to the atmosphere through any of three stacks; two are 150 feet tall and the third is 80 feet tall. Emissions also occur from the facility's automobile shredding operation, melt shop, and scrap and slag handling. Many of these operations also are equipped with air pollution controls. For example, the slag crusher and alloy processes have baghouses that capture PM from exhaust streams that would otherwise be emitted to the air. The extent of air pollution controls changed over time. For instance, in 1988, Gerdau Ameristeel installed a new baghouse that considerably reduced emissions of particulate matter, and further reductions occurred in the early 1990s when another new baghouse was installed and the facility's "roof vents" in certain production areas were removed. A complete list of these controls is available from the facility's submissions to TCEQ's Point Source Emission Inventory (TCEQ, 2011a). Currently, Gerdau Ameristeel is not required to continuously monitor pollutant emission rates from any of its main stacks.

  According to queries run on TCEQ's Web site, the agency received 52 complaints from residents about air emissions from Gerdau Ameristeel during the period 2002 to 2010 (TCEQ, 2010b). These complaints were filed for various reasons: odor was cited as a reason for 24 of these complaints. The most frequently cited odor was a burning plastic smell (for 12 of the complaints). Residents also reported detecting diesel, metal, sulfur, and chemical odors. Other reasons that residents filed complaints included deposition of dust, visible smoke, and excessive industrial activity. Nearly every complaint specific to Gerdau Ameristeel occurred during nighttime hours.

- **Annual estimated air emissions.** Section 3 below reviews the history of Gerdau Ameristeel's annual emissions for the pollutants considered in this Health Consultation.

- **Short-term estimated air emissions.** During the period 2003 to 2011, Gerdau Ameristeel submitted 30 air contaminant emission event reports to TCEQ: 28 excess opacity events and two emission events. One of the emission events involved approximately 800 excess pounds of PM released to the air over a 32-hour time frame, when dust control measures for unpaved roads were suspended related to a failed water supply well.

2.3.3. Holcim

- **Overview.** Holcim Texas Limited Partnership (LP) (referred to in this document as "Holcim") is a Portland cement manufacturing facility located northeast of Midlothian. The facility began its operations as Box Crow Cement Company and subsequently became Holnam Texas LP before being renamed to Holcim Texas LP. Holcim operates two dry kilns; the first began operating in 1987 and the second in 2000. An onsite quarry provides limestone and other raw materials used to feed the rotary kilns, which operate at temperatures reaching 3,000° F. Raw materials are crushed and milled onsite before being fed to pre-heaters that precede the kilns. The solid product from the kilns, or clinker, is cooled and ground together with gypsum to make Portland cement.

  Since 1987, Holcim has used multiple fuels to fire its kilns. The facility was originally permitted to use coal and natural gas. In 1994, Holcim was also authorized to burn tire chips as supplemental fuel in pre-processing operations. Data that the facility reported to TCEQ indicate that the amount of tire scraps burned at Holcim varies from one year to the next (TCEQ, 2009). Annual statistics for the facility's usage of tire-derived fuel follow (TCEQ 2009, 2010c):

1994	5,313 tons	**2002**	15,480 tons
1995	18,722 tons	**2003**	25,629 tons
1996	18,513 tons	**2004**	8,403 tons
1997	11,076 tons	**2005**	13,137 tons
1998	1,647 tons	**2006**	14,464 tons
1999	417 tons	**2007**	9,918 tons
2000	829 tons	**2008**	9,256 tons
2001	1,015 tons	**2009**	10,430 tons

According to Holcim's air permit, the facility is currently allowed to fire its kilns with natural gas, coal, tire chips, oil, non-hazardous liquids, non-hazardous solids, and petroleum coke.

Holcim's cement manufacturing operations emit air pollutants from multiple sources, and various measures are in place to reduce facility emissions. Both kilns now operate with selective non-catalytic reduction (SNCR) technology to reduce emissions of nitrogen oxides. Exhaust air from the two kilns (and other production areas) passes through baghouses (to reduce PM in emissions) and wet scrubbers (to reduce sulfur dioxide emissions). Process gases from the kilns eventually vent to the atmosphere through 250-foot and 273-foot tall stacks, in which the facility continuously monitors emissions of sulfur dioxide, carbon monoxide, nitrogen oxides, and ammonia. Emissions also occur from the facility's quarry activities, physical processing of raw materials, materials handling operations, and storage areas, and some of these emission sources are also equipped with baghouses to remove PM from process exhaust streams.

In July 2005, following an application to increase nitrogen oxide emissions, Holcim reached a settlement agreement with DFW Blue Skies Alliance and Downwinders at Risk. This agreement led to Holcim funding several projects to reduce emissions and monitor local air quality. For example, Holcim agreed to continuously measure downwind ambient air concentrations of fine PM—a project that operated from 2006 to early 2010. In 2014, Holcim requested to amend their permit to install addition air pollution control technologies to reduce total hydrocarbons (THC) to meet emission limits for the Portland Cement Manufacturing Industry. Although these additional controls will reduce emissions of several air pollutants, it will also result in an increase of 103 tons per year of allowable $PM_{2.5}$ emissions—most of which (102 tons per year) will be as sulfuric acid (TCEQ, 2014a).

According to queries run on TCEQ's Web site, the agency received 11 complaints from residents about air emissions from Holcim between 2002 and 2010 (TCEQ, 2010b). Five of these complaints were filed during the period May 2005 to April 2006. Most of the complaints pertained to a strong burning plastic or burning chemical odor emanating from the facility. The odor reportedly caused headaches in some residents and forced others to stay indoors.

- **Annual estimated air emissions.** Section 3 below reviews the history of Holcim's annual emissions for the pollutants considered in this Health Consultation.

- **Short-term estimated air emissions.** From 2003 to 2010, Holcim submitted 17 air emission event reports to TCEQ. Of these, six were scheduled maintenance or startup activities. The remaining 11 events were excess opacity events and emission events. All but one of these were of short duration (i.e., roughly between 5 minutes and 2.5 hours); one event reportedly lasted approximately 9 hours. Opacity measurements appeared to trigger most of these reportable events, and none were apparently triggered by an excessive pollutant-specific emission rate.

2.3.4. TXI Operations

- **Overview.** TXI Operations, the largest of the three Portland cement manufacturing facilities in Midlothian, is located southwest of the city center, adjacent to Gerdau Ameristeel. The facility was formerly known as Midlothian Cement Plant. TXI Operations began operating in 1960 and operated five cement kilns that came online in 1960, 1964, 1967, 1972, and 2002. Four of these were "wet kilns," and the newest is a "dry kiln." An onsite quarry provides the limestone and shale used to manufacture cement. Other raw materials are delivered via truck. The kilns are fired at temperatures that reach 2,800 ^{o}F and produce clinker, which is ground together with gypsum to make the Portland cement product. The four wet kilns were permanently shut down in 2008.

  TXI Operations has used multiple fuels to fire its kilns, originally natural gas. In 1974, TXI Operations was also permitted to fire its kilns with fuel oil. In 1980, 1983, and 1987, the facility was authorized to fire kilns using coal, petroleum coke, and waste-derived fuel, respectively. In the past, the four wet kilns were authorized to fire natural gas, fuel oil, coal, petroleum coke, and waste-derived fuel. The dry kiln is authorized to fire natural gas and coal as fuel. Although TXI Operations was permitted to burn hazardous waste since 1987, the facility has not used this fuel continuously over the years. Data summarized later in this section indicate that the facility burned hazardous waste during 1991 to 2007. TXI no longer burns hazardous waste in its wet kilns; TXI has permanently shut down its wet kilns and the authority to operate these kilns has been removed from its permit.

TXI Operations has many air emission sources that are typically found at cement manufacturing facilities. Exhaust air from the active kiln passes through a high-efficiency fabric filter baghouse to reduce emissions of PM and a wet scrubber to reduce emissions of sulfur dioxide, nitrogen oxides, and other pollutants. This exhaust gas then passes through a regenerative thermal oxidizer, which reduces emissions of carbon monoxide and VOCs. Ultimately, the exhaust from the kilns exits through 200-foot or 310-foot tall stacks, which TXI Operations continuously monitors emissions of several pollutants, including carbon monoxide, nitrogen oxides, and sulfur dioxide. The specific monitoring requirements varied across the kilns, although only a single kiln operates. In addition to pollution controls for kiln emissions, the facility has equipped several other process operations with baghouses and other types of dust collectors to reduce PM emissions.

Every other year, TXI Operations is required to provide EPA information on the amount of waste-derived fuel (i.e., hazardous waste) that the facility feeds to its kilns for energy recovery purposes (EPA, 2010a). That information is loaded into EPA's Biennial Reporting System (BRS) database, which can be queried by the public. Currently, BRS waste management statistics are available for every other year during 1989 through 2009. Following is a summary of the total amount of hazardous waste that TXI Operations burned for purposes of energy recovery, according to the facility's BRS reports:[2]

1991	40,600 tons	**2001**	62,400 tons
1993	56,200 tons	**2003**	31,600 tons
1995	90,700 tons	**2005**	50,000 tons
1997	57,700 tons	**2007**	42,100 tons
1999	74,700 tons		

On average, across the years listed, TXI Operations burned approximately 56,200 tons of hazardous waste annually for purposes of energy recovery (EPA, 2010a)—an amount roughly equivalent to burning more than 150 tons of hazardous waste per day, assuming continuous operations. The quantities burned since 2001 are low in comparison with other years because of permit restrictions that limited the number of kilns that could operate simultaneously. This waste has come almost entirely from offsite sources. Examples of the specific types of waste burned at TXI Operations include, but are not limited to, organic liquids and sludge, waste oils, and solvents. During the years TXI Operations burned hazardous waste, automatic waste feed cutoff systems were employed

[2] The BRS data are presented for all years with available information. Data shown are for the amount of hazardous waste burned for purposes of energy recovery. TXI Operations did not report any data to BRS for 1989. All data points are rounded to three significant figures.

to ensure that the quantities of waste-derived fuel did not exceed pre-established input limits that were based on compliance testing. Further, continuous emissions monitoring for total hydrocarbons provided data that could be used to assess the adequacy of fuel combustion. Various other requirements were mandated under an EPA regulation affecting combustion of hazardous waste in boilers and industrial furnaces.

TCEQ's web site documents 84 complaints that residents submitted to the agency between from 2002 to 2010 regarding TXI Operations' air emissions (TCEQ 2010b). More than half of these complaints were filed because of odors, when residents and passers-by reported smelling strong chemical and chlorine-like odors. Some odor complaints referenced odors of sulfur and burning tires, and nearly every odor complaint occurred at night. The other complaints pertained to primarily dust and smoke coming from the facility. In some cases, the complainants reported symptoms (e.g., cough, burning sensation in nostrils) believed to result from facility emissions.

- **Annual estimated air emissions.** Section 3 reviews the history of TXI Operations' annual emissions for the pollutants considered in this Health Consultation.

- **Short-term estimated air emissions.** From 2003 to 2011, TXI Operations submitted 36 air emission event reports to TCEQ. Thirty-five were excess opacity events and emission events and the other one was a scheduled maintenance event. Four emission events in the database were reported for the following: the safety valve in a storage tank ruptured in April 2005, releasing several VOCs; a dislodged brick in a rotary kiln in August 2006 caused increased emissions reported as excess opacity; a kiln shutdown in February 2008 led to excess emissions of sulfur dioxide; and problems encountered with a pump in April 2008 caused ammonia emissions to exceed allowable levels for 3 hours. None of these emission events occurred on days when TCEQ received complaints about TXI Operations' emissions.

2.3.5. Other Emission Sources

Air quality in Midlothian is affected by emissions from all local (and some distant) sources and not only by emissions from the four main facilities of interest. Consequently, the ambient air monitors in the area measure air pollution levels that reflect contributions from several emission sources.

Most industrial facilities, like the cement kilns and steel mill in Midlothian, are referred to as point sources. Other emission sources are typically classified into two categories: area sources and mobile sources. Area sources are small air pollution sources that individually do not emit enough pollutants to be considered a point source, but collectively throughout an area can account for a considerable quantity of emissions. Examples of area sources include agricultural tilling, dry cleaners, and gasoline stations. Mobile sources refer to any vehicle or equipment with a gasoline or diesel engine (e.g., on-road and off-road motor vehicles, construction equipment), and aircraft and recreational watercraft. The following paragraphs briefly review information on emissions from sources other than the four facilities of interest.

EPA's National Emissions Inventory (NEI) estimates the relative magnitude of annual emissions from point, area, and mobile sources for every county across the nation. According to the 2005 NEI, the most recent release available when ATSDR started this evaluation, the four industrial facilities of interest emit approximately 85 % of the sulfur dioxide and 60 % of the nitrogen oxides released to the air throughout all of Ellis County, and they account for approximately 20 % of the countywide emissions of carbon monoxide and fine PM (EPA, 2010b). NEI does not present emission data for short-term emission events.

These data offer some insights on the different types of emission sources found in and near Midlothian but must be interpreted in proper context. Although the NEI data suggest that sources other than the facilities of interest might account for the majority of countywide emissions for certain pollutants, that suggestion does not necessarily mean air pollution levels at a given location are dominated by these other sources. On the contrary, emissions from the four facilities of interest are expected to have considerably greater air quality impacts at locations nearest these facilities, especially considering their proximity to each other.

2.4. Demographics

ATSDR examines demographic data to determine the number of people who are potentially exposed to environmental contaminants and to consider the presence of sensitive populations, such as young children, women of childbearing age (aged 15–44 years) and the elderly (aged 65 years and older). This section considers general population trends for residents in the city of Midlothian and also identifies residential areas closest to the facilities.

- **General population trends.** Information compiled in the 2000 U.S. Census, provides demographic data for areas within 3 miles of the property boundaries of the four industrial facilities of interest. An estimated 38,908 people live within 3 miles of any of these facilities, and some people are life-long residents. The main population center of Midlothian is located between the facilities of interest, although several residential developments and individual properties are located throughout the area. According to the census data, approximately 11 % of the population within 3 miles of these facilities, are children; 6 % are elderly; and 22 % are women of childbearing age. Please refer to ATSDR's earlier health consultation (ATSDR, 2015) for a map and details on the demographic characteristics of the area.

- **Residents closest to the facilities.** Observations from site visitors and review of aerial photographs confirm that numerous residents live just beyond the four facilities' property lines. For instance, several dozen homes are located along the eastern boundary of TXI Operations. Multiple homes along Ward Road, Wyatt Road, Cement Valley Road, and other streets are located across U.S. Highway 67 from TXI Operations and Gerdau Ameristeel. Similarly, a residential area and Jaycee Park are located along the southeastern boundary of Ash Grove Cement, and another residential area is near the facility's northeastern boundary. Holcim has nearby residential receptors; the closest ones live near the facility's northwestern and southeastern boundaries.

- **Nearest areas with potential for elevated short-term exposures.** In addition to the residential neighborhoods and areas listed above, ATSDR considered short-term exposures that residents and visitors might experience when they are in proximity to the four industrial facilities. These short-term exposures can occur at many places, such as along U.S. Highway 67, which passes along the boundary of all four facilities; at recreational facilities near the facility boundaries (e.g., Jaycee Park, Pecan Trails Golf Course, Massey Lake); and at various nearby business establishments. Exposures to those traveling on U.S. Highway 67 would that exposure to those on US-67 would not normally be considered a concern due to the short time expected in this zone.

2.5. Local Climatic and Meteorological Conditions

ATSDR reviewed climatic and meteorological conditions in the Midlothian area because these factors affect how air emissions move from their sources to downwind locations. The Midlothian area is flat with gently rolling terrain. The National Climatic Data Center (NCDC) collects climatic data at multiple locations in Ellis County, and the Waxahachie weather station has the longest period of record. From 1971 to 2000, the average temperature in this area ranged from 46.0° F in January to 84.6° F in July, and the area received an average of 38.81 inches of precipitation a year, almost entirely in the form of rain (NCDC, 2004).

To assess the prevailing wind patterns, ATSDR obtained wind speed and wind direction data for multiple meteorological stations in the Midlothian area. ATSDR summarized data for two of these stations in a format known as a wind rose (see ATSDR, 2015). A wind rose displays the statistical distribution of wind speeds and directions observed at a meteorological station. The wind roses indicate that the most frequent wind direction in the Midlothian area is from south to north, although pronounced contributions also are observed from north to south and from southeast to northwest. For example, the Wyatt Road and Old Fort Worth Road monitors are considered downwind of TXI and Gerdau Ameristeel when the winds are blowing in the most freqent directions. However, on occasion, the Midlothian Tower might be downwind of these facilities when the wind is blowing from the north to the south. (See ATSDR 2012a for details on this analysis.)

ATSDR then examined the extent to which the more frequent wind patterns in the Midlothian area vary by month and time of day. At the Old Fort Worth Road and Midlothian Tower meteorological stations, average wind speeds were highest in March and April and lowest in August and September; wind speeds, on average, were also highest during the early afternoon (2:00 p.m. to 4:00 p.m.); wind speeds at both stations tended to be lightest around sundown (6:00 p.m. to 8:00 p.m.) and sunup (4:00 a.m. to 6:00 a.m.). In nearly every month of the year, winds blew most frequently from south to north. Contributions from the other main directions in the area varied slightly from month to month. Wind direction did not vary considerably with time of day.

2.6. General Air Quality in Ellis County

For more than 20 years, EPA and state environmental agencies have evaluated general air quality in populated areas by measuring ambient air concentrations of six common air pollutants, also known as criteria pollutants. These pollutants are carbon monoxide, lead, nitrogen dioxide, ozone, two forms of PM, and sulfur dioxide. For every criteria pollutant, EPA has established a health-based National Ambient Air Quality Standard. In cases where air quality does not meet the standard, states are required to develop and implement plans to bring air pollution levels into attainment with the health-based standards. The following paragraphs review the general air quality near Midlothian, as gauged by measured levels of criteria pollutants:

- **Ozone.** Currently, numerous ambient air monitoring stations measure ozone levels throughout selected summer and fall months in the Dallas-Fort Worth metropolitan area. Measured ozone levels at several of these stations have exceeded EPA's health-based standards, suggesting that the air quality in this area is at times unhealthy. As a result, EPA currently designates the Dallas-Fort Worth area as a "non-attainment area" for ozone. All of Ellis County is included in this non-attainment area. Air quality warnings are typically issued when ozone levels are expected to be elevated. The Dallas-Fort Worth area is considered one of three "serious" non-attainment areas for ozone in the United States. This designation is lower than the two "extreme" and three "severe" non-attainment areas but higher than the numerous other "moderate" non-attainment areas nationwide. Residents can learn more about ozone at http://www.AirNow.gov.

  The ozone air quality issues in Dallas-Fort Worth are complex and result from numerous industrial and motor vehicle emissions over a broad geographic region. The exact contribution of any single source to elevated ozone levels is difficult to assess.

- **Other pollutants.** For the criteria pollutants (carbon monoxide, lead, nitrogen dioxide, PM, and sulfur dioxide), the Dallas-Fort Worth area is considered to be in attainment with EPA's health-based air quality standards (except for a small portion of Collin County that is designated nonattainment for the lead standard). In June 2010, EPA strengthened its health-based standard for sulfur dioxide, but the agency recently reported that air quality in the Dallas-Fort Worth metropolitan area currently meets the stricter (and more health-protective) standard (EPA, 2010c). Attainment status for the Dallas-Fort Worth area for the new stricter 2012 $PM_{2.5}$ standard is still pending review.

3. Measured and Estimated Air Pollution Levels

This section summarizes data on air pollution levels measured in Midlothian. For each pollutant considered in this Health Consultation, this section presents background information on the pollutant and why it is expected to be found in the facilities' emissions. The section also documents reported emission rates for the pollutants of interest, including how those emissions vary across facilities and with time. Finally, the section documents the measured air pollution levels and how those vary from one location to the next. Modeling results are presented for the pollutant or areas for which no direct measurements are available (i.e., carbon monoxide for the general Midlothian area and for sulfur dioxide downwind of the Ash Grove and Holcim facilities). Data summaries and maps are used throughout this section to document the air pollution measurements and where they were collected.

As an initial step in the health evaluation, the measured air pollution levels are compared with health-based air quality standards and guidelines published by EPA, TCEQ, or the World Health Organization (WHO). These values have been developed to protect the health of all individuals, including sensitive populations (e.g., persons with asthma, children, and the elderly). Sections 3.1 through 3.6 present detailed data evaluations for the individual pollutants, and Section 3.7 summarizes these findings. Section 4 of this Health Consultation presents ATSDR's detailed health evaluations for each pollutant above health-based guidelines or standards.

It is important to note that ATSDR used the EPA NAAQS standards and World Health Organization (WHO) guidelines only as a way to screen the environmental levels to determine which of the NAAQS air pollutants would be further evaluated in the Public Health Implications Section below—they were not used alone to determine if harmful effects were possible in the past or currently. ATSDR used the current standards as health comparison values for screening purposes in relation to current and past exposures as they reflect the most updated information on our understanding of the possible harmful effects of the NAAQS air pollutants. Moreover, EPA has specific statistical approaches to evaluate environmental monitoring data for determining if a standard has been exceeded and whether an area is not in attainment of the standard. For the most part (except for past SO_2 levels from 1997-2011), ATSDR's screening process simply evaluated whether the measured levels of a particular NAAQS air pollutant were numerically above the value of the standard and did not evaluate the data using the statistical approach used by EPA under its regulatory authority. Moreover, the only NAAQS air pollutant that has been above the EPA standards, either currently or in the past, in the Midlothian area, is for ozone, but not for all years.

3.1. Carbon Monoxide

Carbon monoxide is released by many sources, typically when carbon-containing fuels do not burn completely. On a national scale, motor vehicles account for approximately 90 % of carbon monoxide emissions from manmade sources (EPA, 2008a). However, emissions from industrial sources can dominate in areas with certain manufacturing activity.

Environmental exposure to CO can occur while traveling in motor vehicles, working, visiting urban locations associated with combustion sources, or cooking and heating with domestic gas, charcoal, or wood fires, and by inhaling environmental tobacco smoke. WHO (1999) summarized environmental concentrations as follows: CO concentrations in ambient air monitored from fixed-site stations are usually below 9 ppm (8 h average). However, short-term peak concentrations up to 50 ppm are reported on heavily traveled roads. The CO levels in homes are usually lower than 9 ppm; however, the peak value in homes could be up to 18 ppm with gas stoves, 30 ppm with wood combustion, and 7 ppm with kerosene heaters. The CO concentrations inside motor vehicles are generally 9–25 ppm and occasionally over 35 ppm. Similar exposure levels were reported by EPA (2000b). However, trends in ambient outdoor concentrations of carbon monoxide (CO) are decreasing over time, likely resulting in part from the widespread use of emission control technology. EPA monitoring data indicate that CO concentrations decreased over the period 1980 to 2013 nationally and in the Southern region of the U.S. (including Texas) by a factor of about two to four (EPA, 2015a).

Table 1 summarizes CO emissions data available from TCEQ's Point Source Emissions Inventory (PSEI) for the four facilities of interest. According to this inventory, these four facilities have consistently had the highest CO emissions among the industrial facilities found in Ellis County. The emissions also rank high among facilities statewide. For example, in 2005, the PSEI includes carbon monoxide emissions for more than 1,600 facilities. In that year, emissions from the Midlothian facilities ranked 13th (Holcim), 28th (Gerdau Ameristeel), 63rd (TXI Operations), and 99th (Ash Grove Cement) when compared with the other facilities across the state.
Other emissions trends are evident from Table 1. For instance, during the last 23 years of inventory data shown, Holcim's annual carbon monoxide emissions were the highest of the four facilities, followed by emissions from Gerdau Ameristeel, TXI, and Ash Grove Cement. During this 23-year period, emissions were lowest in 2009 and 2010. Emissions in these 2 years were particularly low for the three cement manufacturing facilities, consistent with an industry-wide decline in production that occurred during this same time (USGS, 2011).

ATSDR has compiled all publicly available ambient air monitoring data for the Midlothian area. However, no monitors in or near Midlothian have measured air pollution levels for carbon monoxide. To fill this gap in the environmental data, ATSDR used models to estimate past air quality impacts for this pollutant. Appendix A of this report documents the modeling analysis, which was based on assumptions generally designed to assess worst-case air quality impacts. For example, the emissions data used in the model were based on the highest years of emissions documented in Table 1. The model included the carbon monoxide emissions data for Ash Grove Cement from 1990, for Gerdau Ameristeel from 1994, for Holcim from 2004, and for TXI from 1990. Further, to assess the worst case scenario, ATSDR assumed that these emissions all occurred at the same time. The model was run to predict air pollution levels from all four sources combined, and the main results were as follows:

- The highest 1-hour average carbon monoxide concentration estimated by the model was 0.85 parts per million (ppm) at a location north of the Gerdau Ameristeel property line, near the intersection of Wyatt Road and U.S. Highway 67. In contrast, the NAAQS HCV for this air contaminant is 35 ppm. Further, WHO's health guideline for 1-hour levels is 26 ppm (WHO, 2000). Thus, the highest estimated air quality impact attributed to the facilities is more than 30 times lower than the corresponding health comparison values.

- The highest 8-hour average carbon monoxide concentration estimated by the model was 0.55 ppm, again at a location north of Gerdau Ameristeel. Both the NAAQS HCV and WHO's health guideline for this variable is 9 ppm—more than 15 times higher than the estimated air quality impacts from the facilities.

- The model used in this analysis does not estimate air concentrations for averaging periods shorter than 1 hour. Therefore, ATSDR could not compare estimated concentrations with WHO's health guidelines derived for 15-minute and 30-minute averaging periods. This lack of data is not considered a major limitation in the health evaluation because even if we assume that the highest 1-hour CO value increased by a factor of four to simulate what a 15-minute value might be, the levels would all be below the WHO guideline.

- ATSDR has not developed a Minimal Risk Level for CO. Given the physiologic role of endogenous carbon monoxide (i.e., natural production of CO by the human body), an exposure threshold for carbon monoxide actions, if one exists at all, is likely at or near the endogenous production rate. Therefore, any exogenous source of carbon monoxide exposure would have the potential for exceeding the threshold and producing potentially adverse effects. Although there might be an exposure level that can be tolerated with minimal risk of adverse effects, the currently available toxicologic and epidemiologic data do not identify such minimal risk levels. The lowest levels of effects have been seen in epidemiologic studies. These studies indicate an increased risk of arrhythmias in coronary artery disease patients and exacerbation of asthma when the concentration range is about 0.5-10 ppm (ATSDR, 2012). ATSDR estimated 1 and 8 hour CO concentrations in Midlothian at 0.85 and 0.55, respectively. Although ATSDR cannot rule out a harmful effect in some very sensitive persons, the estimated worst-case exposure levels are at the low end of the range that showed these effects in epidemiologic studies. Moreover, the estimated levels are below the background level for the Dallas-Fort Worth metropolitan area and what might be typically found in a home or automobile.

The modeling results are estimates of carbon monoxide air quality impacts from the four Midlothian facilities, and do not consider contributions from other sources. To assess potential contributions from other sources (e.g., motor vehicles), ATSDR considered carbon monoxide monitoring data collected in two high motor vehicle traffic areas in the Dallas–Fort Worth metropolitan area. These data are accessible from EPA's "AirData" database, which is a clearinghouse of air pollution measurements collected nationwide. According to that database, the highest 1-hour average carbon monoxide concentration over the last 5 years at the two long-term monitoring stations in Dallas and Fort Worth was 3 ppm (EPA, 2012a). Therefore, carbon monoxide levels in the Midlothian area caused by mobile sources are likely substantially less than this amount, but no measurements are available to support this judgment.

Overall, no carbon monoxide monitoring has occurred in Midlothian, and Ellis County is not designated as a non-attainment area for EPA's air quality standards. ATSDR's modeling analysis indicates that the greatest air quality impacts from carbon monoxide are lower than HCVs. Even when considering reasonable estimates for contributions from mobile sources, carbon monoxide levels throughout Midlothian likely do not exceed health-based air quality standards.

ATSDR acknowledges that estimated air quality impacts for carbon monoxide are based entirely on a modeling analysis, which has inherent uncertainties and limitations. The main sources of uncertainty are the model inputs for local meteorology, the model inputs for facility emission rates, and inherent limitations in air dispersion models. As Appendix A indicates, the meteorologic data used in this assessment were developed specifically for modeling air quality concerns in Ellis County, and the most frequent wind patterns in that data set are consistent with those recently observed in the Midlothian area. Further, the modeling considers 5 years of meteorologic data—the number of years of data that EPA recommends be included in air quality modeling analyses to ensure that worst-case meteorologic conditions are adequately captured (EPA, 2005). Further, ATSDR believes the model inputs do not underestimate actual annual emissions for three reasons. First, the values entered into the model were the highest facility-specific emissions data from 1990 to 2011. Second, the model assumed that the highest emission rate from all four facilities occurred in the same year, even though that was not the case. Third, the emissions data for the three cement manufacturing companies are measured directly with continuous emissions monitors and are therefore expected to be highly accurate. Taken together, these observations all suggest that the modeling analysis offers a reasonable account of carbon monoxide air pollution levels attributable to the facilities' emissions. However, the principal limitation in the assessment is that the modeling is based on annual average emission rates, and not peak hourly releases, as discussed in Appendix A. Nonetheless, given that the estimated air quality impacts are more than 15 times lower than the corresponding air HCVs, ATSDR has confidence in basing its health conclusions on the carbon monoxide modeling results.

Based on the above analyses, ATSDR will not further evaluate carbon monoxide in the Public Health Implications Section below.

3.2. Lead

Lead is a naturally occurring metal. Typically found at low levels in soils, lead is processed for many industrial and manufacturing applications, and it is found in many metallic alloys. Lead was previously found in many gasoline additives, but this use was gradually phased out starting in the 1970s. On a national level, many different sources emit lead, including boilers, electricity-generating facilities, and incinerators. A recent EPA assessment found that iron and steel foundries (which includes Gerdau Ameristeel) accounted for approximately 7.7 % of the nation's total manmade emissions in 2002, whereas emissions from Portland cement manufacturing facilities (which includes the other three Midlothian facilities) accounted for approximately 1.5 % of the nation's total emissions (EPA, 2006a).

Table 2 summarizes lead emissions data available from TCEQ's PSEI and for EPA's Toxics Release Inventory (TRI) for the four facilities of interest. In any given calendar year, a facility's emissions data reported to PSEI are not always the same as those reported to TRI because of differences in these two programs' reporting requirements. When compiling data for display in Table 2, ATSDR selected the higher value for annual emissions reported in either inventory.

Table 2 reveals two important trends in the facilities' lead emissions. First, air emissions of lead from Gerdau Ameristeel far exceeded emissions from the other facilities over the entire period of record. For the past 20 years, this facility's lead emissions accounted for at least 80 % of the total emissions from all four facilities. In fact, emissions from Gerdau Ameristeel have consistently ranked high among other industrial facilities in Texas. For example, according to the PSEI data for 1995, lead emissions from Gerdau Ameristeel ranked 2nd out of the 67 facilities in the state for which emissions data are in the inventory (TCEQ, 2011a). Second, a substantial decrease in lead emissions occurred in the late 1980s; the total emissions summed across all four facilities decreased by more than 95 % during this time. Two improvements in capturing lead emissions occurred at Gerdau Ameristeel in 1988 and 2003 (Personal Communication, Dale Harmon, Gerdau Ameristeel, 2/15/12). Information about these improvements helps in interpreting the ambient air monitoring data.

Table 3 summarizes the ambient air monitoring data collected for lead in the Midlothian area. ATSDR's first Health Consultation for this site concluded that these data were collected with scientifically defensible methods and met standard data quality objectives (ATSDR, 2015). During the past 30 years, airborne lead levels have been measured at 16 monitoring locations in the Midlothian area (Figure 1). Table 3 organizes the lead summary statistics by decade to illustrate how air quality impacts have changed with time:

EPA's Lead Air Quality Standards

EPA issued its first health-based NAAQS for lead in 1978. That standard required that ambient air concentrations of lead averaged over a calendar quarter must not exceed 1.5 µg/m^3. This standard is based on lead in air samples for total suspended particulate (TSP) matter.

In 2008, EPA issued a new NAAQS for lead, based on a more current health-effects review. The 2008 standard requires lead concentrations for any 3-month rolling average not to exceed 0.15 µg/m^3. The new standard still applies to lead in TSP; however, monitoring for lead in other particle sizes is permitted in some circumstances when assessing compliance with the standard. TCEQ requires lead levels to meet EPA's standards.

Note: The WHO health guideline for lead is 0.5 µg/m^3 based on annual average concentrations (WHO, 2000). This document uses EPA's health-based NAAQS for evaluating lead concentrations, because that value is more health protective.

- *Lead data from the 1980s.* The only monitoring station in the Midlothian area that measured lead in the 1980s was located on the roof of Midlothian City Hall. From 1981 to 1983, 24-hour average samples were collected every sixth day, following standard sampling frequencies applied throughout Texas and the United States. The highest 3-month rolling average lead concentration at this site was 0.237 µg/m^3. This 3-month average occurred in October-November-December, 1981. Therefore, the highest quarterly average lead concentration at this station was below the health-based NAAQS that was active at the time (1.5 µg/m^3) but higher than the NAAQS HCV (0.15 µg/m^3).

  However, the Midlothian City Hall monitoring station is not located directly downwind from the largest industrial lead emission source in the area (Gerdau Ameristeel). In fact, winds in this area rarely blow from the southwest to the northeast, which suggests that measurements at Midlothian City Hall likely do not reflect the highest air quality impacts associated with the local industrial emission sources. ATSDR compared measurements from Midlothian City Hall with other measurements statewide, which were made in 1981 by the Texas Air Control Board and other agencies. To do so, ATSDR accessed all lead monitoring data archived on TCEQ's Texas Air Monitoring Information System (TCEQ, 2012a). In 1981, ambient air monitoring for lead occurred at more than 100 sites statewide. This monitoring was conducted using consistent methods, and 89 of these sites had a sufficient number of samples to calculate quarterly average concentrations.[3] Across these 89 sites, the highest quarterly average lead concentration ranged from 0.04 to 1.96 μg/m^3. Further, the highest quarterly average concentration at Midlothian City Hall (0.23 μg/m^3) ranked 45th of the 89 stations considered for this analysis, which included a mix of stations in urban, suburban, and rural locations.

Considered together, these factors suggest that the lead levels measured in 1981 and 1983 do not capture the greatest air quality impacts from nearby industrial sources, but instead reflect contributions from sources common to populated areas. Emissions from mobile sources likely were a major contributor to the lead levels measured at Midlothian City Hall. Although the United States began phasing out use of lead additives in gasoline in the late 1970s, these additives continued to be used into the 1990s, and mobile sources accounted for most of the nation's lead emissions up through 1990 (EPA, 2006a).

- *Lead data from the 1990s.* As Table 3 indicates, five ambient air monitoring stations in the Midlothian area measured airborne lead levels at some time during the 1990s. Some of the stations measured lead in TSP, but others measured lead in particulate matter with aerodynamic diameter of 10 microns or less (PM_{10}). Total suspended particles are considered inhalable—meaning there can be exposure via inhalation and by ingestion when cilia remove lead from lung (thorax) and the lead is subsequently swallowed and ingested. This smaller particle size fraction is often applied in air quality studies because PM_{10} is commonly viewed as "respirable" particles—those that tend to pass through the nose and mouth and enter the lungs. ATSDR reviews the two types of measurements separately.

  The Gerdau Ameristeel site that measured lead in TSP was located at 2060 South Highway 67. As Figure 1 shows, this site is located directly north of the Gerdau Ameristeel facility. At this site, 24-hour average samples were collected every sixth day, and 319 valid lead sampling results are available from January 1993 to August 1998. Data are available for 23 consecutive calendar quarters. None of the quarterly average concentrations exceeded EPA's health-based NAAQS at the time (1.5 μg/m^3). However, 18 of the 23 quarterly average concentrations are greater than current NAAQS HCV (0.15 μg/m^3). The highest average lead concentration for any calendar quarter was 0.443 μg/m^3, and this was observed for the months of April, May, and June in 1995. This site also recorded some of the highest quarterly average concentrations of lead in the state. For example, according to the Texas Air Monitoring Information System, 35 lead monitoring stations operated statewide in 1993. That year, the highest quarterly average lead concentration at the Gerdau Ameristeel site was 0.239 μg/m^3, and only one other monitoring station in the state had higher quarterly average lead concentrations (TCEQ, 2012a). The measurements at this site occurred during 1993 –1998, after Gerdau Ameristeel's emissions had decreased considerably from their highest levels on record (see Table 2). Therefore, it is uncertain if this monitoring station captured the facility's

[3] For purposes of this evaluation, ATSDR considered only those monitoring sites that had at least 10 valid 24-hour average samples per calendar quarter.

highest air quality impacts. Moreover, given the proximity of the Gerdau monitor and Highway 67, it is possible that some portion of the lead captured was from automobiles and not from Gerdau Ameristeel emissions.

ATSDR acknowledges that the lead concentrations measured from the ambient air monitor located north of the Gerdau fence line from 1993 through 1998 would be expected to include contributions from traffic on U.S. Highway 67. However, ATSDR believes that lead concentrations attributable to Highway 67 traffic from 1996 through 1998 would be relatively low because the Clean Air Act Amendments issued in 1990 mandated the elimination of lead from all U.S. motor fuel by January 1, 1996. Assuming a gradual elimination of leaded gasoline in vehicles, lead emissions from vehicles would have been significantly reduced by mid-1996 (EPA, 1995). Moreover, the Gerdau facility must be considered one of the major sources of air lead levels detected by the monitor at that time. In fact, emissions from Gerdau Ameristeel did consistently rank high among other industrial facilities in Texas. For example, according to the PSEI data for 1995, lead emissions from Gerdau Ameristeel ranked 2nd out of the 67 facilities statewide with emissions data in the inventory (TCEQ, 2011a).

Annual average lead concentrations detected at the Gerdau Ameristeel monitor during this timeframe are as follows:

1993	0.244 $\mu g/m^3$
1994	0.174 $\mu g/m^3$
1995	0.255 $\mu g/m^3$
1996	0.205 $\mu g/m^3$
1997	0.196 $\mu g/m^3$
1998	0.187 $\mu g/m^3$ (based on samples taken from January through August)

As Table 3 shows, four other lead monitoring stations operated in the 1990s. These stations were located throughout the Midlothian area and measured lead in PM_{10} in the 1991–1993 period. During this time, the highest average lead concentrations were at the monitoring station (Cement Valley Road) closest to and downwind from the Gerdau Ameristeel facility; lower concentrations occurred at the other three stations. The highest quarterly average lead concentration (0.035 $\mu g/m^3$) observed across all four stations is lower than EPA's current and former health-based lead standards, but the measured concentrations were in the PM_{10} size fraction, and the health standard is based on the TSP size fraction. However, a recent statistical analysis conducted by EPA indicates that, on average, lead concentrations in TSP are usually no more than twice as high as lead concentrations in PM_{10}.[4] Applying this result to Midlothian suggests that airborne lead levels at these four monitoring stations were not above the level of the current health-based standard; however, we do not know what the levels were before monitoring began.

[4] When EPA proposed the current health-based standard for lead, agency officials conducted a statistical analysis of the relative amounts of lead in PM_{10} and TSP. This was done by obtaining monitoring data from all sites nationwide that concurrently measured both lead in PM_{10} and lead in TSP. EPA's statistical analysis of the data from these 23 sites found that the average concentration of lead in TSP was never more than twice the average concentration of lead in PM_{10} (EPA, 2008b).

In summary, quarterly average lead concentrations immediately north of Gerdau Ameristeel exceeded the lead NAAQS HCV, but not the standard in place at that time, throughout much of the 1990s, but the available data suggest that this was a highly localized effect. ATSDR's modeling analysis (see Appendix A) also confirms that air quality impacts from Gerdau Ameristeel would decrease rapidly with downwind distance. Moreover, it is likely that automobile traffic along Highway 67 contributed to some of the air lead levels detected by the Gerdau monitor during the years 1993-1998.

- *Lead data from the 2000s.* Table 3 lists the ten monitoring sites that measured ambient air concentrations of lead since 2000. The monitoring data from these sites continue to exhibit the same spatial variations; lead levels are highest at locations immediately downwind from Gerdau Ameristeel. TCEQ's recent air quality study in Midlothian found that lead levels at the Wyatt Road monitoring station were higher than at the three other fixed stations considered in that program, a finding that was statistically significant (TCEQ, 2010d). However, the magnitude of the lead concentrations during this period was considerably lower than what was observed in earlier years. The highest quarterly average lead concentration during this period was 0.026 $\mu g/m^3$ in PM_{10}. Based on the statistical analysis previously cited, such lead levels in PM_{10} are almost certainly lower than EPA's current health-based standard for lead in TSP.

  Overall, the data presented in this section highlight important spatial and temporal variations for airborne lead levels in Midlothian. Spatially, the highest lead concentrations were observed at the monitoring station closest to Gerdau Ameristeel—the facility with the highest lead emissions in the Midlothian area (see Table 2). Temporally, the highest ambient air concentrations of lead were observed in the mid- to late-1990s, but even higher lead concentrations likely occurred during earlier years, when emissions from Gerdau Ameristeel were higher.

  Considering that lead was detected at the Gerdau Ameristeel monitoring station for the years 1993–1998 above the lead NAAQS HCV, lead will be further evaluated in the Public Health Implications Section below.

3.3. Nitrogen Dioxide

Nitrogen oxides are a group of nitrogen-containing pollutants typically found in urban air. Nitrogen dioxide accounts for most nitrogen oxides and is the pollutant for which EPA has developed its health-based NAAQS. Most airborne nitrogen oxides come from combustion-related sources, including mobile sources, industrial sources, and electricity generating facilities. Cement manufacturing facilities and steel mills emit nitrogen oxides.

Table 4 presents nitrogen oxides emissions data available from TCEQ's Point Source Emissions Inventory (PSEI) for the four Midlothian facilities from 1990 to 2010. These four facilities have consistently had the highest nitrogen oxides emissions among the industrial facilities in Ellis County. The emissions also rank high among the industrial facilities statewide. For example, in 2005, the PSEI contains nitrogen oxides emissions for more than 1,600 facilities in Texas. In that year, emissions from the Midlothian facilities ranked 14^{th} (Holcim), 19^{th} (TXI Operations), 38^{th} (Ash Grove Cement), and 195^{th} (Gerdau Ameristeel) when compared with other facilities across the state. It should be noted that based on data retrieved from STARS on December 11, 2012, Owens Corning Insulating Systems LLC and Saint Gobain Containers were also consistently in the top six for nitrogen oxides emissions for Ellis County. For many years between 1993 and 2010, Owens Corning Insulating Systems LLC and Saint Gobain Containers reported higher nitrogen oxides emissions than Gerdau Ameristeel. The three Midlothian cement facilities consistently reported the top three nitrogen oxides emissions from 1990-2010 for Ellis County.

Other emissions trends are evident from Table 4. For instance, the highest nitrogen oxides emissions in any given year in the Midlothian area were from Ash Grove Cement, Holcim, or TXI Operations; emissions from Gerdau Ameristeel were considerably lower. Across all four facilities, the years with the highest total emissions were 1994 to 2005. Of the 24 inventory years shown in Table 4, 2009 and 2010 had the lowest combined nitrogen oxides emissions with lower emission trends continuing to 2013. The decreased emissions in these years is consistent with the trend for carbon monoxide emissions and again likely results from a decline in production in the cement manufacturing industry that occurred during this same time (USGS, 2011) or other factors. In addition, reductions in emissions of nitrogen oxides for Holcim and Ash Grove could also be attributed to the installation of selective non-catalytic reduction (SNCR) controls. Ash Grove installed SNCR on kiln 1 in 2007 and on kilns 2 and 3 in 2008. Holcim installed SNCR on kiln 1 and kiln 2 in 2006.

Table 5 summarizes the ambient air monitoring data collected for nitrogen dioxide in the Midlothian area, and Figure 2 shows where the monitors were located. ATSDR's first Health Consultation for this site concluded that these data were collected with scientifically defensible methods and met standard data quality objectives (ATSDR, 2015). Continuous monitors operate at these sites and output a series of 1-hour average concentrations from which annual average concentrations can be calculated. As Table 5 shows, the annual average nitrogen dioxide concentrations at the three stations of interest ranged from 4.0 to 10.87 parts per billion (ppb). These values are lower than 53 ppb, which is EPA's health-based standard, and TCEQ has adopted the same standard. The range of annual average concentrations measured in Midlothian (4.0 to 10.87 ppb) is also lower than 21 ppb—the corresponding health guideline published by WHO (WHO, 2006). Similarly, the highest 1-hour average concentration measured during this time was 78.61 ppb. EPA's health-based standard for 1-hour average concentrations is 100 ppb, based on the 98^{th} percentile concentration averaged over 3 consecutive calendar years; TCEQ has adopted this standard. The measured 1-hour average levels are also lower than the WHO health guideline for 1-hour concentrations (106 ppb). Therefore, all short-term and long-term nitrogen dioxide concentrations measured in the Midlothian area were lower than current air quality standards and within health guidelines.

These observations are notable because the monitoring data span the years 2000 to 2014, which include many years when the combined emissions from the four facilities were highest. Further, two of these monitoring stations were located in residential neighborhoods immediately downwind from the Gerdau Ameristeel and TXI Operations facilities. These stations are therefore expected to provide a reasonable indication of the highest exposures that might have occurred during 1990–2014. Inferences about air quality impacts before 1990 are difficult to make without information on nitrogen dioxide emission rates for these years.

Based on the above analyses, ATSDR will not further evaluate nitrogen dioxide exposures in the Public Health Implications Section below.

3.4. Ozone

Ozone is commonly found in urban air pollution. Ozone levels are typically highest during the afternoon of the summer months, when the influence of direct sunlight is the greatest. The Midlothian facilities do not release ozone directly into the air. Rather, ozone forms in air when emissions of nitrogen oxides and volatile organic compounds mix together and react with sunlight. Although the Midlothian facilities emit these pollutants (e.g., see Table 4), mobile sources and numerous other industrial sources throughout the area also contribute to the local ozone air quality issues.

Ellis County, where Midlothian is located, is one of 10 counties that together constitute the Dallas–Fort Worth ozone non-attainment area. This designation means that airborne ozone levels in these counties do not meet, or are expected not to meet, EPA's health-based air quality standard for this pollutant. The current version of EPA's standard is 0.075 ppm for 8-hour average ozone concentrations, and compliance with the standard is calculated based on statistical analyses of three consecutive years of measurements. TCEQ has adopted the EPA health-based standard, and WHO has established a health guideline of 0.05 ppm for 8-hour average ozone concentrations (WHO, 2006). The measured concentrations of ozone throughout the metropolitan area have occasionally exceeded all of these levels. On November 25, 2014, EPA proposed to change the NAAQS standard for ozone to 65-70 ppb (8-hour standard). EPA was also announced that is seeking comments on levels for the health standard as low as 60 ppb and comments on retaining the current standard. This proposed change is based on current scientific evidence of ozone's effect on public health. EPA's independent science advisors, the Clean Air Scientific Advisory Committee or CASAC, concluded that scientific evidence supports a standard within the range of 60-70 ppb (EPA, 2014). Subsequently, in 2015, EPA revised the ozone standard to 70 ppb (see http://www3.epa.gov/airquality/ozonepollution/actions.html).

The Dallas-Fort Worth metropolitan area has not met EPA's ozone standards for approximately 20 years, although EPA has revised the standard multiple times during this time. TCEQ monitors ozone throughout this area and has operated two ozone monitoring stations in the vicinity of Midlothian (see Figure 3): the Midlothian Tower site monitored ozone from 1997 to 2007, and the Old Fort Worth Road site monitored ozone from 2006 to 2012. The Midlothian Tower site recorded ozone concentrations above the level of the NAAQS for several years (TCEQ, 2011b), and the Old Fort Worth Road site has been measuring ozone concentrations close to the level of the NAAQS. Based on the available data from both monitors, from 1997 to 2012, the 8-hour NAAQS ozone HCV was exceeded 227 times as shown below (TCEQ, 2014b):

Year	Frequency of 8-Hour Values (76-95 ppb)	Frequency of 8-Hour Values (96-115 ppb)
1997	9	0
1998	26	4
1999	40	4
2000	37	5
2001	3	0
2002	20	1
2003	12	0
2004	10	3
2005	11	0
2006	16	2
2007	7	0
2008	1	0
2009	2	0
2010	0	0
2011	7	0
2012	6	1
Totals	**207**	**20**

The levels above the standard tended to be highest during May through September, although April and October have also had 8-hour periods above the standard. In addition, the data generally show a decreasing number of days, especially since 2007, that were within the concentration ranges shown in the above table. Moreover, for several of the years since 2007, the Midlothian monitors did not exceed the standard as defined by EPA.

Some additional observations regarding ozone in the Midlothian area deserve mention. First, the ozone air quality issues in the Dallas-Fort Worth area are not unique; the area is one of many metropolitan areas nationwide that does not meet EPA's ozone standard. EPA has recently estimated that more than 100 million people nationwide live in areas that do not meet the agency's health-based ozone standard (EPA, 2010d). Second, the ozone issues near Midlothian cannot be attributed to a single emissions source. Emissions from the Midlothian facilities certainly contribute to the ozone found throughout the metropolitan area, as do emissions from industrial sources, motor vehicles, and natural sources over a broad geographic region. For example, planning documents suggest that total nitrogen oxides emissions throughout the Dallas-Fort Worth non-attainment area were 519 tons per day in 2006 (TCEQ, 2011b); however, the combined emissions of nitrogen oxides across all four Midlothian facilities in 2006 (see Table 4) was approximately 25 tons per day—less than 5 % of the area wide nitrogen oxides emissions.

The Midlothian area has been and currently is in compliance for all criteria pollutants except for ozone. Because Ellis County is included in the Dallas/Fort Worth non-attainment, it is also included in the ozone State Implementation Plan which includes measures for further reducing ozone.

For these and other reasons, this Health Consultation addresses ozone as a general air quality issue that is only partly affected by emissions from the Midlothian facilities and will be further evaluated in the Public Health Implications Section below.

3.5. Particulate Matter

Particulate matter (PM), which refers to airborne droplets and particles, comes from many sources, including wind-blown dust, other natural sources, and manmade sources. For more than 30 years, various government agencies have regulated air concentrations of PM, and those regulations have been based on a scientific understanding of how different sizes of PM affect human health. The text box (see below) explains how EPA regulations have changed over the years and documents the current WHO PM health guidelines. The remainder of this section is organized by the three PM size fractions most often used when evaluating outdoor air quality.

3.5.1. Total Suspended Particulates (TSP)

Ambient air monitoring for TSP occurred at one place in Midlothian. During May 1981–December 1984, the 24-hour average TSP samples were collected once every 6 days at the monitoring station located on the rooftop of Midlothian City Hall (see Figure 4). During this time, the highest individual 24-hour measurement was 194 $\mu g/m^3$, which is below EPA's health-based standard at the time. The highest annual average TSP concentration at this location (86.3 $\mu g/m^3$) occurred in 1982. This concentration was higher than EPA's health-based standard at the time, and ranked high among annual average TSP levels observed statewide. Specifically, in 1982, nearly 150 TSP monitoring stations collected enough data to calculate annual average concentrations, and the value observed at Midlothian City Hall ranked 22nd among these sites (TCEQ, 2012a).[5] The extent to which emissions from the Midlothian facilities contributed to these measured concentrations is unclear, especially considering that the most frequent wind direction in the area would not have blown emissions from the facilities to this monitor. Another complication is that TSP includes larger particles of natural origin (e.g., wind-blown dust), which typically do not factor as much into the finer particle sizes. Since the scientific community currently believes that $PM_{2.5}$ and PM_{10} are better indicators of exposure to particles than TSP and that the former TSP monitoring station was not located where facility emissions would likely have the greatest impact, the majority of this evaluation focuses on PM_{10} and $PM_{2.5}$—the size fractions that currently have health-based standards. ***Based on the above information, TSP exposures during 1981–1984 will not be further evaluated in the Public Health Implications Section below.***

[5] This comparison was based on all sites documented in TCEQ's TAMIS database that had at least 40 valid 24-hour average TSP measurements during calendar year 1982.

PM: Particle Size and Public Health
For more than 40 years, EPA has regulated airborne concentrations of PM. Health studies have documented that the size of airborne particles is related to types of adverse health effect. This Health Consultation classifies emissions and air concentrations of PM according to their size, using the following three categories:

Total suspended particulate (TSP). EPA issued its first health-based air quality standards for PM in 1971, and the health-based standard required that annual average concentrations of TSP not exceed 75 $\mu g/m^3$ and that 24-hour average concentrations not exceed 260 $\mu g/m^3$ more than once per year. Particulates up to 100 micrometer in diameter are referred to as total suspended particulate (TSP) matter; however, samples below 0.1 micrometer in diameter are not normally collected by the methods used to sample particulate matter (EPA, 1999).

Particulate matter smaller than 10 microns (PM_{10}). PM_{10} is the subset of TSP composed of particles and droplets with aerodynamic diameters of 10 microns or less—a diameter much smaller than that of human hair. Regulators began focusing on PM_{10} because research started to indicate that these particles were more likely to pass through the nose and mouth and enter the lungs. In other words, these particles were respirable. In 1987, EPA's health-based air quality standards shifted focus from TSP to PM_{10}. At the time, EPA issued standards based on annual average and 24-hour average PM_{10} concentrations. However, the agency recently revoked the annual standard, and only the short-term standard remains: 24-hour average PM_{10} concentrations are not to exceed 150 $\mu g/m^3$ more than once per year (on average) over a 3-year period. WHO's health guidelines are much lower: the annual average health guideline for PM_{10} is 20 $\mu g/m^3$, and the 24-hour health guideline for PM_{10} is 50 $\mu g/m^3$.

Particulate matter smaller than 2.5 microns ($PM_{2.5}$). $PM_{2.5}$—or "fine particulate"—is the subset of TSP composed of particles and droplets with aerodynamic diameters of 2.5 microns or less. By definition, $PM_{2.5}$ is also a subset of PM_{10}. EPA started regulating air concentrations of $PM_{2.5}$ in 1997, after research demonstrated that exposure to these smaller particles can be associated with a range of adverse health effects (see Section 4). EPA's health-based standards require that annual average concentrations of $PM_{2.5}$, averaged over three consecutive calendar years, do not exceed 12 $\mu g/m^3$. Further, the 98th percentile of 24-hour average $PM_{2.5}$ concentrations, averaged over three consecutive calendar years, must not exceed 35 $\mu g/m^3$. WHO's health guidelines for $PM_{2.5}$ are even lower: the annual average health guideline is10 $\mu g/m^3$, and the 24-hour health guideline is 25 $\mu g/m^3$.

3.5.2. Particulate Matter Smaller than 10 Microns (PM_{10})

Table 6 presents PM_{10} emissions data available from TCEQ's Point Source Emissions Inventory (PSEI) for the four Midlothian facilities from 1990 to 2013. The PM_{10} emissions listed for these facilities have consistently ranked among the highest for industrial facilities in Ellis County. The emissions also rank high among industrial sources statewide. In 2005, the PSEI contains PM_{10} emissions data for more than 1,600 facilities in Texas. In that year, emissions from the Midlothian facilities ranked 43rd (Holcim), 44th (TXI Operations), 53rd (Ash Grove Cement), and 91st (Gerdau Ameristeel) when compared with the other facilities across the state. Since 1995, estimated annual PM_{10} emissions from the three cement manufacturing facilities were always higher than those from Gerdau Ameristeel. During that time, the highest PM_{10} emissions across all four facilities occurred during 1996– 2002—years when air monitoring also occurred; the lowest PM_{10} emissions from the cement manufacturing facilities occurred in 2009 and 2010, consistent with the timing of an industry-wide decline in production (USGS, 2011) or other reasons.

As Figure 5 shows, PM_{10} monitoring has occurred at 13 locations in the immediate vicinity of the Midlothian facilities. These sites operated at different periods during 1991– 2004. Monitoring sites were not established and emissions data for PM_{10} was not required to be collected until the PM10 NAAQS was established in 1987. ATSDR's first Health Consultation for this site concluded that these data were collected with scientifically defensible methods and met standard data quality objectives (ATSDR, 2015). All sites employed the same sampling schedule: 24-hour average samples were collected every sixth day. Across all sites, more than 2,500 valid sampling results are available for review. The following paragraphs and Tables 7 and 8 summarize these monitoring data for annual and 24-hour averaging periods:

- *Annual average concentrations.* As Table 7 shows, the highest annual average PM_{10} concentration observed across all 13 monitoring locations was 50.8 µg/ m^3, which is marginally higher than the level of EPA's former health-based NAAQS.[6] This former standard was withdrawn by EPA because new scientific information indicated that it was not a good indicator of long-term health effects from PM exposures (EPA, 2006b). This highest annual average was based on data from the Gerdau Ameristeel monitor from 1996. The annual average levels for 1997 and 1998 from this same station were 48.1 and 50.2 µg/m^3, respectively. All but one of these monitoring locations had at least one annual average PM_{10} concentration higher than the WHO health guideline. However, it is not uncommon for PM_{10} levels to exceed 20 µg/m^3. A recent EPA study evaluated air quality trends at more than 2,000 ambient air monitoring stations and found that more than half of these stations had annual average concentrations greater than 20 µg/m^3 (EPA, 2009a). Another important insight comes from Table 8, which indicates that, except for the immediate vicinity north of the Gerdau Ameristeel fenceline, annual average PM_{10} concentrations upwind from the Midlothian facilities did not differ from PM_{10} concentrations downwind from Gerdau Ameristeel and TXI Operations. This observation suggests that many sources contribute to the PM_{10} levels in the area. Moreover, given the proximity of the Gerdau monitor and Highway 67, it is possible that some portion of the particulate matter captured was from automobiles or other sources and not from Gerdau Ameristeel emissions. Furthermore, the following data suggest that the highest PM_{10} levels were likely localized in an area just north of the Gerdau Ameristeel fence line (which is consistent with ATSDR's modeling results):

Annual Average PM_{10} (µg/m^3), 1996–1998

Station	1996	1997	1998
Gerdau Ameristeel	50.8	48.1	50.2
Old Fort Worth Road	20.9	19.9	24.9
Midlothian Tower	22.0	21.4	26.0
Tayman Drive Treament Plant	21.9	No data	No data

- *24-Hour average concentrations.* Across all 13 monitoring stations, more than 2,500 PM_{10} measurements were collected during 1991–2004. The highest 24-hour average

[6] The former NAAQS was based on annual arithmetic mean concentrations, averaged over 3 consecutive calendar years. Although the highest annual average concentration for a single calendar year at the Gerdau Ameristeel site was greater than 50 µg/m^3, none of the arithmetic mean concentrations averaged over 3 consecutive calendar years exceeded this value.

PM_{10} concentration recorded to date (127 µg/m^3) occurred at the monitoring station directly downwind from Gerdau Ameristeel. The highest 24-hour average levels at nearly every station were greater than the corresponding WHO health guideline (50 µg/m^3), but this level is not uncommon for monitoring stations in Texas and other arid environments. To determine whether PM_{10} concentrations were higher on days when sampling was not conducted or to quantify how high those concentrations might have been is impossible.

Most of the data summarized in Tables 7 and 8 suggest that PM_{10} concentrations measured in the Midlothian area were not above the NAAQS HCV or the former EPA health-based standards, but are greater than WHO's health guidelines, which are highly protective. Further, annual average PM_{10} concentrations did not vary considerably between locations upwind and downwind from Gerdau Ameristeel and TXI Operations except for the immediate vicinity north of the Gerdau Ameristeel fenceline. Although annual average PM_{10} levels numerically exceeded the EPA's former health-based standard for 2 years at the monitoring station located just north of Gerdau Ameristeel (the standard was not exceeded as defined by EPA), the available data suggest that this was a highly localized effect and that contributions from Highway 67 or other sources were possible. ATSDR's modeling analysis (see Appendix A) also confirms that air quality impacts from Gerdau Ameristeel would decrease rapidly with downwind distance. Inferences about PM_{10} levels before1990 are difficult to make because of the lack of emissions and ambient air monitoring data for those years.

Based on the above analysis, ATSDR will not further evaluate long- or short-term PM_{10} exposures in the immediate vicinity north of the Gerdau Ameristeel fenceline or elsewhere in Midlothian in the Public Health Implications Section below.

3.5.3 Particulate Matter Smaller than 2.5 Microns ($PM_{2.5}$)

Table 9 presents $PM_{2.5}$ emissions data available from TCEQ's Point Source Emissions Inventory (PSEI) for the four Midlothian facilities. Unlike other pollutants, which had extensive emissions data documented back to 1990, the available $PM_{2.5}$ emissions data is complete from only 2000 to 2013. Monitoring sites were not established and emissions data for PM2.5 was not required to be collected until PM2.5 NAAQS were established in 1997. Consistent with the other pollutants discussed earlier, the estimated annual $PM_{2.5}$ emissions listed for these facilities are among the highest for Ellis County and also rank high among industrial sources statewide. In 2005, the PSEI contains $PM_{2.5}$ emissions data for more than 1,500 facilities in Texas. In that year, emissions from the Midlothian facilities ranked 25th (Holcim), 33rd (Ash Grove Cement), 57th (Gerdau Ameristeel), and 58th (TXI Operations) when compared with the other facilities across the state. During 2000–2008, the total $PM_{2.5}$ emissions across the four facilities did not change considerably. However, the total $PM_{2.5}$ emissions decreased in 2009 and 2010.

As Figure 6 shows, $PM_{2.5}$ monitoring has occurred at four locations in the immediate vicinity of the Midlothian facilities. These sites operated at different periods during 2000–2014. Two different monitoring methods are used at these sites: some collect 24-hour average samples every sixth day, and others operate continuously with real-time measured concentrations recorded every hour. ATSDR's first Health Consultation for this site concluded that these data were collected with scientifically defensible methods and met standard data quality objectives; however, a slight negative bias was noted in the continuous $PM_{2.5}$ monitoring data (ATSDR, 2015). The following paragraphs and Table 10 summarize these monitoring data for two averaging periods:

Annual average concentrations. The scientific community now believes that the current standard (12 µg/m^3) for fine PM (measured by $PM_{2.5}$) is a better indicator of possible long-term health effects from PM exposures than was the former EPA annual average standard for PM_{10} (EPA, 2006b and EPA, 2013). As Table 10 shows, the highest full year annual average $PM_{2.5}$ concentration observed across all four monitoring locations was 11.9 µg/m^3(except for a partial-year value of 12.4 µg/m^3 at Midlothian Tower in 2005), which is lower than EPA's current standard. The highest annual average concentration in Midlothian was observed at the Wyatt Road site that operated a continuous monitor. In ATSDR's first Health Consultation (ATSDR, 2015), a negative bias was identified in data from continuous monitors versus data from 24-hour monitors at the TCEQ monitors located on Old Fort Worth Road. TCEQ had previously identified this concern and began adjusting all its continuous monitoring data by 2 µg/m^3 in 2005 (Personal Communication, Tracie Phillips, TCEQ, 9/27/2012). To be consistent with this approach, ATSDR adjusted all TCEQ continuous monitoring data before 2005 by this same value. ATSDR is uncertain about the magnitude of the negative bias for the Holcim continuous monitoring data, which was not operated by TCEQ, because these data were not adjusted (Personal Communication, Kate Gross, Trinity Consultants, 10/5/12). If the Holcim data are adjusted in the same manner as the TCEQ data, these would represent the highest annual average $PM_{2.5}$ levels detected in Midlothian and be in the range proposed by EPA for lowering the $PM_{2.5}$ annual average standard. Moreover, many of the annual average $PM_{2.5}$ concentrations in Table 10 were above the more conservative WHO health guideline (10 µg/m^3). ATSDR is uncertain whether harmful exposures actually occurred downwind of Holcim because of the potential negative data bias (discussed above) and because the monitor is located at the fence line in a sparsely populated area. Table 10 also documents that the highest annual average $PM_{2.5}$ concentrations were nearly identical across the four monitoring stations, which included stations south of TXI Operations and north of Holcim, indicating some regional contributions.

For these reasons, long-term exposures to $PM_{2.5}$, in will not be further evaluated in the Public Health Implications Section below. Moreover, ATSDR is not able to evaluate $PM_{2.5}$ exposures downwind of the Holcim facility for the reasons given above.

24-hour average concentrations. Across all four monitoring stations, the highest 24-hour average $PM_{2.5}$ concentration recorded to date (52.1 µg/m^3) occurred at the Wyatt Road monitoring station, which is downwind from Gerdau Ameristeel and TXI Operations. All four monitoring stations recorded at least one 24-hour average concentration greater than the NAAQS HCV of 35 µg/m^3 for $PM_{2.5}$. Because of the possible negative bias in data from the continuous $PM_{2.5}$ monitors, a level above the standard or even higher may have occurred on additional days; however, ATSDR cannot determine how many days or what the highest levels could have been.

Based on the highest concentrations on record from all monitoring stations (Table 10), the 24-hour average NAAQS HCV was exceeded infrequently (about 22 times during 2000–2011, and several of these high concentrations occurred on the same day at different monitors). Several of these levels slightly exceeded the NAAQS HCV. It is important to note that although the NAAQS HCV was exceeded several times on a numerical basis, it did not exceed the standard as defined by EPA. ***Based on this analysis, short-term exposures to $PM_{2.5}$ will be further***

evaluated in the Public Health Implications Section in relation to the overall air exposures to the community.

ATSDR's previous health consultation noted a data gap which primarily relates to particulate matter. The monitoring that has been conducted in Midlothian clearly does not characterize air pollution levels at every single residential location over the entire history of facility operations. In ATSDR's judgment, one notable gap in monitor placement is the lack of monitoring data for residential neighborhoods in immediate proximity to the four industrial facilities, where fugitive emissions (those not accounted for in stack emissions) likely have the greatest air quality impacts. Current and past monitoring locations might not adequately characterize particulate matter levels for all residents located immediately adjacent to certain onsite operations, such as limestone quarry activity (ATSDR 2012a). In addition, as stated above, another important data and information gap is in our understanding of $PM_{2.5}$ exposures downwind of the Holcim facility.

3.6. Sulfur Dioxide

Sulfur dioxide is a gas formed when fuels containing sulfur (e.g., coal) are burned, and during metal smelting and other industrial processes. On a national level, manmade sulfur dioxide emissions are dominated by contributions from fuel combustion at electricity-generating facilities and other industrial sources; fuel combustion in mobile sources accounts for smaller amounts (EPA, 2008a). Cement manufacturing facilities and steel mills are both known to emit sulfur dioxide.

Table 11 presents sulfur dioxide emissions data available from TCEQ's Point Source Emissions Inventory (PSEI) for the four Midlothian facilities from 1990 to 2013. The three cement manufacturing facilities have consistently had the highest sulfur dioxide emissions among the industrial facilities in Ellis County. Emissions from these three facilities also have ranked high among the industrial facilities statewide. For example, in 2005, the PSEI contains sulfur dioxide emissions data for approximately 1,400 facilities in Texas. In that year, emissions from the cement manufacturing facilities in Midlothian ranked 22^{nd} (Ash Grove Cement), 31^{st} (TXI Operations), and 34^{th} (Holcim) when compared with the other facilities across the state. In that year, sulfur dioxide emissions from Gerdau Ameristeel did not rank among the top 100 facilities statewide.

Other trends are evident from Table 11. For instance, in any given year, the three cement manufacturing facilities accounted for at least 98% of the sulfur dioxide emissions across all four facilities combined; Gerdau Ameristeel always accounted for less than 2%. Before 2000, TXI Operations tended to have the highest sulfur dioxide emissions, but since that time the highest values were reported for Ash Grove Cement. Finally, of the 23 inventory years shown in Table 11, the years with the lowest sulfur dioxide emissions combined across all four facilities were between 2009 and 2013—a trend consistent with the emissions data reported in this section for other pollutants.

Tables 12 and 13 summarize the ambient air monitoring data collected for sulfur dioxide in the Midlothian area. ATSDR's first Health Consultation for this site concluded that these data were collected with scientifically defensible methods and met standard data quality objectives (ATSDR, 2015). As Figure 7 shows, sulfur dioxide monitoring has occurred at four locations.

Continuous monitors operate at these sites and provide 1-hour average concentrations, from which concentrations can be calculated for different averaging periods. These monitors can provide data for averaging times as short as 5-minutes. The EPA does not have a standard for this short averaging time, but the WHO has a 10-minute guideline of 200 ppb (WHO, 2006). This section focuses on data from the three stations with at least 1 full calendar year of data.[7] ATSDR evaluated summary statistics for three different averaging periods:

- *Annual average concentrations.* The highest annual average sulfur dioxide concentration measured was 5.47 ppb. This occurred in 2000 at the Old Fort Worth Road monitoring station, located downwind from the stacks at TXI Operations. From 1971 to 2010, EPA's health-based NAAQS for annual average sulfur dioxide concentrations was 30 ppb. However, that standard was revoked in 2010, following EPA's most recent health effects review of long-term exposures to sulfur dioxide (EPA, 2008c). The purpose of including annual average concentrations in this Health Consultation is to indicate how air quality impacts changed over time. As Table 12 shows, annual average sulfur dioxide concentrations were typically higher at locations downwind from TXI Operations, as compared with the upwind monitoring location. Further, the highest annual averages occurred during 1999–2001, when emissions from TXI Operations were high.

- *1-Hour average concentrations.* The highest 1-hour average sulfur dioxide concentration was 211.54 ppb in 2001 at the Old Fort Worth Road monitoring station. Before 2010, EPA did not have a health-based air quality standard for 1-hour averages, which was then set at 75 ppb. Specifically, for every monitoring station, the standard requires that the 99th percentile of 1-hour daily maximum sulfur dioxide concentrations averaged over 3 consecutive years to not exceed 75 ppb. Table 13 displays these values for the Midlothian data for the two stations that had at least 3 years of data. Elevated 1-hour SO_2 concentrations began to increase around 5 p.m. and taper off around 6 a.m.; the higher frequency of elevations (above 20 times) were between 8 pm and 2 am with the maximum frequencies (above 30 times) and levels usually occurring between late evening and early morning hours (9 pm to 1 am) with the lowest frequencies occurring between around 10 am and 4 pm (see Appendix D, public comment B.3.14 for frequency figure). All months of the year have experienced 1-hour SO_2 levels above the standard; however April, May, and October have the highest frequency, and June, August, November, and December have the lowest frequency.

  Based on EPA's approach, Table 13 shows that the 1-hour measurements at the upwind station (Midlothian Tower) were all lower than the NAAQS HCV; however, individual measurements exceeded the HCV 24 times between 1997 and 2005. Short-term average concentrations of sulfur dioxide measured at Old Fort Worth Road between 1997 and 2008 (except for 2002-2004) would not have met EPA's current air quality standards, but they met the standard at the time. The NAAQS HCV for 1-hour SO_2 levels was exceeded 312 times at the Old Fort Worth Road monitor during 1997 to early 2008 and six times at the Wyatt Road station during 2005 to early 2006. After annual sulfur dioxide emissions

[7] In 1986, a sulfur dioxide monitoring station at Cedar Drive operated for 4 months. Sulfur dioxide was rarely detected at the station, and the average concentrations were lower than all health-based screening levels discussed in this section.

from TXI fell below 2,000 tons per year, the measured concentrations were lower than EPA's current standard. Definitive conclusions regarding SO_2 exposures north of TXI before 1997 cannot be made because of the lack of monitoring data. In addition, 1-hour measurements were location specific. For example, on days when the SO_2 levels exceeded the NAAQS HCV at the Old Fort Worth Road station, they did not exceed it at the Midlothian Tower station (except for one day in March 2005). This information suggests that elevated SO_2 levels are likely from a specific source rather than a regional effect. The number of SO_2 exceedances of the 1-hour NAAQS HCV at the Old Fort Worth Road monitor were generally consistent with trends for TXI emissions when evaluating the entire period of 1997-2008.

To evaluate this trend further, we compared the hourly wind direction measurements at the Old Forth Worth Road monitor and similar hourly SO_2 measurements (see Figure 9). The highest SO_2 levels were downwind from TXI. Figure 9 also shows some minor SO_2 peaks downwind from Ash Grove and Holcim. ATSDR evaluated the wind direction during the 24 instances of exceedances of the 1-hour NAAQS HCV at the Midlothian Tower station. The peaks occurred almost exclusively when the wind was blowing from the main sources at TXI (i.e., in a downwind direction from TXI). ATSDR cannot rule out a minor contribution of SO_2 from Gerdau Ameristeel to the peak levels found at the Old Fort Worth and Midlothian Tower monitors; however, based on reported emissions data, the main contributor is likely to be TXI.

- *24-Hour average concentrations.* At Midlothian Tower, 24-hour average concentrations of sulfur dioxide varied; the highest 24-hour average concentration in a given year ranged from 11 ppb in 2007 to 25 ppb in 1997. At Old Fort Worth Road, the highest 24-hour average levels were between 15 ppb and 49 ppb during 1997–2008, and then declined to 5 ppb and less in recent years.

  During 1971–2010, EPA's health-based standards for sulfur dioxide included a 24-hour average concentration of 140 ppb, not to be exceeded more than once per year. All 24-hour values in Midlothian were lower than EPA's former standard. However, the WHO's health comparable guideline is 8 ppb (WHO, 2006). This value was exceeded at both the Midlothian Tower and Old Fort Worth Road stations in most years of monitoring through 2008, but levels were below that level after 2008. The significance of this observation will be discussed further in Section 4.

  For additional context, ATSDR compared the 24-hour average concentrations of sulfur dioxide measured in the Midlothian area with those measured elsewhere in Texas. This comparison was done for 2 years: the year with the highest measured sulfur dioxide concentrations (2001) and for 2010 in Midlothian. In 2001, only one of 21 other monitoring stations in Texas recorded 24-hour average sulfur dioxide concentrations higher than those at Old Fort Worth Road (EPA, 2012a). In 2010, 28 sulfur dioxide monitoring stations in Texas were submitting data to EPA's Air Quality System, and 13 of those stations recorded 24-hour average concentrations higher than those at Old Fort Worth Road. Overall, in the years 1999 to 2001, Old Fort Worth Road ranked among the stations with the highest 24-hour average sulfur dioxide concentrations in the state. As sulfur dioxide emissions from TXI Operations decreased in following years, so did the measured concentrations at this station.

In summary, ambient air monitoring for sulfur dioxide in the Midlothian area has focused on areas southwest of Midlothian and downwind of the TXI Operations. The highest concentrations were consistently observed at the Old Fort Worth Road monitoring station, which is located immediately downwind from TXI Operations. Sulfur dioxide levels at this station were highest during 1997–2008 and have decreased since then—consistent with the decreasing emissions at the TXI Operations facility and for other reasons. ***Based on the data and information above, short-term exposures to SO_2, especially downwind of the TXI operations, will be further evaluated in the Public Health Implications Section below.***

In the public comment version of this health consultation, ATSDR identified a data gap relating to the lack of sulfur dioxide monitoring data at locations north of Midlothian. As Figure 7 shows, sulfur dioxide has never been monitored at locations immediately downwind from the Ash Grove Cement and Holcim facilities. Of these two facilities, Ash Grove Cement had higher annual emissions and has emitted more than 4,000 tons of sulfur dioxide in recent years (except for 2009). Another data gap is that no inferences can be made about sulfur dioxide concentrations before 1990 because of the lack of information on facility emissions. Since the release of this health consultation for public comment, ATSDR conducted screening air dispersion modeling for the years 2006-2010 for Ash Grove and Holcim for their combined emission sources of sulfur dioxide that does not account for influences from other sources (see Appendix C). Two of these years (2006 and 2007) represent the two highest years of SO_2 emission from Ash Grove for all the years reported (see Table 11).

ATSDR's approach was to model yearly emission rates of SO_2 from one stack per facility, and the stack selected was the one expected to have the least favorable dispersion (i.e., the shortest kiln or furnace stack and the lowest exit velocity). For each facility, ATSDR allocated 100% of the facility-wide emissions to the one stack selected for modeling. In other words, 100% of each facility's SO_2 emissions were assumed to be emitted from the stack that would lead to the highest offsite air quality impacts. Although some facilities may have ground-level emission sources of SO_2 (e.g., exhaust from trucks and small engines), these account for small fraction of the facility's overall inventories and were not considered for modeling. Building downwash was not considered, primarily because the stacks are considerably higher than the nearby buildings and structures.

The combined emissions were dominated by Ash Grove which is not unexpected given the yearly SO_2 emissions as compared to Holcim's annual emissions. As stated above, EPA's standard for SO_2 requires that the 99^{th} percentile of 1-hour daily maximum sulfur dioxide concentrations averaged over 3 consecutive years to not exceed 75 ppb. The 99^{th} percentile equates to the 4^{th} highest reported value in a given year. For this modeling, we choose to use the same 4^{th} highest 1-hour maximum value for each of the years 2006-2010 that was estimated from the modeling analysis. As can be seen from Figures C-2 through C-11, Appendix C, 1-hour maximum concentrations above 75 ppb (which is equivalent to 197 $\mu g/m^3$, as shown in the figure legends) were predicted from the model. From this analysis, the highest predicted levels of SO_2 are likely to be found on-site and within the fence line of the Ash Grove Facility. However, the model also predicts some higher concentration areas (above 75 ppb) outside the Ash Grove fence line. ATSDR did a further areal review of the off-site areas and determined that there were no structures or playgrounds located within the areas where the model predicted levels above 75 ppb. However, computer modeling using annual emissions to predict shorter-term SO_2 levels is likely to result in large uncertainty. ATSDR attempted to obtain shorter-term emission data (i.e., 1-hour emissions data) in order to conduct the modeling to reduce this uncertainty. ATSDR was not able to obtain these data for Ash Grove (which is the primary emitter of SO_2 compared to Holcim for the years the modeling was performed). Therefore, ATSDR will not be able to make any firm health conclusions based on the SO_2 modeling results for past exposures to SO_2 emitted by Ash Grove and Holcim. Moreover, it is likely that the levels emitted from Ash Grove have been substantially reduced as the facility was upgraded with a new kiln design and emission control technology which should reduce the likelihood of any off-site exposures of concern in the future. These emission reductions at Ash Grove would need to be verified once the 2015 annual emission reports are available.

3.7. Hydrogen Sulfide

Hydrogen sulfide is a gas released from many natural and manmade sources. Some industrial sources include sewage treatment facilities, manure-handling operations, pulp and paper mills, petroleum refineries, and food processing plants (ATSDR, 2006). Steel mills and cement manufacturing facilities can have operations (e.g., wastewater treatment) known to release hydrogen sulfide gases. However, these two industries are not listed among the largest emissions sources of hydrogen sulfide documented in various recent environmental health reviews (e.g., ATSDR, 2006; WHO, 2003).

Reliable estimates of hydrogen sulfide emissions from the Midlothian facilities are not available. TCEQ's emissions inventory has no hydrogen sulfide emissions data for the four facilities, and TRI has only recently required industrial facilities to report releases of hydrogen sulfide. A recent rule added hydrogen sulfide to the list of TRI chemicals, and industrial facilities that meet the reporting thresholds will be required to disclose emissions that occurred in 2012 and thereafter. Accordingly, the first TRI air emissions data for hydrogen sulfide was not be publicly available until late in 2013.

Ambient air monitoring for hydrogen sulfide has occurred at four locations in the Midlothian area (see Figure 8), at the same locations where sulfur dioxide monitoring took place. The monitoring focused on air quality impacts southwest of Midlothian, near the Gerdau Ameristeel and TXI Operations facilities. ATSDR's first Health Consultation for this site concluded that the data collected generally followed scientifically defensible methods and met data quality objectives (ATSDR, 2015). However, two limitations were noted: (1) monitoring results from the Cedar Drive monitoring station are not considered because they were collected by using an insensitive device that never detected hydrogen sulfide; and (2) monitoring results from 1997 to 1999 had a detection limit of approximately 5 to 10 ppb and therefore are not sufficient for evaluating long-term exposures at levels comparable to EPA's Reference Concentration of 1.4 ppb. Table 14 summarizes all remaining data, which highlight the following trends:

- *Annual average concentrations.* The highest annual average concentration of hydrogen sulfide was 0.76 ppb, which occurred in 2014 at the Wyatt Road monitoring station. This value—and all other annual average concentrations shown in Table 14—is lower than

EPA's Reference Concentration (1.4 ppb) for long-term hydrogen sulfide exposures. ATSDR has an intermediate Minimal Risk Level (exposures from 15-364 days of 20 ppb) but does not have a long-term or chronic MRL. Further, the data in Table 14 indicate that annual average hydrogen sulfide concentrations were not different between upwind and downwind monitoring stations. In some years, the monitoring station upwind from the industrial facilities (Midlothian Tower) exhibited higher annual average concentrations than the station downwind from these facilities. This finding is consistent with a statement made earlier about steel mills and cement manufacturing facilities not typically being the largest emissions sources for this pollutant.

- *1-Hour average concentrations.* Table 14 shows that the highest 1-hour average hydrogen sulfide concentrations were measured between 2000 and 2014. The highest individual hourly measurement—14.4 ppb—is lower than the health-based screening values. For short-term exposures, the most relevant screening values are ATSDR's acute inhalation Minimal Risk Level (70 ppb for exposure durations of less than 2 weeks), TCEQ's air quality standard (80 ppb averaged over a 30-minute period), and WHO's health guideline (106 ppb averaged over a 24-hour period).

Overall, all short-term and long-term average hydrogen sulfide concentrations recorded for the Midlothian area have been lower than corresponding health-based air quality standards and guidelines. Hydrogen sulfide has not been monitored in the vicinity of Ash Grove Cement or Holcim. However, trends in the available monitoring data suggest that cement manufacturing facilities likely have limited air quality impacts —a finding that is consistent with ATSDR's broad research for this pollutant. ***Based on the above evaluation, ATSDR will not further evaluate hydrogen sulfide exposures in the Public Health Implications Section below.***

3.8. Summary

The following paragraphs summarize the air quality data for the pollutants considered in this Health Consultation. Refer to Section 4 for ATSDR's public health evaluation for these pollutants. In addition, please see Table 15 for a summary of health comparison values considered in the above evaluation and which air pollutants are determined to be a contaminant of concern for further evaluation in the Public Health Implications Section below.

Carbon monoxide. The estimated carbon monoxide concentrations attributed to the Midlothian facilities are lower than EPA's health-based standards and WHO's health guidelines. This finding is based on ATSDR's modeling analysis, which considered the highest carbon monoxide emission rates reported for the four facilities of interest during 1990–2013.

No inferences can be made about carbon monoxide levels before 1990, because of the lack of information on facility emissions in those years. ***Based on the above analyses, ATSDR will not further evaluate carbon monoxide in the Public Health Implications Section below***

Lead. The highest airborne lead levels in the Midlothian area were measured downwind from Gerdau Ameristeel—the facility that consistently had the highest lead emissions of the four facilities of interest. Measured lead concentrations were typically greatest immediately north of this facility. In the mid-1990s, the lead levels measured in this area ranked among the highest lead concentrations measured statewide. This appears to be a highly localized effect, with lead concentrations decreasing rapidly with downwind distance from the facility and some airborne lead contributions from traffic along Highway 67 was likely.

In the 1990s, measured lead concentrations immediately north of the facility were below EPA's health-based lead standard at the time (1.5 $\mu g/m^3$), but were greater than the NAAQS HCV of 0.15 $\mu g/m^3$. In 18 of 23 consecutive calendar quarters with sufficient data during 1993–1998, the quarterly average lead concentrations at the Gerdau Ameristeel monitoring station exceeded the NAAQS HCV. The highest downwind quarterly average lead concentration (0.443 $\mu g/m^3$) was observed in 1995. No annual average measurements were greater than WHO's current health guideline (0.5 $\mu g/m^3$). Lead emissions from Gerdau Ameristeel were notably higher before ambient air monitoring for lead took place at locations downwind from the facility, especially in 1987, 1988, and 1989 (see Table 2). Because of the lack of monitoring data available for this period, ATSDR cannot determine what the off-site lead exposures might have been downwind of the Gerdau Ameristeel facility during its first years of operation (1975-1986).

In 1981 and 1983, quarterly average lead concentrations at Midlothian City Hall exceeded the NAAQS HCV, but did not exceed the WHO health guideline. This most likely reflected influences from mobile sources and was not directly downwind of the largest industrial lead emission source operating in the area at that time (Gerdau Ameristeel), because numerous monitoring stations throughout Texas exhibited comparable lead levels during the early 1980s. No inferences can be made about lead levels before 1987, because information on facility emissions in those years is lacking. ***Given that lead was detected at Gerdau Ameristeel monitoring station for the years 1993–1998 above the NAAQS HCV, lead will be further evaluated in the Public Health Implications Section below.***

Nitrogen dioxide. All measured nitrogen dioxide concentrations in the Midlothian area have been lower than EPA's health-based standards and WHO's health guidelines, considering both long-term (annual) and short-term (1-hour) exposure durations. The monitoring data from 2000 to 2011 and emissions data from 1990 to 2013 suggest that nitrogen dioxide levels have not exceeded health-based standards or guidelines in residential areas dating back to 1990. No inferences can be made about nitrogen dioxide levels before 1990, because information on facility emissions in those years is lacking. ***Based on the above analyses, ATSDR will not further evaluate nitrogen dioxide in the Public Health Implications Section below.***

Ozone. Ellis County is one of 10 counties that make up the Dallas–Fort Worth ozone non-attainment area, which means that ozone levels in the metropolitan area occasionally exceed EPA's health-based standards. Levels in Ellis County also have been above WHO's health guidelines. Emissions from industrial sources, mobile sources, and natural sources throughout the area contribute to this problem. ***For these and other reasons, this Health Consultation addresses ozone as a general air quality issue that is only partly affected by emissions from the Midlothian facilities and will be further evaluated in the Public Health Implications Section below.***

Particulate matter. Ambient air monitoring of particulate matter has occurred for many years in Midlothian, with the particle size fraction measured—TSP, PM_{10}, and $PM_{2.5}$—changing from one year to the next. Unlike other pollutants, which showed distinct spatial variations and peak concentrations downwind from certain facilities, the PM concentrations were uniform across the locations where sampling occurred except for the PM sampling that occurred at the Gerdau Ameristeel monitor during the years 1996–1998. ATSDR's evaluation focuses on the particle sizes that are most likely to be inhaled (PM_{10} and $PM_{2.5}$). The available data suggest that measured annual average $PM_{2.5}$ concentrations were all below EPA's current health-based standard (except for a partial year at Midlothian Tower for 2005) of 12 $\mu g/m^3$; however, many were greater than WHO's protective health guideline. None of the measured 24-hour PM_{10} levels were above the EPA standard but some were above the WHO standard that is designed to protect against harmful $PM_{2.5}$ exposures.

Based on the highest concentrations on record from all monitoring stations (Table 10), the 24-hour average NAAQS HCV for $PM_{2.5}$ were exceeded infrequently (about 22 times during 2000–2014, and several of these higher concentrations occurred on the same day at different monitors). Several of these levels slightly exceeded the NAAQS HCV**. Although the levels infrequently exceeded the NAAQS HCV, it did not exceed the standard as defined by EPA.** This finding is considerable because much of the monitoring occurred in areas expected to have the greatest air quality impacts; therefore, the data suggest that short-term PM exposures, especially for fine particles, were likely from a combination of regional and local sources with an exact contribution from each uncertain. However, localized PM elevations found north of the Gerdau Ameristeel fence line, during the years 1996–1998, were likely from emissions from Gerdau as one of the primary contributors although some contribution from automobiles traveling on Highway 67 and other sources were also likely. As with the other pollutants, no inferences can be made about PM concentrations for years before 1990, because available emissions and ambient air monitoring data for those times were limited.

ATSDR is uncertain whether harmful exposures actually occurred downwind of Holcim because of the potential negative data bias (discussed above) and because the monitor is located at the fence line in a sparsely populated area. The highest annual average $PM_{2.5}$ concentrations in Midlothian were nearly identical across the four monitoring stations, which included stations south of TXI Operations and north of Holcim, indicating some regional contributions.

For these reasons, ATSDR will not further evaluate long-term PM_{10} or $PM_{2.5}$ exposures in the Public Health Implications section below. However, short-term exposures to $PM_{2.5}$ will be further evaluated.

Sulfur dioxide. Ambient air concentrations of sulfur dioxide were extensively measured at three locations southwest of Midlothian during 1997–2014. The measured air quality impacts were consistently highest at the monitoring station directly north of—and downwind from—TXI Operations. The concentrations at this station **generally** tracked with the facility's emissions: air quality impacts were highest in years when emissions were high, and air quality impacts were lowest after the facility's emissions began to decrease; however, this relation is not a direct one as other factors such as weather affect this relationship. For example, there is a definitive decline in emissions from the 1997-2001 timeframe as compared to the 2002-2008 period and this decline does correlate with a lower frequency of SO_2 elevations above 75 ppb. For the period 1997-2001, emissions averaged about 5,316 tons/year and the frequency of SO2 levels above 75 ppb averaged about 53 times per year. For the timeframe 2002-2008, the emissions averaged 2,411 tons/year and with the average number of times above 75 ppb of about 7 times per year.

During 1997–2008, some 1-hour sulfur dioxide concentrations at Old Fort Worth Road exceeded the NAAQS HCV, but met EPA's health-based standards that were in place at the time. Similarly, until 2008, 24-hour average concentrations of sulfur dioxide at both the upwind and downwind stations were above WHO's health guideline. No inferences can be made about sulfur dioxide levels before 1990, because of the lack of information on facility emissions.

ATSDR further evaluated potential sulfur dioxide exposures downwind of both Ash Grove and Holcim and determined that although we cannot say with certainty that no one was exposed to levels of potential concern (e.g., while exercising in the area, etc.), we do not have evidence that people reside in the areas where the model predicted levels above 75 ppb. ***However, given the uncertainties in the model results, ATSDR cannot make a definitive health conclusion regarding past exposures to SO_2 downwind of Ash Grove***. Moreover, it is likely that the levels emitted from Ash Grove have been substantially reduced as the facility was upgraded with a new kiln design and emission control technology in 2014 which should reduce the likelihood of any off-site exposures of concern in the future. These emission reductions at Ash Grove would need to be verified once the 2015 annual emission reports are available.

Based on the data and information above, short-term past exposures to SO_2, especially in the area downwind of the TXI and Gerdau Ameristeel operations, will be further evaluated in the Public Health Implications Section below.

Hydrogen sulfide. All measured hydrogen sulfide concentrations in the Midlothian area have been lower than health-based standards and guidelines published by ATSDR, EPA, TCEQ, and WHO. This finding applies to both long-term (annual) and short-term (1-hour) exposure durations. The concentrations measured at the monitoring station downwind from Gerdau Ameristeel and TXI Operations were not different from those measured at the monitoring station upwind from these facilities, suggesting that emissions from these facilities are not the primary influence on local hydrogen sulfide levels. No quantitative data are available for assessing hydrogen sulfide levels before 2000, because of the lack of information on facility emissions in those years. However, the available information suggests that these facilities have minimal impacts on local hydrogen sulfide levels. ***Based on the above analyses, ATSDR will not further evaluate hydrogen sulfide exposures in the Public Health Implications Section below.***

4. Public Health Implications Discussion

4.1. Sulfur dioxide

Conclusions for Sulfur Dioxide

For the *general population,* breathing sulfur dioxide for short intervals (based on peak 5-minutes) at measured concentrations from 1997 to 2011 in the Cement Valley and in areas east and south of the TXI facility boundary is not expected to be result in harmful effects.

Sensitive populations (e.g., individuals with asthma) may experience respiratory symptoms if they were exposed to peak sulfur dioxide concentrations higher than 400 ppb, specifically during times of elevated inhalation rates, such as while exercising. Potential exposures above 400 ppb have occurred very infrequently (only three times and all at the Wyatt Road monitor on 8/2/05 at just past midnight). Symptoms may include coughing, wheezing, or chest tightness, and are likely reversible. However, it is likely that the number of sensitive persons exposed to these highest levels was limited for several reasons.

For concentrations between 100-400 ppb sulfur dioxide, sensitive individuals at elevated breathing rates may have experience health effects such as bronchoconstriction without developing symptoms. Moreover, ATSDR would not expect that all sensitive persons in Midlothian who were exposed to levels between 100-400 ppb and engaged in activities that increased their breathing rate would experience the effects described above.

People with asthma, children, and older adults (65+ years) have been identified as groups susceptible to the health problems associated with breathing SO_2. Clinical investigations and epidemiologic studies have provided strong evidence of a causal relationship between SO_2 and respiratory diseases (morbidity) in people with asthma and more limited epidemiologic studies have consistently reported that children and older adults (65+ years) may be at increased risk for SO_2-associated adverse respiratory effects. In general, the potentially susceptible groups to air pollutants include obese individuals, those with preexisting cardiopulmonary disease, and those with a pro-inflammatory condition such as diabetes. However, there are no studies linking increased risk from SO_2 exposures to diabetes or obesity and studies linking SO_2 exposures to cardiopulmonary disease are limited.

Outdoor vs. Indoor Exposures--outdoor SO_2 can enter indoor settings, primarily when residents have their windows open. No valid SO_2 indoor air monitoring data are, however, available at this site. Indoor air concentrations likely will not exceed the peak outdoor concentrations noted in this section, unless a resident has a substantial indoor source. When windows are open, we expect the same conclusions presented here for outdoor settings to apply to indoor settings. However, because indoor and personal SO_2 concentrations are generally much lower than outdoor or ambient measurements, individuals that spend most of their time indoors, such as older adults, are not anticipated to be as vulnerable to high SO_2 exposures. Another factor that potentially alters vulnerability to SO_2 is air conditioning use due to the reduced penetration of SO_2 into buildings when windows are closed (EPA, 2008c).

EPA's 1-hour standard of 75 ppb is designed to protect people from exposures to high, short-term peaks of SO_2 (from 5-minutes to 24-hour exposures). In addition, EPA determined that little health evidence suggests an association between long-term low-level exposure to SO_2 and public health effects (EPA, 2010e).

For ATSDR's initial screening process for sulfur dioxide, we calculated the 1-hour average based on EPA's approach for determining whether the 1-hour values may be a concern (i.e., the 99th percentile of 1-hour daily maximum sulfur dioxide concentrations averaged over 3 consecutive years is not to exceed 75 ppb). The new EPA standard is designed to protect against harmful shorter term peaks in sulfur dioxide concentrations. As seen from Table 13, except for the period 2002-2004, all values were above the current standard (but not the standard in place at that time). This information alone provides evidence that there were shorter-term sulfur dioxide exposures of potential health concern. Based on this evaluation, ATSDR then choose to use 5-minute sulfur dioxide data as we have done elsewhere (ATSDR, 2011b) to further evaluate the public health implications of these past exposures and to help determine the possible severity of these past exposures. Although EPA and TCEQ do not have a basis for comparing health effects to the 5-

minute data, ATSDR believes that looking at these data is the best approach for making a final determination as to whether harmful effects are possible as this is a similar timeframe used in clinical studies. The remainder of this section uses this averaging period, even though EPA's and TCEQ's short-term health-based standards are based on 1-hour average levels. Please note that TCEQ provided ATSDR with several potential limitations of using the 5-minute data (TCEQ, 2012a) and clarifications of some of these limitations in a follow-up correspondence (Personal Communication, TCEQ e-mail from Tracie Phillips, 11/10/14). For various reasons (please see Appendix D, public comment B.3.32 and ATSDR's response), ATSDR believes that the 5-minute data are adequate for the purposes of this health consultation.

SO_2 peak (5-minute) exposure summary

ATSDR grouped the 5-minute peak SO_2 concentrations into categories based on health endpoints (Appendix B provides a detailed discussion and additional references). Clinical studies reported in peer-reviewed scientific literature provided the basis for the health endpoint derivations.

ATSDR bases its public health evaluation of sulfur dioxide exposures largely on previous clinical studies that involved recruitment of volunteers who were exposed to sulfur dioxide and monitored for effects. These studies required informed consent and were closely monitored to ensure they were conducted ethically. For sulfur dioxide, these clinical studies have been conducted on healthy volunteers, including some who had mild to moderate asthma. However, the studies did not include children or people with severe asthma. Some people who live in Midlothian might be more sensitive to sulfur dioxide than were the volunteers who participated in these clinical studies. For sensitive people at increased breathing rates, effects of exposure to SO_2 concentrations below 200 ppb are uncertain because studies in free-breathing persons have not been conducted below this level. In general, these clinical studies have controlled exposure conditions that include humidity and temperature. Cold and dry air, which occurs in real-world exposure conditions, has been reported to induce effects at lower SO_2 concentrations (Bethel, et al., 1984; Linn, et al., 1985). Moreover, not all asthmatics demonstrated effects in the clinical studies. For example, for the exposure range of 200-300 ppb, we would expect about 5-30% of exposed exercising asthmatics to demonstrate effects. Please see Appendix B, Table B-1, for more information on the percent of exercising asthmatics potentially affected at various levels of exposure.

People with asthma, children, and older adults (65+ years) have been identified as groups sensitive to the health problems associated with breathing SO_2 (EPA, 2010e; EPA, 2008c). Human health studies (clinical investigations and epidemiologic studies) have provided strong evidence of a causal relationship between SO_2 and respiratory diseases (morbidity) in people with asthma and more limited epidemiologic studies have consistently reported that children and older adults may be at increased risk for SO_2-associated adverse respiratory effects (EPA, 2010e). Potentially sensitive groups to air pollutants include obese individuals, those with preexisting cardiopulmonary disease, and those with a pro-inflammatory condition such as diabetes (EPA, 2008c), but some of these relationships have not been examined specifically in relation to SO_2.

Analysis of the sampling conducted during 1997–2011 resulted in the following average exposure estimates by concentration category (see Figure 10 for a scatterplot of peak 5-minute average SO_2 data and health endpoints and Table 16 for the percentages of peak [5-minute] SO_2 concentrations by monitoring station and year during 1997–2011).

Greater than (>) 400 ppb

During this period, 5-minute SO_2 concentrations >400 ppb occurred only three times--all at the Wyatt Road site (440.4 ppb, 475.8 ppb, and 568.4 ppb, all on around the same time on 8/2/05). On two other occasions (one at Midlothian Tower and on at the Old Fort Worth Road monitors), SO_2 concentrations approached 400 ppb. No values above 400 ppb have occurred since August 2005.

Sensitive individuals, especially when at increased breathing rates, to levels above 400 ppb could result in bronchoconstriction resulting in *symptoms* such as coughing, wheezing, or chest tightness. For concentrations >500 ppb, exposure to sensitive individuals may result in more frequent use of medication, seeking medical assistance, or cessation of physical activity. These exposures are estimated to have occurred infrequently and were temporally and spatially limited to the area north of TXI and Gerdau Ameristeel in the Cement Valley area. Moreover, it is likely that the number of sensitive persons who were exposed to these higher levels may have been limited due to a combination of factors, including:

1) the infrequency of their occurrence;

2) the time of day they occurred (around midnight); and,

3) the percentage of asthmatics who showed effects in the clinical studies was about 25-35%.

200 ppb - 400 ppb

During this period, 129 5-minute SO_2 levels between 200–400 ppb occurred at the Old Fort Worth Road and Wyatt Road monitors; eight occurred at the Midlothian Tower.

When exposed to SO_2 at this concentration range, sensitive individuals breathing at an increased rate could have effects such as mild bronchoconstriction *without* experiencing *symptoms* such as coughing, wheezing, or chest tightness. Affected individuals may not be aware of the bronchoconstriction, which is estimated as mild and transient. Based on available data and information, exposure occurred infrequently and was temporally and spatially limited primarily to individuals living in the Cement Valley and, secondarily, those residing in the areas just east, south, and southeast of the TXI fence line (see Figure 7). Moreover, in clinical studies of exercising asthmatics who were exposed to SO_2 in this range, about 5-30% showed the health effects described above.

10 ppb - 200 ppb

Detections between 100–200 ppb SO_2 were- multiple and widespread, especially in the Cement Valley area. During this period, 2,603 5-minute SO_2 measurements between 100–200 ppb occurred at the Old Fort Worth Road and Wyatt Road monitors and 225 at the Midlothian

Tower. The 5-minute SO_2 level, between ATSDR's acute MRL of 10 ppb and 100 ppb, occurred 59,820 times at the Old Fort Worth Road and Wyatt Road monitors and 22,895 times at the Midlothian Tower monitor.

In clinical studies, sensitive individuals (such as those with mild to moderate asthma) using a mouthpiece have experienced effects when exposed to sulfur dioxide concentrations less than 200 ppb. The primary effects for exposures between 100-200 ppb would be asymptomatic increased specific airway resistance (bronchoconstriction) to moderately exercising asthmatics which was found in the study by Shepard et al (1991). The lowest observed adverse effect level (LOAEL) from this study was 100 ppb. This is the same study that produced a Lowest-Observed-Adverse-Effect-Level of 100 ppb which was used by ATSDR to develop its MRL of 10 ppb (ATSDR, 1998). Whether exposures below 200 ppb might cause effects in sensitive individuals at increased ventilation rates under normal environmental conditions is uncertain, given that clinical investigations have not been conducted in free-breathing asthmatics at concentrations below 200 ppb. Moreover, according to EPA (2009b):

"While there is very strong support for SO2 being causally linked to lung function responses within the range of tested exposure levels (i.e., ≥ 200 ppb) and even down to the 100 ppb level (where SO2 was administered by mouthpiece (Sheppard et al. 1981; Koenig et al., 1990)), there is increasing uncertainty about whether SO2 is causally related to lung-function effects at lower exposure levels below 100 ppb. Since this assessment assumes there is a causal relationship at levels below 100 ppb, the influence of this source of uncertainty would be to over-estimate risk. The SO2-related lung function responses have been observed in controlled human exposure studies and, thus there is little uncertainty that SO2 exposures are responsible for the lung function responses observed for SO2 exposures in the range of levels tested. Given the lack of chamber data at levels below 100 ppb, the uncertainty is rated as medium"

Individuals who lived in Cement Valley likely experienced exposures above the LOAEL every year from 1997 to early 2008 and possibly those living east, south and southeast of the TXI facility, likely experienced exposures above the LOAEL during 1997–2006 (except 2004). Moreover, the highest frequency of exposures above the LOAEL in Cement Valley likely occurred from late 1997 to early 2002 and dropped appreciably during the period from early 2002 to the end of 2004, with periods within this timeframe where no exposures above the LOAEL occurred. The frequency of exposures above the LOAEL in Cement Valley increased in early 2006 to 2008, but not to the same frequency observed between late 1997 to early 2005 (see Figure 10). No exposures above the LOAEL were likely from early 2008 to the end of 2014 in Cement Valley, and starting in 2007, not in areas south, east, and southeast of the TXI facility boundaries (although this is somewhat uncertain because we do not have data from the Midlothian Tower after 2007 but we base our assessment on lower TXI emissions and the much lower levels in the Cement Valley). Moreover, as 5-minute SO_2 levels began to appreciably drop below the 100 ppb LOAEL in the beginning of 2008, but still frequently above our MRL, ATSDR has determined that harmful effects were not likely.

As defined by ATSDR (ATSDR, 1997), that not all persons in the study that were used to derive the LOAEL or in other studies experience harmful effects and it is likely that any exposures in Midlothian would be categorized as less serious (see Appendix B, particularly Table B-1). Therefore, ATSDR would not expect that all sensitive persons in Midlothian who were exposed to levels between 100-400 ppb, and engaged in activities that increased their breathing rate, would have experience the effects described above. Moreover, there is a question of the timing of SO_2 levels above the LOAEL and when persons might be engaging in activities that would increase their breathing rates. As can be seen in the data presented in figures provided to ATSDR during public comment (see Appendix D, Comments B.3.14, B.3.15, and B.3.22), the highest frequency of elevated SO_2 levels in Cement Valley were found in the late evening or early morning hours when persons were generally not be likely to exercise. The figures also show that the lowest frequency of elevated SO_2 levels occurred when most community members might not be at their residence (during normal business hours). However, ATSDR does not have perfect knowledge of when the residents of Cement Valley or other areas might be working, exercising, gardening, etc. Therefore, especially during the years when the frequency of SO_2 levels above the LOAEL were greatest (late 1997-early 2005), ATSDR believes that there was opportunity for some sensitive persons to be exposed to SO_2 levels that may have produced less-serious harmful effects.

4.2. Fine Particulate Matter ($PM_{2.5}$)

Mortality and cardiovascular and respiratory morbidity have been associated with both short-and long-term exposure to $PM_{2.5}$ (EPA, 2009a). Most measured annual average $PM_{2.5}$ levels since 2000 in the Midlothian area are not above EPA's current or proposed standard. In addition, short-term $PM_{2.5}$ levels infrequently exceeded the NAAQS HCV of 35 $\mu g/m^3$ during the period 2000-2011; however, as defined by EPA, short-term levels of $PM_{2.5}$ in the Midlothian area have not exceeded the current standard as defined by EPA.

As PM health effect thresholds have not been identified, and given a substantial interpersonal variability in exposure and subsequent harmful effects, that any standard or guideline value will lead to complete protection for everyone against all possible adverse health effects is unlikely (WHO, 2006). Population subgroups that may be more sensitive to the effects of PM exposure include infants, older adults (65+ years), individuals with asthma, COPD or cardiovascular disease, diabetics, lower socioeconomic status, and those with certain genetic polymorphisms (EPA 2009a).

Epidemiologic studies that examined the effect of $PM_{2.5}$ on cardiovascular emergency department (ED) visits and hospital admissions reported consistent positive associations (predominently for ischemic heart disease and congestive heart failure), with the majority of studies reporting increases ranging from 0.5 to 3.4% per 10 $\mu g/m^3$ increase in $PM_{2.5}$. These effects were observed in study locations with mean1 24-h avg $PM_{2.5}$ concentrations ranging from 7-18 $\mu g/m^3$. The recent epidemiologic studies evaluated report consistent positive associations between short-term exposure to $PM_{2.5}$ and respiratory ED visits and hospital admissions for chronic obstructive pulmonary disease (COPD) and respiratory infections. Positive associations were also observed for asthma ED visits and hospital admissions for adults and children combined, but effect estimates are imprecise and not consistently positive for children alone. Most studies reported effects in the range of ~1% to 4% increase in respiratory hospital admissions and ED visits and were observed in study locations with mean 24-h average $PM_{2.5}$ concentrations ranging from 6.1-22 $\mu g/m^3$. An evaluation of the epidemiologic literature indicates consistent positive associations between short-term exposure to $PM_{2.5}$ and all-cause, cardiovascular-, and respiratory-related mortality. The evaluation of multicity studies found that consistent and precise risk estimates for all-cause (non-accidental) mortality that ranged from 0.29 to 1.21% per 10 µg/m3 increase in $PM_{2.5}$ at lags of 1 and 0-1 days (EPA, 2009a).

Results from using the EPA AirNow AQI Calculator, indicate that the highest 24-hour $PM_{2.5}$ levels recorded in Midlothian show in an increased likelihood of respiratory symptoms in sensitive individuals, aggravation of heart or lung disease and premature mortality in individuals with cardiopulmonary disease and the elderly but not for the general population (EPA, 2012b). However, the frequency of these potentially harmful levels of $PM_{2.5}$ exposure were limited to only a small number of days during the period evaluated for this health consultation and the source of the $PM_{2.5}$ elevations was likely from a combination of local as well as regional sources.

4.3. Ozone

Breathing air containing ozone can reduce lung function and increase respiratory symptoms, thereby aggravating asthma or other respiratory conditions. Ozone exposure also has been associated with increased susceptibility to respiratory infections, more frequent medication use by people with asthma, doctor's visits, and emergency department and hospital admissions for individuals with respiratory disease. Ozone exposure also might contribute to premature death, especially in people with heart and lung disease. More recent information indicates that other outcomes such as school absenteeism, cardiac-related effects, and greater, more serious, and more long-lasting symptoms among people with asthma may occur (EPA, 2008d). Moreover, a controlled exposure study of healthy young volunteers to ozone at levels similar to the EPA standard resulted in cardiovascular changes that could put a sensitive individual at risk for an adverse cardiovascular event. These results provide biological plausibility and support to the previous findings in other types of human health studies (epidemiologic) of an association between ozone exposures and increased risk of death and disease (Devlin et al., 2012).

Conclusions for Ozone:
Ellis County is one of 10 counties that make up the Dallas–Fort Worth ozone non-attainment area, which means that ozone levels in the metropolitan area occasionally exceed EPA's health-based standards and WHO's health guidelines. Emissions from industrial sources, mobile sources, and natural sources throughout the area contribute to this problem.
The *general population* of Midlothian is not expected to experience harmful effects from ozone exposure except on rare occasions when ozone levels reach around 100 ppb or more. Many of the levels of ozone detected in Midlothian since monitoring began in 1997 indicate that *sensitive individuals* have an increased likelihood of experiencing harmful respiratory effects (respiratory symptoms and breathing discomfort). This is primarily true for active children and adults and people with respiratory diseases, such as asthma. However, it is important to note that the overall trends in the frequency of ozone levels above the current standard has decreased in recent years (2007-2012) and, during this same timeframe, no harmful ozone exposures occurred for the general public based on the 2008 standard. However, current science on what levels constitute a harmful exposure is evolving and scientists advising EPA have concluded that scientific evidence supports a standard within the range of 60-70 ppb (EPA, 2014).
Subsequently, EPA changed the ozone standard to 70 ppb see the following link for details:
http://www3.epa.gov/airquality/ozonepollution/actions.html.

Many of the 8-hour ozone levels reported in the Midlothian area since monitoring began in late 1997, indicate that sensitive individuals have an increased likelihood of respiratory symptoms and breathing discomfort. These reactions are true for primarily active children and adults and people with respiratory disease, such as asthma. On rare occasions during this period, levels reached 100 ppb or more, indicating that even non-sensitive individuals from the general population may have experienced harmful effects (EPA, 2012b). However, it is important to note that for the period 2007-2012, the frequency of ozone 8-hour levels above a level of concern for sensitive persons has dropped from an average of about 18 events per year from 1997-2006 (range of 3-40 per year) to about 4 events per year (ranging from zero to 7 per year). Moreover, during the period 2007-2012, there have been no ozone exposures above levels of concern for the general public; whereas, there was an average of about 2 events per year from 1997-2006 (range of zero to 5 per year). ***All of the above trends are based on the 2008 NAAQS standard. However, current science on what levels constitutes a harmful exposure is evolving and scientists advising EPA have concluded that scientific evidence supports a standard within the range of 60-70 ppb (EPA, 2014) which supported the standard being revised in 2015 to 70 ppb. Therefore, although levels have been decreasing, they are still above levels of concern, especially for sensitive persons.***

4.4. Lead

4.4.1. Recent Human Studies on the Effects of Lead

Until recently, the CDC had established a level of concern for case management of 10 µg/dL. This means that when blood lead levels in children exceed 10 µg/dL, CDC recommends that steps be taken to lower their blood lead levels. More information about CDC's recommendations can be found in *Preventing Lead Poisoning in Young Children* (CDC, 2005). CDC also provides tips for preventing exposure to lead. These tips can be found at this web address: http://www.cdc.gov/nceh/lead/tips.htm.

Many people have mistakenly used this level in blood as a safe level of exposure or as a no effect level. Recent scientific research, however, has shown that blood lead levels below 10 µg/dL can cause serious harmful effects in children. As a result, there is no identified "safe" blood lead level for children. Blood lead levels below 10 µg/dL have been shown to cause neurological, behavioral, immunological, and developmental effects in young children. Specifically, lead causes or is associated with decreases in (IQ; attention deficit hyperactivity disorder (ADHD); deficits in reaction time; problems with visual-motor integration and fine motor skills; withdrawn behavior; lack of concentration; issues with sociability; decreased height; and delays in puberty, such as breast and pubic hair development, and delays in menarche (ATSDR, 1999).

On January 4, 2012, CDC's Advisory Committee on Childhood Lead Poisoning Prevention (ACCLPP) recommended that CDC adopt the 97.5 percentile for children aged 1–5 years as the reference value for blood lead levels to identify children and environments associated with lead-exposure hazards. The 97.5% currently is 5 ug/dL (CDC, 2012a). The full report is available at http://www.cdc.gov/nceh/lead/ACCLPP/Final_Document_011212.pdf. On June 7, 2012, the CDC released a statement concurring with the recommendations of the ACCLPP (CDC, 2012b). The full statement can be found at:

http://www.cdc.gov/nceh/lead/ACCLPP/CDC_Response_Lead_Exposure_Recs.pdf. Based on CDC's concurrence, there is no longer a blood lead "level of concern."

4.4.2. Estimating children's lead dose from air levels just north of the Gerdau Ameristeel facility

The 2008 EPA lead standard for air was developed to prevent the loss of 1–2 IQ points in young children (EPA, 2008e). In addition, the U.S. EPA developed a model to estimate the contribution of lead in air (and other media, including soil) to children's blood lead level. The model is called the integrated exposure uptake biokinetic (IEUBK) model (http://www.epa.gov/superfund/lead/products.htm#guid). The model estimates the percentage of children aged 6 months to 7 years that exceed a specified blood lead level at certain air lead concentrations. In most situations, the EPA's goal is to limit exposure to lead in a child or group of similarly exposed children that would have an estimated risk of no more than 5% chance of exceeding a blood lead level of 10 µg/dL (EPA, 2002).

> **Conclusions for Lead:**
> Past air lead exposures, during 1993–1998, in a localized area just north of the Gerdau Ameristeel fence line, could have harmed the health of children who resided or frequently played in these areas. The estimated neurological health effect of these exposures would have been a slight lowering of IQ levels (1–2 points) for some children living in this area. There is some uncertainty with these findings given that we do not know what the lead levels in air were downwind of the Gerdau monitor, and we do not know if small children were exposed at all in this sparsely populated area of Cement Valley.
>
> Since 1998, lead levels in this localized area have decreased sharply. Monitoring data do not indicate that lead exposures above EPA standards have occurred in other areas of Midlothian currently or in the past.

In an attempt to better quantify the risk of inhaling lead in the area of the Gerdau monitor between 1993-1998, ATSDR ran the model using EPA's default parameters for lead in food and in water. ATSDR also ran the model using the updated reference value of 5 µg/dL to account for the risk of adverse health effects in children with levels below 10 µg/dL. To run the EPA IEUBK model, the health assessor must either use the default values already present in the model or substitute them for site-specific parameters. For the soil concentration parameter, ATSDR reviewed sampling data from an area nearest to the former Gerdau monitor (TACB, 1991; 1993-1995) and determined that the average site-specific soil lead level was about 72 ppm. Therefore, using a combination of default and area-specific parameters and the highest annual average levels from the Gerdau Ameristeel monitor for the 1993–1998 period (i.e., 0.255 µg/m^3 for

1995), the model estimated that children do not have an elevated risk of having a blood lead level above a concentration above 5 or 10 µg/dL.

Although the results for the IEUBK model run at 5 or 10 µg/dL may appear inconsistent with the 2008 NAAQS for lead, the NAAQS is not strictly based on the IEUBK model. In fact, the 2008 NAAQS for lead is based on air-related exposure and IQ loss that was established to prevent a loss of 1-2 IQ points. This evidence-based framework was established by a quantitative exposure/risk assessment process that relied on an air to blood ratio (Personal Communication, Mark Follansbee, EPA IEUBK Contractor, March 14, 2012). Moreover, uncertainty in ATSDR's findings exist because of the following:

1) We do not know what the air levels were downwind of the Gerdau monitor; however, the lead levels would likely have decreased appreciably as you move north of the Gerdau monitor.

2) That a small population was exposed is likely, given the low-population density in Cement Valley near the Gerdau monitor. However, ATSDR believes that the closest possible receptor was about 450-500 feet west of the Gerdau Monitor (TNRCC, 1994; TNRCC, 1995b; TNRCC, 1995c). ATSDR does not know whether any young children resided in this nearest home.

Evaluation of the actual childhood blood lead data in the Midlothian area has been conducted in a separate ATSDR Health Consultation (this document is available at: http://www.atsdr.cdc.gov/sites/midlothian/health_consultations.html).

4.5. Mixtures (including ozone)

Throughout this section, the health evaluations have focused on individual pollutants. This analysis is consistent with the toxicological literature, which focuses on health effects following single pollutant exposures. In the Midlothian area, however, as with many industrial sites, real-world environmental exposures occur simultaneously and involve multiple pollutants. This section considers the public health implications of such exposures, focusing particularly on the potential for co-exposures to ozone, $PM_{2.5}$, and sulfur dioxide. Many gaps exist in our understanding of the full range of health impacts of air pollution (i.e., the mixture of pollutants) and scientific and regulatory communities are at least 10 years away from being able to implement changes to address these issues (Mauderly et al., 2010).

Conclusions for Mixtures:
ATSDR believes the severity of health effects from a mixture exposure is not likely to exceed those discussed for SO_2, $PM_{2.5}$, or ozone exposure alone. Moreover, ATSDR believes that sufficient information exists to warrant concern for multiple air pollutant exposures to sensitive individuals, especially in the past (during the period 1998 to 2002) when SO_2 levels were higher and more frequent and when these persons were breathing at higher rates (e.g., while exercising). Data also suggest that the number of potential co-exposures of concern were infrequent.

For past SO_2 exposures, however, the number of sensitive individuals affected may have been greater because effects may have occurred at a lower SO_2 concentration when combined with exposure to ozone. Potential effects to a larger sensitive population, especially in the past, may be limited to the same locations but during the warmer months when ozone levels were usually the highest. In addition, potential effects to this larger sensitive population may also have resulted from multiple exposures that occurred during several consecutive days; however, the number of these potential occurrences was also infrequent based on the 2008 ozone standard. However, current science on what levels constitutes a harmful exposure to ozone is evolving and scientists advising EPA have concluded that scientific evidence supports a standard within the range of 60-70 ppb (EPA, 2014). Subsequently in 2015, EPA revised the ozone standard to 70 ppb. Therefore, the number of possible co-exposures to SO_2 and ozone of concern in the past might be higher given the new lower level of concern for harmful ozone exposures. These overall mixtures conclusions are based on our best professional judgment and ATSDR recognizes the uncertainty associated with them.

Using the available ambient air monitoring data, ATSDR first notes where and when individual pollutants reached their peak levels:

- **Ozone.** Ambient air concentrations of ozone tend to peak in the summer with the highest levels likely in the afternoons primarily during May and September with some elevations reported in April and October.
- **$PM_{2.5}$.** Levels in the Midlothian area tend to be highest during warm months. All of the levels above the 24-hour $PM_{2.5}$ NAAQS HCV occurred between May and September. However, as defined by EPA, the 24-hour standard has not been exceeded in Midlothian.

- **Sulfur dioxide.** Monitoring data from the Old Fort Worth Road, Wyatt Road, and Midlothain Tower indicated elevated sulfur dioxide concentrations (i.e., above the LOAEL of 100 ppb). For the Old Fort Worth Road and Wyatt Road monitors, in general, elevated concentrations begin to increase around 5 p.m. and taper off around 6 a.m.; the highest frequency of elevations occurred between 7 p.m. and 3 a.m., with the highest frequency and levels occurring in the late evening and early morning hours. In all months of the year, 1-hour SO_2 levels were above the standard; however April, May, and October had the highest frequency and June, August, November, and December had the lowest. As noted previously, the populations exposed lived primarily in the Cement Valley area and, secondarily, east, southeast, or south of the TXI property boundary.

Taken together, the previous observations suggest that the timeframe of greatest concern for past exposures to a mixture of SO_2 and ozone were on days in the spring to early fall and during the years when the highest frequency of SO_2 levels above the LOAEL of 100 ppb and ozone levels above 75 ppb occurred (late 1997 to early 2005). However, based on data provided to ATSDR during public comment, there were only 14 instances when SO_2 and ozone levels occurred both in the same day and all of those occurred between 1998 and 2000 (see Appendix D, Table in Attachment). Moreover, these data indicate that there were only three days when $PM_{2.5}$ was above the NAAQS HCV and ozone was above 75 ppb, and all of these occurred in 2002. In addition, there were no observed days when a mixture, at levels of concern, occurred between SO_2 and $PM_{2.5}$ and, therefore, also for all three air pollutants. However, these types of mixture comparisons with $PM_{2.5}$ could not be made for the years when the frequency of elevated SO_2 and ozone levels were the greatest (1998-2000) because $PM_{2.5}$ data were not available. Any mixtures exposures would have likely occurred in the past for persons residing in Cement Valley because that is where the highest and most frequent sulfur dioxide concentrations occurred. Finally, current science on what levels constitutes a harmful exposure to ozone is evolving and scientists advising EPA have concluded that scientific evidence supports a standard 60-70 ppb (EPA, 2014) which resulted in EPA lowering the standard to 70 ppb in 2015. Therefore, the number of possible co-exposures to SO2 and ozone of concern in the past of potential concern might been higher given this new lower standard.

The individual effects of ozone, sulfur dioxide, and $PM_{2.5}$ exposures may have a lag effect and a direct relationship to co-exposures around the same hour or on the same day is not likely to tell the whole story regarding the total effects of the past and current mixtures exposures. For example, a sensitive person may be exposed to harmful levels of one NAAQS constituent on one day only but may not exhibit the effect until the next day or several days later (called a lag effect). Meanwhile, this person could then be exposed again to harmful levels of the same or other NAAQS constituents during subsequent days. Most epidemiological studies on the effects of exposures to air pollutants report lag effects of zero to several days. For sulfur dioxide, reported lags showing increased effects were reported from zero to two days and cumulative lags for up to 4-5 days (EPA, 2008c). Lag effects have also been seen in epidemiological studies of various outcomes following exposures to ozone and $PM_{2.5}$ (EPA, 2009a and 2013b). However, based on data provided to ATSDR in public comments (see Appendix D, Comments B.8.11, B.8.14 and the attached table to Appendix D), even assuming a lag period of 6 days, only an average of 3 potential mixture events per year over the time period of 1998 to 2008 were possible, with a maximum of 12 events in 1999.

Some sulfur-dioxide sensitive individuals functioning at elevated ventilation rates may have experienced enhanced effects from exposure to a mixture of sulfur dioxide and ozone or $PM_{2.5}$. The number of sensitive individuals affected in the past may have increased because effects may have occurred at a lower sulfur dioxide concentration. Scientific information is insufficient to allow meaningful quantitative analysis, but is sufficient to warrant concern for sensitive populations, especially those who are at higher ventilation rates (e.g., exercising, etc.). Nevertheless, past exposure to the mixture of all three constituents is limited temporally and spatially by sulfur dioxide, primarily in the Cement Valley and secondarily to areas south, east, and southeast the TXI boundary. However, other areas may have had concurrent $PM_{2.5}$ and ozone exposures without elevated SO_2 exposures. Given the infrequent elevations of SO_2 above 200 ppb and the spatial and temporal limitations identified here, ATSDR believes the severity of health effects from a mixture exposure is not likely to exceed those discussed for SO_2, $PM_{2.5}$, or ozone exposure alone. Because, however, effects may have occurred at a lower SO_2 concentration, the number of affected individuals might have increased beyond what would be expected from exposure to a single air pollutant.

ATSDR's conclusions are based on our best professional judgement related to our understanding of the possible harmful effects of air pollutants in Midlothian and our interpretation of the current scientific literature; therefore, our conclusions are presented with some uncertainty. We do know that asthmatics are likely a sensitive population. We also know that exposures to irritant gases (like ozone and sulfur dioxide) exacerbates asthma symptoms. The likely mechanism is that epithelial cells that line the airway passages in asthma (and other respiratory disorders) are damaged and these cells start shedding. The shedding of these cells exposures nerve endings allowing irritant gases access to free nerve endings which in turn aggravates asthma and allergy. Even healthy individuals exposed to polluted environments (e.g., ozone) can experience epithelial shedding which can last up to 2 weeks or more (Shiffman et al., 2000). Moreover, in a study of exercising allergic asthmatic adolescent subjects, who were exposed to ozone (at 120 ppb) and then sulfur dioxide (at 100 ppb), they found that prior ozone exposures increased bronchial hyper-responsiveness in these subjects such that they responded to an ordinarily subthreshold concentration of sulfur dioxide. Their bottom line findings were that their data suggest that assessment of pulmonary changes to single pollutant challenges overlooks the interactive effect of common co-existing or sequentially occurring air pollutants (Koenig et al., 1990). In a more recent mouthpiece study, Trenga et al. (2001) evaluated a similar scenario as Koenig et al (1990), however, they studied adults and administered a higher level of sulfur dioxide exposure (250 ppb). They showed slight changes in the pre-ozone exposed group as compared to the group with was pre-exposed to filtered air. Regarding SO_2 exposures with particular matter, animal toxicological studies do suggest that SO2 effects may be potentiated by co-exposure to particulate matter but the relevance of these results to ambient exposures is not clear (EPA 2008c). Therefore, although we do not currently know how to quantify the effect of co-exposures to ozone and sulfur dioxide, we believe that, at the very least, it is possible that the number of sensitive individuals affected may be greater because effects may have occurred at a lower SO_2 concentration when combined with ozone.

4.6 Gaps and Limitations

In this health consultation, ATSDR considered the public health implications of the measured and estimated air pollution levels in the Midlothian area relating to the NAAQS constituents and hydrogen sulfide. Furthermore, ATSDR considered whether the available data form an adequate basis for reaching conclusions. The following discussion does not focus on gaps and limitations for those timeframes in the past where ATSDR will never be able to evaluate exposures; however, it focuses on the gaps in our understanding of current and future exposures and the limitations of our evaluation. A more in-depth discussion can be found in ATSDR's previous health consultation (ATSDR, 2015).

4.6.1 SO_2 Limitation

ATSDR's conclusions for sulfur dioxide were based primarily on data from a monitoring network that indicate exposures to person living in the Cement Valley or east, south, or southeast of the TXI facility boundary. TCEQ changed their procedures in 2009 for how they validated their 5-minute SO2 data. Therefore, some of the 5-minute data used by ATSDR were either considered by TCEQ as not validated or were of mixed validation levels that predate the changes in their validation procedure in 2009. However, all of the 5-minute data was retrospectively screened by TCEQ for outlying values greater than or equal to 70 ppb. For any months in which an outlying value greater than or equal to 70 ppb was measured, the 5-minute data was reviewed by TCEQ technical personnel (TCEQ, 2012b). Please see responses to either public or peer reviewer comments on this limitation. In addition to the limitation relating to the 5-minute SO2 data, ATSDR also noted a limitation in the use of annual emissions data for modeling potential past shorter-term exposures from SO_2 emission from Ash Grove. ATSDR attempted to obtain the needed 1-hour emission data to help reduce this uncertainty, but was unsuccessful. Therefore, ATSDR cannot make and definitive conclusion regarding past exposures to SO_2 being emitted from Ash Grove.

4.6.2 PM Limitations

One notable gap is the lack of monitoring data for residential neighborhoods in immediate proximity to the four industrial facilities, where fugitive emissions would be expected to have the greatest air quality impacts. Current and past monitoring locations likely do not adequately characterize particulate matter levels for all residents located immediately adjacent to certain onsite operations, such as limestone quarry activity. Particulate matter monitoring is needed in these areas to evaluate exposures. ATSDR noted several data gaps in relation to particulate matter exposures. In general, monitoring stations in the Midlothian area have been placed near or at locations believed to either have high air quality impacts from facility operations or a high potential for exposure. However, ***ATSDR is uncertain about $PM_{2.5}$ exposures downwind of Holcim because the available $PM_{2.5}$ monitoring used methods that may have underestimated the $PM_{2.5}$ levels, especially given the lowering of the NAAQS standard from 15 µg/m^3 to 12 µg/m^3.***

4.6.3 Mixtures Limitations

ATSDR notes that a limitation inherent in the public health assessment process is that scientists do not have a complete understanding how simultaneous exposures to several environmental contaminants may cause health effects. For the pollutants considered in this analysis—especially sulfur dioxide, ozone and particulate matter, however, hundreds of toxicologic and epidemiologic studies have examined how exposures are possibly related to health effects in humans. Therefore, the evaluations of individual pollutants considered in this health consultation are based on extensive scientific research, but the scientific understanding of the health effects of exposures to pollutant mixtures is less advanced. ATSDR's conclusions regarding the health implication of exposures to a mixture of air pollutants is based on our best professional judgment related to our understanding of the possible harmful effects of air pollutant exposures in Midlothian and our interpretation of the current scientific literature; therefore, these conclusions are presented with some uncertainty.

As with most site-specific environmental health evaluations ATSDR conducts, the findings and conclusions in this health consultation have some inherent gaps and limitations. But for the reasons cited above, ATSDR concludes that this assessment does not have major limitations that would preclude scientifically defensible conclusions.

5. Child Health Considerations

In communities with air pollution issues, the many physical differences between children and adults demand special emphasis. Children could be at greater risk than adults from certain kinds of exposure to hazardous substances. Children frequently play outdoors, especially during the summertime or after school during the warm months, which can increase their exposure potential. Further, a child's lower body weight and higher intake rate results in a greater dose of hazardous substance per unit of body weight. If toxic exposure levels are high enough during critical growth stages, the developing body systems of children can sustain permanent damage. Further, children are dependent on adults for access to housing, access to medical care, and risk identification. Thus adults need as much information as possible to make informed decisions regarding their children's health.

When preparing this health consultation, ATSDR considered these and other children's health concerns. For instance, when selecting health-based comparison values for the exposure evaluation, ATSDR identified, when available, comparison values protective of children's exposure and of health conditions, such as asthma, more common in children. As one example, ATSDR used the most recent EPA's National Ambient Air Quality Standards to screen either current or past air pollution levels (except for hydrogen sulfide which is not an NAAQS air pollutant) given that they represent the most up-to-date science. EPA developed these standards to protect the health of sensitive populations, including children. In addition, ATSDR compared the environmental data to other guidelines, such as those from WHO.

It is not clear that children are more toxicologically sensitive to SO_2 but might be more vulnerable because of increased exposure. While physiologically based pharmacokinetic modeling has suggested that children might be more vulnerable in the pulmonary region to fine particulate matter, it also suggests that children's airways might not be more sensitive than adults to reactive gases such as SO_2 (Ginsberg et al., 2005).

Factors that might contribute to enhanced lung deposition in children include higher ventilation rates, less contribution from nasal breathing, less efficient uptake of particles in the nasal airways, and greater deposition efficiency of particle and some vapor phase chemicals in the lower respiratory tract. A child breathes faster than an adult, which might result in increased uptake (Koenig et al., 2000). Children spend 3 times as much time outdoors as adults and engage in 3 times as much time playing sports and other vigorous activities (EPA, 1997). Based on these parameters, children are more likely to be exposed to more outdoor air pollution than adults. Epidemiologic evidence suggests that air pollution effects (lung function decrements) in children might not be fully reversible, even if the exposure stops, although SO_2 was not a major contaminant in these studies (Gauderman et al., 2004).

Recent literature suggests that exposure to air pollution during pregnancy causes adverse birth outcomes and health problems for the mother and child. Two of the pollutants of concern for these outcomes, particulate matter and ozone, are also considered a concern in Midlothian. Research shows that prenatal exposure to these pollutants can increase the risk of preterm delivery and low birth weight, which contribute substantially to infant death and developmental disabilities (EPA, 2010f).

ATSDR identified other environmental health concerns specific to children for this site: elevated airborne levels of ozone and fine particulate matter. Many children who live in the Midlothian area, like children who live in numerous urban and suburban areas in Dallas-Fort Worth Metropolitan area and across the country, have a greater risk of suffering from ozone-related adverse health effects than do adults.

ATSDR's concern for this subject is based partly from the fact that ozone and $PM_{2.5}$ levels are generally highest during the afternoon hours on sunny summer days, when most children are not in school and might be playing outdoors. Another reason for concern is that people with asthma have been identified as a sensitive population for both ozone and $PM_{2.5}$ exposure, and asthma is more prevalent among children than among adults (Mannino et al., 2002). Finally, some families with children might not seek or understand information in air quality forecasts. These factors are of concern because children with asthma or children who engage in moderate to strenuous exercise (e.g., swimming and running) during poor air quality days are at risk for respiratory problems.

Many resources are available to help prevent children from exposure to unhealthful levels of ozone and $PM_{2.5}$. On days with the most elevated air pollution levels, TCEQ issues air quality alerts or forecasts, which are typically broadcast by the local media. Parents should encourage their children, especially children with asthma, to play indoors on days when air pollution levels are predicted to be unhealthful. EPA's Web site now includes a substantial amount of information on ozone, $PM_{2.5}$, and related air quality problems. Adults are encouraged to access this information, whether from their home computers or those at local libraries, at www.epa.gov/airnow. Additionally, EPA recently launched a Web site that presents air pollution information related to children's health. The site, "Air Quality Index for Kids!", is available in English and Spanish at www.epa.gov/airnow/aqikids.

6. Community Concerns Evaluation

Since 2005, ATSDR and TDSHS have been collecting and documenting community concerns regarding the Midlothian facilities. The agencies have learned of these concerns through various means, including a door-to-door survey of residents, a community survey, and multiple public meetings and availability sessions in Midlothian. The concerns expressed by community members have addressed many topics, including human health, animal health, and the adequacy and reliability of ambient air monitoring data collected in the Midlothian area.

Concerns Addressed in This Document:

This Health Consultation addresses community concerns regarding the potential exposures to the NAAQS constituents and H_2S related to the Midlothian facilities and for potential exposures to these air pollutants from other sources. Other ATSDR evaluations have evaluated community concerns related to exposures to other air pollutants, animal concerns and health-outcome data.

ATSDR released this health consultation for public comment on November 16, 2012 and accepted comments through February 14, 2013. ATSDR's response to public comments can be found in Appendix D. At the request of the community, ATSDR also conducted a peer review of this document which included ATSDR draft responses to the public comments received (see Appendix E for ATSDR responses to peer reviewer comments).

The following are responses to community concerns related to the evaluation of the NAAQS constituents:

1. **Protectiveness of the regulatory health-based screening guidelines**

Response: ATSDR used several sources for health-screening guidelines (EPA, ATSDR, and WHO) to evaluate which air pollutants to further evaluate. ATSDR used the most recent EPA's National Ambient Air Quality Standards to screen current or past air pollution levels (except for hydrogen sulfide since that is not a NAAQS air pollutant) because they represent the most up-to-date science. EPA developed these standards to protect the health of sensitive populations, including children. In addition, ATSDR compared the environmental data to other guidelines, such as those from WHO. This information was taken into account in this health consultation.

2. **Persistence of emissions and the effects of continuous low-level exposure to individual chemicals and/or mixtures**

Response: The ability of the scientific community to fully and quantitatively evaluate the health effects from the mixture of air pollutants people are exposed to is at least ten years away (Mauderly et al., 2010). However, in this health consultation, in addition to evaluating the health effects of exposure to single air pollutants, we attempted to evaluate the combined effect of the three major air pollutants that may be harmful to the health of a person living in Midlothian (particularly sensitive individuals). ATSDR believes that sufficient information exists to warrant concern for multiple air pollutant exposures to sensitive individuals, especially in the past (during the period 1998 to 2002) when SO_2 levels were higher and more frequent and when these persons were breathing at higher rates (e.g., while exercising). Data also suggest that the number of potential co-exposures of concern were rare and any co-exposures were more likely between

SO_2 and ozone, and to a lesser extent, between ozone and $PM_{2.5}$. Any mixtures exposures would have likely occurred in the past for persons residing in Cement Valley because that is where the highest and most frequent sulfur dioxide concentrations occurred. See more information above in the Public Health Implications for individual air pollutants and in the Mixtures section.

3. **Impact on pregnant women, infants, children, the elderly, the immune-suppressed. What is the impact on emissions at schools and other areas where children gather and engage in active sports?**

Response: Infants, children, the elderly, and immune-suppressed individuals are all considered populations sensitive to the effects of exposures to air pollutants. Recent literature suggests that exposure to air pollution during pregnancy causes adverse birth outcomes and health problems for the mother and child. The specific concerns of children are discussed above in the Child Health Considerations section. In a future health consultation, ATSDR will evaluate data on birth defects and adverse birth outcomes for the Midlothian area.

ATSDR evaluated the locations of schools and parks in the Midlothian area and determined that there are three schools (J.A Vitovsky, T.E. Baxter, and Mt. Peak Elementary schools) and Jaycee Park that are located nearest to the boundaries of the facilities in Midlothian. The J.A. Vitovsky Elementary and Jaycee Parks are located south of the Ash Gove boundary, T.E. Baxter is located south of Holcim, and the Mt. Peak Elementary is located southeast of TXI and Gerdau, east of Midlothian Tower. Neither of these schools nor Jaycee Park are located in the most frequent downwind direction (downwind would be north of the facilities) although they may on occasion be considered downwind during certain times of the year. The primary concern for potential exposures, based on the findings of this Health Consultation, is for SO_2. For the Mt. Peak Elementary School, the nearest monitor is Midlothian Tower and, based on our analysis, the primary concern is for SO_2 exposures north of the facility in Cement Valley, not south or southeast of the facility. Therefore, we do not have any evidence that children who attend the Mt. Peak Elementary School were exposed to harmful levels of SO_2. As for the other schools and Jaycee Park, ATSDR performed an additional analysis of SO_2 by conducting air modeling (since air monitoring data were not available) using emissions from Ash Gove and Holcim. Based on this analysis, it does not appear that children who attend or staff that work at the J.A. Vitowsky or T.E. Baxter schools would have experienced any harmful SO_2 exposures from Ash Grove of Holcim. However, in response to a peer review comment, ATDSR determined that too much uncertainty exists in the modeling analysis to definitively conclude whether past harmful SO_2 exposures (between 2006-2010) occurred to children or staff at the J.A. Vitowsky school. However, two kilns at Ash Grove have been shut down and significant upgrades to the emissions controls to the remaining kiln occurred in late 2014. These actions should significantly reduce SO_2 emissions from Ash Grove. ATSDR recommends that TCEQ verify that these reductions have occurred when they evaluate the 2015 annual SO_2 emissions from Ash Grove.

4. Confounding circumstances (i.e., Ellis Co. is an ozone non-attainment area)

Response: This health consultation evaluated the public health implications of all NAAQS constituents whether they were primarily related to the major industries (sulfur dioxide), partially related ($PM_{2.5}$), or primarily unrelated (ozone). See the Mixtures discussion above for details.

5. Health effects of air quality. Are there air quality issues in Midlothian?

Response: First, it is important to note that, except for ozone, no NAAQS air pollutant has been above the EPA standards for attainment purposes in Midlothian and that this response only applies to the air pollutants evaluated in this health consultation. Actions have been taken by TCEQ and local industry to reduce the emissions of several air pollutants evaluated in this health consultation. ATSDR did determine that that past exposure to sulfur dioxide as a concern, especially for person residing in Cement Valley; however, actions have been taken by TXI to reduce emissions and monitoring data do not indicate that potentially harmful exposures have occurred since early 2008**.** However, ATSDR cannot determine if past SO_2 exposures downwind of Ash Grove may have resulted in harmful effects. Although computer modeling of SO_2 emissions from Ash Grove indicated that persons who resided or recreated near the Ash Grove facility were not exposed to harmful levels of SO_2, there is too much uncertainty to make a definitive conclusion. Moreover, SO_2 emitted from Ash Grove should be substantially reduced as the Ash Grove facility has been upgraded with new kiln and emission control technology in 2014 which would reduce the likelihood of any off-site exposures of concern in the future—these SO_2 emission reductions need to be verified.

Exposure to ozone in Midlothian, since monitoring began in 1997, indicate that sensitive individuals have an increased likelihood of experiencing harmful respiratory effects (respiratory symptoms and breathing discomfort). This likelihood is primarily true for active children and adults and for people with respiratory diseases, such as asthma. The general population of Midlothian is not expected to experience harmful effects from ozone exposure except on rare occasions when ozone levels reach approximately 100 ppb or more. The highest frequency of ozone exposures of concern (to both sensitive persons and the general public) occurred in the 1997-2006 timeframe; however, from 2007-2012, the frequency of harmful exposures to sensitive person has dropped and there have been no harmful exposures to the general public during this same timeframe. ATSDR cannot determine if this trend will continue and the current science on what levels constitutes a harmful ozone exposure is evolving and scientists advising EPA have concluded that scientific evidence supports a standard within the range of 60-70 ppb (EPA, 2014). EPA revised the standard to 70 ppb in 2015. Therefore, although levels have been decreasing, they are still above levels of concern, especially for sensitive persons. Ellis County is included in TCEQ's State Implementation Plan which includes measures to reduce emissions that cause the formation of ozone.

Breathing air contaminated with $PM_{2.5}$ (particulate matter with aerodynamic diameter of 2.5 microns or less) in Midlothian for one year or more is not likely to have harmed people's health. Measured annual average $PM_{2.5}$ levels in the Midlothian area were not above EPA's past or current standard which was revised in 2012. However, infrequent short-term levels of $PM_{2.5}$ could harm the health of sensitive individuals who currently or previously resided in Midlothian. However, the Midlothian area has been in compliance with the current EPA short-term standard for $PM_{2.5}$. Moreover, ATSDR is uncertain about $PM_{2.5}$ exposures downwind of Holcim and for the residential neighborhoods in immediate proximity to the cement manufacturing facilities' limestone quarries because of a lack of data and information.

No harmful effects in Midlothian are expected from current or past exposures to the air pollutants carbon monoxide, nitrogen dioxide, and hydrogen sulfide. If these air pollutant concentrations remain at these levels, future exposures should not result in adverse effects.

6. **Strong smell in air. Smell of rotten eggs around sunset**

Response: Hydrogen sulfide and not SO_2 is usually associated with the smell of rotten eggs. Sulfur dioxide odors have been described as having a very pungent smell or similar to the smell when one lights a match. The nature and sources of these odors are uncertain. ATSDR is not aware of any documented major sources of H_2S in the vicinity of the residents; however, minor sources (e.g., decaying organic matter, sewer gas, etc.) may exist. ATSDR acknowledges that this issue may remain unresolved until further data becomes available that may explain the source of the emissions that caused the odor reported by the residents. ATSDR has developed a website that deals with many of the issues related to odors and it can be found at http://www.atsdr.cdc.gov/odors/.

7. **Transportation contribution to air quality problem**

Response: Throughout the country, air pollution is affected by many sources of emissions including large industrial facilities like the cement manufacturing operations and steel mills in Midlothian, smaller industrial and commercial operations typically found in populated areas (e.g., gasoline stations, dry cleaners, auto refinish shops), and mobile sources (e.g., automobiles, trucks, locomotives, and aircraft). Some emission sources are of natural origin, such as wildfires and wind-blown dust. All of these sources combined will affect air pollution levels at a given location. Midlothian is no exception in this regard.

Quantifying precisely the extent to which different sources affect air pollution levels can be difficult. However, some insights can be gleaned from EPA's National Emissions Inventory (NEI), which includes estimates of the relative magnitude of annual emissions from different types of manmade emission sources for every county across the nation. To comment on the contribution of "transportation sources" to local air quality, ATSDR compiled the 2008 NEI data for several different pollutants (EPA, 2012c). For inventory year 2008, this analysis showed that transportation sources accounted for an estimated: 72 % of the total carbon monoxide emissions in Ellis County; 39 % of the total nitrogen oxides emissions in Ellis County; and less than 5 % of the total emissions for sulfur dioxide and fine particulate matter.

Therefore, for certain pollutants (e.g., carbon monoxide, nitrogen oxides), transportation sources account for a considerable portion of the emissions in Ellis County; but for other pollutants (e.g., sulfur dioxide, particulate matter), transportation sources are less important. However, focusing strictly on Midlothian—and not all of Ellis County—the emissions from the four large industrial sources account for most emissions of most pollutants of interest in this Health Consultation.

8. Need to address cement kiln dust

Response: At cement manufacturing facilities, the high-temperature kilns are designed to manufacture clinker, which is used to make cement. During this process, the kilns also generate fine-grained particles that are carried in the cement kiln exhaust gas. These fine-grained particles are referred to as cement kiln dust (CKD). CKD is a highly alkaline material. The primary constituent is calcium oxide, which can account for almost half of CKD by weight; with lesser quantities of silicon dioxide, sulfur trioxide, aluminum oxide, and potassium oxide (EPA, 1993; KDOT, 2004).

Cement kiln dust may cause dry skin, discomfort, irritation, severe burns, and dermatitis. Exposure of sufficient duration to wet kiln dust, or dry kiln dust on moist areas of the body, can cause serious, potentially irreversible damage to the skin, eye, respiratory and digestive tracts because of chemical (caustic) burns, including third-degree burns. Kiln dust is also capable of causing dermatitis by irritation and allergy. Skin affected by dermatitis may include symptoms such as redness, itching, rash, scaling, and cracking. Breathing CKD may cause nose, throat, or lung irritation and choking, depending on the degree of exposure. Inhalation of high levels of dust can cause chemical burns to the nose, throat, and lungs (Lafarge, 2011; Ash Grove, ND).

Most of the CKD generated in cement kilns is captured in air pollution control devices (e.g., electrostatic precipitators, baghouses), but some is emitted to the air through the kiln stacks. CKD that is collected in air pollution controls can then be used for various purposes. For instance, this material is often recycled into the cement manufacturing process or collected and used for commercial purposes: CKD is used to stabilize soils in construction projects, for landfill cover, and as a filler for mine reclamation activities. However, some CKD generated is still disposed of in landfills and other disposal units. CKD can enter ambient air through the stacks and also as releases from handling captured CKD. Although facilities typically take measures to reduce the amount of CKD released to the air, some of the material inevitably escapes.

In this Health Consultation, the consideration is the extent to which CKD contributes to airborne particulate matter. CKD includes particles of many sizes, and the particle size distribution depends on the specific production processes and air pollution controls at a given cement manufacturing facility. Some CKD will have particles small enough that they can blow from open surfaces into the air and that they can also be respirable—meaning, they are small enough to be inhaled and enter the lungs. Specifically, EPA has reported that between 22 % and 95 % of CKD can be found in the respirable range (EPA, 1993). Therefore, any CKD that the Midlothian facilities release in the respirable size fraction should be reflected in the ambient air monitoring data collected from offsite locations.

ATSDR evaluated pictures and videos of emissions from TXI and Gerdau Ameristeel (we do not expect CKD emissions from Gerdau) which were provided by local citizens. These videos and pictures confirm that many fugitive dust emission events have occurred at these facilities. Some videos also show emission events where large plumes of dust appear to be originating from the ground level and not from the stacks. These events do not appear to be normal. ATSDR cannot determine from these videos and pictures whether any of the releases shown contain CKD or dust from other materials (for example, limestone).

In summary, airborne CKD needs to be evaluated from many perspectives. This Health Consultation considers the extent to which CKD contributes to particulate matter found in outdoor air. ATSDR has or will be issuing two other Health Consultations that will further evaluate CKD: one document will consider the specific chemicals in CKD and whether those pose a health hazard when inhaled and another document will consider the extent to which CKD has contaminated soils and waterways through atmospheric deposition.

9. Cars are dusty all the time – thick/white dust

Response: Baghouse ruptures or operational upsets at local facilities could have resulted in dust being deposited on area automobiles (either on the facilities or off). Moreover, releases of dust that could blanket automobiles is not inconsistent with the operations at the three cement plants operating in Midlothian, especially in relation to cement kiln dust (see answer to #8 above). At least one other community near a cement processing plant also has noted that their cars frequently have a coat of thick, white, dust covering their cars, which they believe is cement kiln dust (Boulder Weekly, n.d). A future ATSDR health consultation will more thoroughly evaluate the extent to which airborne particles have deposited to, and possibly contaminated, other media.

10. Concern for specific health effects, such as:

- **Respiratory diseases (e.g., respiratory infections, asthma that improves when out of area, etc.)**
- **Allergies**
- **Sinus problems**
- **Cancer**
- **Autoimmune diseases (e.g., Graves disease and sarcoidosis involving lungs and eye lids)**

Response: Certain respiratory illnesses, including sinus problems and allergies, are consistent with what might be expected from exposures to SO_2, ozone, or $PM_{2.5}$, but this statement does not suggest that any given incident of these health outcomes is caused solely by inhalation of ozone, $PM_{2.5}$, or sulfur dioxide in the Midlothian area. Rather, causality of any given disease is usually a result of multiple factors, such as smoking, lifestyles, eating habits, occupational exposures, etc. In addition, the air pollutants of concern are known to aggravate conditions such as asthma and these conditions could alleviate once individuals are outside the Midlothian area. Long-term particulate matter exposures have been associated with lung cancer. However, particulate matter is composed of many different combinations of chemicals, depending on the sources in any given area. Therefore, particulate matter itself might not be carcinogenic, but an individual constituent may be. Potential cancer effects of these constituents (e.g., metals) have been evaluated by ATSDR in a separate health consultation. No studies have been conducted to assess the relationship between air pollutants and the specific autoimmune diseases of concern to the public. Exposures to particulate matter air pollution is a concern for sensitive populations, which includes individuals with diabetes (type-1 diabetes is an autoimmune disease). However, no studies have associated particulate matter exposures with cause of diabetes. ATSDR has evaluate data for cancer, respiratory and cardiovascular disease, diabetes, and other diseases in the Midlothian area in a separate` health consultation.

7. Conclusions and Recommendations

Sulfur dioxide exposures : sensitive (e.g., individuals with asthma) and general populations

Conclusions

In the past (1997–late 2008), breathing air contaminated with sulfur dioxide (SO_2) for short periods (5 minutes) could have harmed the health of sensitive individuals (e.g., people with asthma), particularly when performing an activity (such as exercising or climbing steps) that raised their breathing rate. SO_2 levels that might have harmed sensitive individuals were infrequent and limited to areas primarily in Cement Valley and possibly areas east, south, and southeast of the TXI Operations, Inc (TXI) fence line. Moreover, the frequency of exposures above levels of concern was the highest between late 1997-early 2005, not all sensitive individuals exposed while exercising would have experienced a harmful effect, and ATSDR would categorize any effects from these exposures to be less serious. ***Breathing air contaminated with SO_2 in the past (during the period 1997 to late 2008) was not expected to harm the health of the general population.***

Past SO_2 exposures were not above the Environmental Protection Agency (EPA) standard in place at that time but were numerically above the current standard which ATSDR used as a health comparison value. When SO_2 concentrations exceed 400 ppb (parts per billion), sensitive individuals may experience symptoms such as coughing, wheezing, and chest tightness. Sensitive persons are unlikely to have experienced these health effects as the occurrence of levels above 400 ppb was extremely rare, the levels occurred late at night (around midnight), and, even if exposure occurred, ATSDR would not expect these effects in all sensitive persons (about 25-35% of exercising asthmatics show effects in clinical studies).

At lower SO_2 concentrations (200 ppb to 400 ppb), sensitive individuals functioning at elevated breathing rates may experience asymptomatic effects (e.g., mild constriction of bronchial passages). Moreover, in clinical studies of exercising asthmatics who were exposed to SO_2 in this range, about 5-30% showed the effects described. Adverse health effects from exposures to SO_2 concentrations less than 200 ppb are uncertain, but may occur in some people more sensitive or vulnerable than people participating in clinical studies because these studies were conducted on healthy volunteers (some with mild to moderate asthma) and the studies did not include children or people with severe asthma. Some people who live in Midlothian might be more sensitive to sulfur dioxide than were the volunteers who participated in these clinical studies. Moreover, ATSDR would consider any harmful effects of SO_2 exposures above 100 ppb (which is equal to the ATSDR Lowest-Observed-Adverse-Effect-Level) to 400 ppb to be less-serious in nature.

People with asthma, children, and older adults ($\geq$65 years) have been identified as groups susceptible to the health problems associated with breathing SO_2. Human scientific studies (clinical investigations and epidemiologic studies) have provided evidence of a causal relationship between SO_2 and respiratory disease (morbidity) in people with asthma and other more limited human studies (epidemiologic) have consistently reported that children and older adults may be at increased risk for SO_2-associated adverse respiratory effects. Groups potentially sensitive to air pollutants include the obese, people with preexisting cardiopulmonary disease, and people with a pro-inflammatory condition such as diabetes. However, there are no studies linking increased risk from SO_2 exposures to diabetes or obesity and studies linking SO_2 exposures to cardiopulmonary disease are limited.

Reductions in SO_2 levels in Cement Valley have occurred since late 2008 resulting in exposures to both sensitive individuals and the general public that are not expected to be harmful. These reductions are likely a primary result of actions taken at TXI to reduce emissions and, in part, by declining production levels at local industrial facilities. The potential for future harmful exposures in Cement Valley from TXI have been greatly reduced by the actions taken by TXI to reduce emissions.

ATSDR cannot determine if past SO_2 exposures downwind of Ash Grove may have resulted in harmful effects. Although computer modeling of SO_2 emissions from Ash Grove indicated that persons who resided or recreated near the Ash Grove facility were not exposed to harmful levels of SO_2, there is too much uncertainty to make a definitive conclusion. The primary uncertainty around the findings of ATSDR computer modeling relates to the available SO_2 emissions data from Ash Grove which had higher emissions as compared to Holcim. ATSDR attempted to obtain the needed emissions data to re-run the computer modeling but was unsuccessful.

For the computer modeling analysis using annual emissions data from Ash Grove and Holcim, the SO_2 predicted modeled values, for the years 2006-2010, indicated that levels approaching or exceeding the NAAQS standard may have occurred near the Ash Grove fence line or, in some cases, outside the fence line (although no residences, playgrounds or schools are located within this area based on an aerial evaluation of these off-site areas by ATSDR). However, computer modeling using annual emissions to predict shorter-term SO_2 levels is likely to result in large uncertainty. ATSDR attempted to obtain shorter-term emission data (i.e., 1-hour emissions data) in order to conduct the modeling to reduce this uncertainty. ATSDR was not able to obtain these data for Ash Grove (which is the primary emitter of SO_2 compared to Holcim for the years the modeling was performed). Therefore, ATSDR will not be able to make any firm health conclusions based on the SO_2 modeling results for past exposures to SO_2 emitted by Ash Grove and Holcim. ***Moreover, SO_2 emitted from Ash Grove should be substantially reduced as the Ash Grove facility has been upgraded with new kiln and emission control technology in 2014 which would reduce the likelihood of any off-site exposures of concern in the future—these SO_2 emission reductions need to be verified.***

TCEQ provided ATSDR with several potential limitations of using 5-minute data (TCEQ, 2012a) and clarifications of some of these limitations in a follow-up correspondence (Personal Communication, TCEQ e-mail from Tracie Phillips, 11/10/14). For various reasons (please see Appendix D, public comment B.3.32 and ATSDR's response), ATSDR believes that the 5-minute data are adequate for the purposes of this health consultation.

Recommendations

ATSDR recommends that TCEQ evaluate the 2015 annual emission report for Ash Grove to verify that substantial SO_2 emissions reductions have occurred after the installation of new kiln and emissions control technology in 2014.

Fine particulate matter ($PM_{2.5}$) exposures

Conclusions

Based on available data, breathing air contaminated with $PM_{2.5}$ (particulate matter with aerodynamic diameter of 2.5 microns or less) in Midlothian for one year or more is not likely to have harmed people's health. However, ATSDR is uncertain about $PM_{2.5}$ exposures downwind of Holcim because of a lack of data and information. Measured annual average $PM_{2.5}$ levels in the Midlothian area were not above EPA's past or current standard which was revised in 2012.

Short-term potentially harmful levels of $PM_{2.5}$ have been infrequent in Midlothian. These infrequent exposures could have resulted in harmful cardiopulmonary effects, especially in sensitive individuals, but not the general public. However, it is important to note that the Midlothian area has been in compliance with the current EPA short-term standard for $PM_{2.5}$. Infrequent, short-term $PM_{2.5}$ levels in Midlothian have been in the range considered by the EPA (based on the Air Quality Index or AQI) to be a concern for sensitive populations, but not the general public. However, as defined by EPA, short-term levels of $PM_{2.5}$ in the Midlothian area have not exceeded the current standard.

$PM_{2.5}$ is both a local and regional air quality concern. Short- and long-term $PM_{2.5}$ levels observed in the Midlothian area are not considerably different from levels measured in multiple locations throughout the Dallas— Fort Worth metropolitan area. These $PM_{2.5}$ levels are caused by emissions from mobile (e.g., cars and trucks) and industrial sources in the Midlothian area and beyond.

ATSDR noted several data gaps in relation to PM exposures. In general, monitoring stations in the Midlothian area have been placed near or at locations believed to have either high air-quality impacts from facility operations or a high potential for exposure. In addition, ambient air monitoring data are more limited for the residential neighborhoods in immediate proximity to the cement manufacturing facilities' limestone quarries. PM exposure is the primary concern for these localized residential areas. ***Although annual average $PM_{2.5}$ levels detected at the Holcim monitor indicate possible harmful levels, ATSDR is uncertain about what actual off-site exposures are occurring downwind of Holcim.*** Moreover, Holcim's recent request to amend their permit to reduce total hydrocarbons will likely increase their allowable $PM_{2.5}$ emissions by an estimated 103 tons per year.

Recommendations

Conduct appropriate ambient air monitoring to characterize exposures to persons located downwind of the Holcim facilities and take actions to reduce $PM_{2.5}$ emissions from these facilities if harmful exposures are indicated. In addition, particulate matter monitoring is needed in residential areas that are in immediate proximity to the facilities' limestone quarries.

Ozone Exposures

Conclusions

Several of the levels of ozone detected in Midlothian since monitoring began in 1997 indicate that sensitive individuals have an increased likelihood of experiencing harmful respiratory effects (respiratory symptoms and breathing discomfort). This likelihood is primarily true for active children and adults and for people with respiratory diseases, such as asthma. The

general population of Midlothian is not expected to experience harmful effects from ozone exposure except on rare occasions when ozone levels reach approximately 100 ppb or more. It is important to note that the highest frequency of ozone exposures of concern (to both sensitive persons and the general public) occurred in the 1997-2006 timeframe; however, from 2007-2012, the frequency of harmful exposures to sensitive person has dropped and there have been no harmful exposures to the general public during this same timeframe.

All of the above trends are based on the NAAQS standard in place during these time periods. However, current science on what levels constitutes a harmful ozone exposure is evolving and scientists advising EPA have concluded that scientific evidence supports a standard within the range of 60-70 ppb (EPA, 2014). EPA revised the standard to 70 ppb in 2015. Therefore, although levels have been decreasing, they are still above levels of concern, especially for sensitive persons.

Ellis County is one of 10 counties that make up the Dallas–Fort Worth ozone non-attainment area, which means that ozone levels in the metropolitan area occasionally exceed EPA's health-based standards. Ozone levels also have exceeded the World Health Organization (WHO) health guidelines. Emissions from industrial sources, mobile sources, and natural sources throughout the area contribute to this problem.

Scientific studies indicate that breathing air containing ozone at concentrations similar to those detected in Midlothian can reduce lung function and increase respiratory symptoms, thereby aggravating asthma or other respiratory conditions. Ozone exposure also has been associated with increased susceptibility to respiratory infections, medication use by persons with asthma, doctor's visits, and emergency department and hospital admissions for individuals with respiratory disease. Ozone exposure also might contribute to premature death, especially in people with heart and lung disease. School absenteeism and cardiac-related effects may occur, and persons with asthma might experience greater and more serious responses to ozone that last longer than responses among people without asthma.

Many of the 8-hour ozone levels reported in the Midlothian area since monitoring began in late 1997 indicate that sensitive individuals have an increased likelihood of respiratory symptoms and breathing discomfort. These reactions are primarily true for active children and adults and people with respiratory disease, such as asthma. On rare occasions during this period, levels reached 100 ppb or more, indicating that even non-sensitive individuals from the general population may have experienced harmful effects. For the period 2007-2012, the frequency of ozone 8-hour levels above levels of concern for sensitive persons has dropped from an average of about 18 events per year from 1997-2006 (range of 3-40 per year) to about 4 events per year (ranging from zero to 7 per year). Moreover, during the period 2007-2012, there have been no ozone exposures above levels of concern for the general public; whereas, there was an average of about 2 events per year from 1997-2006 (range of zero to 5 per year). All of the above trends are based on the 2008 NAAQS standard. However, current science on what levels constitutes a harmful exposure is evolving and scientists advising EPA have concluded that scientific evidence supports a standard within the range of 60-70 ppb (EPA, 2014); therefore, although levels have been decreasing, they are still above levels of concern, especially for sensitive persons.

Recommendations

ATSDR supports actions to reduce ozone levels in Midlothian area to below levels of concern—see Public Health Action Plan below.

Mixtures Exposure (including ozone)

Conclusion

ATSDR believes the severity of health effects from a mixture exposure is not likely to exceed those discussed for SO_2, $PM_{2.5}$, or ozone exposure alone. Moreover, ATSDR believes that sufficient information exists to warrant concern for multiple air pollutant exposures to sensitive individuals, especially in the past (during the period 1998 to 2002) when SO2 levels were higher and more frequent and when these persons were breathing at higher rates (e.g., while exercising). Data also suggest that the number of potential co-exposures of concern in the past were infrequent. Any mixtures exposures of concern would have likely occurred in the past for persons residing in Cement Valley because that is where the highest and most frequent sulfur dioxide exposures occurred.

Current science on what levels constitutes a harmful exposure to ozone is evolving and scientists advising EPA have concluded that scientific evidence supports a standard within the range of 60-70 ppb (EPA, 2014). Therefore, the number of possible co-exposures to SO_2 and ozone of concern in the past might have been higher given this new range of possible harmful ozone exposures.

For past SO_2 exposures, however, the number of sensitive individuals affected may have been greater because effects may have occurred at a lower SO_2 concentration when combined with exposure to ozone. Potential effects to a larger sensitive population, especially in the past, may be limited to the same locations but during the warmer months when ozone levels were usually the highest. In addition, potential effects to this larger sensitive population may also have resulted from multiple exposures that occurred during several consecutive days; however, the number of these potential occurrences was also infrequent.

Asthmatics are likely a sensitive population that when they are exposed to irritant gases (like ozone and sulfur dioxide) exacerbates their symptoms. The likely mechanism is that epithelial cells that line the airway passages in asthma (and other respiratory disorders) are damaged and these cells start shedding. The shedding of these cells exposures nerve endings allowing irritant gases access to free nerve endings, which in turn, aggravates asthma and allergy. A limited number of studies suggest that the evaluation of pulmonary changes to single pollutant exposure overlooks the interactive effect of common co-existing or sequentially occurring exposures to air pollutants. For example, sensitive persons first exposed to ozone and then to sulfur dioxide increased airway restriction such that the subjects responded to a concentration of sulfur dioxide that would not have produced an effect if exposed to sulfur dioxide alone.

Only 14 instances occurred when SO_2 and ozone levels occurred both in the same day and all of those occurred between 1998 and 2000. Moreover, these data indicate that there were only three days when $PM_{2.5}$ was above the NAAQS health comparison value and ozone was above 75 ppb, and all of these occurred in 2002. In addition, there were no observed days when a mixture, at levels of concern, occurred between SO_2 and $PM_{2.5}$ and, therefore, also for all three air pollutants. However, it is important to note that these types of mixture comparisons with $PM_{2.5}$ could not be made for the years when the frequency of elevated SO_2 and ozone levels were the greatest (1998-2000) because $PM_{2.5}$ data were not available. Finally, current science on what levels constitutes a harmful exposure to ozone is evolving and scientists advising EPA have concluded that scientific evidence supports a standard within the range of 60-70 ppb (EPA, 2014). Therefore, the number of possible co-exposures to SO_2 and ozone of concern in the past might been higher given this new range of possible harmful ozone exposures.

Recommendations

ATSDR supports actions that have or will be taken by TCEQ, TXI or Ash Grove, as applicable, to reduce SO_2 and ozone exposures (see Public Health Actions below) and, therefore, the potential for any harmful mixtures exposures in the future.

Lead Exposures

Conclusions

Past lead air exposures during the period 1993 to 1998, in a localized area just north of the Gerdau Ameristeel fence line, could have harmed the health of children who resided or frequently played in this area. The estimated neurological health effect of these exposures would have been a slight lowering of IQ (Intelligence quotient) levels (1-2 points) for some children living in the area. Since 1998, air lead levels in this area decreased sharply. Monitoring data do not indicate that lead levels in air have occurred above EPA's current standard (0.15 µg/m3) in other areas of Midlothian, either now or in the past.

Past lead air exposures were not above the EPA standard at that time but were above the current standard which ATSDR used as a health comparison value. EPA's 2008 standard for lead in air was developed to prevent a loss of 1-2 IQ points in young children.

Some uncertainty exists with these findings given that we do not know what the lead levels in air were downwind of the Gerdau monitor and we do not know if small children were exposed at all in this sparsely populated area of Cement Valley. However, we do know that the closest possible receptor was about 450-500 feet west of the Gerdau Monitor (which detected the elevated lead levels back in the 1990's).

Recommendations

Because there is no known safe blood lead level (BLL) for children, we emphasize the importance of environmental assessments to identify and mitigate lead hazards before children demonstrate BLLs above the reference value. Continue existing prevention strategies to reduce environmental exposures from lead in soil, dust, paint and water before children are exposed. Educate families, service providers, advocates, and public officials on primary prevention of lead exposure in homes and other child-occupied facilities, so that lead hazards are eliminated before children are exposed. Clinicians should monitor the health status of all children with a confirmed BLL ≥5 µg/dL for subsequent increase or decrease in BLL until all recommended environmental investigations and mitigation strategies are complete, and should notify the family of all affected children of BLL test results in a timely and appropriate manner.

Exposure to Other NAAQS Air Contaminants

Conclusion

ATSDR does not expect harmful effects in Midlothian from current or past exposures to the air pollutants carbon monoxide, nitrogen dioxide, and hydrogen sulfide. If these air pollutant concentrations remain at these levels, future exposures should not result in adverse effects.

Based on available monitoring data and other information (emission reports, knowledge of what might be emitted from cement or steel operations, and worst-case computer air modeling) the levels of carbon monoxide, nitrogen dioxide, hydrogen sulfide are below health-protective comparison values developed by the EPA, WHO, or ATSDR.

Recommendation

No recommendations at this time as measures are being taken by TCEQ to monitor carbon monoxide and nitrogen dioxide levels in the Midlothian area in order to maintain compliance with federal requirements—see Public Health Action Plan below.

8. Public Health Action Plan

This health consultation is one of the several evaluations being conducted by ATSDR under the overall Public Health Response Plan developed to address community concern evaluations. The Public Health Response Plan and ATSDR's other evaluations can be found at: http://www.atsdr.cdc.gov/sites/midlothian/index.html.

The following are public health actions taken, on-going or planned specifically related to the findings from this health consultation:

ATSDR has or will:
Issue two other Health Consultations that will further evaluate cement kiln dust (CKD): one document will consider the specific chemicals in CKD and whether they pose a health hazard when inhaled, and another document will consider the extent to which CKD has contaminated soils and waterways through atmospheric deposition.

TCEQ and Local Industry have or will take the following actions to reduce emissions in Midlothian:

Retirement of older cement kilns in Midlothian and the introduction of newer technology have resulted in lower emissions of SO_2 from TXI. Since 1999, the permitted SO_2 emission limits for TXI have been reduced by 90%. The retirement of two older kilns and the introduction of new kiln design and emission controls at Ash Grove should reduce SO_2 emission significantly; however, ATSDR recommends that TCEQ review the 2015 annual emissions from Ash Grove to verify these reductions.

The Midlothian area has been and currently is in compliance for all criteria pollutants except for ozone. Because Ellis County is included in the Dallas/Fort Worth non-attainment, it is also included in the ozone State Implementation Plan which includes measures for further reducing ozone. An attainment demonstration state implementation plan (SIP) revision will be developed for the DFW area to address the 2008 eight-hour ozone standard. The SIP revision will be developed with stakeholder input and will undergo separate notice and comment procedures. At that time, the TCEQ will develop rules and control measures as necessary to bring the area into attainment by the appropriate attainment deadline.

All areas of the state are currently in attainment of the carbon monoxide and nitrogen dioxide standards. TCEQ will continue to monitor these and other pollutants in order to maintain compliance with federal requirements.

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10. References

American Lung Association. 2001. Urban air pollution and health inequities: a workshop report. Environ Health Perspect 109(S3):357–73.

Ash Grove, ND. Ash Grove Cement Company—Midlothian, Texas Plant. Material Data Sheet for Ash Grove Durabase (Manufactured in Midlothian, Texas). Available at: http://ashgroveresources.com/PDFs/MSDS/Durabase_Midlothian_MSDS.pdf.

Ash Grove Cement. 2010. Annual tire derived fuel usage at Ash Grove Cement Company, Midlothian, Texas plant. E-mails from Michael Harrell, Ash Grove Cement dated June 28, 2010.

ATSDR, 1998. Agency for Toxic Substances and Disease Registry. Toxicological profile for sulfur dioxide. Atlanta, Georgia: US Department of Health and Human Services; December, 1998.

ATSDR, 1999. Agency for Toxic Substances and Disease Registry. Toxicological profile for lead (update). Atlanta, Georgia: US Department of Health and Human Services; July, 2007.

ATSDR, 2005. Agency for Toxic Substances and Disease Registry. Public Health Assessment Guidance Manual (Update). Atlanta, Georgia: US Department of Health and Human Services; January, 2005.

ATSDR, 2006. Toxicological Profile for Hydrogen Sulfide: Update. Agency for Toxic Substances and Disease Registry. September, 2006. Available at: http://www.atsdr.cdc.gov/ToxProfiles/tp114.pdf.

ATSDR, 2011a. Public Health Response Plan: Midlothian, Texas. Public Comment Release. Agency for Toxic Substances and Disease Registry. Atlanta, GA: US Department of Health and Human Services; January. Available from: http://www.atsdr.cdc.gov/sites/midlothian. Last accessed October 31, 2011.

ATSDR, 2011b. Health Consultation: Review of Ambient Air Monitoring Data, Mirant Potomac River Generating Station. Agency for Toxic Substances and Disease Registry. March 2, 2011. Available at: http://www.atsdr.cdc.gov/HAC/pha/MirantPotomacRiver/MirantPotomacRiverGSFinalHC03212011.pdf.

ATSDR, 2012. Toxicological Profile for Carbon Monoxide. Agency for Toxic Substances and Disease Registry. June, 2012. Available at: http://www.atsdr.cdc.gov/toxprofiles/tp201.pdf

ATSDR, 2015. Health Consultation: Midlothian Air Quality: Assessing the Adequacy of the Ambient Air Monitoring Database for Evaluating Community Health Concerns. Agency for Toxic Substances and Disease Registry. July 28, 2015. Available at: http://www.atsdr.cdc.gov/HAC/PHA/index.asp.

Bethel RA, Sheppard D, Epstein J, Tam E, Nadel JA, Boushey HA. 1984. Interaction of sulfur dioxide and dry cold air in causing bronchoconstriction in asthmatic subjects. J Appl Physiol, 57, 419-423.

Boulder Weekly, n,d. Concrete Evidence, Whistle-Blower gives Boulder Weekly an inside look at Conditions at Cemex. Editorial by Pamela White. Available at: http://www.oocities.org/watchdogs_99/dust_wind.html

CDC, 2005. Preventing Lead Poisoning In Young Children (5th Revisions). Centers for Disease Control and Prevention. Atlanta: U.S. Department of Health and Human Services. 2005

CDC, 2012a. Low Level Lead Exposure Harms Children: A Renewed Call for Primary Prevention. A Report of the Advisory Committee on Childhood Lead Poisoning Prevention. Centers for Disease Control and Prevention. Atlanta: Department of Health and Human Services. 2012.

CDC, 2012b. CDC Response to Advisory Committee on Childhood Lead Poisoning Prevention Recommendations in "*Low Level Lead Exposure Harms Children: A Renewed Call of Primary Prevention*". Centers for Disease Control and Prevention, June 7, 2012. Available at: http://www.cdc.gov/nceh/lead/ACCLPP/CDC_Response_Lead_Exposure_Recs.pdf

Devlin RB, et al., 2012. Controlled Exposure of Healthy Young Volunteers to Ozone Causes Cardiovascular Effects. Circulation (published on-line) June 25, 2012 at: http://circ.ahajournals.org/content/early/2012/05/18/CIRCULATIONAHA.112.094359.

Dockery DW, et al. 1993. An association between air pollution and mortality in six U.S. cities. N Engl J Med 329:1753–59.

EPA, 1993. US Environmental Protection Agency. 1993. Report to Congress on Cement Kiln Dust. EPA 530-R-94-001. December 1993. Available from: http://www.epa.gov/osw/nonhaz/industrial/special/ckd/cement2.htm. accessed October 31, 2011.

EPA, 1995. US Environmental Protection Agency—Region 10. Lead Gas Phaseout: Air Quality Fact Sheet. June 1995. Available from: http://yosemite.epa.gov/R10/airpage.nsf/webpage/Leaded+Gas+Phaseout

EPA, 1997. US Environmental Protection Agency. 1997. Exposure factors handbook. Washington, DC.

EPA, 1999. US EPA, Center for Environmental Research Information, Office of Research and Development. Compendium of Methods for the Determination of Inorganic Compounds in Ambient Air. Available at: http://www.epa.gov/ttnamti1/files/ambient/inorganic/mthd-2-1.pdf

EPA, 2000a. US Environmental Protection Agency. Economic Impact Analysis of Proposed Integrated Iron and Steel NESHAP. EPA-452/R-00-008. December 2000. Available from: http://www.epa.gov/ttn/ecas/regdata/EIAs/iands.pdf.

EPA. 2000b. Air quality criteria for carbon monoxide. Washington, DC: U.S. Environmental Protection Agency. EPA600P66001F. http://www.epa.gov/NCEA/pdfs/coaqcd.pdf.

EPA, 2002. US Environmental Protection Agency. User's Guide of the Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK). Windows Version—32 Bit Version. Office of Solid Waste and Emergency Response. OSWER Directive #92857-42. May 2002.

EPA, 2005. Guideline on Air Quality Models. Appendix W to Part 51 of Title 40 in the Code of Federal Regulations. U.S. Environmental Protection Agency. 2005.

EPA, 2006a. Air Quality Criteria for Lead: Volume I of II. U.S. Environmental Protection Agency. EPA/600/R-5/144aF. October, 2006. Available at: http://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=158823.

EPA, 2006b. Fact Sheet: Final Revisions to the National Ambient Air Quality Standards for Particulate Pollution (Particulate Matter). Available at: http://www.epa.gov/pm/pdfs/20060921_factsheet.pdf

EPA, 2008a. EPA's Report on the Environment. U.S. Environmental Protection Agency. EPA/600/R-07/045F. May, 2008. Available at: http://www.epa.gov/roe/.

EPA, 2008b. Lead NAAQS Review: Development of Pb-PM_{10} to Pb-TSP Scaling Factors. Memorandum from Mark Schmidt (EPA) and Kevin Cavender (EPA) to the Lead NAAQS Review Docket (EPA-HQ-OAR-2006-735). April 22, 2008. Available at: http://epa.gov/ttn/naaqs/standards/pb/data/20080428_scalingfactors.pdf.

EPA, 2008c. Integrated Science Assessment for Sulfur Oxides—Health Criteria. U.S. Environmental Protection Agency. EPA/600/R-08/047F. September, 2008. Available at: http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=198843.

EPA, 2008d. Fact Sheet: Final Revisions to the National Ambient Air Quality Standards for Ozone. Available at: http://www.epa.gov/airquality/ozonepollution/pdfs/2008_03_factsheet.pdf

EPA, 2008e. National Ambient Air Quality Standards for Lead; Final Rule. Environmental Protection Agency. Federal Register, 40 CFR Parts 50, 51, 53, and 58: Volume 73, No. 219. November 12, 2008.

EPA, 2009a. Integrated Science Assessment for Particulate Matter. U.S. Environmental Protection Agency. EPA/ 600/R-08/139F. December, 2009. Available at: http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=216546.

EPA, 2009b. EPA Risk and Exposure Assessment to Support the Review of the SO2 Primary National Ambient Air Quality Standard Final Report. U.S. Environmental Protection Agency. July, 2009. Available at: http://www.epa.gov/ttn/naaqs/standards/so2/data/200908SO2REAFinalReport.pdf

EPA, 2010a. US Environmental Protection Agency. Waste management data downloaded from the Biennial Reporting System (BRS). Available from: http://www.epa.gov/enviro/html/brs. Last accessed March 1, 2010.

EPA, 2010b. US Environmental Protection Agency. Emission data from the 2005 National Emissions Inventory. Available from: http://www.epa.gov/ttn/chief/net/2005inventory.html.

EPA, 2010c. US Environmental Protection Agency. Counties with Monitors Currently Violating the Revised Primary 1-Hour Sulfur Dioxide Standard of 75 ppb. Available from: http://www.epa.gov/oar/oaqps/sulfurdioxide/pdfs/20100602map0709.pdf.

EPA, 2010d. Our Nation's Air: Status and Trends through 2008. U.S. Environmental Protection Agency. EPA-454/R-09-002. February, 2010. Available at: http://www.epa.gov/airtrends/2010/.

EPA, 2010e. US Environmental Protection Agency. Final Rule. Primary NAAQS for sulfur Dioxide. 40 CFR Parts 50, 53,and 58. EPA-HQ-OAR-2007-0352; RIN 2060-A048. Last accessed 6/08/2010. Available at: http://www.epa.gov/air/sulfurdioxide/actions.html

EPA, 2010f. Promoting Good Prenatal Health: Air Pollution and Pregnancy. U.S. Environmental Protection Agency. Office of Children's Health Protection and Environmental Education, Child and Aging Health Protection Division. EPA-1F-09-020, January 2010.

EPA, 2011a. Policy Assessment for the Review of the Particulate Matter National Ambient Air Quality Standards. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Health and Environmental Impacts Division, RTP, NC. EPA 452/R-11-003, April 2011.

EPA, 2011b. Data downloaded from EPA's Toxics Release Inventory website. U.S. Environmental Protection Agency. Site last accessed in 2011. Available at: http://www.epa.gov/tri.

EPA, 2012a. Data downloaded from EPA's "AirData" Web site. U.S. Environmental Protection Agency. Site last accessed January 23, 2012. Available at: http://www.epa.gov/airdata.

EPA, 2012b. AirNow AQI Calculator. Retrieved on March 29, 2012 from: http://www.airnow.gov/index.cfm?action=resources.conc_aqi_calc

EPA, 2012c. US Environmental Protection Agency. Emissions data downloaded from the 2008 National Emissions Inventory. Data accessed using EPA's online geographic search tool at: http://neibrowser.epa.gov/eis-public-web/geo/search.html. Site last accessed April 1, 2012.

EPA, 2012d. US Environmental Protection Agency. Proposed Rule. National Ambient Air Quality Standard for Particulate Matter. 40 CFR Parts 50, 51, 52, et al. Federal Register, Vol. 77, No. 126, 6/29/12.

EPA, 2013a. US Environmental Protection Agency. Final Rule. National Ambient Air Quality Standard for Particulate Matter. 40 CFR Parts 50, 51, 52, and 58. EPA-HQ-OAR-2007-0492; FRL-9761-8. Last accessed 8/18/2014. Available at: http://www.gpo.gov/fdsys/pkg/FR-2013-01-15/pdf/2012-30946.pdf.

EPA, 2013b. US Environmental Protection Agency. Integrated Science Assessment for Ozone and Related Photochemical Oxidants. EPA 600/R-10/076F. February 2013. Available at: http://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=247492

EPA, 2014. US Environmental Protection Agency. Overview of EPA's Proposal to Update the Air Quality Standards for Ground-Level Ozone. Available at: http://www.epa.gov/ozonepollution/pdfs/20141125fs-overview.pdf

EPA, 2015a. EPA Carbon Monoxide Air Trends. Available at: http://www.epa.gov/airtrends/carbon.html.

EPA, 2015b. Data downloaded from EPA's "AirData" Web site. U.S. Environmental Protection Agency. Site last accessed January 23, 2012. Available at: http://www.epa.gov/airdata.

Gauderman WJ, Avol E, Gilliland F, Vora H, Tomas D, et al. 2004. The effect of air pollution on lung development from 10 to 18 years of age. N Engl J Med. 351(11):1057–67.

Gauderman WJ, Vora H, McConnell R, Berhane K, Gilliland F, Thomas D, Lurmann F, Avol E, Kunzli N, Jerrett M, Peters J. 2007. Effect of exposure to traffic on lung development from 10 to 18 years of age: a cohort study. Lancet 369(9561):571–7.

Ginsberg GL, Foos BP, and Firestone MP. 2005. Review and analysis of inhalation dosimetry methods for application to children's risk assessment. J Toxicol Environ Health A. 68(8):573–615.

HEI, 2000. Health Effects Institute. A reanalysis of the Harvard six-cities study and the American Cancer Society study of particulate air pollution and mortality. Cambridge, MA: A Special Report of the Institute's Particle Epidemiology Reanalysis Project.

Jerrett M. 2005. Spatial analysis of air pollution and mortality in Los Angeles. Epidemiol 16:727–36.

KDOT, 2004. Kansas Department of Transportation. Use of Cement Kiln Dust for Subgrade Stabilization. Report No. KS-04-3. October, 2004.

Koenig JQ; Covert DS; Hanley QS; van Belle G; Pierson WE. (1990). Prior exposure to ozone potentiates subsequent response to sulfur dioxide in adolescent asthmatic subjects. Am Rev Respir Dis, 141, 377-380.

Koenig JQ and Mar TF. 2000. Sulfur dioxide: evaluation of current California air quality standards with respect to protection of children. Prepared for the California Air Resource Board, California Office of Environmental Health Hazard Assessment; September 1.

Lafarge, 2011. Lafarge North America, Inc. Material Data Sheet: Cement Kiln Dust, revised 03/01/11. Available at: http://www.lafargenorthamerica.com/MSDS_North_America_English-Cement_Kiln_Dust.pdf.

Linn WS, Shamoo DA, Anderson KR, Whynot JD, Avol EL, Hackney JD. 1985. Effects of heat and humidity on the responses of exercising asthmatics to sulfur dioxide exposure. Am Rev Respir Dis, 131, 221-225.

Mannino DM, Homa DM, Akinbami LJ, Moorman JE, Gwynn C, Redd SC. 2002. Surveillance for asthma, United States, 1980–1999. MMWR 51(SS-1):1–13.

Mauderly, J.L., Burnett, R.T., Castillejos, M., Ozkaynak, H., Samat, J.M., Stieb, D.M., Vedal, S., and Wyzga, R.E. 2010. Commentary: Is the air pollution health research community prepared to support a multipollutant air quality management framework? Inhal Toxicol 22(S1): 1-19.

McConnell R, Berhane K, Yao L, Jerrett M, Lurmann F, Gilliland F, Künzli N, Gauderman J, Avol E, Thomas D, Peters J. 2006. Traffic, susceptibility, and childhood asthma. Environ Health Perspect 114(5):766–72.

NCDC, 2004. National Climatic Data Center. Climatography of the United States No. 20: 1971-2000; Texas. Available from: http://cdo.ncdc.noaa.gov/climatenormals/clim20/state-pdf/tx.pdf. February, 2004.

Pope CA III, Thun MJ, Namboodiri MM, et al. 1995. Particulate air pollution as a predictor of mortality in a prospective study of U.S. adults. Am J Respir Crit Care Med 151:669–74.

Pope CA III, Burnett RT, Goldberg MS, et al. 2002. Lung cancer, cardiopulmonary mortality, and long-term exposure to fine particulate air pollution. JAMA 287:1132–41.

Schiffman SS, Walker JM, Dalton P, Lorig TS, Raymer JH, et al. 2000. Potential health effects of odor from animal operations, wastewater treatment, and recycling of byproducts. J of Agromedicine, 7(1): 7-81.

TACB, 1991. Texas Air Quality Control Board (May 1991). Sampling and Analysis of Soil in the Vicinity of the North Texas, Texas Industries, Inc, and Box Crow Cement Plants Midlothian, Texas, Final Report.

TACB, 1993. Texas Air Quality Control Board (June 1993). Sampling and Analysis of Soil in the Vicinity of the North Texas, Texas Industries, Inc, and Box Crow Cement Plants Midlothian, Texas, Final Report.

TACB, 1994. Texas Air Quality Control Board (January 1994). Sampling and Analysis of Soil in the Vicinity of the North Texas, Texas Industries, Incorporated, and Holcim Cement Plants Midlothian, Texas, Final Report.

TACB, 1995. Texas Air Quality Control Board (October 1995). Sampling and Analysis of Soil in the Vicinity of the North Texas, Texas Industries, Incorporated, and Holcim Cement Plants Midlothian, Texas, Final Report.

TCEQ, 2009a. Texas Commission on Environmental Quality. Open records review of TCEQ files for the Midlothian facilities. October 21-23, 2009.

TCEQ, 2010a. Texas Commission on Environmental Quality. Query of TCEQ's Air Emission Event Report Database. Available from: http://www11.tceq.state.tx.us/oce/eer/. Last accessed March 1, 2010.

TCEQ, 2010b. Texas Commission on Environmental Quality. Query of facility-specific complaint data. Available from: http://www.tceq.state.tx.us/compliance/complaints/waci.html. Last accessed March 1, 2010.

TCEQ, 2010c. Texas Commission on Environmental Quality. Information on scrap tire usage. E-mail correspondence between Brooke Johnson (TCEQ) and John Wilhelmi (Eastern Research Group, Inc.). July 2, 2010.

TCEQ, 2010d. Evaluation of the Midlothian, Texas, Ambient Air Collection and Analytical Chemical Analysis Data. Texas Commission on Environmental Quality. July 23, 2010. Available at: http://www.tceq.state.tx.us/assets/public/implementation/tox/midlothian/finaleval.pdf.

TCEQ, 2011a. Point Source Emission Inventory Data. Spreadsheets sent by Adam Bullock (TCEQ) via email to Jennifer Lyke (ATSDR). December 15, 2011.

TCEQ, 2011b. Revisions to the State of Texas Air Quality Implementation Plan for the Control of Ozone Air Pollution: Dallas-Fort Worth Eight-Hour Ozone Nonattainment Area. Texas Commission on Environmental Quality. Project Number 2010-022-SIP-NR. December 7, 2011. Available at: http://www.tceq.texas.gov/assets/public/implementation/air/sip/dfw/ad_2011/10022SIP_ado_111811.pdf

TCEQ, 2012a. Ambient air monitoring data downloaded from the "Texas Air Monitoring Information System." Texas Commission on Environmental Quality. Site last accessed January 23, 2012. Available at: http://www5.tceq.state.tx.us/tamis.

TCEQ, 2012b. Current and Historical Ellis County 5-Minute Sulfur Dioxide Data—ATSDR Transmittal Memo from the Data Management Team of the Field Operations Support Division, Texas Commission on Environmental Quality via Tracie Phillips, March 6, 2012.

TCEQ, 2013. Texas Air Reporting System. Point Source Emission Inventory Data. Accessed on May 9, 2013.

TCEQ, 2014a. Texas Commission on Environmental Quality Preliminary Determination Summary, Holcim (Texas) Limited Partnership, Permit Numbers 8996 and PSDTX454M4. October 17, 2014.

TCEQ, 2014b. Texas Commission on Environmental Quality Web Site. Eight-Hour Ozone High Value Days. Accessed in April 2014 at: http://www.tceq.texas.gov/cgi-in/compliance/monops/8hr_exceed.pl.

TCEQ, 2015. Texas Air Reporting System. Point Source Emission Inventory Data. Accessed on April 12, 2015.

TNRCC, 1994. Texas Natural Resource Conservation Commission. Panoramic Gerdau Monitor Photos, October 1994.

TNRCC, 1995a. Critical Evaluation of the Potential Impact of Emissions from Midlothian Industries: A Summary Report. Texas Natural Resource Conservation Commission. October 25, 1995. Available at: http://www.dnr.mo.gov/env/hwp/hprofile/docs/tnrcctxsummary.pdf.

TNRCC 1995b. Texas Natural Resource Conservation Commission. Site Classification Worksheet (8/7/95) prepared by Timmy Burris.

TNRCC 1995c. Texas Natural Resource Conservation Commission. Panoramic Gerdau Monitor Photos, March 11, 1995.

Trenga CA; Koenig JQ; Williams PV. (2001). Dietary antioxidants and ozone-induced bronchial hyperresponsiveness in adults with asthma. Arch Environ Health, 56, 242-249.

Sheppard D, Saisho A, Nadel JA. 1981. Exercise increases sulfur dioxide-induced bronchoconstriction in asthmatic subjects. Am Rev Respir Dis 123:486–91

USGS, 2011. Minerals Commodity Summaries: 2011. United States Geological Survey. January, 2011. Available at: http://minerals.usgs.gov/minerals/pubs/mcs/2011/mcs2011.pdf.

UT-Arlington. 2008-2010. Technical memoranda prepared by Dr. Melanie Sattler and Dr. Yvette Weatherton and submitted to Downwinders at Risk and Blue Skies Alliance. June 12, 2008; February 26, 2009; and March 9, 2010.

WHO (World Health Organization). 1999. Carbon Monoxide, 2nd Ed. Environmental Health Criteria 213. Geneva: World Health Organization [online]. Available: http:/www.inchem.org/documents/ehc/ehc/ehc213.htm.

WHO, 2000. Air Quality Guidelines for Europe. Second Edition. World Health Organization. 2000. Available at: http://www.euro.who.int/__data/assets/pdf_file/0005/74732/E71922.pdf.

WHO, 2003. Concise International Chemical Assessment Document 53. Hydrogen Sulfide: Human Health Aspects. World Health Organization. 2003. Available at: http://www.who.int/ipcs/publications/cicad/en/cicad53.pdf.

WHO, 2006. WHO Air Quality Guidelines for Particulate Matter, Ozone, Nitrogen Dioxide, and Sulfur Dioxide. Global Update: 2005. World Health Organization. 2006. Available at: http://whqlibdoc.who.int/hq/2006/WHO_SDE_PHE_OEH_06.02_eng.pdf.
Ash Grove Cement. 2010. Annual tire derived fuel usage at Ash Grove Cement Company Midlothian, TX plant. E-mails from Michael Harrell, Ash Grove Cement dated June 28, 2010.

11. Tables

Table 1. Estimated Annual Carbon Monoxide Emissions from Midlothian Facilities[a,b]

Year	Ash Grove Cement (tons per year)	Gerdau Ameristeel (tons per year)	Holcim (tons per year)	TXI Operations (tons per year)
1990	627	1,835	__d	1,052
1991	__c	__c	__c	__c
1992	181	2,063	__d	89
1993	506	2,046	__d	1,046
1994	281	2,139	433	747
1995	364	2,136	1,502	741
1996	327	1,736	3,091	844
1997	506	1,873	2,798	1,032
1998	425	1,781	3,399	966
1999	466	1,602	2,332	982
2000	530	1,719	4,383	818
2001	587	1,582	5,375	716
2002	418	1,608	5,052	763
2003	382	1,578	5,100	692
2004	362	1,642	6,088	613
2005	505	1,590	3,536	779
2006	477	1,736	4,173	1,017
2007	497	1,700	3,354	774
2008	413	1,503	5,365	653
2009	175	906	2,520	294
2010	275	1,315	1,776	306
2011	414	1,344	2,028	324
2012	482	1,360	2,517	468
2013	357	1,246	2,861	674

Notes: [a] All data are shown in units of tons per year (tpy).

[b] Emissions data are taken from TCEQ's Point Source Emissions Inventory (TCEQ, 2011a and 2015), with all data points rounded to the nearest ton.

[c] No Point Source Emissions Inventory were available for calendar year 1991.

[d] In the earliest years of the Point Source Emissions Inventory, Holcim reported data for numerous pollutants, but has entries of zero emissions for carbon monoxide.

Table 2. Estimated Annual Lead Emissions from Midlothian Facilities[a,b]

Year	Ash Grove (tons per year)	Gerdau Ameristeel (tons per year)	Holcim (tons per year)	TXI Operations (tons per year)
1987	__[c]	***17.55***	__[c]	__[c]
1988	__[c]	***11.21***	__[c]	__[c]
1989	__[c]	***9.42***	__[c]	__[c]
1990	0.06	0.68	__[d]	__[d]
1991	__[c]	***1.45***	__[c]	__[c]
1992	0.10	***1.60***	__[d]	0.12
1993	0.02	2.45	__[d]	0.02
1994	0.02	3.00	__[d]	0.01
1995	0.02	3.00	__[d]	0.01
1996	0.02	0.99	__[d]	< 0.01
1997	0.02	***2.16***	__[d]	0.02
1998	0.02	***1.93***	__[d]	0.01
1999	0.02	1.95	__[d]	***0.13***
2000	0.02	2.11	0.07	***0.13***
2001	*0.02*	1.93	0.09	***0.01***
2002	*0.02*	1.97	***0.03***	***0.01***
2003	*0.02*	1.28	0.13	***0.01***
2004	***0.02***	0.52	0.08	***< 0.01***
2005	***0.02***	0.50	0.08	0.02
2006	***0.01***	0.55	0.08	0.02
2007	***0.01***	0.54	0.08	0.03
2008	***0.01***	0.47	0.08	0.03
2009	***0.01***	***0.28***	0.04	0.02
2010	***0.01***	***0.41***	***0.01***	***0.01***
2011	***0.01***	0.49	***0.01***	0.02
2012	***0.01***	0.42	***0.01***	0.03
2013	***0.01***	0.40	***0.01***	0.04

Notes: [a] All data are shown in units of tons per year (tpy).

[b] Emissions data were accessed from both TCEQ's Point Source Emissions Inventory (TCEQ, 2011a and 2015) and EPA's Toxics Release Inventory (EPA, 2011). The table displays the higher annual emissions number from these inventories. Numbers displayed in plain font are from the Point Source Emissions Inventory, and numbers shown in bold italic font are from the Toxics Release Inventory. All data are rounded to the second decimal place. When summarizing TRI data, emissions for both "lead" and "lead compounds" were considered in the tallies.

[c] No Point Source Emissions Inventory were available for calendar years 1987, 1988, 1989, and 1991. TRI emissions data are shown for these calendar years.

[d] In the earliest years of the Point Source Emissions Inventory, Holcim reported data for numerous pollutants, but has entries of zero emissions for lead for several years; and TXI has an entry of zero emissions for lead for inventory year 1990.

Table 3. Summary of Ambient Air Monitoring Data for Lead, 1981-2015[a]

Name of Monitoring Station	Time Frame	Number of Samples	Particle Size	Highest 24- Hour Average Concentration (µg/m^3)	Highest Quarterly Average Concentration (µg/m^3
Monitors operating in the 1980s					
City Hall Roof	5/1981-12/1981, 1/1983-12/1983	94	TSP	0.46	0.233
Monitors operating in the 1990s					
Auger Road	1/1991-10/1992	68	PM_{10}	0.034	0.006
Auger Road Water Treatment Plant	1/1991-12/1991, 2/1993-6/1993	56	PM_{10}	0.034	0.009
Cedar Drive	1/1992-6/1993	14	PM_{10}	0.009	0.004
Cement Valley Road	1/1992-5/1992	13	PM_{10}	0.068	0.035
Gerdau Ameristeel	**1/1993-8/1998**	**319**	**TSP**	**1.51**	**0.443** [c]
Monitors operating in the 2000s					
CAMS 302 – Wyatt Road	1/2001-6/2004	196	PM_{10}	0.125	0.026
J.A. Vitovsky Elementary School	5/5/2009-5/9/2009	5	PM_{10}	0.0023	__b
Jaycee Park	12/2008-7/2009	20	PM_{10}	0.0077	0.001
Midlothian High School	7/3/2009-7/7/2009	5	PM_{10}	0.0027	__b
Midlothian Tower	5/2002-8/2005	197	$PM_{2.5}$	0.0294	0.007
Mountain Peak Elementary School	2/26/2009-3/2/2009	5	PM_{10}	0.0025	__b
Old Fort Worth Road	12/2008-7/2009	20	PM_{10}	0.0117	0.002
	9/2005-9/2011	366	$PM_{2.5}$	0.0331	0.006
	10/2011-1/2015[d]	173	$PM_{2.5}$	0.0244	0.006
Tayman Drive Water Treatment Plant	12/2008-7/2009	20	PM_{10}	0.0138	0.004
Triangle Park	12/6/2008-12/10/2008	5	PM_{10}	0.0060	__b
Wyatt Road	12/2008-7/2009	29	PM_{10}	0.0741	0.015

Notes: [a] Lead monitoring data were either downloaded from TCEQ's Texas Air Monitoring Information System (TCEQ, 2012a) or taken from TCEQ's recent air quality study in Midlothian (TCEQ, 2010d).
[b] Quarterly average concentrations were not calculated for sites that collected 24-hour average lead samples on five consecutive days.

[c] Two health-based screening values were used to evaluate these data. EPA's current NAAQS is a 3-month rolling average concentration of 0.15 µg/m^3, and WHO's health guideline is an annual average concentration of 0.5 µg/m^3. The row shown in bold font had quarterly average lead concentrations above EPA's current NAAQS, though these values met EPA's NAAQS that were in effect at the time the measurements were collected.
[d] Measurements were not recorded April and May 2014.
Source: only monitoring station still operating. No more PM10 information out there. Information in the table was updted.
(http://www17.tceq.texas.gov/tamis/index.cfm?fuseaction=report.view_site&siteID=174&siteOrderBy=name&showActiveOnly=0&showActMonOnly=0&formSub=1&tab=info)

Table 4. Estimated Annual Nitrogen Oxides Emissions from Midlothian Facilities[a,b]

Year	Ash Grove Cement (tons per year)	Gerdau Ameristeel (tons per year)	Holcim (tons per year)	TXI Operations (tons per year)
1990	2,999	388	731	3,022
1991	__[c]	__[c]	__[c]	__[c]
1992	3,359	310	1,341	3,321
1993	3,668	299	1,353	2,268
1994	4,027	346	1,680	5,430
1995	3,771	307	750	5,910
1996	3,908	601	1,975	5,506
1997	3,164	924	2,134	5,819
1998	2,724	653	1,893	6,226
1999	3,005	515	1,222	5,267
2000	2,905	510	3,475	4,515
2001	2,923	479	3,078	4,444
2002	2,572	490	4,204	4,221
2003	2,625	456	3,728	3,472
2004	2,350	471	4,228	4,347
2005	2,250	461	4,867	4,323
2006	2,220	498	3,055	3,446
2007	1,757	481	2,862	2,916
2008	1,385	438	3,184	2,877
2009	1,266	209	951	1,022
2010	1,291	297	694	1,154
2011	1,343	298	646	1,087
2012	1,397	296	756	1,098
2013	1,045	264	687	1,605

Notes: [a] All data are shown in units of tons per year (tpy).
[b] Emissions data are taken from TCEQ's Point Source Emissions Inventory (TCEQ, 2011a and 2015), with all data points rounded to the nearest ton.
[c] No Point Source Emissions Inventory were available for calendar year 1991.

Table 5. Summary of Ambient Air Monitoring Data for Nitrogen Dioxide, 2000–2014[a]

Year	Nitrogen Dioxide Concentrations (ppb)		
	Upwind Stations	Downwind Stations	
	Midlothian Tower	Old Fort Worth Road	Wyatt Road
Annual average concentrations, by year			
EPA NAAQS = 53 ppb; WHO health guideline = 21 ppb			
2000	9.47[b]	__c	__c
2001	4.50	__c	__c
2002	4.52	__c	__c
2003	6.92	10.37[b]	__c
2004	7.55	10.75	9.23[b]
2005	6.85	10.87	8.78
2006	5.56	9.99	9.31[b]
2007	4.75[b]	9.34	__c
2008	__c	10.02	__c
2009	__c	7.24	__c
2010	__c	7.24	__c
2011	__c	6.72[b]	__c
2012	__c	5.5	__c
2013	__c	5.0	__c
2014	__c	4.0	__c
Highest 1-hour average concentrations, by year			
EPA NAAQS = 100 ppb; WHO health guideline = 105 ppb			
2000	40.49[b]	__c	__c
2001	46.53	__c	__c
2002	45.94	__c	__c
2003	51.17	52.41[b]	__c
2004	56.23	66.93	41.79[b]
2005	78.61	49.93	49.83
2006	59.35	58.62	47.83[b]
2007	56.19[b]	49.78	__c
2008	__c	72.79	__c
2009	__c	54.96	__c
2010	__c	52.59	__c
2011	__c	50.29[b]	__c
2012	__c	48.8	__c
2013	__c	42.6	__c
2014	__c	39.9	__c

Notes: [a] Data were downloaded from TCEQ's Texas Air Monitoring Information System (TCEQ, 2012a and 2015).
[b] Monitoring site did not operate during the entire calendar year; data are based on all valid measurements from the calendar year.
[c] Monitoring data were not collected at these sites during these years.
Source: (http://www.tceq.texas.gov/cgi-bin/compliance/monops/yearly_summary.pl)

Table 6. Estimated Annual PM10 Emissions from Midlothian Facilities[a,b]

Year	Ash Grove (tons per year)	Gerdau Ameristeel (tons per year)	Holcim (tons per year)	TXI Operations (tons per year)
1990	235	129	119	26
1991	__c	__c	__c	__c
1992	210	135	90	371
1993	228	137	78	331
1994	259	123	53	332
1995	282	140	47	295
1996	830	114	306	270
1997	541	134	305	291
1998	565	119	361	296
1999	549	151	361	305
2000	505	166	393	310
2001	445	155	356	366
2002	451	157	379	301
2003	271	150	342	300
2004	274	155	341	309
2005	276	156	328	327
2006	290	167	502	273
2007	277	163	399	301
2008	274	148	338	291
2009	169	109	198	163
2010	217	129	130	141
2011	262	134	119	187
2012	300	144	143	249
2013	227	143	132	290

Notes: [a] All data are shown in units of tons per year (tpy).
[b] Emissions data are taken from TCEQ's Point Source Emissions Inventory (TCEQ, 2011a and 2015), with all data points rounded to the nearest ton.
[c] No Point Source Emissions Inventory were available for calendar year 1991.

Table 7. Summary of Ambient Air Monitoring Data for PM_{10}, 1991-2004[a]

Name of Monitoring Station	Time Frame	Number of Samples	Highest 24-Hour Average Concentration (µg/m^3)	Highest Annual Average Concentration (µg/m^3)
Auger Road	1/1991-1/1993	118	84	21.0
Auger Road Water Treatment	1/1991-1/1992, 1/1993-11/1994	148	70	23.2
Box Crow	11/1993-1/1995	66	79	23.5
CAMS 302 – Wyatt	1/2000-6/2004	256	73	27.4
Cedar Drive	1/1992-10/1994	168	79	21.0
Cement Valley Road	1/1992-6/1992	24	30	__[b]
Gerdau Ameristeel	**1/1996-12/1998**	**181**	127	**50.8**[d]
Gorman Road	3/1992-4/1993	66	99	31.0
Hidden Valley	9/1992-10/1993	68	72	22.0
Midlothian Tower	11/1994-6/2004	569	94	26.0
Mountain Creek	3/1992-4/1993	62	52	19.0
Old Fort Worth Road	11/1994-6/2004	566	126	29.5
Tayman Drive Water Treatment Plant	1/1993-12/1996	279	83	23.6

Notes: [a] PM_{10} monitoring data were downloaded from TCEQ's Texas Air Monitoring Information System (TCEQ, 2012a) and obtained from an air quality study published in 1995 by the Texas Natural Resource Conservation Commission (TNRCC, 1995).

[b] Annual average concentrations were only calculated for sites that recorded at least 30 valid 24-hour average PM_{10} measurements in a calendar year.

[c] The following health-based screening values were used to evaluate these data:

For *24-hour average concentrations*, EPA's health-based NAAQS is 150 µg/m^3, not to be exceeded more than once per year on average over 3 years; and WHO's health guideline is 50 µg/m^3.

For *annual average concentrations*, EPA's former health-based NAAQS is 50 µg/m^3; and WHO's current health guideline is 20 µg/m^3.

[d] Bold font is used to indicate measured concentrations above the level of EPA's current or former NAAQS for PM_{10}.

Table 8. Annual Average PM_{10} Concentrations at Selected Monitoring Stations[a,b]

Year	Annual Average PM_{10} Concentrations ($\mu g/m^3$)			
	Upwind Stations	Downwind Stations		
	Midlothian Tower	Old Fort Worth Road	Wyatt Road	Gerdau Ameristeel
1995	22.5	22.7	__c	__c
1996	22.0	20.9	__c	50.8
1997	21.4	19.9	__c	48.1
1998	26.0	24.9	__c	50.2
1999	22.7	24.6	__c	__c
2000	24.8	26.9	27.4	__c
2001	21.7	24.7	25.1	__c
2002	23.2	23.7	23.6	__c
2003	24.7	29.5	27.1	__c
2004	19.6[b]	20.5[b]	26.1[b]	__c

Notes: [a] Data were downloaded from TCEQ's Texas Air Monitoring Information System (TCEQ, 2012a).
[b] Monitoring site did not operate during the entire calendar year; data are based on all valid measurements from the calendar year.
[c] Monitoring data were not collected at these sites during these years.

Table 9. Estimated Annual $PM_{2.5}$ Emissions from Midlothian Facilities[a,b]

Year	Ash Grove (tons per year)	Gerdau Ameristeel (tons per year)	Holcim (tons per year)	TXI Operations (tons per year)
2000	258	136	393	101
2001	96	128	355	143
2002	348	130	378	115
2003	234	125	300	114
2004	239	135	323	127
2005	241	136	309	131
2006	247	145	465	141
2007	235	140	356	155
2008	234	128	292	151
2009	145	97	167	76
2010	183	119	106	70
2011	221	124	96	94
2012	253	134	117	122
2013	191	133	132	143

Notes: [a] All data are shown in units of tons per year (tpy).
[b] Emissions data are taken from TCEQ's Point Source Emissions Inventory (TCEQ, 2011a and 2015), with all data points rounded to the nearest ton. The earliest year with $PM_{2.5}$ data available for all four facilities is 2000.

Table10. Summary of Ambient Air Monitoring Data for PM2.5, 2000-2014[ab]

Name of Monitoring Station	Year	Type of Sampling	Annual Average Concentration ($\mu g/m^3$)[c]	Highest 24-Hour Average Concentration ($\mu g/m^3$)[c]
CAMS 302—Wyatt Road (8/2000-3/2006)	2001	Continuous	10.2	**52.1**
	2002		11.4	
	2003		11.7	
	2004		10.9	
	2005		11.9	
Holcim Facility Boundary (1/2006-1/2010)	2006	Continuous	11.5	**42.2**
	2007		10.2	
	2008		11.8	
	2009		10.5	
Midlothian Tower (2/2000-12/2006)	2000	Continuous	10.0	**50.2**
	2001	Continuous	10.4	
	2002	24-hour	11.8 (partial)	
	2003	24-hour	11.5	
	2004	24-hour	11.5	
	2005	24-hour	***12.4(partial)***	
	2006	24-hour	10.2	
Old Fort Worth Road (9/2005-12/2011)	2006	24-hour	11.0	**50.6**
	2007		11.4	
	2008		11.8	
	2009		9.2	
	2010		9.7	
	2011		10.3	
	2012	24-hour	9.0	27.7
	2013	24-hour	9.2	32.0
	2014	24-hour	8.8	25.8

Notes: [a] $PM_{2.5}$ monitoring data were downloaded from TCEQ's Texas Air Monitoring Information System (TCEQ, 2012a and 2015) and obtained from researchers at the University of Texas at Arlington (UT-Arlington, 2008-2010). ATSDR adjusted the annual average $PM_{2.5}$ TCEQ data from the continuous monitors before 2005 by 2 $\mu g/m^3$ to account for the negative bias from these types of monitors. TCEQ reported all annual average continuous monitoring data from 2005 forward by including this adjustment (Personal Communication, Tracie Phillips, TCEQ, 2012); therefore, ATSDR did not do this adjustment for TCEQ continuous monitoring data for this timeframe. ATSDR does not have side-by-side 24-hour data to determine what the magnitude of the negative bias might have been for the Holcim continuous monitoring data; therefore, it is possible that the values presented may underestimate $PM_{2.5}$ exposure downwind of Holcim. If data were available from both continuous and 24-hour sampling, ATSDR reports the highest value. ATSDR did not report partial year data unless at least 50% of the data were available for that year.

[b] The following health-based screening values were used to evaluate these data:
For *24-hour average concentrations*, EPA's health-based NAAQS is 35 $\mu g/m^3$, based on the 98[th] percentile concentration averaged over 3 years; and WHO's health guideline is 25 $\mu g/m^3$.
For *annual average concentrations*, EPA's health-based NAAQS is 12 $\mu g/m^3$ averaged over 3 years and WHO's health guideline is 10 $\mu g/m^3$.

[c] Bold font is used to indicate which maximum concentrations are above the level of EPA's NAAQS for daily $PM_{2.5}$; refer to Section 4.5.3 for further insights on the magnitude of the 98[th] percentile concentrations, which are more relevant for comparing to the health-based standards. Bold and italicized font is used to indicate which annual average concentrations were above EPA's standard—none of the reported full-year values are above the current EPA NAAQS for annual average $PM_{2.5}$.

Table 11. Estimated Annual Sulfur Dioxide Emissions from Midlothian Facilities[a,b]

Year	Ash Grove Cement (tons per year)	Gerdau Ameristeel (tons per year)	Holcim (tons per year)	TXI Op (tons p
1990	2,796	1[d]	3,053	13,068
1991	__[c]	__[c]	__[c]	__[c]
1992	4,388	1[d]	3,756	4,398
1993	2,284	1[d]	2,967	4,357
1994	3,577	1[d]	4,116	4,983
1995	2,083	1[d]	3,643	6,111
1996	3,134	144	5,864	5,109
1997	3,633	142	3,903	5,317
1998	3,872	129	3,691	5,490
1999	4,830	121	2,522	5,129
2000	4,368	131	4,483	6,303
2001	4,927	120	2,427	4,339
2002	4,434	122	3,167	2,099
2003	5,026	120	2,501	2,333
2004	6,216	125	2,658	2,324
2005	6,013	122	2,655	3,356
2006	6,263	133	3,330	2,551
2007	6,227	130	2,481	2,497
2008	4,776	115	2,706	1,721
2009	2,697	74	1,661	550
2010	4,115	108	1,089	493
2011	4,937	111	1,190	456
2012	5,680	112	1,251	572
2013	5,101	103	949	639

Notes: [a] All data are shown in units of tons per year (tpy).
[b] Emissions data are taken from TCEQ's Point Source Emissions Inventory (TCEQ, 2011a and 2015), with all data points rounded to the nearest ton.
[c] No Point Source Emissions Inventory were available for calendar year 1991.
[d] In the earliest years of the Point Source Emissions Inventory, emissions data for Gerdau Ameristeel were considerably lower than what the facility reported in subsequent years. The reason for this is not known.

Table 12. Annual Average Sulfur Dioxide Concentrations, 1997-2014[a]

Year	Annual Average Sulfur Dioxide Concentrations (ppb)		
	Upwind Stations	Downwind Stations	
	Midlothian Tower	Old Fort Worth Road	Wyatt Road
Annual average concentrations, by year			
No health-based standards available from EPA, TCEQ, or WHO			
1997	2.47[b]	1.82[b]	__[c]
1998	1.41	2.61	__[c]
1999	1.13	3.87	__[c]
2000	1.60	5.47	__[c]
2001	1.35	3.51	__[c]
2002	0.92	0.88	__[c]
2003	1.15	1.22	__[c]
2004	1.08	1.02	0.46[b]
2005	1.53	2.65	0.93
2006	1.11	2.11	0.48[b]
2007	0.82[b]	0.87	__[c]
2008	__[c]	0.87	__[c]
2009	__[c]	0.54	__[c]
2010	__[c]	0.87	__[c]
2011	__[c]	0.65[b]	__[c]
2012	__[c]	0.6	__[c]
2013	__[c]	0.6	__[c]
2014	__[c]	0.2	__[c]

Notes: [a] Data were downloaded from TCEQ's Texas Air Monitoring Information System (TCEQ, 2012a and 2015).
[b] Monitoring site did not operate during the entire calendar year; data are based on all valid measurements from the calendar year.
[c] Monitoring data were not collected at these sites during these years.

Table 13. Additional Trends in 1-Hour Average Sulfur Dioxide Monitoring Data[a,b]

Evaluation Based on EPA's Health-Based NAAQS: 75 ppb		
3-Year Period	**99th Percentile of Daily Maximum 1-Hour Sulfur Dioxide Concentrations(ppb), Averaged over Three Consecutive Calendar Years**	
	Midlothian Tower	**Old Fort Worth Road**
1997-1999	54.3	**122.7**
1998-2000	56.7	**139.7**
1999-2001	62.7	**158.7**
2000-2002	71.7	**125.3**
2001-2003	65.7	**92.0**
2002-2004	58.3	62.3
2003-2005	51.7	**81.0**
2004-2006	49.3	**93.3**
2005-2007	52.3	**101.3**
2006-2008	__c	**85.7**
2007-2009	__c	57.3
2008-2010	__c	31.0
2009-2011	__c	15.3
2012-2014	__c	13.0[e]

Notes: [a] Data were accessed using queries on EPA's AirData system, including exceptional events (EPA, 2012a and 2015b). The 99th percentile values were downloaded for individual years, from which averages were calculated over three consecutive years.

[b] Summaries are shown for only those sites with three consecutive years of sulfur dioxide monitoring data.

[c] Monitoring data were not collected at these sites for the entire 3-year periods.

[d] Entries in bold font are higher than the level of EPA's current health-based standard, which the agency passed in 2010.

[e] Annual statistics for 2014 were not finalized at the time of this report. 2014 data is a projected and expected value.

Table 14. Summary of Ambient Air Monitoring Data for Hydrogen Sulfide, 2000-2014[a]

Year	Hydrogen Sulfide Concentrations (ppb)		
	Upwind Stations	Downwind Stations	
	Midlothian Tower	Old Fort Worth Road	Wyatt Road
Annual average concentrations, by year			
EPA RfC = 1.4 ppb			
2000	0.28	0.31	__c
2001	0.39	0.29	__c
2002	0.35	0.34	__c
2003	0.58	0.55	__c
2004	0.33	0.60[b]	0.59[b]
2005	0.23	__c	0.60
2006	0.13	0.20[b]	0.48[b]
2007	0.01[b]	0.47	__c
2008	__c	0.42	__c
2009	__c	0.35	__c
2010	__c	0.28	__c
2011	__c	0.27	__c
2012	__c	0.44	__c
2013	__c	0.55	__c
2014	__c	0.76	__c
Highest 1-hour average concentrations, by year			
ATSDR Acute MRL = 70 ppb; TCEQ standard = 80 ppb; WHO health guideline = 106 ppb			
2000	2.82	2.88	__c
2001	10.08	2.82	__c
2002	4.77	6.98	__c
2003	7.27	13.95	__c
2004	2.85	3.72[b]	3.16[b]
2005	2.66	__c	14.36
2006	4.05	2.92[b]	2.15[b]
2007	2.13[b]	7.25	__c
2008	__c	4.32	__c
2009	__c	4.16	__c
2010	__c	3.60	__c
2011	__c	3.97	__c
2012	__c	3.79	__c
2013	__c	6.43	__c
2014	__c	3.71	__c

Notes: [a] Data were downloaded from TCEQ's Texas Air Monitoring Information System (TCEQ, 2012a and 2015).
[b] Monitoring site did not operate during the entire calendar year; data are based on all valid measurements from the calendar year.
[c] Monitoring data were not collected at these sites during these years.

Table 15. Summary of Health Comparison Values Used and Selection of NAAQS/H_2S Air Pollutants as a Contaminant of Concern[a]

Air Pollutant	EPA HCV	WHO HCV	ATSDR HCV	COC (Y/N)
Carbon monoxide	35 ppm (1-hour) 9 ppm (8-hour)	26 ppm (1-hour) 9 ppm (8-hour)	NA	N
Lead	0.15 µg/ m^3	0.5 µg/ m^3 (annual)	NA	**Y**
Nitrogen dioxide	100 ppb (1-hour) 53 ppb (annual)	106 ppb (1-hour) 21 ppb (annual)	NA	N
Ozone	70 ppb (8-hour)	50 ppb (8-hour)	NA	**Y**
PM (as TSP)	260 µg/m^3 (24-hour)[b] 75 µg/m^3 (annual)[b]	NA	NA	N
PM_{10}	150 µg/ m^3 (24-hour 50 µg/m^3 (annual)[b]	50 µg/m^3 (24-hour) 20 µg/m^3 (annual)	NA	N
$PM_{2.5}$	35 µg/m^3 (24-hour) 12 µg/m^3 (annual)	25 µg/m^3 (24-hour) 10 µg/m^3(annual)	NA	**Y (24-hour)**
Sulfur dioxide	75 ppb (1-hour)	8 ppb (24-hour) 190 ppb (10-minute)	10 ppb (acute, 1-14 days)	**Y**
Hydrogen sulfide	1.4 ppb (annual)	106 ppb (24-hour)	70 ppb (acute, 1-14 days)	N

Notes: [a] A Contaminant of Concern is defined as one that is selected for further evaluation in the Public Health Implications Section because it is above a HCV.
[b] Previous EPA standard which has since been revoked.
EPA-United States Environmental Protection Agency
HCV-Health Comparison Value
WHO-World Health Organization
COC-Contaminant of Concern
ppm-parts per million
NA-none available
µg/m^3-micrograms per meter cubed
ppb-parts per billion
PM-particulate matter
TSP-total suspended particulates

Table 16: Percentage Peak (5-Minute Average) Sulfur Dioxide Concentrations by Monitoring Station (1997-2011)

Monitoring Station (Timeframe)	Sulfur Dioxide Concentration (ppb)			
	% > 400	% >200-400	% >100-200	% >10-100
OFWR (1997-2008)	<<0.001	0.01	0.23	5.1
OFWR (2009-2011)	0	0	0	0.58
Wyatt Road (2004-2006)[a]	0.002[b]	0.008	0.04	1.3
Midlothian Tower (1997-2007)	<<0.001	<<0.001	0.2	2.3

ppb-parts per billion
>-Greater than
OFWR-Old Fort Worth Road
<<-Much less than
a-The only full year of data available for the Wyatt Road monitor was 2005—data for 2004 and 2006 accounted for about 20-25% of all possible measurements for those years.
b-Three 5-minute SO_2 measurements above 400 ppb occurred at the Wyatt Road Monitor during 2005. The highest SO2 level recorded for all monitors and timeframes (568 ppb) was one of these measurements.

12. Figures

Figure 1

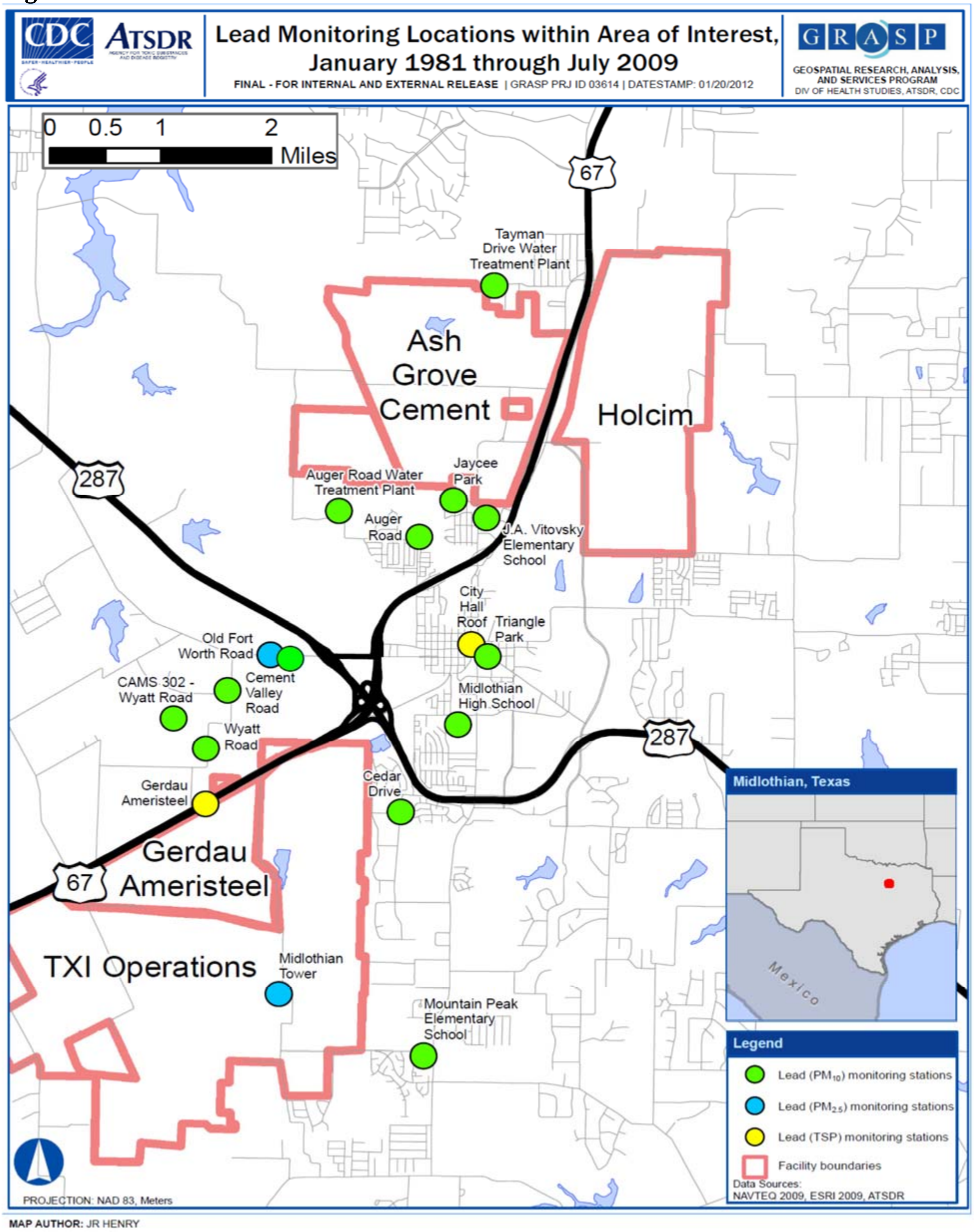
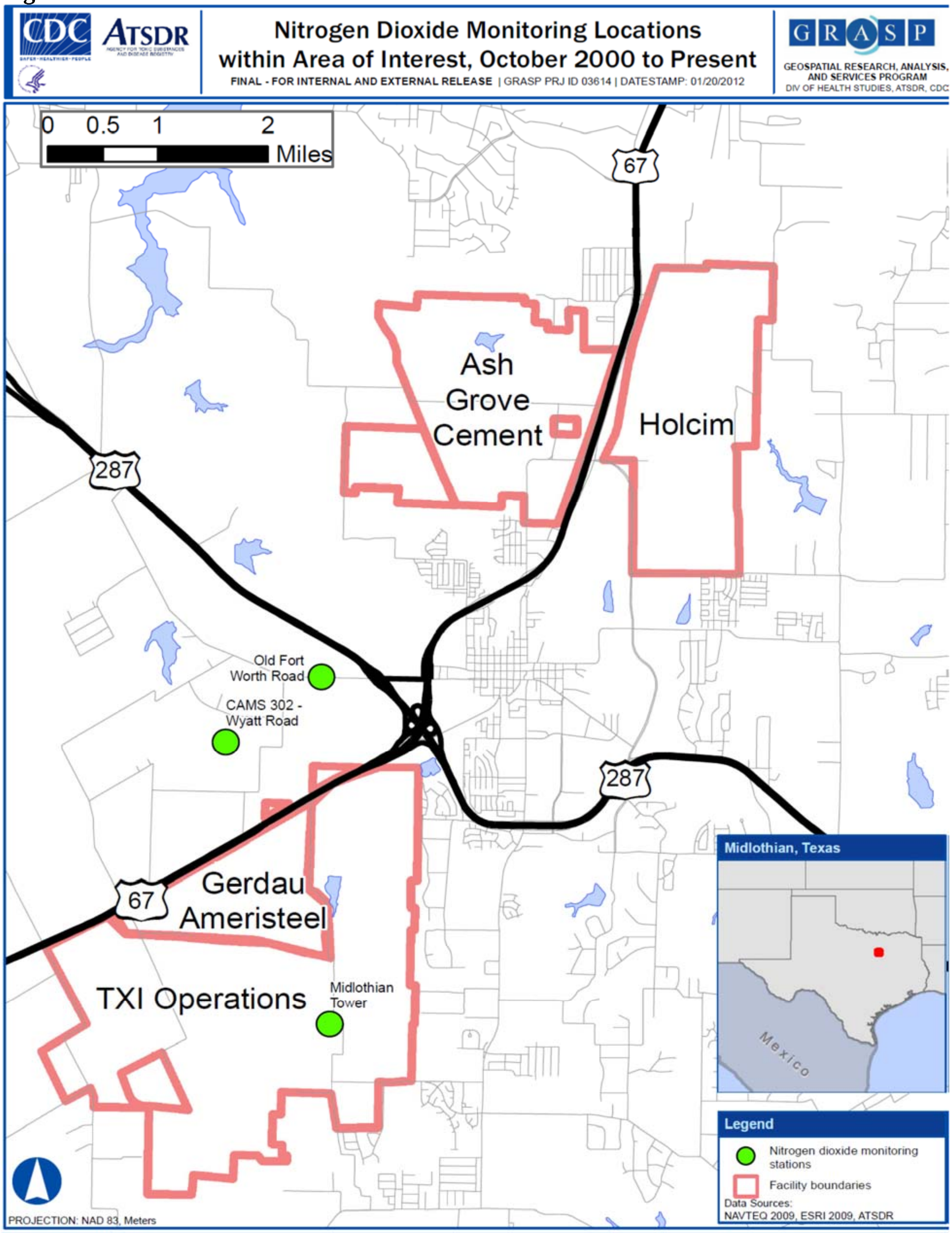
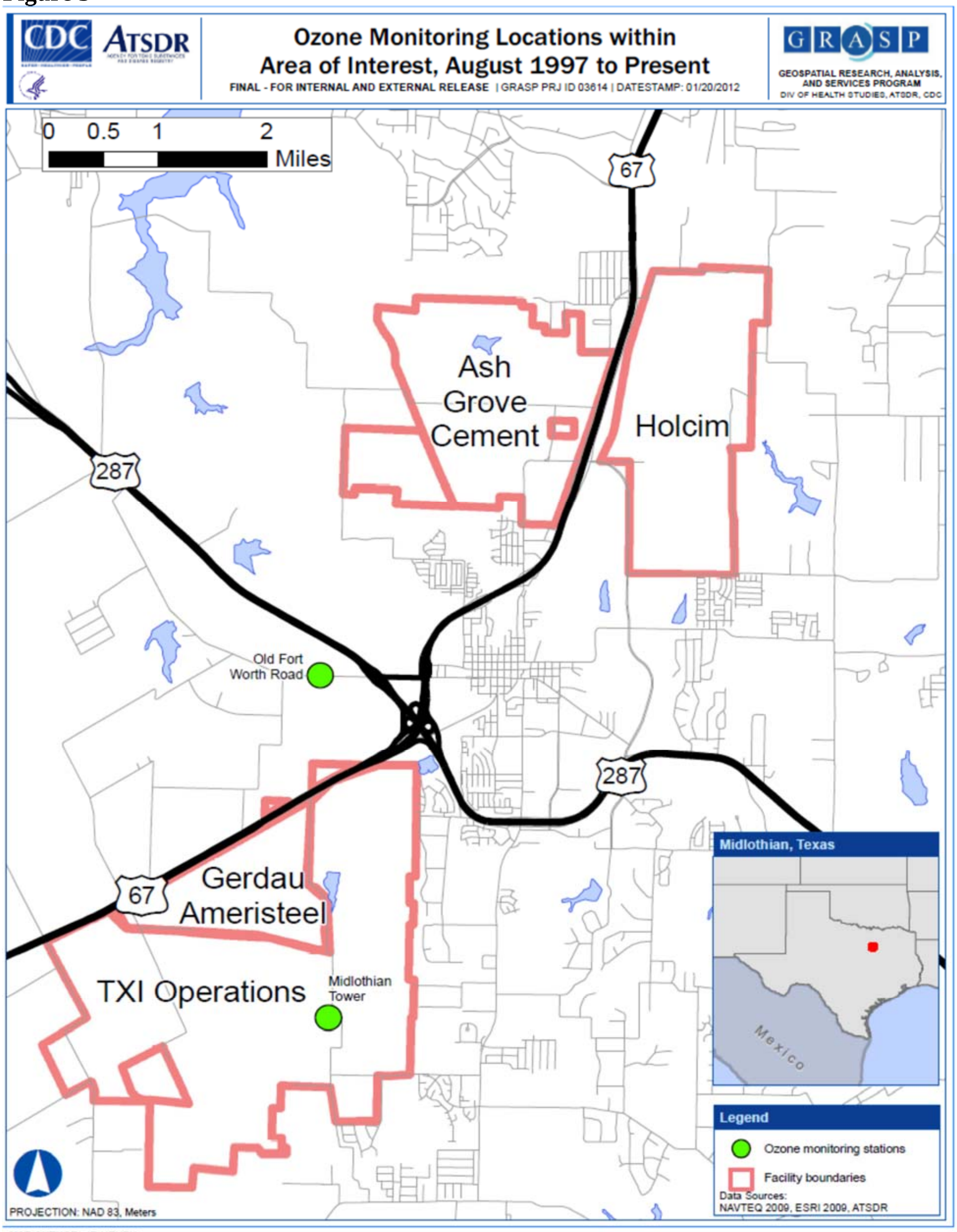

CDC
ATSDR
Lead Monitoring Locations within Area of Interest, January 1981 through July 2009
FINAL - FOR INTERNAL AND EXTERNAL RELEASE | GRASP PRJ ID 03614 | DATESTAMP: 01/20/2012
GRASP
GEOSPATIAL RESEARCH, ANALYSIS, AND SERVICES PROGRAM
DIV OF HEALTH STUDIES, ATSDR, CDC
0 0.5 1 2 Miles
67
287
Tayman Drive Water Treatment Plant
Ash Grove Cement
Holcim
Auger Road Water Treatment Plant
Jaycee Park
Auger Road
J.A. Vitovsky Elementary School
City Hall Roof
Triangle Park
Old Fort Worth Road
CAMS 302 - Wyatt Road
Cement Valley Road
Wyatt Road
Midlothian High School
Gerdau Ameristeel
Cedar Drive
Gerdau Ameristeel
TXI Operations
Midlothian Tower
Mountain Peak Elementary School
Midlothian, Texas
Mexico
Legend
Lead (PM10) monitoring stations
Lead (PM2.5) monitoring stations
Lead (TSP) monitoring stations
Facility boundaries
Data Sources: NAVTEQ 2009, ESRI 2009, ATSDR
PROJECTION: NAD 83, Meters
MAP AUTHOR: JR HENRY

Figure 2



MAP AUTHOR: JR HENRY

Figure 3


Ozone Monitoring Locations within
Area of Interest, August 1997 to Present
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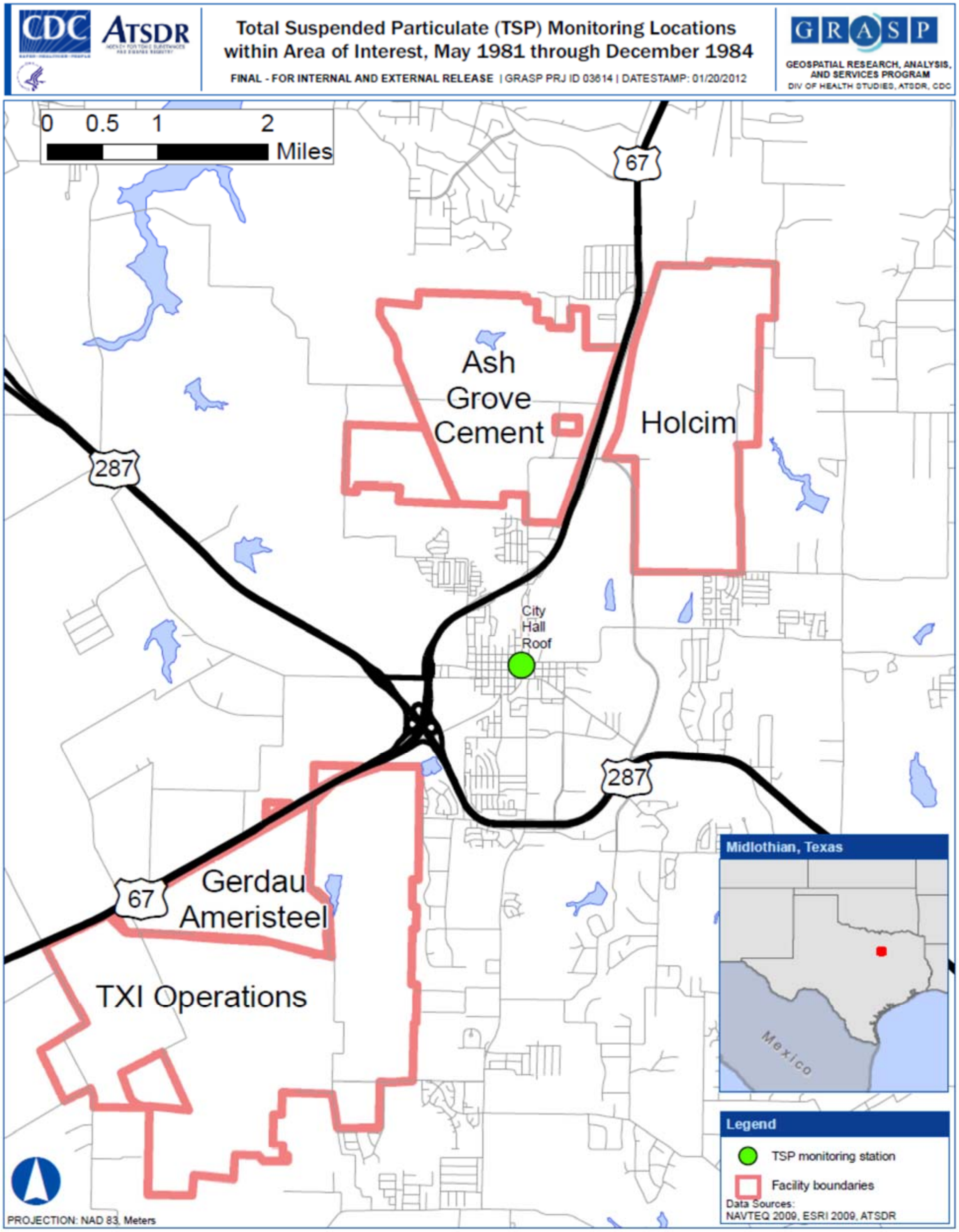
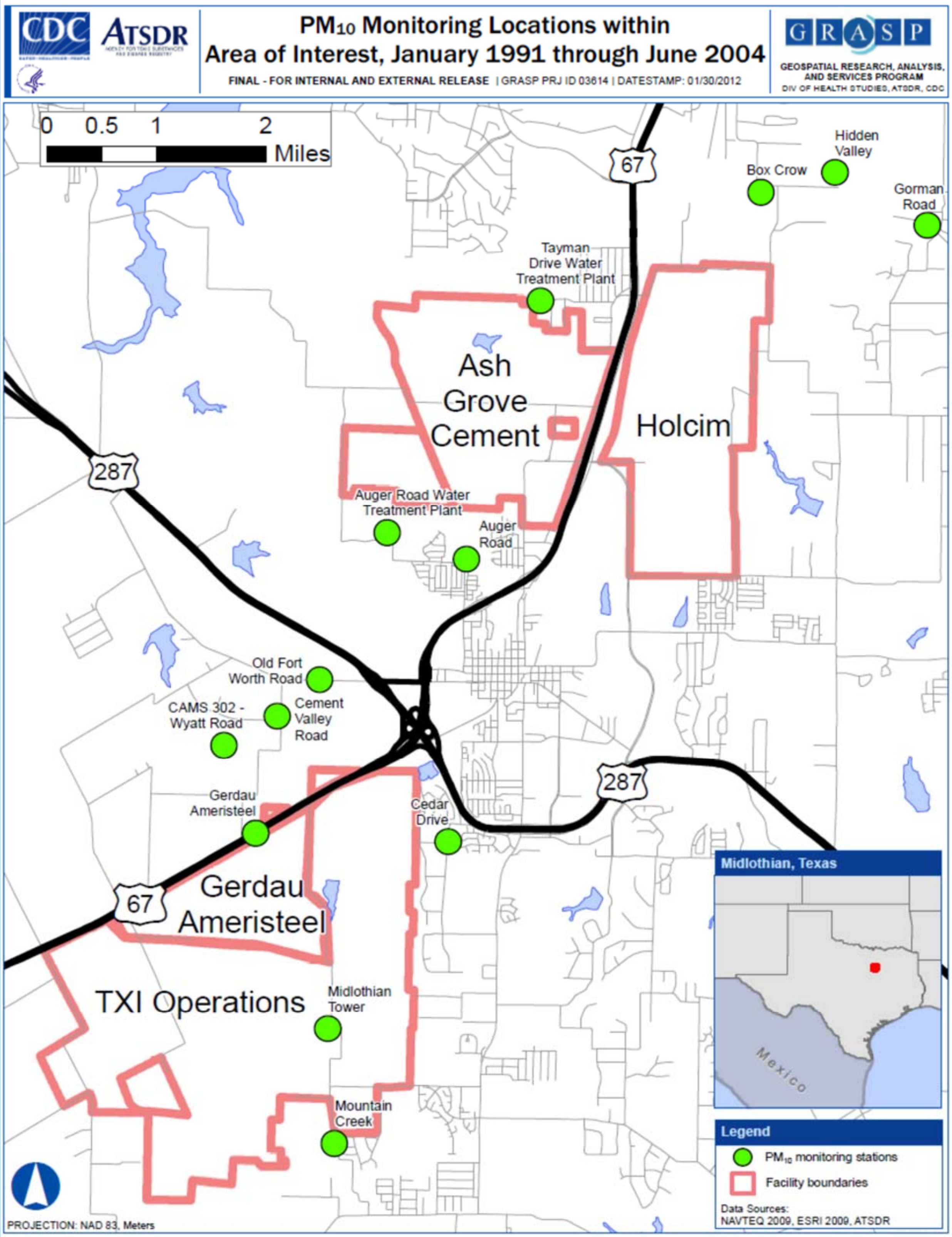
GEOSPATIAL RESEARCH, ANALYSIS, AND SERVICES PROGRAM
DIV OF HEALTH STUDIES, ATSDR, CDC
0 0.5 1 2 Miles
67
287
Ash Grove Cement
Holcim
Old Fort Worth Road
287
Gerdau Ameristeel
67
TXI Operations
Midlothian Tower
Midlothian, Texas
Mexico
Legend
Ozone monitoring stations
Facility boundaries
Data Sources:
NAVTEQ 2009, ESRI 2009, ATSDR
PROJECTION: NAD 83, Meters
MAP AUTHOR: JR HENRY

Figure 4



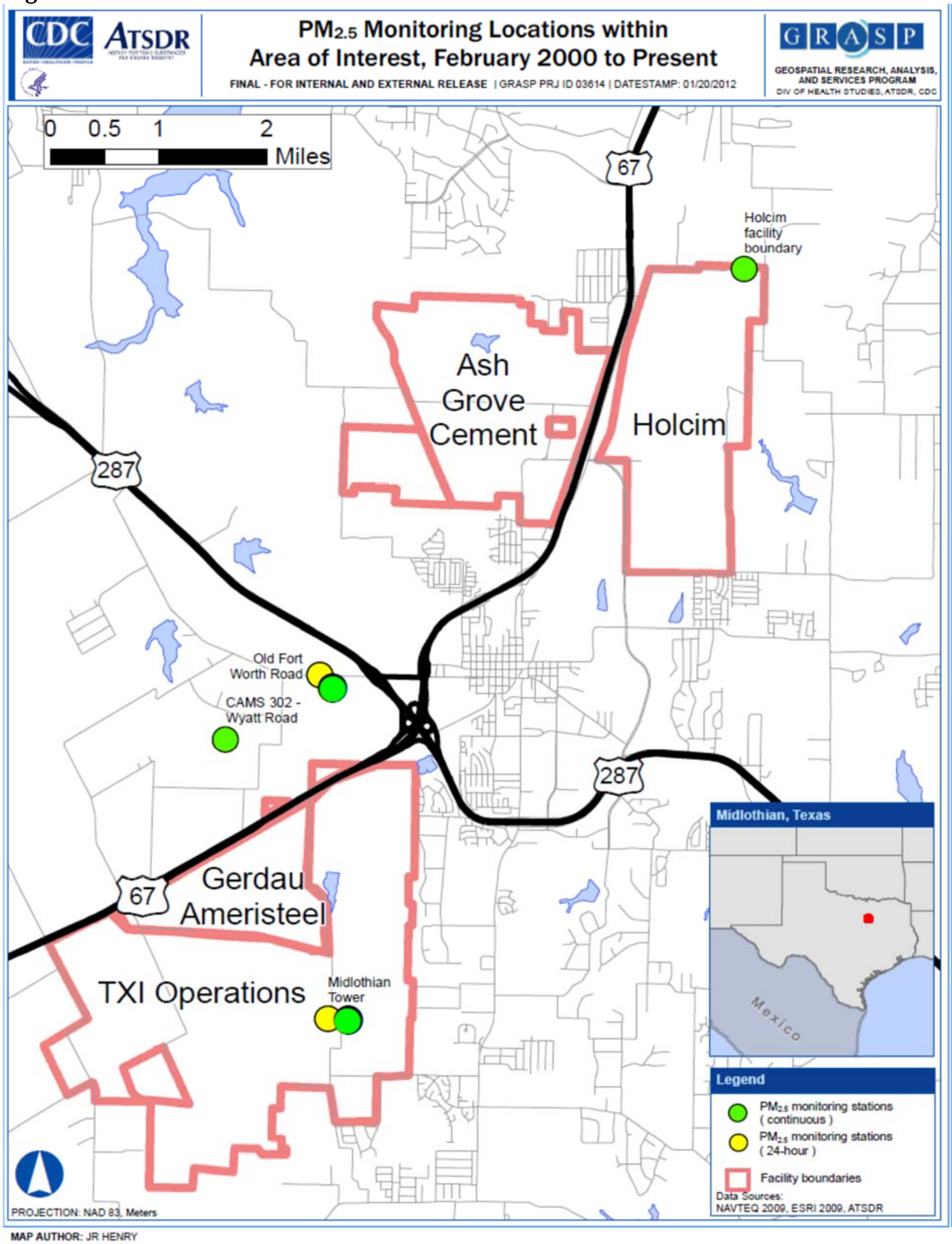
MAP AUTHOR: JR HENRY

Figure 5



MAP AUTHOR: JR HENRY

Figure 6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ATSDR
PM2.5 Monitoring Locations within
Area of Interest, February 2000 to Present
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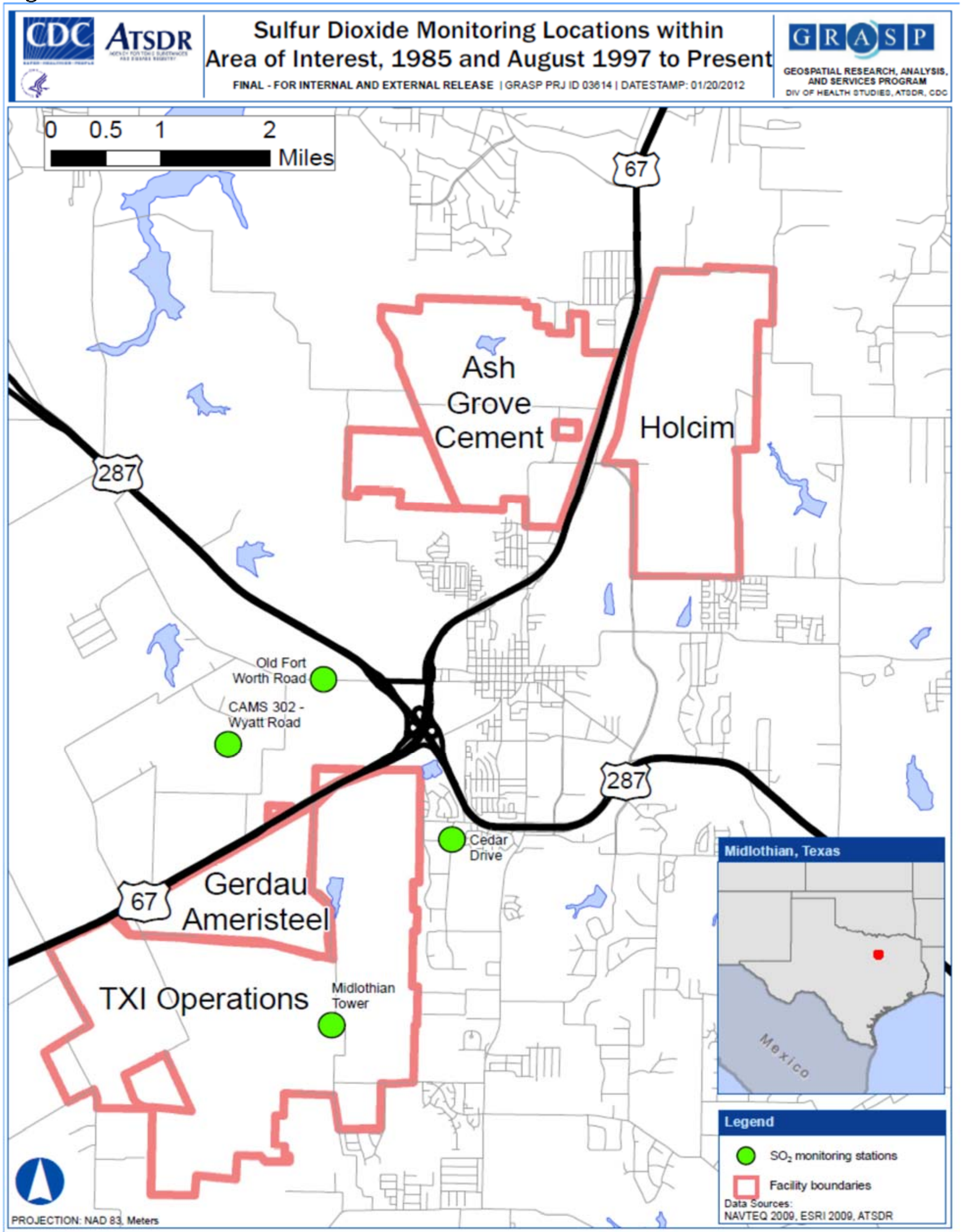
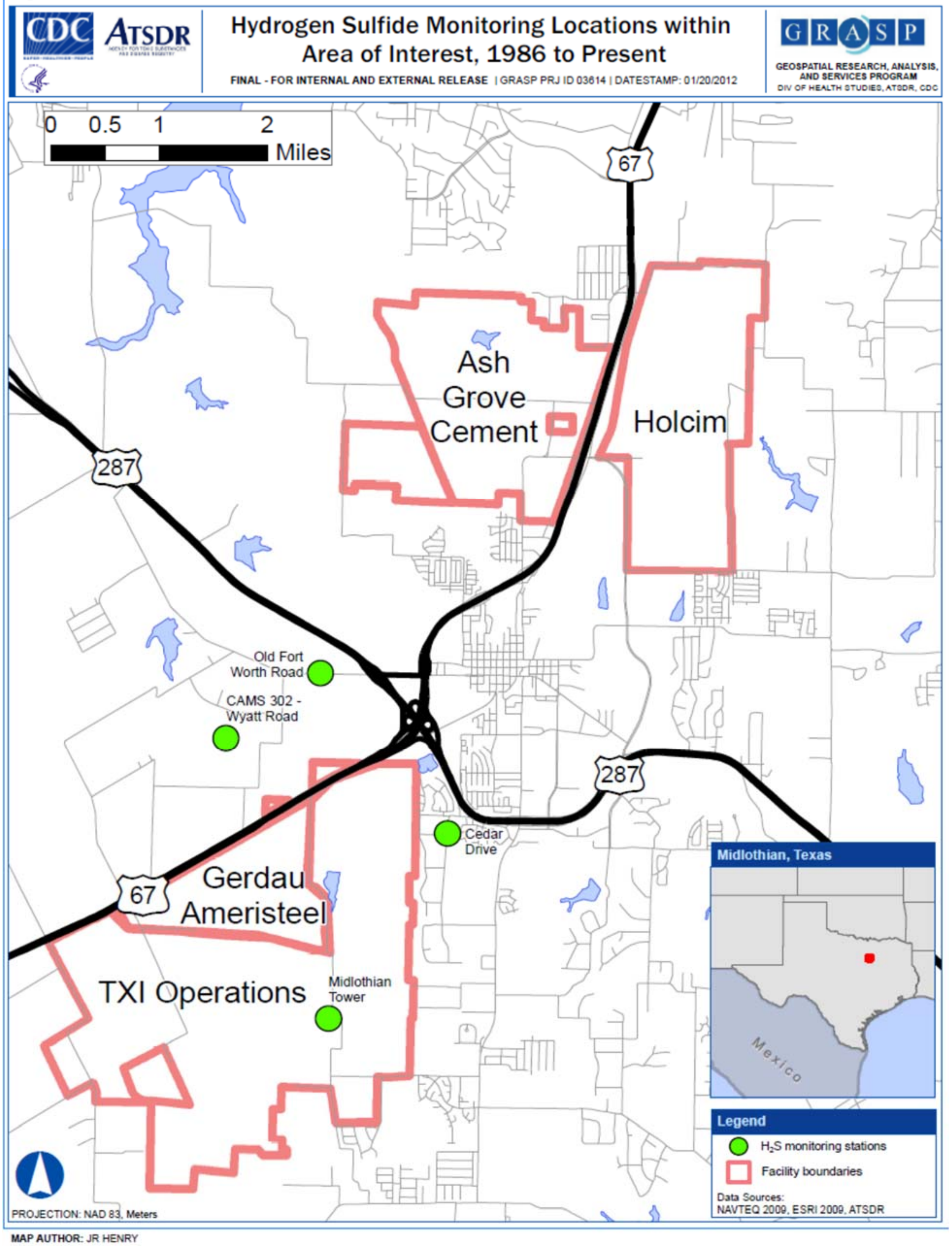
GRASP
GEOSPATIAL RESEARCH, ANALYSIS, AND SERVICES PROGRAM
DIV OF HEALTH STUDIES, ATSDR, CDC
0 0.5 1 2
Miles
67
Holcim facility boundary
Ash Grove Cement
Holcim
287
Old Fort Worth Road
CAMS 302 - Wyatt Road
287
67
Gerdau Ameristeel
TXI Operations
Midlothian Tower
Midlothian, Texas
Mexico
Legend
PM2.5 monitoring stations (continuous)
PM2.5 monitoring stations (24-hour)
Facility boundaries
Data Sources:
NAVTEQ 2009, ESRI 2009, ATSDR
PROJECTION: NAD 83, Meters
MAP AUTHOR: JR HENRY

Figure 7



MAP AUTHOR: JR HENRY

Figure 8


CDC
ATSDR
Hydrogen Sulfide Monitoring Locations within Area of Interest, 1986 to Present
FINAL - FOR INTERNAL AND EXTERNAL RELEASE | GRASP PRJ ID 03614 | DATESTAMP: 01/20/2012
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GEOSPATIAL RESEARCH, ANALYSIS, AND SERVICES PROGRAM
DIV OF HEALTH STUDIES, ATSDR, CDC
0 0.5 1 2
Miles
67
287
Ash Grove Cement
Holcim
Old Fort Worth Road
CAMS 302 - Wyatt Road
Cedar Drive
Gerdau Ameristeel
TXI Operations
Midlothian Tower
Midlothian, Texas
Mexico
Legend
H2S monitoring stations
Facility boundaries
Data Sources:
NAVTEQ 2009, ESRI 2009, ATSDR
PROJECTION: NAD 83, Meters
MAP AUTHOR: JR HENRY

Figure 9: Frequency of Sulfur Dioxide Exceedances by Wind Direction at the Old Fort Worth Road Monitor (September 1997- May 2009)

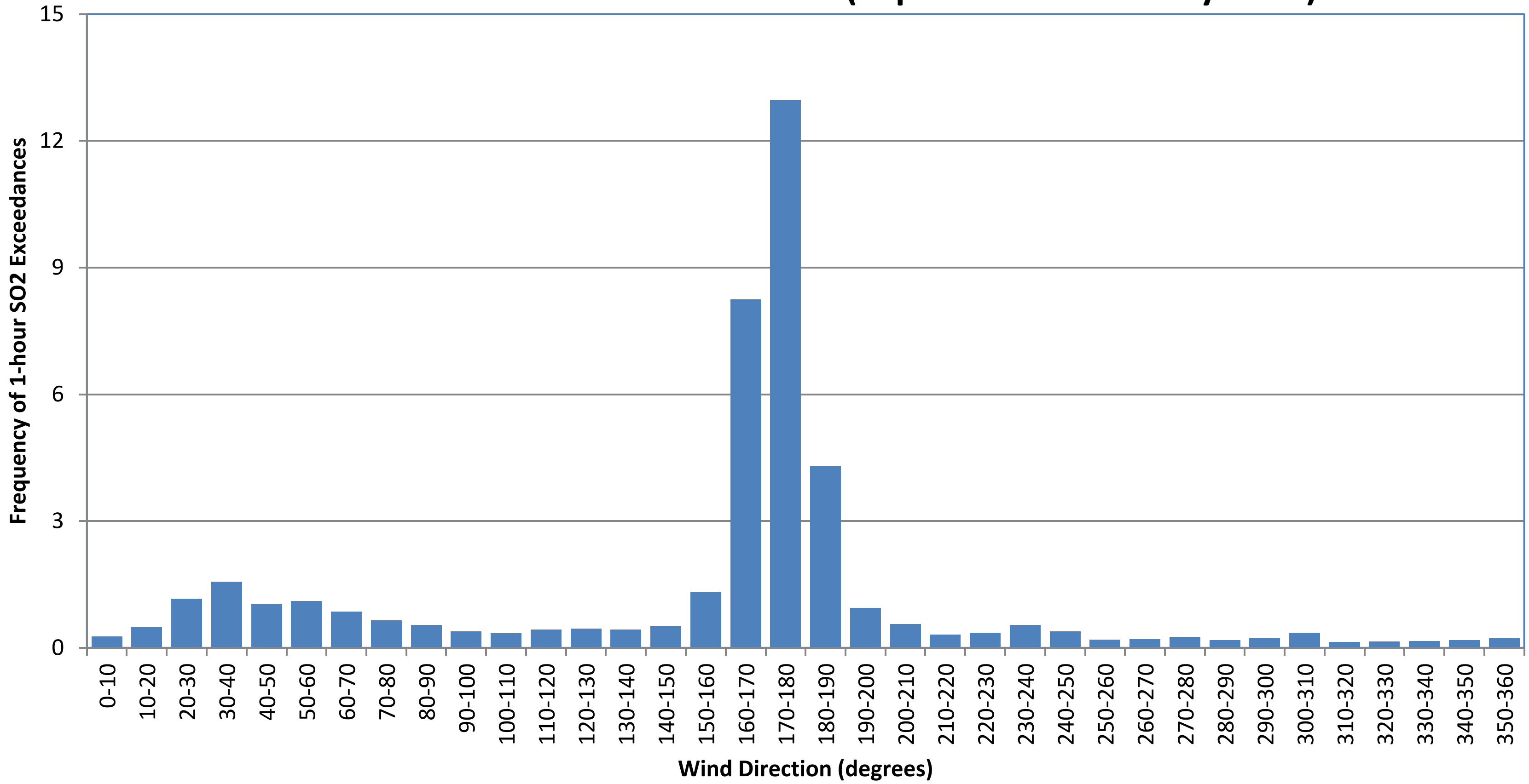
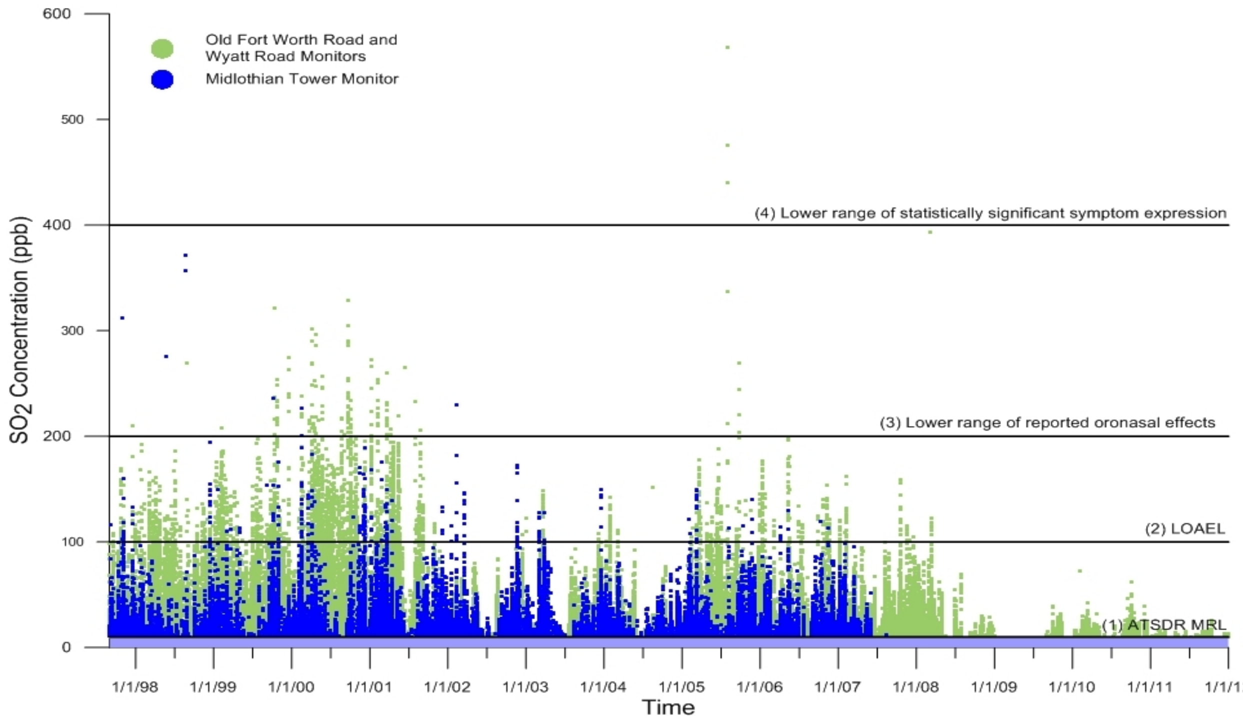


Figure 10: Peak 5-Minute Sulfur Dioxide Levels in Midlothian Area from 1997-2011



1. ATSDR MRL – ATSDR's acute Minimal Risk Level (10 ppb) for Sulfur Dioxide. ATSDR 1998: Toxicological profile for sulfur dioxide.
2. LOAEL – ATSDR acute Lowest Observed Adverse Effect Level (LOAEL)(100 ppb) using mouthpiece exposure in human clinical study. Shepard et al. 1981: Exercise increases sulfur dioxide-induced bronchoconstriction in asthmatic subjects. Am Rev Respir Dis 123:486-491.
3. Lower range of reported oronasal effects (200 ppb), based on several studies. USEPA 2008c: Integrated science assessment for sulfur oxides – health criteria. Office of Research and Development. EPA/600/R-08/047FA.
4. Lower range of statistically significant symptom expression (400 ppb), based on several studies. USEPA 2009c: Risk and exposure assessment to support the review of the SO_2 Primary National Ambient Air Quality Standards: second draft.

Appendices

Appendix A: ATSDR Carbon Monoxide Modeling

For most of the criteria pollutants considered in this Health Consultation, ATSDR based its conclusions on ambient air monitoring data, or direct measurements of levels of air pollution in the Midlothian area. This basis was not the case for carbon monoxide because no ambient air monitoring data are available for this pollutant. Therefore, ATSDR conducted air dispersion modeling analysis for carbon monoxide. Such models can be used to estimate air pollution levels based on facility configurations, emission rates, local meteorologic conditions, and other factors. This appendix describes the air dispersion modeling analysis that ATSDR conducted. All model input files used for this modeling are available in electronic format from ATSDR, upon request. The modeling described in this appendix was designed to characterize the combined air quality impacts from all four industrial facilities in the Midlothian area and does not account for influences from any other sources.

Model selection. Modeling was performed using the AERMOD model, version number 11103. AERMOD was chosen because it is recommended in EPA's Guideline on Air Quality Models (EPA, 2005). AERMOD has been widely used for modeling how pollutants move from industrial facilities through the air to offsite locations. This model can be used for evaluating different types of emission sources, including point, area, and volume sources. AERMOD also can be used to assess air pollution levels in all types of terrain, including flat and complex.

Pollutants. This appendix reviews the modeling that ATSDR conducted for carbon monoxide. ATSDR also used this model to evaluate air-quality impacts for several other air pollutants. Those results will be presented in a separate Health Consultation.

Facilities and sources modeled. The modeling focused on emissions from Ash Grove Cement, Gerdau Ameristeel, Holcim, and TXI Operations. For carbon monoxide, the overwhelming majority of emissions that the facilities reported to the state emission inventory come from either kiln stacks (at the cement manufacturing facilities) or furnace stacks (at the steel mill). This reporting is consistent with the knowledge that industrial emission sources of carbon monoxide are dominated by fuel combustion sources and other high-temperature sources.

ATSDR's approach was to model carbon monoxide emissions from one stack per facility, and the stack selected was the one expected to have the least favorable dispersion (i.e., the shortest kiln or furnace stack and the lowest exit velocity). For each facility, ATSDR allocated 100 %of the facilitywide emissions to the one stack selected for modeling. In other words, 100 %of each facility's carbon monoxide emissions were considered in the model—they were just assumed to be emitted from the stack that would lead to the highest offsite air quality impacts. Although some facilities have ground-level emissions source of carbon monoxide (e.g., exhaust from trucks and small engines), these account for a small fraction of the facility's overall inventories. The tables at the end of this protocol list the stack parameters and emission rates for the facilities of interest. Building downwash was not considered, primarily because the stacks are higher than the nearby buildings and structures.

Meteorologic data. AERMOD, like most refined dispersion models, requires inputs that characterize local meteorologic conditions—typically hourly observations of wind speed, wind direction, temperature, and other parameters. For this modeling, ATSDR used the electronic meteorologic data sets that TCEQ had already processed for modeling applications in Ellis County, Texas. The data used were for medium surface roughness, which is appropriate for rural and suburban areas. The specific data set processed by TCEQ and used in modeling applications in this area includes surface meteorological data from the Dallas–Fort Worth Airport for calendar years 1985, 1987, 1988, 1989, and 1990; these data are processed with upper air data from Stephenville, Texas. The five individual year datasets were combined into a single file for input to the model.

Terrain data. Elevation data for the Midlothian area were obtained from the National Elevations Dataset available from the U.S. Geological Survey. These data were used to assign elevations to every location where air pollution was modeled and to make realistic assessments of how local terrain affects atmospheric dispersion.

Receptor grid. In the field of dispersion modeling, "receptors" refer to the locations where models estimate air pollution levels. Receptors can be assigned to any geographic area of interest. The proposed receptor grid for this modeling application was selected to help pinpoint locations with maximum impact from the primary stack at an individual facility. It is standard practice to have a high concentration of receptors in areas where one expects air pollution levels to be highest and fewer receptors in other areas. This approach helps ensure the highest air pollution levels are identified, while saving computational time. The receptor grid for this modeling is depicted in Figures C-1, C-2, and C-3, and included three tiers of receptors:

- *Fine grid for near-field receptors.* The most receptors were placed in the immediate vicinity of the four facilities. Specifically, receptors were placed at 100-meter intervals along the facility boundaries and at regular spacing to a distance 1 kilometer from the facility boundary. Concentrations were not modeled for locations within the facility boundaries. Figures C-1 and C-2 show the near-field receptor grid.

- *Intermediate grid receptors.* At distances between 1 and 5 kilometers from the facility boundaries, receptors were placed at 500-meter intervals. Figure C-3 shows these receptors.

- *Coarse grid for far-field receptors.* At locations between 5 and 10 kilometers from the facilities, receptors were placed at 1,000-meter intervals. Figure C-3 shows the locations of these receptors. Modeling was not conducted for locations more than 10 kilometers away from the facility boundaries. The outputs from the modeling confirmed that this modeling domain was adequate and that higher air quality impacts for carbon monoxide did not occur at locations further downwind.

Model inputs and emission rates. Table C-1 lists all of the model inputs for the individual facilities. For the stacks considered in the analysis, the table lists the geographic coordinates, the stack height and diameter, and the temperature and velocity of the emissions from the stack. These parameters are all taken from publicly available Emission Inventory Questionnaire data. Carbon monoxide emission rates used in the modeling (and shown in Table C-1) are the highest annual carbon monoxide emissions levels documented in the TCEQ Point Source Emission

Inventory for any year during the period 1990– 2010. These annual emissions are the total amounts of carbon monoxide released over the course of the year. For purposes of modeling, these values were used to calculate emission rates, which were assumed to remain constant throughout the year.

Model outputs and averaging times. The model was run with 5 years of meteorological data, and carbon monoxide concentrations were calculated for each receptor. These concentrations represent the combined air quality impact from all four Midlothian facilities, not considering contributions from other sources. The highest air quality impacts were observed at locations immediately north of the Gerdau Ameristeel and TXI Operations facilities. Table C-2 lists the highest predicted carbon monoxide concentrations for several averaging periods.

Uncertainties and limitations. ATSDR considered the uncertainties and limitations of these modeling results. The model inputs for stack parameters are based on direct observations of facility conditions, and these are believed to be highly accurate. The meteorological data used in the model are based on observations at the Dallas–Fort Worth Airport. Although this location is approximately 30 miles away from Midlothian, the prevailing wind directions in the data set are similar to those encountered in the Midlothian area.

The main source of uncertainty is likely associated with the emissions data. ATSDR took steps to ensure that the highest annual emissions were modeled. For example, for each facility, the highest annual carbon monoxide emissions were considered in the assessment. Further, even though the highest emissions occurred during different years across the four facilities, the model assumed the highest annual emissions from all four facilities occurred at the same time. ATSDR believes the emissions data to be accurate, given that reported emissions (at least in recent years) are largely based on continuous emissions monitoring data from the stacks; some of the facilities are required to directly measure the amounts of carbon monoxide that they are releasing. Despite these efforts to ensure that the modeling is based on health-protective assumptions, the main limitation in the emissions data is that the assessment is based on annual emissions, which were assumed to remain constant throughout the year. In reality, emissions vary from one hour to the next, and short-term fluctuations in emissions are not captured in the modeling analysis (but short-term fluctuations in the local meteorological conditions are addressed). Therefore, the possibility remains that some short-term carbon monoxide concentrations were higher than the worst-case levels predicted by the model, but they probably would have occurred only if elevated short-term emissions happened during times with unfavorable meteorological conditions.

References

[EPA] US Environmental Protection Agency. 2005. Guideline on Air Quality Models. Code of Federal Regulations, Chapter 40, Part 51, Appendix W. November 9, 2005.

Table A-1. Model Input Parameters

Input Parameters	Facility			
	Ash Grove Cement	**Gerdau Ameristeel**	**Holcim**	**TXI Operations**
Stack modeled	"Kiln #1"	"Baghouse A"	"Kiln #1"	"Kiln #4"
UTM-North (zone 14)	3,599,875 meters	3,592,800 meters	3,599,176 meters	3,593,584.25 meters
UTM-East (zone 14)	687,419 meters	684,525 meters	690,633 meters	685,435.55 meters
Stack height	150 feet	80 feet	273 feet	200 feet
Stack diameter	10.5 feet	11.9 feet	13.5 feet	9 feet
Exit temperature	350 °F	150 °F	233 °F	383 °F
Exit velocity	31 feet/second	5.9 feet/second	56 feet/second	37.43 feet/second
CO annual emissions	1,254,600 lbs/year	4,278,660 lbs/year	12,175,846 lbs/year	2,104,000 lbs/year
Source of emissions data	1990 emission inventory	1994 emission inventory	2004 emission inventory	1990 emission inventory

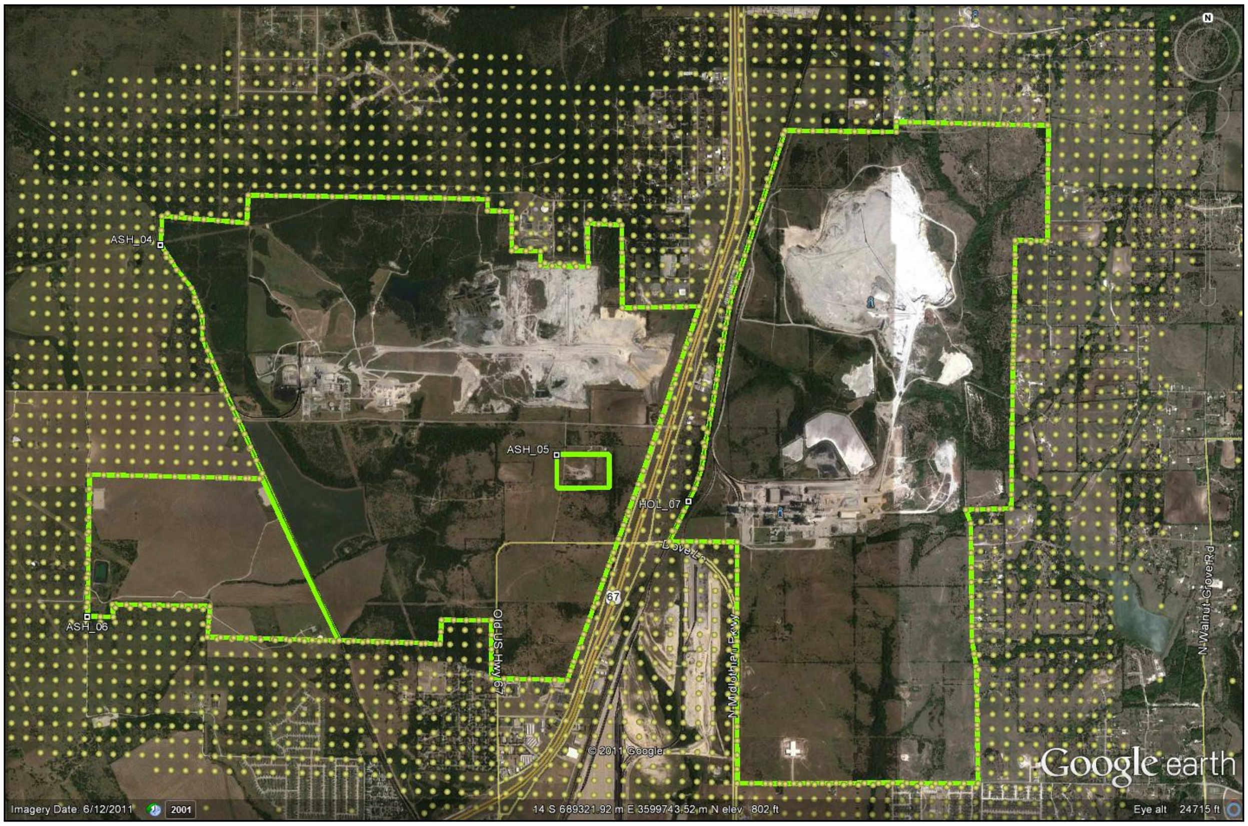
Notes: The stack parameters are all taken from data documented on the facility's Emission Inventory Questionnaires for years 2000, 2007, 2010. Stack parameters are not expected to change from one year to the next. In each case, the stack modeled is the kiln or furnace stack expected to have the highest air quality impacts. For purposes of the modeling, 100 % of the facility's carbon monoxide emissions were assumed to be emitted from these stacks.

The emissions data represent the highest annual carbon monoxide emission rates that were available from TCEQ's Point Source Emissions Inventory. ATSDR obtained all relevant records for the four industrial facilities, dating back to the first year of this emission inventory (1990). The entries shown above are the highest annual emissions over the entire period of record. ATSDR's modeling assumed that emissions occurred at these rates over the entire period considered in the modeling analysis.

Table A-2. Highest Estimated Carbon Monoxide Concentrations

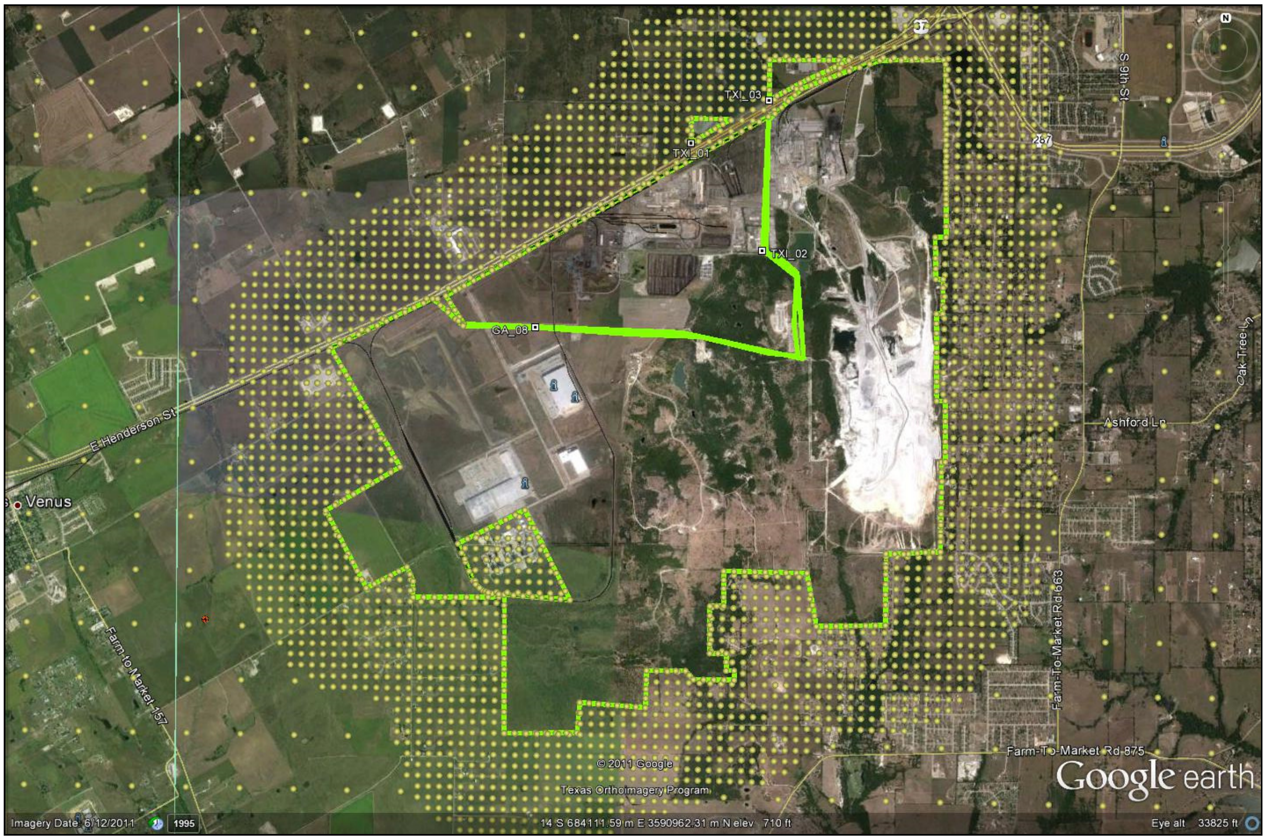
Averaging Time	Highest Estimated Carbon Monoxide Concentration	
	Parts per billion (ppb)	Micrograms per cubic meter ($\mu g/m^3$)
1-hour	848	971
8-hour	553	633
Annual average	103	118
5-year average	87	100

Figure A-1. Aerial Photograph Showing Near-Field Receptor Grid near Ash Grove Cement and Holcim



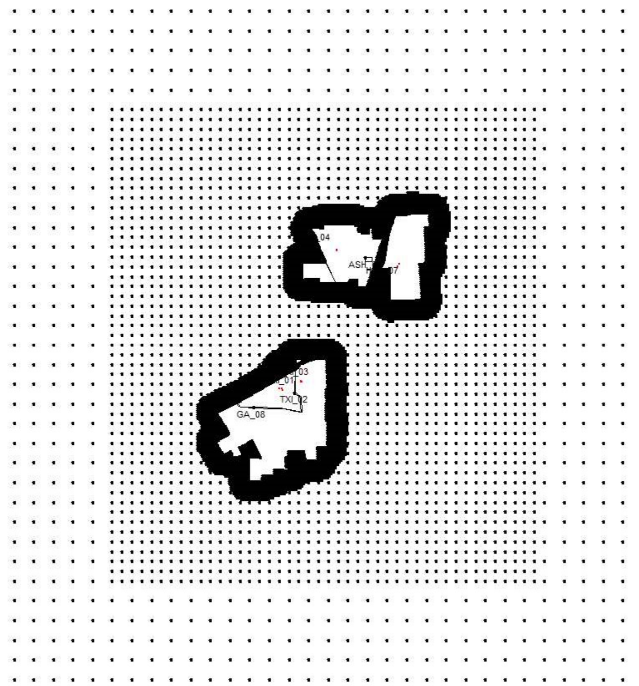
Note: Map shows placement of near-field receptors in the vicinity of the Ash Grove Cement and Holcim facilities. The near-field receptors are placed along the property lines and at 100-meter intervals and appear in the map as green dots. No receptors are placed within the facility boundaries.

Figure A-2. Aerial Photograph Showing Near-Field Receptor Grid near Gerdau Ameristeel and TXI Operations



Note: Map shows placement of near-field receptors in the vicinity of the Gerdau Ameristeel and TXI Operations facilities. The near-field receptors are placed along the property lines and at 100-meter intervals and appear in the map as green dots. No receptors are placed within the facility boundaries. Some intermediate-range receptors (placed at 500-meter intervals) also are displayed.

Figure A-3. Illustration Showing Entire Receptor Grid for Modeling Domain



Note: Map shows proposed placement of all receptors. The far-field receptors at 1,000-meter intervals appear around the exterior of the illustration. The intermediate range receptors at 500-meter intervals also are visible. The near-field receptors at 100-meter intervals also are displayed, but they appear as a shaded area rather than individual points because of their close proximity when displaying the entire modeling domain.

Appendix B: Sulfur Dioxide Health Evaluation

ATSDR addresses health concerns in public health assessments using both quantitative and qualitative methods. For SO_2, the qualitative strength of evidence approach will serve a primary role in deciding the public health significance of SO_2 levels. The strength of evidence approach requires (1) a thorough review of the scientific literature for health effects from acute and chronic exposures, (2) an evaluation of the potential for sensitive groups to be exposed, (3) the evaluation of site-specific exposure scenarios, and (4) the evaluation of co-exposures to other air pollutants.

Although health guidelines describe levels believed to be safe from exposure to a specific chemical on a population basis, they do not describe the likelihood of adverse health effects for exposures above that value. As part of ATSDR's strength of evidence evaluation, we evaluate the likelihood of harmful effects occurring should a health guideline be exceeded. The site-specific evaluation will consider sensitive populations, co-exposures to other contaminants, and the location, frequency, duration and time of day the exposures occur.

Health Effects Assessment

ATSDR evaluated potential health effects in the health consultation by considering the locations of concentrations of SO_2 of concern, the time of day, the frequency and duration of SO_2 peaks of concern, and co-exposure to other contaminants. The following identifies the SO_2 concentration ranges and associated ATSDR level of concern.

>10 – 400 ppb SO_2.
ATSDR recognizes the variability in asthmatic response and uncertainty associated with adopting any single SO_2 concentration as a level of concern.
Exposures to 10-400 ppb SO_2 appears to be the range of most uncertainty as to whether an effect will occur and whether that effect should be considered adverse. ATSDR will use the Midlothian 5-minute data to conduct a site-specific assessment to characterize the likelihood of health effects occurring in this range.

Exposures in this range might be considered a public health hazard depending on the frequency and duration of exposure, co-exposures to other contaminants, and exposure of potentially more sensitive populations, such as children and individuals with pre-existing respiratory disease. Exposures in this range will be evaluated using a site-specific strength of evidence approach.

Peak exposures (5 -minutes) above 10 ppb SO_2 to 400 ppb SO_2 are described as a dose-response continuum (Table B-1 below) where higher concentrations in this range are more likely to cause a response in a greater number of sensitive individuals than lower concentrations in this range. Clinical exposures in this range resulted in a response in healthy mild-to-moderate asthmatic adults and adolescents who were exercising (at an increased ventilation rate). Persons with severe asthma, unhealthy individuals, and children were not included in these studies. These populations might be more sensitive than the populations that were included in the clinical studies. The lowest effect level reported in human clinical studies was 100 ppb SO_2 via mouthpiece exposure (oral breathing) which bypasses the protective effect of the nasal mucosa [1, 2]. The lowest level reported for effects in free-breathing or oronasal breathing subjects occurred about 200-250 ppb SO_2 [3, 4]. An estimated 5 - 30 % of persons with asthma are believed to be sensitive to exposures between 200 and 300 ppb SO_2 and experience moderate or greater decrements in lung function (greater than or equal to a 100% increase in sRaw (airway resistance) and/or greater than or equal to a 15% decrease in Forced Expiratory Volume in 1 second, or FEV1) [7]. Further, an estimated 20% – 35 % of exercising persons with asthma experience moderate or greater lung function decrements at SO_2 concentrations 400 – 500 ppb [5].

Acute effects reported in exercising adult and adolescents with asthma exposed to <400 ppb SO_2 (5 minutes) are considered less serious than those exposed to > 400 ppb SO_2 (exposures <500 ppb do not usually require the individual to cease the activity, do not usually require medication, and do not usually require the individual to seek medical attention). Effects up to 250 ppb SO_2 are equivalent to reported effects of asthmatic responses to exercise alone [6]. Effects such as bronchoconstriction might not be perceived by the exposed individuals at the lower end of this range and symptoms (coughing, wheezing, dyspnea) begin to appear > 400 ppb SO_2.

Exposures of 10 ppb to 400 ppb SO_2 (5 minutes) might be considered of variable *public health concern*, depending on the intensity, frequency and duration of SO_2 exposure. Although about 200 ppb is the lower level of mild to moderate asthmatics experiencing effects while at increased ventilation rates in clinical studies, these studies did not include potentially more sensitive individuals. These studies were performed at laboratory conditions of controlled humidity and temperature, whereas actual exposures might occur at colder and dryer conditions that have been reported to result in an increased response [7, 8].

Current scientific literature links health effects with short-term exposure to SO2 ranging from 5-minutes to 24-hours. The Environmental Protection Agency (EPA) examined potential 5-minute health benchmark values in the 100 – 400 ppb range in the Risk and Exposure Assessment to Support the Review of the SO_2 Primary National Ambient Air Quality Standards [9]. Moreover, according to EPA [9]:

"While there is very strong support for SO2 being causally linked to lung function responses within the range of tested exposure levels (i.e., ≥ 200 ppb) and even down to the 100 ppb level (where SO2 was administered by mouthpiece (Sheppard et al. 1981; Koenig et al., 1990)), there is increasing uncertainty about whether SO2 is causally related to lung-function effects at lower exposure levels below 100 ppb. Since this assessment assumes there is a causal relationship at levels below 100 ppb, the influence of this source of uncertainty would be to over-estimate risk. The SO2-related lung function responses have been observed in controlled human exposure studies and, thus there is little uncertainty that SO2 exposures are responsible for the lung function

responses observed for SO2 exposures in the range of levels tested. Given the lack of chamber data at levels below 100 ppb, the uncertainty is rated as medium."

In addition, the frequency and duration of exposures might increase the risk for longer-term health effects leading to respiratory or cardiac disease. For example, increased frequency and duration of exposure to SO_2 leading to a 24-hour average concentration of 140 ppb SO_2, the former EPA National Ambient Air Quality Standard (NAAQS) may be considered a *public health hazard to all populations.* In epidemiologic studies, SO_2-related respiratory effects were consistently reported at lower concentrations than the clinical studies observed and in areas where the maximum ambient 24-hour average SO_2 concentration was below the former 24-hour average NAAQS level of 140 ppb.

A decrease in heart rate variability has been reported in adults with asthma exposed to 200 ppb SO_2 for 60 minutes [10]. The significance of these short-term effects to chronic cardiac endpoints is still being investigated but such exposures suggest the need for public health concern.

>400-1000 ppb SO_2
Exposures >600 ppb and less than 1000 ppb SO_2 (5 minutes) might cause adverse health effects in an estimated 35% - 60 % of exercising persons with asthma and an unknown portion of other sensitive populations [5]. Effects in exercising adult or adolescent persons with asthma exposed to this concentration range might include more serious health effects that necessitate (1) stopping the exercise, (2) taking medication, or (3) seeking medical attention. Exposures in this concentration range might be considered a *public health hazard to sensitive populations at elevated ventilation rates.*

>1000 ppb SO_2
Exposures to >1000 ppb SO_2 (5 minutes) are considered an *acute public health hazard to all populations.*

Sensitive populations
The following populations are considered sensitive or potentially sensitive to SO_2 exposures in that the response to SO_2 might be more severe or occur at a lower threshold than the general population.

Asthmatics
Many persons with asthma are sensitive to SO_2 exposure [11]. The referenced SO_2 exposure ranges above are based on exposure to exercising asthmatic adults and adolescents.

Children
Children might be at increased risk from exposure to ambient air contaminants with respect to both toxicology and exposure. That children are more toxicologically sensitive to SO_2 but might be more vulnerable because of increased exposure is not clear. Although physiologically based pharmacokinetic modeling has suggested that children might be more vulnerable in the pulmonary region to fine particulate matter, it also

suggests that children's airways might not be more sensitive than adults to reactive gases such as SO_2 [12].

Factors that might contribute to enhanced lung deposition in children include higher ventilation rates, less contribution from nasal breathing, less efficient uptake of particles in the nasal airways, and greater deposition efficiency of particle and some vapor phase chemicals in the lower respiratory tract. A child breathes faster compared with an adult, which might result in increased uptake [13]. Children spend three times as much time outdoors as adults and engage in three times as much time playing sports and other vigorous activities [14]. Based on these parameters, children are more likely to be exposed to more outdoor air pollution than adults. Epidemiologic evidence suggests that air pollution effects (lung function decrements) in children might not be fully reversible, even if the exposure stops, although SO_2 was not a major contaminant in these studies [15].

Other SO_2 sensitive or vulnerable populations
Other sensitive populations might include obese individuals, individuals who have chronic pro-inflammatory state like diabetics, older adults (65+ years), and individuals with pre-existing respiratory and cardiopulmonary disease [16]. Vulnerable individuals are those who spend time outdoors at increased exertion levels and might include children, outdoor workers, and individuals who play sports or exercise outdoors.

Adverse health effects.
What constitutes an adverse health effect has long been debated [17]. Whether a less serious observed effect to SO_2 exposures in the 100 – 400 ppb range is considered an adverse health effect is still the subject of uncertainty. Some scientists consider a biological effect as an adverse effect only if the effect is medically significant in that the subject must take medication, seeks medical treatment (hospital or medical practitioner visit), or must stop the activity in which the subject was engaged. Other scientists consider a biological effect to be adverse if the exposure reduces the reserve function of the lung, reducing the subject's ability to withstand additional insults.

ATSDR recognizes the variability in asthmatic response and uncertainty associated with adopting any single health comparison value. ATSDR has described the reported range of health effects from the scientific literature in the range of most uncertainty, 10 – 400 ppb SO_2. ATSDR needs to make a site-specific assessment to characterize the likelihood of health effects occurring in this range. A site-specific evaluation would consider the location of SO_2 concentrations, the frequency, duration, time of day and day of week, and co-exposures to other contaminants.

Severity and incidence of respiratory symptoms has been shown to increase with increasing concentrations between 200 and 600 ppb SO_2 in free-breathing exercising adults with asthma following peak exposures (5-10 minutes). Statistically significant increases in symptoms (chest tightness, coughing, or wheezing) are observed at concentrations > or = 400 ppb SO_2.

Exposure to concentrations at or above 200 ppb SO_2 is considered by ATSDR to potentially result in a diminished capacity to respond to exposures to other agents in sensitive individuals at elevated ventilation rates. The diminished capacity results from a moderate or greater decrement in lung function (i.e. increases in sRaw > or = 100% or decrease in FEV1 > or = 15% in 5-30% of exercising asthmatics at 200-300 ppb SO_2 with 5-10 minute exposures). This diminished capacity from the decrement in lung function is considered an ***adverse health effect***. This adverse health effect might be considered a ***public health hazard to sensitive populations at elevated ventilation rates*** depending on the potential impact of site-specific frequency and duration of exposure and the temporal and spatial considerations and co-exposure potential. In addition, exposure must occur to a sensitive individual while at an elevated ventilation rate.

Exposure to concentrations at or above 400 ppb SO_2 might result in the increasing potential for the development of symptoms (chest tightness, coughing, and wheezing) in sensitive populations at elevated ventilation rates. SO_2 induces moderate or greater decrements in lung function (described above) in 20%-60 % of persons with asthma at 400 – 1000 ppb SO_2 with 5-10 minute exposures.

Exposure to concentrations at or above 600 ppb SO_2 is considered a ***public health hazard to sensitive populations at elevated ventilation rates*** because of the increasing potential that medical intervention may be appropriate.

These conclusions are based on clinical investigations reported in peer-reviewed scientific literature. These clinical investigations are based on responses in typically mild to moderate healthy adults with asthma at elevated ventilation rates in controlled temperature and humidity environments. Because of ethical considerations, investigations do not usually involve persons with severe asthma, children, or unhealthy individuals. These and other potentially sensitive or vulnerable individuals (obese individuals, individuals with pro-inflammatory state like diabetics, adults greater than 65 years, and individuals with pre-existing respiratory and cardiopulmonary disease) might be at risk for effects at lower SO_2 concentrations or more severe effects at equivalent concentrations. In addition, sensitive populations might experience an exacerbation of effects from exposure to dry, cold air or co-exposure to other agents such as particulate matter or ozone. Therefore, adverse health effects could occur to the more vulnerable or sensitive individuals at levels below 200 ppb SO_2. Although clinical investigations have not addressed free-breathing levels below 200 ppb, mouthpiece investigations have reports effects at 100 ppb.

Epidemiologic studies have provided consistent evidence of an association between ambient SO_2 exposures and increased respiratory symptoms in children, particularly those with asthma or chronic respiratory symptoms. Multicity studies have observed these associations at a median range of 17 to 37 ppb (75^{th} percentile: -25 to 50) across cities for 3-hr average SO_2 and 2.2 to 7.4 ppb (90^{th} percentile: 4.4 to 14.2) for 24-hr average SO_2 [18].

Table B-1. Sulfur Dioxide Concentrations of Interest
Peak exposures

Respiratory effects in clinical studies. Peak exposures < 15 minutes.

	Less serious effects in exercising asthmatics →			More serious effects in exercising asthmatics →	
10 ppb MRL	**100 ppb** Lowest oral exposure effects	**200-250 ppb** Lowest oronasal exposure effects	**400 ppb** Symptoms: cough wheeze dyspnea	**500-600 ppb** Take medication Seek medical attention Stop activity	**1000 ppb** Lowest Non-sensitive Populations
% asthmatics affected	5 - 30 % (200-300 ppb)	20 – 35 % (400 – 500 ppb) →		35 - 60 % (600 – 1000 ppb) →	

Short-term exposure
75ppb
1-hour (short-term)
NAAQS (99th percentile daily maximum concentration averaged over three consecutive years)

[1]EPA has revoked their previous short-term 24-hour standard and annual average standard.

Health Guideline Values

The following are health-based guidelines for sulfur dioxide.

Short-term health-based criteria (based on human clinical studies)

ATSDR Acute MRL screening level (10 min)		10 ppb
UK/N Ireland	(15 minutes)	100 ppb
	(60 minutes)[1]	135 ppb
WHO 2005 Guidelines [2] (10 minutes)		190 ppb
CA EPA[1]	(60 minutes)	250 ppb
EPA[3]	(1-hour current standard)	75 ppb

Chronic health-based criteria (based on epidemiological studies)

EPA[4] (24-hour NAAQS-Revoked in 2010)	140 ppb
Northern Ireland (24 hour)[5]	48 ppb
CA EPA[2] (24-hour)	40 ppb
WHO 2005 Guidelines (24-hour)	8 ppb
EPA (Annual Average NAAQS—Revoked in 2010)	30 ppb

1 not to be exceeded more than 24 times/calendar year
2 not to be exceeded value
3 not to exceed the 99th percentile of 1-hour daily maximum concentration averaged over three consecutive years
4 not to be exceeded more than once per year
5 not to be exceeded more than 3 times/calendar year

ATSDR's acute minimal risk level (MRL) [19]. Acute exposures <10 ppb SO_2 are not likely to cause adverse health effects. The MRL is a screening level below which exposure is believed to be without adverse (non-cancerous) health effects to all populations, including sensitive groups. The MRL is not a threshold for health effects, but exposures to concentrations above the MRL will be evaluated further using the strength of evidence approach and site-specific factors.

EPA acute exposure guideline levels (AEGLs) for sulfur dioxide. AEGLs are intended to apply to once-in-a-lifetime exposures to the general population including infants and children, and other individuals who might be sensitiveand susceptible.

AEGL1 (10 minutes – 4 hours)	200 ppb
AEGL2 (10 minutes – 4 hours)	750 ppb

AEGL 1 – general population and susceptible individuals could experience notable discomfort, irritation, or certain asymptomatic, non-sensory effects. Effects are not disabling and are transient and reversible upon cessation of exposure.

AEGL 2 – general population and susceptible individuals could experience irreversible or other serious, long-lasting adverse health effects or impaired ability to escape.

References

1. Sheppard D, Saisho A, Nadel JA, et al. 1981. Exercise increases sulfur dioxide-induced bronchoconstriction in asthmatic subjects. Am Rev Respir Dis 123:486-491.

2. Trenga CA, Koenig JQ, Williams PV. 2001. Dietary antioxidants and ozone-induced bronchial hyperresponsiveness in adults with asthma. Arch Environl Health. 56(3):242-249.

3. Horstmann DH, Roger LJ, Kehrl HR, and Hazucha MJ. 1986. Airway sensitivity of asthmatics to sulfur dioxide. Toxicol Ind Health. 2:298-298.

4. Boushey HA, Bethel RA, Sheppard D, Geffroy B, et al. 1985. Effect of 0.25 ppm sulfur dioxide on airway resistance in freely breathing, heavily exercising, asthmatic subjects. Am Rev Respir Dis. 131:659-661.

5. US Environmental Protection Agency. 2008. Integrated Science Assessment for Sulfur Oxides – Health Criteria. National Center for Environmental Assessment. Office of Research and Development. Research Triangle Park, North Carolina. EPA/600/R-08/047-F.

6. Horstman DH, Seal E, Folinsbee LJ, Ives P, and Rogers LJ. 1988. The relationship between duration and sulfur dioxide induced bronchoconstriction in asthmatic subjects. Am Ind Hyg Assoc J. 49:38-47.

7. Bethel RA, Sheppard D, Epstein J, Tam E, Nadel JA, Boushey HA. 1984. Interaction of sulfur dioxide and dry cold air in causing bronchoconstriction in asthmatic subjects. J Appl Physiol, 57, 419-423.

8. Linn WS, Shamoo DA, Anderson KR, Whynot JD, Avol EL, Hackney JD. 1985. Effects of heat and humidity on the responses of exercising asthmatics to sulfur dioxide exposure. Am Rev Respir Dis, 131, 221-225.

9. US Environmental Protection Agency. EPA Risk and Exposure Assessment to Support the Review of the SO2 Primary National Ambient Air Quality Standard Final Report. U.S. Environmental Protection Agency. July, 2009. Available at: http://www.epa.gov/ttn/naaqs/standards/so2/data/200908SO2REAFinalReport.pdf

10. Tunnicliffe WS, Hilton MF, Harrison RM, and Ayres JG. 2001. The effect of sulphur dioxide exposure on indices of heart rate variability in normal and asthmatic adults. Eur Respir J. 17:604-608.

11. US Environmental Protection Agency. 1994. Review of the National Ambient Air Quality Standards for Sulfur Oxides: Assessment of Scientific and Technical Information. Supplement to the 1986 OAQPS Staff Paper Addendum (Final Report). Research Triangle Park, NC: Office of Air Quality Planning and Standards.

12. Ginsberg GL, Foos BP, and Firestone MP. 2005. Review and analysis of inhalation dosimetry methods for application to children's risk assessment. J f Toxicol Environ Health A. 68(8):573-615.

13. Koenig JQ and Mar TF. Sulfur Dioxide: Evaluation of current California air quality standards with respect to protection of children. Prepared for the California Air Resource Board, California Office of Environmental Health Hazard Assessment. September 1, 2000.

14. US Environmental Protection Agency. Exposure Factors Handbook. 1997. Washington, DC.

15. Gauderman WJ, Avol E, Gilliland F, Vora H, Tomas D, et al. The effect of air pollution on lung development from 10 to 18 years of age. N Engl J Med. 2004. 351(11):1057-1067.

16. US Environmental Protection Agency. 2007. Integrated Science Assessment for Sulfur Oxides- Health Criteria. First External Review Draft. National Center for Environmental Assessment-RTP Division. Office of Research and Development. EPA/600/R-07/108.

17. American Thoracic Society. 2000. What constitutes an adverse effect of air pollution? Am J Respir Crit Care Med. 161:665-673.

18. US Environmental Protection Agency. 2008. Integrated Science Assessment for Sulfur Oxides- Health Criteria. Second External Review Draft. National Center for Environmental Assessment-RTP Division. Office of Research and Development. May 2008. EPA/600/R-08/047.

19. Agency for Toxic Substances and Disease Registry. 1998. Toxicological Profile for Sulfur Dioxide. US Department of Health and Human Services. Atlanta, GA.

Appendix C. ATSDR Sulfur Dioxide Modeling for the Ash Grove and Holcim Facilities

ATSDR conducted air dispersion modeling analysis to estimate levels of air pollution because no ambient air monitoring data were available near Ash Grove and Holcim cement plants in Midlothian area, Texas. Specifically, ATSDR conducted air dispersion modeling analysis to estimate sulfur dioxide (SO_2) levels in the community based on facility configurations, emission rates, local meteorological conditions, and other factors. This appendix describes ATSDR's air dispersion modeling analysis. The modeling was designed to characterize the combined air quality impacts from two industrial facilities in the Midlothian area and does not account for influences from any other sources. All model input files used for this modeling are available in electronic format from ATSDR, upon request.

Model selection. ATSDR utilized the following tiered modeling approach, starting with a basic screening model then working towards more complicated modeling approaches:

- Screening-level dispersion modeling using AERSCREEN Version 11076 – which is the recommended screening level air quality model based on AERMOD (US EPA, 2005; US EPA, 2014a). ATSDR used this screening model to potentially eliminate the need for more detailed modeling effort at the site as well as develop an initial worst-case assessment of what the exposure to SO_2 could be.

- The Human Exposure Model-3 (HEM-3) – ATSDR utilized HEM-3 version 1.3 as an intermediate model between screening with AERSCREEN and more detailed modeling. HEM-3 is primarily used for performing air toxics risk assessments for sources emitting hazardous air pollutants and applicable to other toxic gases/vapors and aerosols released to atmosphere (US EPA, 2013).

- The **A**merican **M**eteorological **S**ociety/**Environmental P**rotection **A**gency **R**egulatory **MODEL** (AERMOD) with AERMOD VIEW™ Version 8.0.5 from Lakes Environmental). ATSDR used AERMOD for in-depth modeling. The AERMOD VIEW™ Version 8.0.5 from Lakes Environmental is supported by US EPA AERMOD Version 12060, which is the preferred/recommended model in EPA's Guideline on Air Quality Models (US EPA, 2005; US EPA, 2014a). AERMOD is a steady-state plume dispersion model for assessing pollutant concentrations from various sources, including point, area, and volume sources. The model employs hourly sequential pre-processed meteorological data to estimate concentrations. AERMOD is applicable to receptors in all types of terrain, including flat and complex. The US EPA have been progressively updated the AERMOD modeling system and its components (US EPA, 2014a).

Pollutants. This appendix reviews the modeling that ATSDR conducted for SO_2.

Facilities to model. The air dispersion modeling included SO_2 emitted from Ash Grove Cement and Holcim Operations in Midlothian Texas. The primary emission source is through kiln stacks. This reporting is consistent with the knowledge that industrial emission sources are dominated by fuel combustion sources and other high-temperature sources (US EPA 2014b).

ATSDR's approach was to model yearly emission rates of SO_2 from one stack per facility, and the stack selected was the one expected to have the least favorable dispersion (i.e., the shortest kiln or furnace stack and the lowest exit velocity). For each facility, ATSDR allocated 100% of the facility-wide emissions to the one stack selected for modeling. In other words, 100% of each facility's SO_2 emissions were assumed to be emitted from the stack that would lead to the highest offsite air quality impacts. Although some facilities may have ground-level emission sources of SO_2 (e.g., exhaust from trucks and small engines), these account for small fraction of the facility's overall inventories and were not considered for modeling. Building downwash was not considered, primarily because the stacks are considerably higher than the nearby buildings and structures.

Meteorological data. AERMOD, like most refined dispersion models, requires inputs that characterize local meteorological conditions-typically hourly observations of wind speed, wind direction, temperature, and other parameters. For this modeling, ATSDR used the electronic meteorological data sets that Texas Commission of Environmental Quality (TCEQ) had already processed for modeling applications in Ellis County, Texas. The data used were for medium surface roughness, which is appropriate for rural and suburban areas. The specific data set processed by TCEQ and used in modeling applications in this area includes surface meteorological data from the Dallas-Fort Worth Airport station(DFW, ID # 03927processed with upper air data from upper station Stephenville, Texas (SEP, ID #13901) for calendar years 2006 to 2010 (TCED, 2013). Each year was modeled separately.

Terrain data. Elevation data for the Midlothian area were obtained from the National Elevation Dataset available from the U.S Geological Survey. These data were used to assign elevations to every location where air pollution was modeled and to make realistic assessment of how terrain affects atmospheric dispersion (USGS, 2014).

Receptor grid. In the field of dispersion modeling, "receptors" refer to the locations where models estimate air pollution levels. Receptors can be assigned to any geographic area of interest. The proposed receptor grid for this modeling application was selected to help pinpoint locations with maximum impact from the primary stack at an individual facility. It is standard practice to have a high concentration of receptors in area where one expects air pollution levels to be highest and fewer receptors in other areas. This approach helps ensure the highest air population levels are identified, while saving computational time. The receptor grid network with three tiers of receptors is presented in Figure C-1: Below is the explanation of each receptor grid tier:

- Fine grid near-field receptors. The most receptors were placed in the immediate vicinity of the two facilities. Specifically receptors were placed at 25-meter intervals along the facility boundaries and at regular spacing to a distance of 100 meter from the facility boundary. Concentrations were not modeled for locations within the facility boundaries (we removed receptors inside the facility boundaries).
- Intermediate grid receptors. At distance up to 10 kilometers from the facility boundaries, receptors were placed at 500-meter intervals.
- Coarse grid for far-field receptors. At locations between 5 and 14 kilometer were placed at 1000-meter intervals. Modeling was conducted up to 50 km away from the facility boundaries, however; only up to 14 km distance results are analyzed. The outputs from the modeling confirmed that this modeling domain was adequate and that higher air quality impacts for SO_2 did not occur at locations further downwind.

Model Inputs and emission rates. Table C-1 presents model setup and input information for AERSCREEN. Table C-2 provides source characteristics and Table C-3 presents annual emission rates per facility for Ash Grove and Holcim cement plants. Eastern Research Group (ERG), an ATSDR contractor, used this data before and was able to provide it to ATSDR. The data in Table C-2 and C-3 is also publicly available through the TCEQ point source emission inventory questionnaire data. The annual emissions are the total amounts of SO_2 released over the course of the year. These values were used to calculate emission rate model input and were assumed to remain constant throughout the year.

Model outputs and averaging times. The results for AERSCREEN and HEM-3 (not shown) revealed a need for a refined modeling analysis with AERMOD. The model was run with yearly meteorological data and annual emission rates converted to g/s. The combined emissions from both facilities were dominated by Ash Grove facility emissions and were then the reference for concentration level contours. The main outputs for each receptor are the 4th highest maximum daily 1-hour concentration values averaged over a year (99th percentile). These concentrations represent the combined air quality impact from both Ash Grove and Holcim cement plant facilities, not considering contributions from other sources. Table C-4 lists the 4th highest predicted SO_2 concentrations for years 2006, 2007, 2008, 2009, and 2010. The 4th highest daily 1-hour concentration levels falls in a location inside the facility boundaries. Figures C-2 to C -11 show aerial maps with overlaid contours of 4th highest concentrations over the distance from the Ash Grove modeled kiln stack. In addition, one map each year shows the distance from the Ash Grove modeled kiln stack and fence line and to the nearest school. Figure C-12 are yearly wind roses for 2006 to 2010 in Midlothian, TX. The highest 24-hour average concentration and the highest annual average concentration are not reported, but available upon request.

Uncertainties and Limitations. ATSDR considered the uncertainties and limitations of these modeling results. The model inputs for stack parameters are based on direct observations of facility conditions, and these are believed to be highly accurate. The meteorological data used in the model are based on observations at the Dallas –Fort Worth Airport. Although this location is approximately 30 miles away from Midlothian, the prevailing wind directions in the data set are similar to those encountered in the Midlothian area and terrain level Dallas-Fort Worth and Midlothian. The emission rates are based on annual emission estimates from the kiln stack without taking into consideration fugitive emissions throughout the cement production process in each facility. Also, the annual emission rates were assumed to remain constant throughout the year. In reality, emission rates vary from one hour to the next, and short-term fluctuations in emissions and resulting concentration changes are not captured in the modeling analysis. Based on comments received during peer review (see Appendix E), this uncertainty did not allow ATSDR to make any definitive health conclusions regarding short-term exposures to SO_2 emitted from Ash Grove and Holcim. ATSDR was not able to obtain 1-hour continuous emissions rate data needed to help overcome this uncertainty. Finally, however, changes in meteorological conditions are addressed into the AERMET processing.

References

[Lakes] Lakes Environmental Software. 2014. AERMOD VIEW^{TM} Gaussian Plume Dispersion Model – AERMOD. Version 8.05 to 8.5. [Updated 2014; Accessed 2014 January 30]. Available online from: http://www.weblakes.com/products/aermod/.

[TCED] Texas Commission on Environmental Quality (2013) Meteorological data for air dispersion modeling. [Updated 2013; Accessed 2014 January 30]. Available from: http://www.tceq.texas.gov/permitting/air/modeling/aermod_datasets.html.

[US EPA] Environmental Protection Agency (2005). Federal Register. Part III. Environmental Protection Agency. 40 CFR Part 51. Revision to the Guidance on Air Quality Models: Adoption of a Preferred General purpose (Flat and complex terrain) dispersion model and other revisions; Final Rule. Federal Register 70(216): 68218 – 61.

[US EPA] Environmental Protection Agency (2013). Technology Transfer Network FERA (Fate, Exposure, and Risk Analysis). Risk Assessment and Modeling – Human Exposure model (HEM). [Updated 2013 February 22; Accessed 2014 January 30]. Available online from: http://www.epa.gov/ttn/fera/human_hem.html .

[US EPA] Environmental Protection Agency (2014a). Preferred/Recommended Models. Technology Transfer Network Support Center for Regulatory Atmospheric Modeling. [Updated 2013 December 24; Accessed 2014 January 30]. Available online from: http://www.epa.gov/ttn/scram/dispersion_prefrec.htm#aermod

[US EPA] Environmental Protection Agency (2014b). Sulfur dioxide. [Updated 2014 January 8; Accessed 2014; January 29]. Available online from: http://www.epa.gov/airquality/sulfurdioxide/

[USGS] United States Geological Survey. National Elevation Dataset. (Updated August 2006; Accessed 2013 January 30]. Available from: http://ned.usgs.gov/ .

Table C-1. Sample of input data for AERSCREEN model

Parameter designation and units	Input
Stack parameters	
Emission rate (g/s)	40.99
Stack height (m)	94.49
Stack inner diameter (m)	4.118
Plume exit temperature (K)	390.8
Plume exit velocity (m/s)	15.98
Other parameters	
Units of inputs	Metric
Urban/rural classification	Rural
Minimum ambient distance	30
Use of flagpole receptors (y/n)	N
Flagpole receptor height	N
Building downwash information	
No inclusion of building downwash	
Terrain Height information	
Maximum distance to probe	Default (5000m)
10 Discrete receptors	No
Flagpole receptors	No
Source elevation (m)	Default (0 m)
Makemet meteorology	
Minimum ambient temperature (K)	Default (250 K)
Maximum ambient temperature(K)	300 K
Minimum wind speed	1.5 m/s
Anemometer Height (m)	Default (10 m)
Surface Characteristics	
AERMET Seasonal Tables	Option 2 among 3 options
Dominant Surface Profile	
Grassland	Option 6 among 6 options
Dominant Climate Profile	
Dry Conditions	Option 3 among 3 options

Table C-2: Stack characteristics for Ash Grove (AG) and Holcim (HO) Cement Plants

Input parameters	Facility	
	Ash Grove Cement	Holcim
Stack modeled	"Kiln # 1"	"Kiln # 1"
UTM-North (zone 14) (m)	3,599,875	3,599,176
UTM-East (zone 14) (m)	687,419	690,633
Stack height (m)	45.7	83.2
Stack diameter (m)	3.20	4.12
Exit temperature (K)	450	384.82
Exit velocity (m/s)	9	17.07
SO_2 annual emissions		

Table C-3: Annual emission rates per facility (Ash Grove and Holcim Cement plants) -

Year	Ash Grove		Holcim	
	Emission rate (TPY)	Emission rate (g/s)	Emission rate (TPY)	Emission rate (g/s)
2006	6263	181.63	3330	96.57
2007	6227	180.58	2481	71.949
2008	4776	138.50	2706	78.474
2009	2697	78.21	1661	48.169
2010	4115	119.34	1089	31.581

Note: The parameters are all taken from data documented on the facility's emission inventory questionnaires for years 2006 through 2010.

Table C-4: Ash Grove & Holcim Cement Plant integrated AERMOD predicted SO_2 concentrations for yearly emissions

Year	Ash Grove Emission rate (TPY)	Holcim Emission rate (TPY)	4th highest 1-hr daily for a year ($\mu g/m^3$)	4th highest 1-hr daily for a year (ppb[1])
2006	6263	3330	325.37	124.19
2007	6227	2481	294.68	112.47
2008	4776	2706	258.16	98.53
2009	2697	1661	149.62	57.11
2010	4115	1089	249.98	95.41

[1]Unit conversions: 75 ppb = 0.075 ppm; 1ppm = 2.62 mg/m^3 1 mg = 1000 µg: 1000ppb = 2620 $\mu g/m^3$

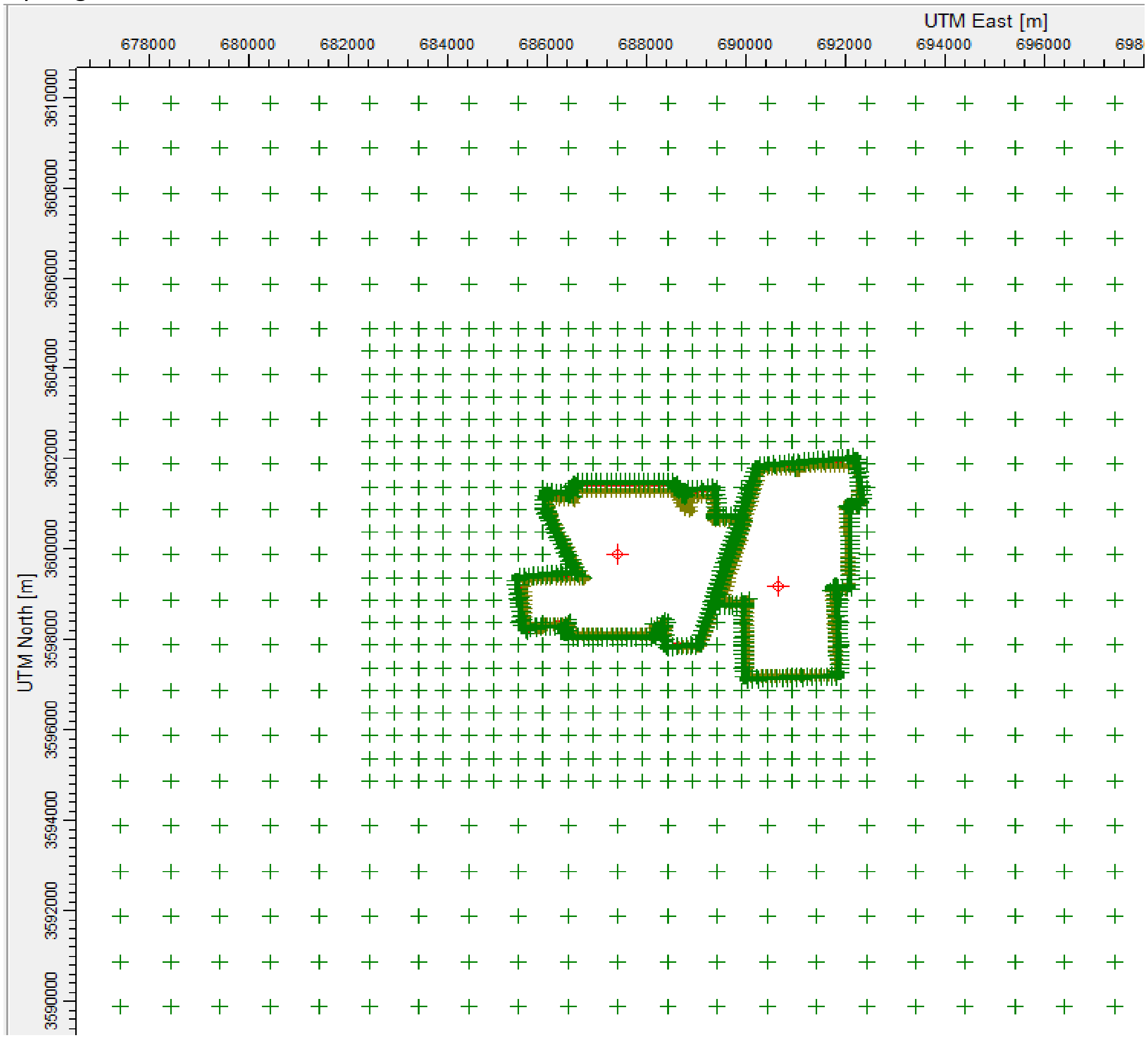
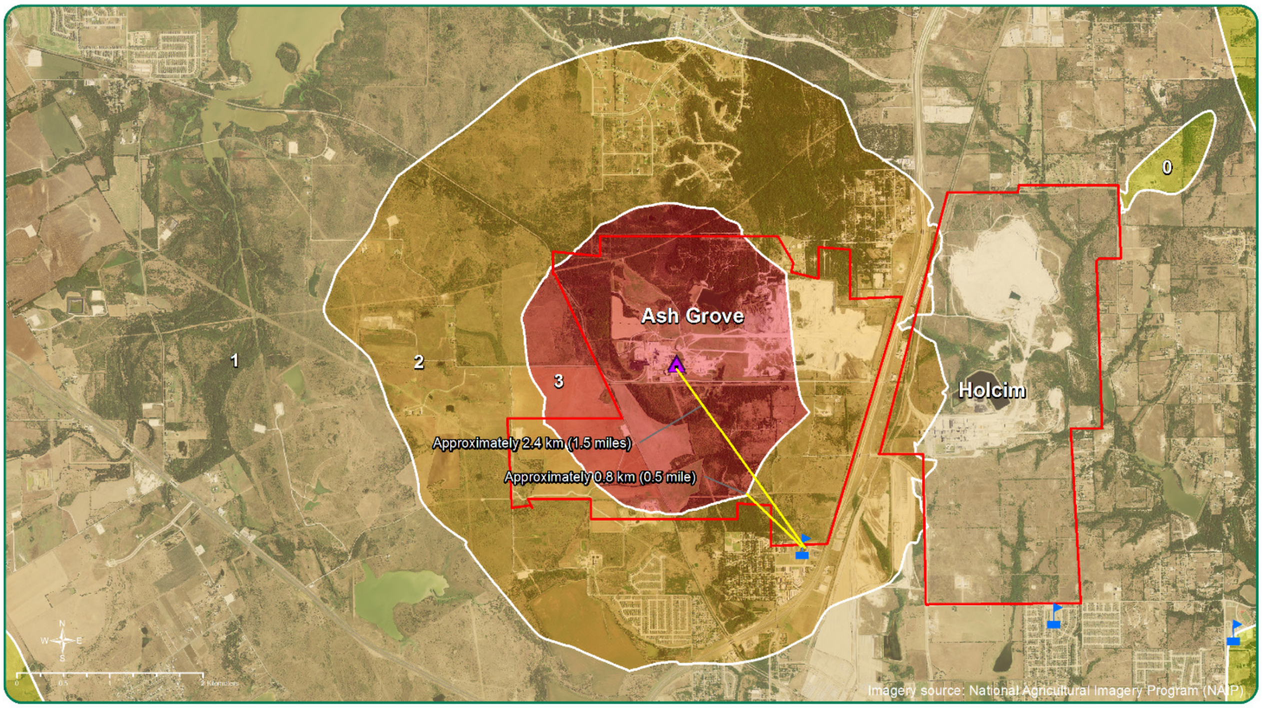


Figure C-1: Receptor grid Network with three tiers (fine, intermediate and coarse) -



Legend

Index: 0, 1, 2, 3 — Facilities — Public schools — Source

Index	Population†	Min — Max distance from the source (km)	Concentration ranges
0	1,013,116	5.04 – 48.65 km	24 – 49 µg/m3 (9-19 ppb)
1	21,163	2.41 – 11.02 km	49 – 98 µg/m3 (19-35 ppb)
2	3,380	Inside fenceline – 3.83 km	98 – 197 µg/m3 (35-75 ppb)
3	0*	Inside fenceline – 1.73 km	>197 µg/m3 (75 ppb) (NAAQS††)

Population Data Source: 2010 U.S. Census
† Calculated using an area-proportion spatial analysis technique
* Population value adjusted based on aerial review
†† National Ambient Air Quality Standards (NAAQS)

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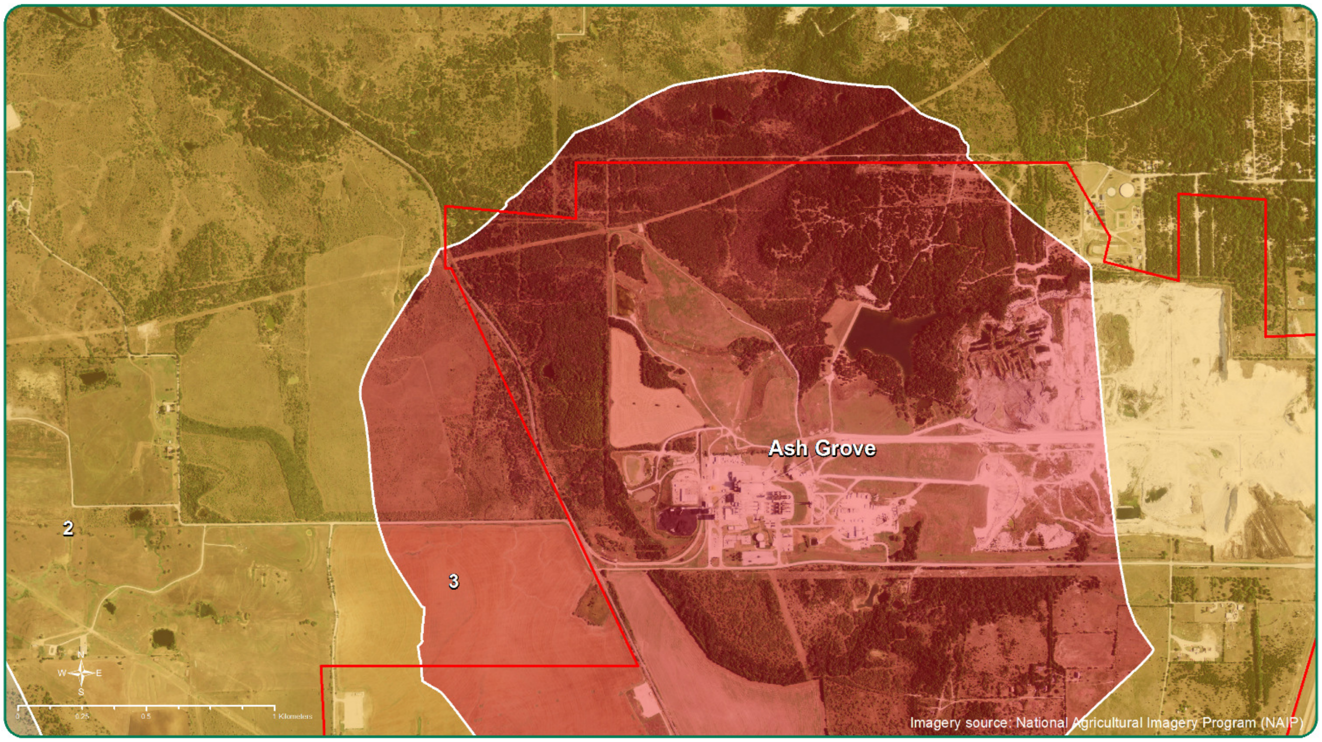
Figure C-2: Aerial map with SO_2 concentration contours overlaid for 2006 -



Legend

Index: 0, 1, 2, 3

Facilities

Index	Population†	Min — Max distance from the source (km)	Concentration ranges
0	1,013,116	5.04 – 48.65 km	24 – 49 µg/m3 (9-19 ppb)
1	21,163	2.41 – 11.02 km	49 – 98 µg/m3 (19-35 ppb)
2	3,380	Inside fenceline – 3.83 km	98 – 197 µg/m3 (35-75 ppb)
3	0*	Inside fenceline – 1.73 km	>197 µg/m3 (75 ppb) (NAAQS††)

Population Data Source: 2010 U.S. Census
† Calculated using an area-proportion spatial analysis technique
* Population value adjusted based on aerial review
†† National Ambient Air Quality Standards (NAAQS)

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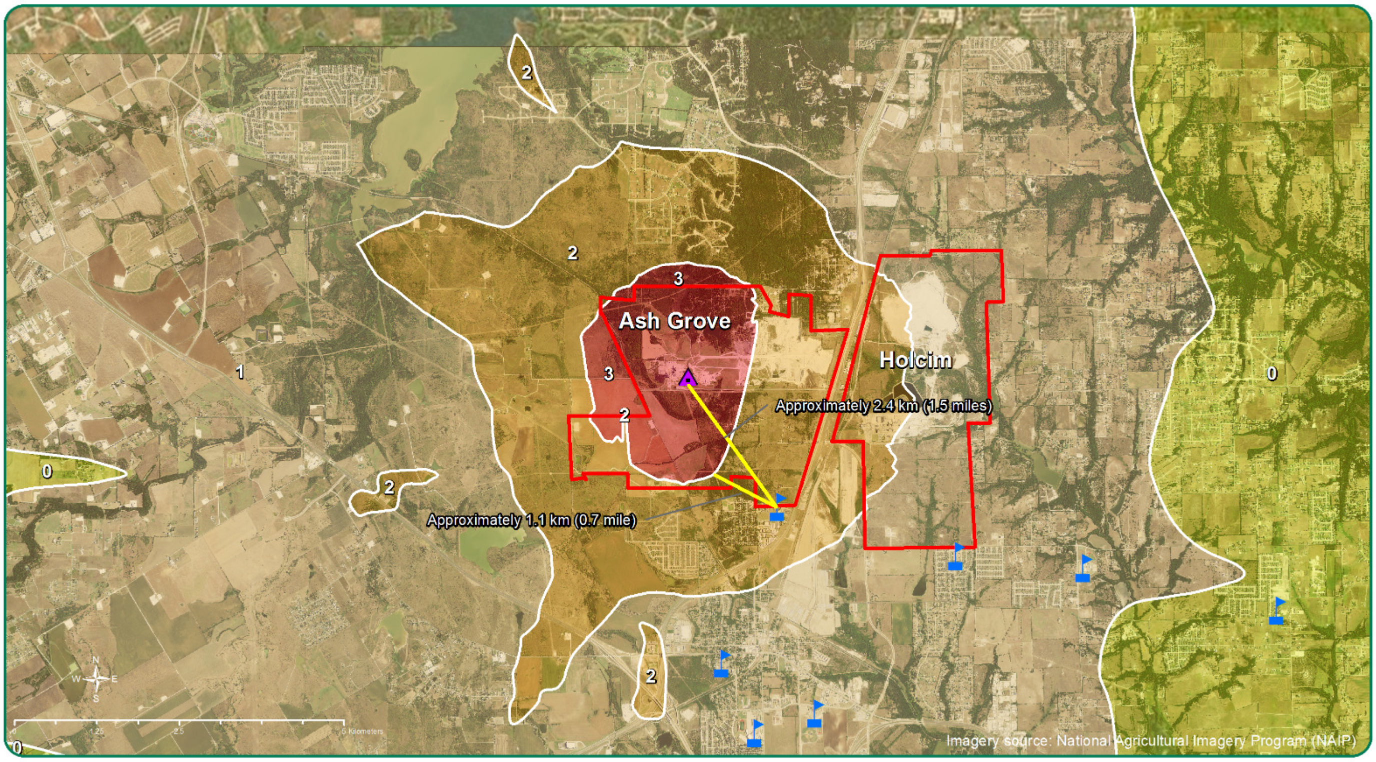
Figure C-3 Aerial map with SO_2 concentration contours overlaid for 2006 [Zoomed]



Legend

Index: 0, 1, 2, 3

Facilities

Public schools

Source

Index	Population†	Min — Max distance from the source (km)	Concentration ranges
0	153,375	7.10 – 21.21 km	24 – 49 µg/m3 (9-19 ppb)
1	41,926	3.02 – 17.83 km	49 – 98 µg/m3 (19-35 ppb)
2	3,489	Inside fenceline – 5.92 km	98 – 197 µg/m3 (35-75 ppb)
3	0*	Inside fenceline – 1.73 km	>197 µg/m3 (75 ppb) (NAAQS††)

Population Data Source: 2010 U.S. Census
† Calculated using an area-proportion spatial analysis technique
* Population value adjusted based on aerial review
†† National Ambient Air Quality Standards (NAAQS)

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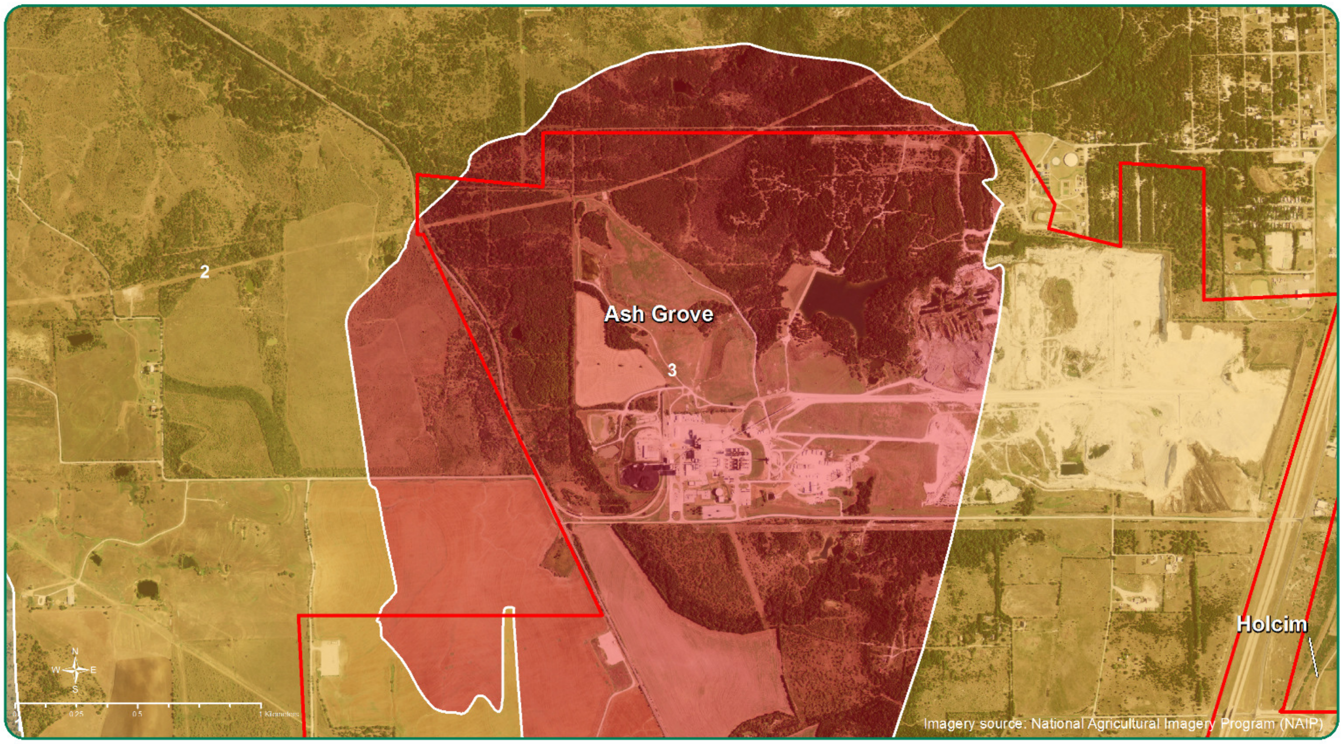
Figure C-4: Aerial map with SO_2 concentration contours overlaid for 2007 -



Legend

Index: 0, 1, 2, 3 — Facilities

Index	Population†	Min — Max distance from the source (km)	Concentration ranges
0	153,375	7.10 – 21.21 km	24 – 49 µg/m3 (9-19 ppb)
1	41,926	3.02 – 17.83 km	49 – 98 µg/m3 (19-35 ppb)
2	3,489	Inside fenceline – 5.92 km	98 – 197 µg/m3 (35-75 ppb)
3	0*	Inside fenceline – 1.73 km	>197 µg/m3 (75 ppb) (NAAQS††)

Population Data Source: 2010 U.S. Census
† Calculated using an area-proportion spatial analysis technique
* Population value adjusted based on aerial review
†† National Ambient Air Quality Standards (NAAQS)

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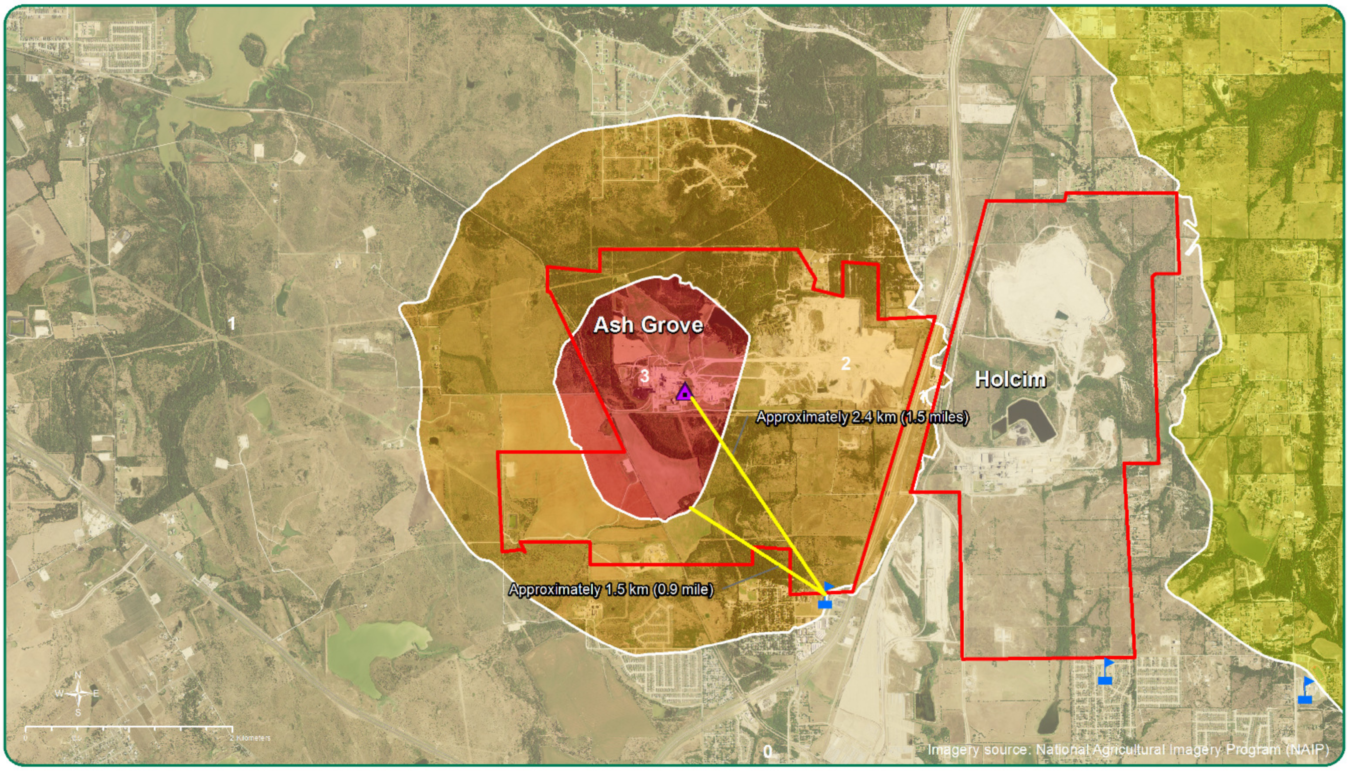
Division of Community Health Investigations

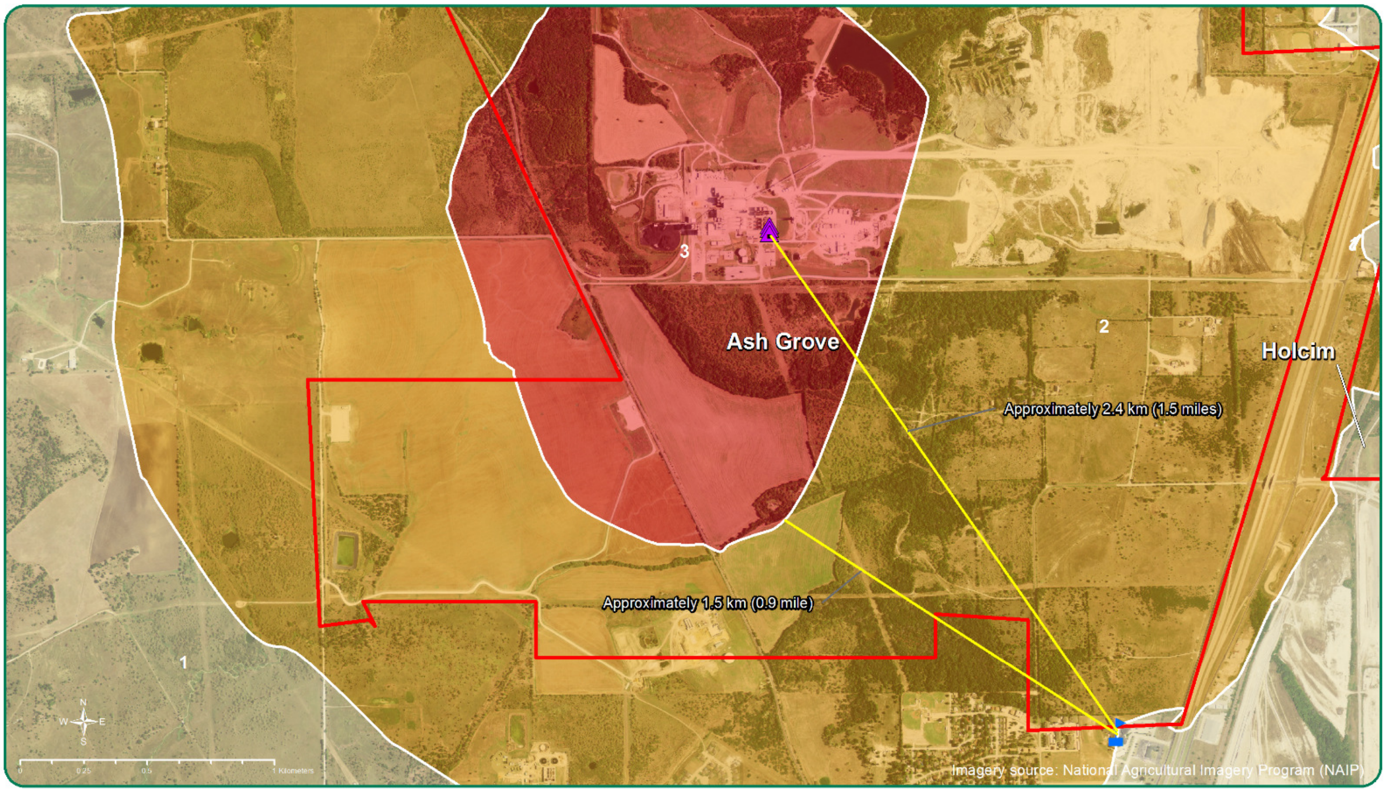
Figure C-5: Aerial map with SO_2 concentration contours overlaid for 2007 [Zoomed]



Index	Population†	Min — Max distance from the source (km)	Concentration ranges
0	177,181	4.7 – 21.21 km	24 – 49 µg/m3 (9-19 ppb)
1	19,434	2.28 – 13.98 km	49 – 98 µg/m3 (19-35 ppb)
2	1,041	Inside fenceline – 2.87 km	98 – 197 µg/m3 (35-75 ppb)
3	0*	Inside fenceline – 1.27 km	>197 µg/m3 (75 ppb) (NAAQS††)

Population Data Source: 2010 U.S. Census
† Calculated using an area-proportion spatial analysis technique
* Population value adjusted based on aerial review
†† National Ambient Air Quality Standards (NAAQS)

Figure C-6: Aerial map with SO_2 concentration contours overlaid for 2008 -



Index	Population†	Min — Max distance from the source (km)	Concentration ranges
0	177,181	4.7 – 21.21 km	24 – 49 µg/m3 (9-19 ppb)
1	19,434	2.28 – 13.98 km	49 – 98 µg/m3 (19-35 ppb)
2	1,041	Inside fenceline – 2.87 km	98 – 197 µg/m3 (35-75 ppb)
3	0*	Inside fenceline – 1.27 km	>197 µg/m3 (75 ppb) (NAAQS††)

Population Data Source: 2010 U.S. Census
† Calculated using an area-proportion spatial analysis technique
* Population value adjusted based on aerial review
†† National Ambient Air Quality Standards (NAAQS)

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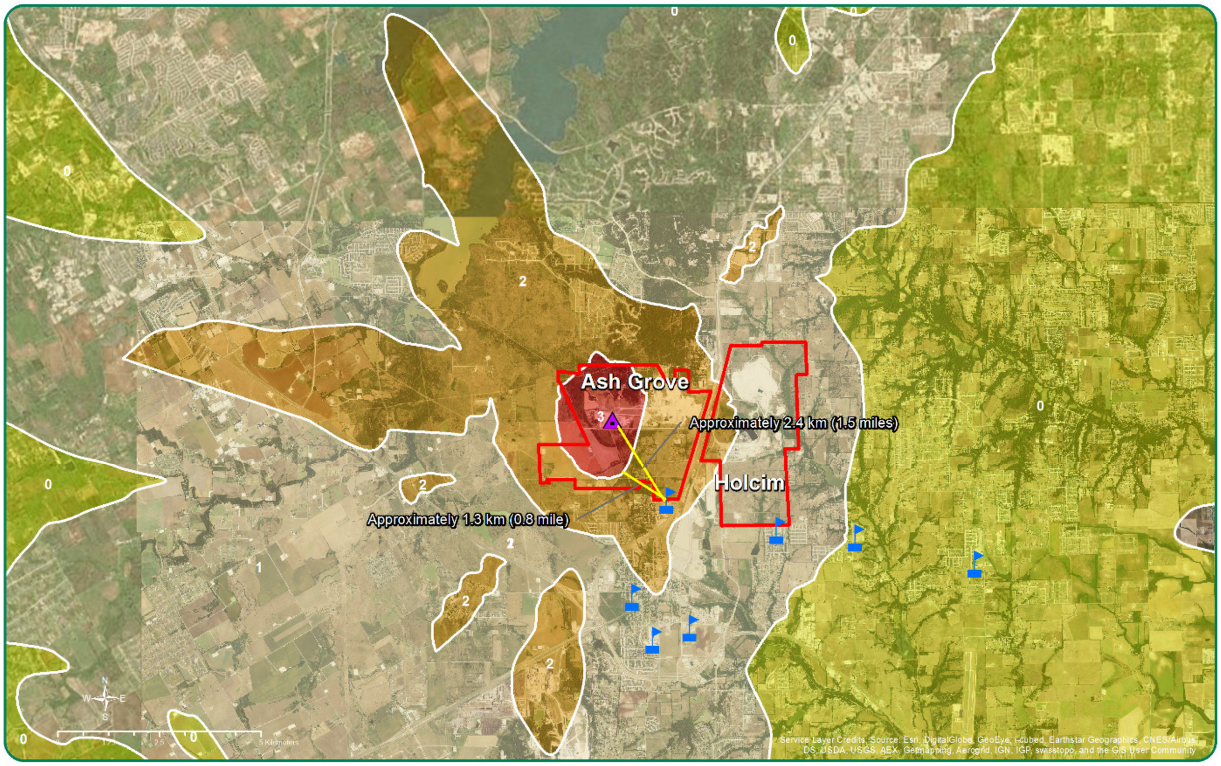
C-7: Aerial map with SO_2 concentration contours overlaid for 2008 [Zoomed]



Legend

Index: 0, 1, 2, 3

Facilities

Public schools

Source

Index	Population†	Min — Max distance from the source (km)	Concentration ranges
0	108,880	5.94 – 21.21 km	12 – 24 µg/m3 (5-9 ppb)
1	85,119	2.64 – 19.60 km	24 – 49 µg/m3 (9-19 ppb)
2	4,755	Inside fenceline – 12.13 km	49 – 98 µg/m3 (19-35 ppb)
3	0*	Inside fenceline – 1.72 km	>98 µg/m3 (>35 ppb)††

Population Data Source: 2010 U.S. Census

† Calculated using an area-proportion spatial analysis technique

* Population value adjusted based on aerial review

†† The NAAQS for SO_2 is 197 µg/m3 (75 ppb)

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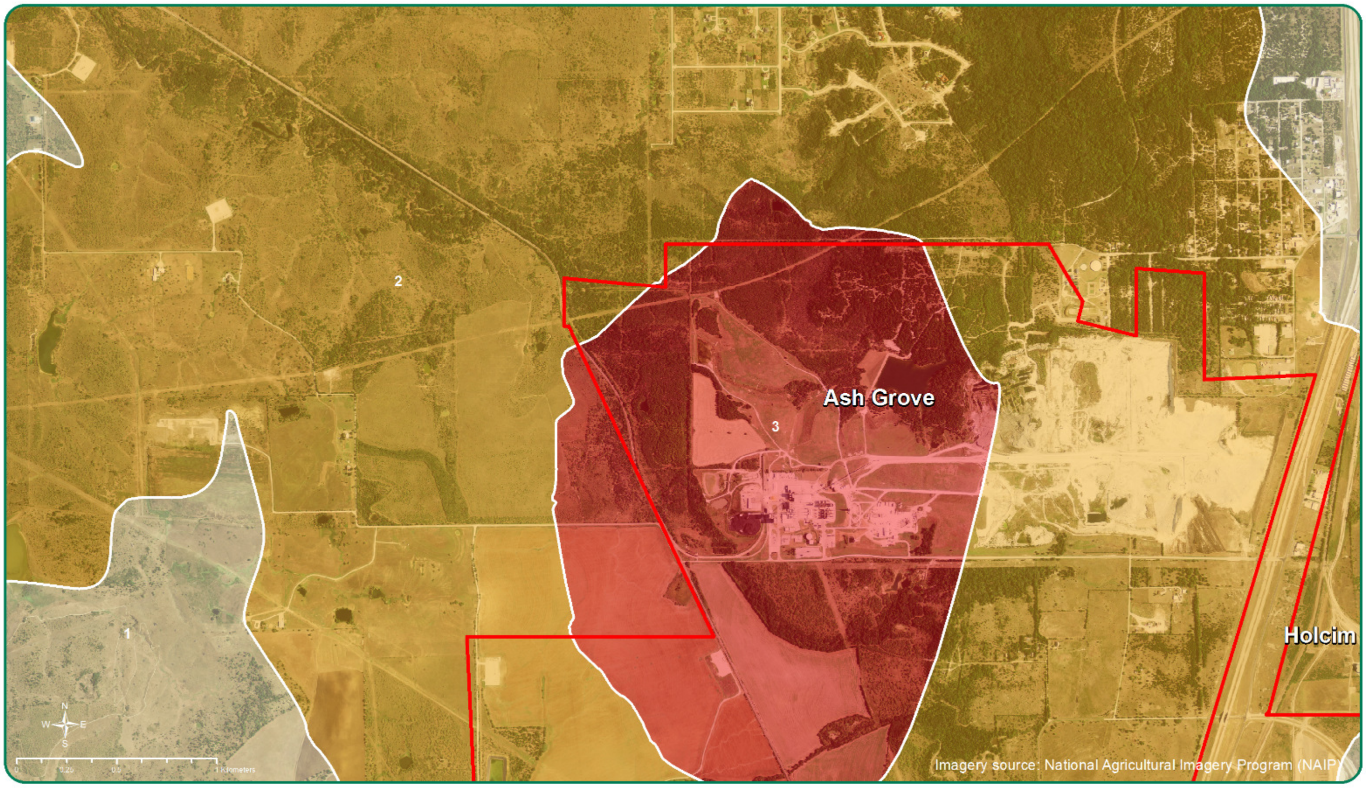
C-8: Aerial map with SO_2 concentration contours overlaid for 2009 -



Legend

Index | Facilities

- 0
- 1
- 2
- 3

Index	Population†	Min — Max distance from the source (km)	Concentration ranges
0	108,880	5.94 – 21.21 km	12 – 24 µg/m3 (5-9 ppb)
1	85,119	2.64 – 19.60 km	24 – 49 µg/m3 (9-19 ppb)
2	4,755	Inside fenceline – 12.13 km	49 – 98 µg/m3 (19-35 ppb)
3	0*	Inside fenceline – 1.72 km	>98 µg/m3 (>35 ppb)††

Population Data Source: 2010 U.S. Census
† Calculated using an area-proportion spatial analysis technique
* Population value adjusted based on aerial review
†† The NAAQS for SO_2 is 197 µg/m3 (75 ppb)

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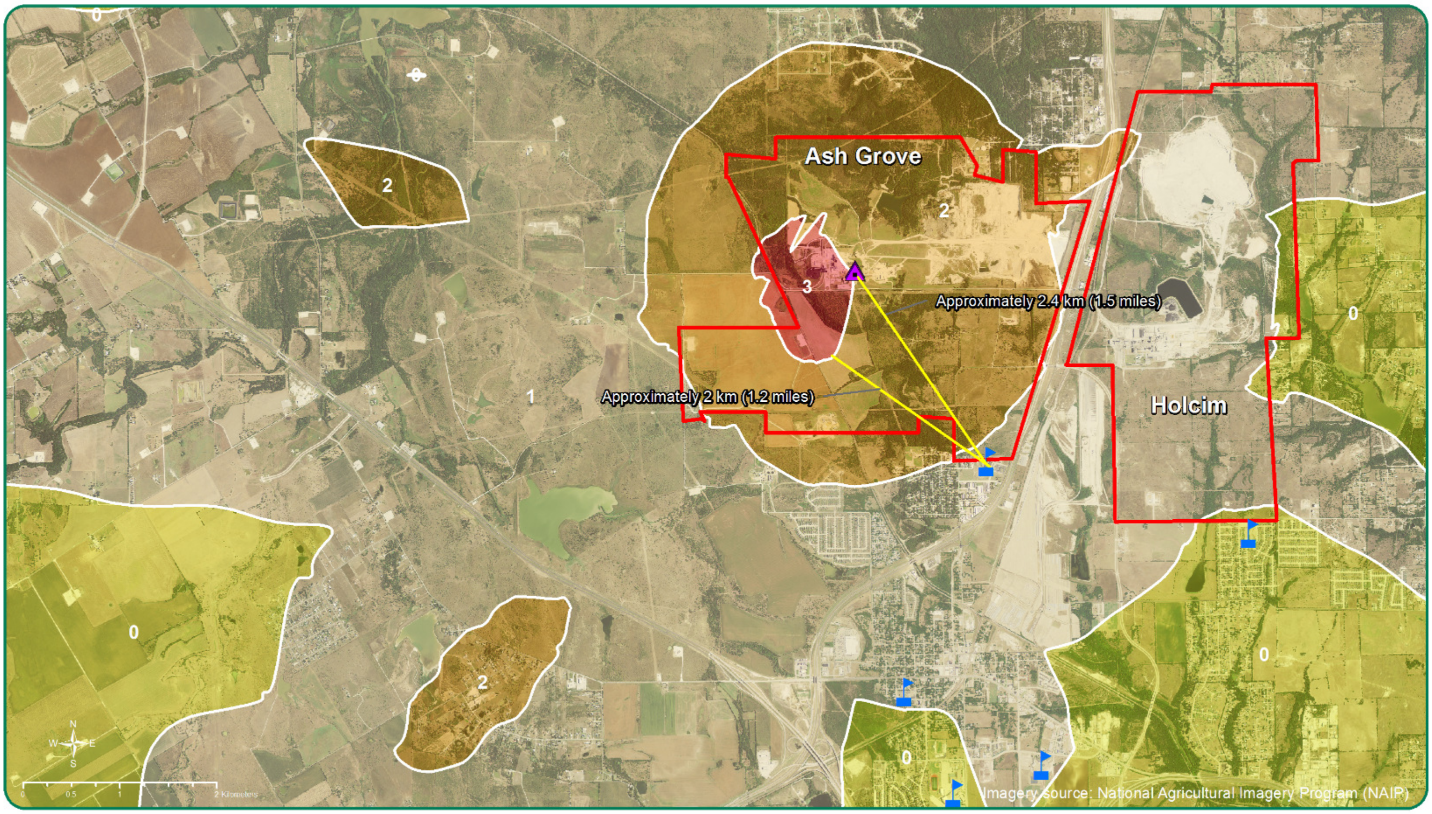
C-9: Aerial map with SO_2 concentration contours overlaid for 2009 [Zoomed]



Legend

Index
- 0
- 1
- 2
- 3

Facilities
Public schools
Source

Index	Population†	Min — Max distance from the source (km)	Concentration ranges
0	174,743	4.36 – 21.21 km	24 – 49 µg/m3 (9-19 ppb)
1	16,205	Inside fenceline – 16.26 km	49 – 98 µg/m3 (19-35 ppb)
2	575	Inside fenceline – 6.92 km	98 – 197 µg/m3 (35-75 ppb)
3	0*	Inside fenceline – 1.06km	>197 µg/m3 (75 ppb) (NAAQS††)

Population Data Source: 2010 U.S. Census
† Calculated using an area-proportion spatial analysis technique
* Population value adjusted based on aerial review
†† National Ambient Air Quality Standards (NAAQS)

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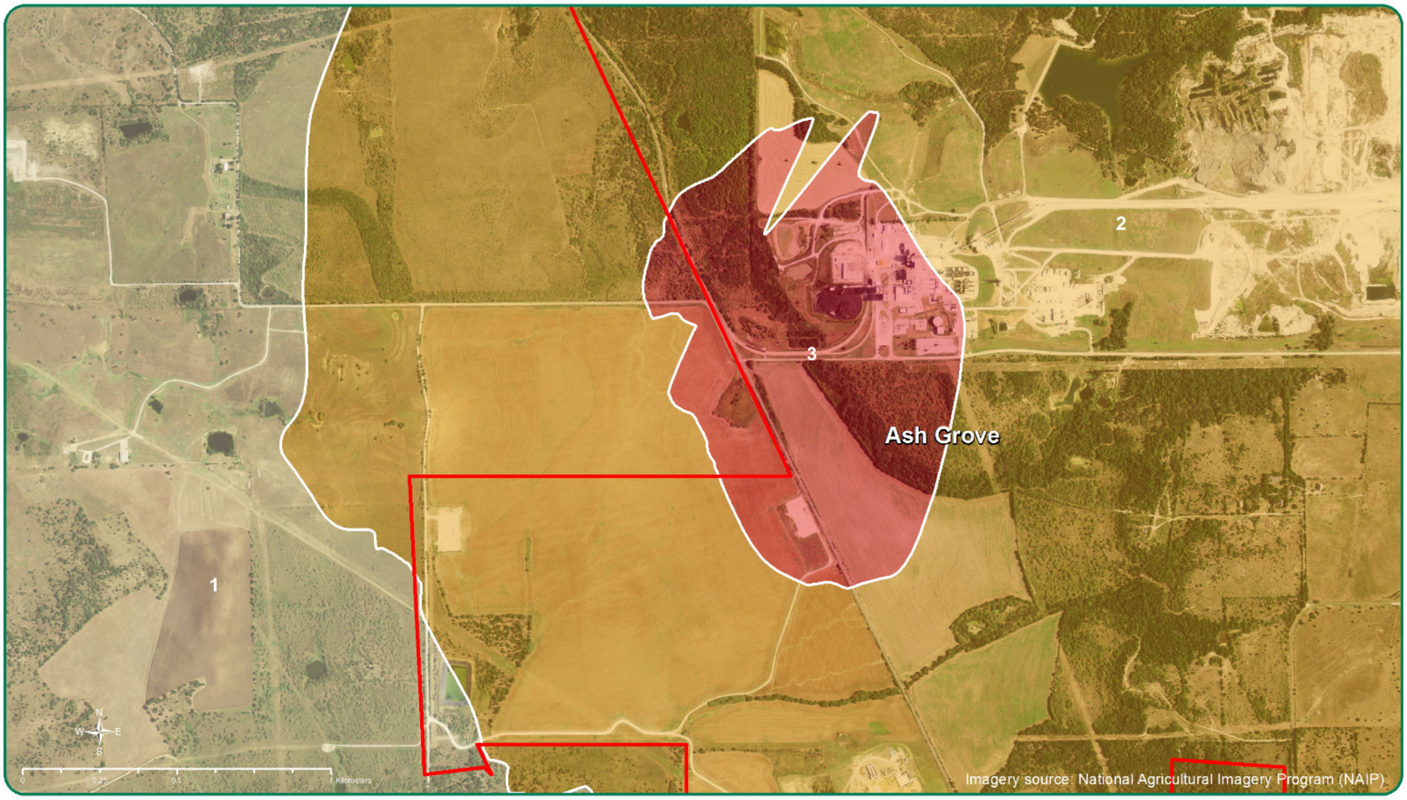
C-10: Aerial map with SO_2 concentration contours overlaid for 2010 -



Legend

Index — Facilities

- 0
- 1
- 2
- 3

Index	Population†	Min — Max distance from the source (km)	Concentration ranges
0	174,743	4.36 – 21.21 km	24 – 49 µg/m3 (9-19 ppb)
1	16,205	Inside fenceline – 16.26 km	49 – 98 µg/m3 (19-35 ppb)
2	575	Inside fenceline – 6.92 km	98 – 197 µg/m3 (35-75 ppb)
3	0*	Inside fenceline – 1.06km	>197 µg/m3 (75 ppb) (NAAQS††)

Population Data Source: 2010 U.S. Census
† Calculated using an area-proportion spatial analysis technique
* Population value adjusted based on aerial review
†† National Ambient Air Quality Standards (NAAQS)

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C-11: Aerial map with SO_2 concentration contours overlaid for 2010 -

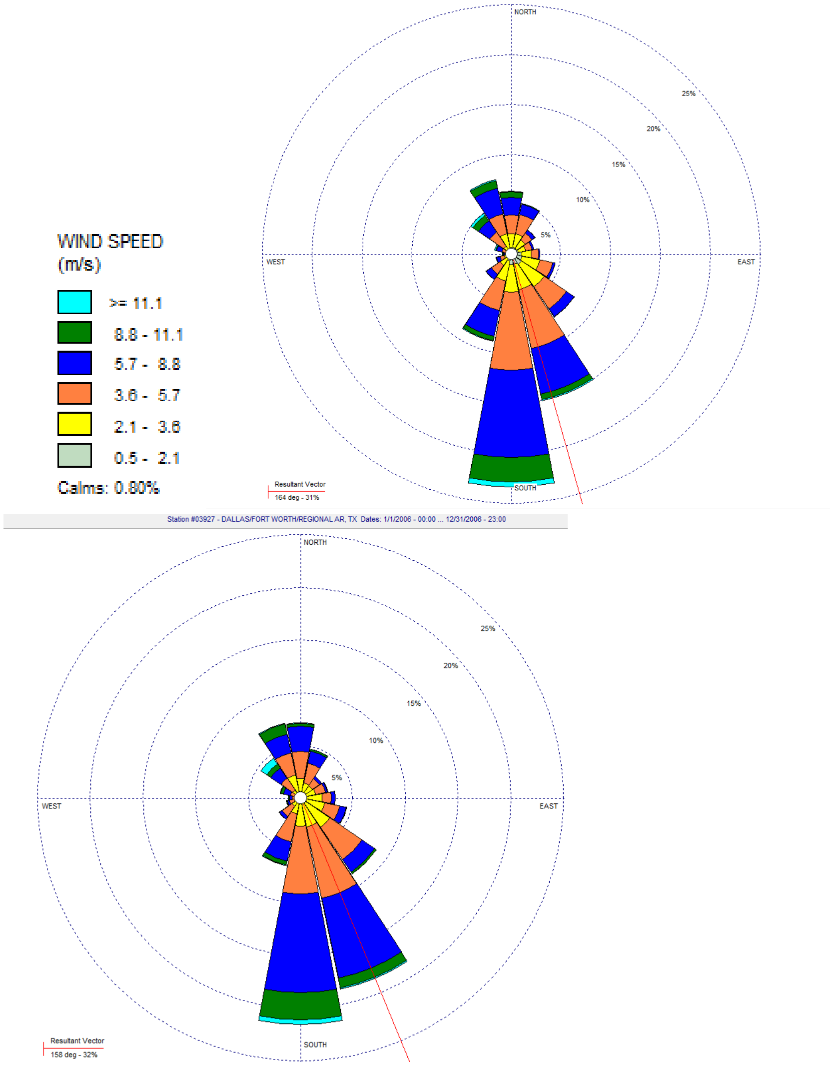


Figure C-12: Wind roses for the Midlothian area near the Ash Grove and Holcim cement plants. Station ID #03927 – DALLAS/FORTH WORTH/REGIONALTX from 2006 and 2007, respectively.

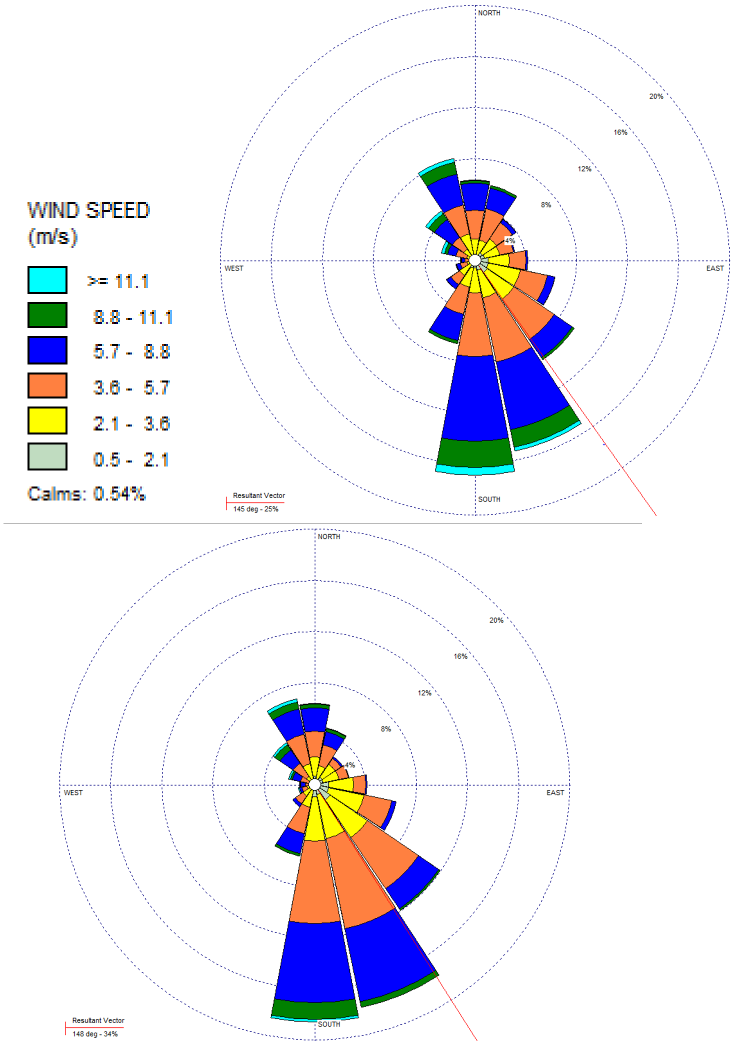


Figure C-12 (continued): Wind roses for the Midlothian area near the Ash Grove and Holcim cement plants. Station ID #03927 – DALLAS/FORTH WORTH/REGIONALTX from 2008 and 2009, respectively.

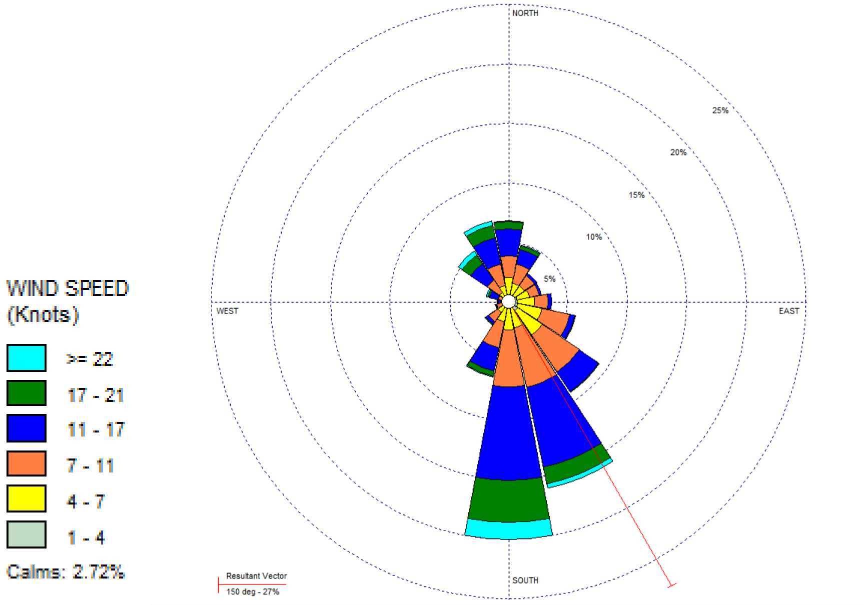


Figure C-12 (cont.): Wind roses for the Midlothian area near the Ash Grove and Holcim cement plants. Station ID #03927 – DALLAS/FORTH WORTH/REGIONALTX for 2010, respectively.

Appendix D. ATSDR Response to Public Comments

In this section we present comments received during the public comment period, from 11/16/12 through 02/14/13, for the Midlothian Area Air Quality Health Consultation titled, "Assessing the Public Health Implications of the Criteria (NAAQS) Air Pollutants and Hydrogen Sulfide", and our responses to those comments. Please note that the numbering scheme is as follows: (1) Section A – General Comments, (2) Section B – Pollutant-specific Comments, and (3) Section C – Editorial/Miscellaneous Comments. Section B is further divided into specific subsections by pollutant category. ATSDR responses directly follow each comment. All page numbers referenced in this section refer to the public comment version of this health consultation.

Section A. General Comments

Comments submitted from industry and the public that are general or overarching comments about our approach, findings, and requests for considering additional information are included in this section. These are organized by subsections: Overarching Comments (A.1) and by Comments on ATSDR Recommendations, and Conclusions (A.2).

Subsection A.1. Overarching Comments:

A.1.1. Comment:

We want to thank you for the all work that went into this ATSDR Midlothian Health Consultation and for the opportunity to provide comments.

It is obvious much effort went into this evaluation. It is one of the better researched (if not the best) and the best written ATSDR document that we have had opportunity to review.

Midlothian is basically a heavily industrial area that happens to have families --children and schools nestled in its midst.

The objective of this consultation as well as all other consultations in this series should not be to incriminate or exonerate the industries. It should remain an effort to evaluate potential environmental impact on current or future public health – and the effort to accomplish this is reflected.

We believe this series of consultations, analyses and recommendations will be used as resources and guides for other communities and industries with similar issues. Recommendations, strengths or weaknesses reflected herein will have impact far beyond Midlothian. These analyses could either be an indicator that the edge has not been reached or additional precautionary measures must be taken to protect public health.

We know we cannot "un-ring the bell," and change the past. Therefore the most important public health task that lies ahead for all of us is, "What can we do to protect the current and future public health of this community?" It is this objective and perspective that this and all further analysis should maintain -- or this great investment of resources, energy and time will be futile.

Schools - A consistent and major concern since ATSDR was petitioned has been exposure at schools and other areas where children gather and engage in active sports. Schools, athletic fields, and parks where children engage in strenuous outdoor sports are all nestled among these industries, railroads, highways, etc. Addressing this issue is critical because these children are a daily concentration of a population who are, because of their activities and immature body systems, more susceptible to environmental contamination and furthermore do not have a choice. We are confident impact on children who attend these schools will be added to this and future consultations.

Response to comment A.1.1: ATSDR evaluated the locations of schools and parks in the Midlothian area and determined that there are three schools (J.A Vitovsky, T.E. Baxter, and Mt. Peak Elementary schools) and Jaycee Park that are located nearest to the boundaries of the facilities in Midlothian. The J.A. Vitovsky Elementary and Jaycee Parks are located south of the Ash Gove boundary, T.E. Baxter is located south of Holcim, and the Mt. Peak Elementary is located southeast of TXI and Gerdau, east of Midlothian Tower. Neither of these schools nor Jaycee Park are located in the most frequent downwind direction (downwind would be north of the facilities) although they may on occasion be considered downwind during certain times of the year. The primary concern for potential exposures, based on the findings of this Health Consultation, is for SO_2. For the Mt. Peak Elementary School, the nearest monitor is Midlothian Tower and, based on our analysis, the primary concern is for SO2 exposures north of the facility in Cement Valley, not south or southeast of the facility. Therefore, we do not have any evidence that children who attend the Mt. Peak Elementary School were exposed to harmful levels of SO_2. As for the other schools and Jaycee Park, ATSDR performed an additional analysis of SO_2 by conducting air modeling (since air monitoring data were not available) using emissions from Ash Gove and Holcim. Based on this analysis, it does not appear that children who attend or staff that work at the J.A. Vitowsky or T.E. Baxter schools would have experienced any harmful SO_2 exposures from Ash Grove of Holcim. However, in response to a peer review comment, ATDSR determined that too much uncertainty exists in the modeling analysis to definitively conclude whether past harmful SO2 exposures (between 2006-2010) occurred to children or staff at the J.A. Vitowsky school. However, two kilns at Ash Grove have been shut down and significant upgrades to the emissions controls to the remaining kiln occurred in late 2014. These actions should significantly reduce SO2 emissions from Ash Grove. TCEQ should verify that these reductions have occurred when they evaluate the 2015 annual SO2 emissions from Ash Grove. ATSDR has added this information to the Community Concerns section relating to a similar concern expressed to ATSDR before public comment.

A.1.2. Comment:

2.3 and 2.3.5 Other Emission Sources - Offsite monitoring adequacy is questioned for determining whether the source is from industries or from other sources – as well as it should be.

When addressing whether emissions from other sources should be attributed to some of the readings, the last sentence in the last paragraph of section 2.3.5 is well stated. It reads, “On the contrary, emissions from the four facilities of interest are expected to have considerably greater air quality impacts at locations nearest these facilities, especially considering their proximity to each other.”

One would need to ask, though, “What difference would this make?” It is the impact – not necessarily the source that needs to be evaluated.

However, there is a concern exposures are greater and broader than those captured by the monitors mainly because monitoring does not exist for a large portion of the affected areas and for the activities involved.

Emissions captured via CEM in the stacks should be relatively reliable – but not all encompassing. However, as this report points out, monitors that could have captured all releases associated with the industries do not exist in many of the potentially affected areas.

Midlothian is affected by emissions from other large local sources. Absent from this analysis is the heavy rail and truck transport associated with these industries. Offsite monitors did not exist to capture the bulk of this activity.

Response to comment A.1.2: The focus of this and other ATSDR health consultations in Midlothian is to evaluate exposures related to the four facilities that we were petitioned to evaluate and not other potential sources. However, some monitors may also capture air emissions from other sources. ATSDR is not making any attempt quantitatively to apportion the exposures to one source or another but has evaluated the total levels of exposure. The placement of monitors and general adequacy of the air monitoring database was evaluated in ATSDR's initial health consultation (ATSDR, 2015). We agree that there are some data gaps that hinder our ability to evaluate all contaminants for all locations and timeframes.

A.1.3. Comment:

The classification "sensitive individuals" or "general public" is confusing when you speak of potential harm. When you are looking at a population that has been exposed to SO_2 and/or ozone and PM for a lifetime, at what point does the general public become "sensitive individuals"? This category should be added to "groups sensitive to air pollution" conclusion 1, page viii.

Response to comment A.1.3: We believe it is important to distinguish between sensitive individuals versus the general public as the scientific literature does provide some direction as to what levels (whether short- or long-term exposures) may effect susceptible or sensitive persons, like asthmatics, versus the population that is considered not to have pre-existing risk factors (termed the general public).

A.1.4. Comment:

Applicable National Ambient Air Quality Standards (NAAQS) - There are repeated instances in the document which evaluated historical monitoring data which was not above the applicable NAAQS at the time the data was collected. This historical data was then compared to a current revised or even proposed NAAQS. Scientific data used to develop NAAQS evolves over time. We ask the document be clear in instances where the applicable NAAQS was not exceeded and to temper public health conclusions based on historical data comparisons to current standards.

Response to comment A.1.4: ATSDR used current standards as health comparison values for screening purposes in relation to current and past exposures as they reflect the most updated information on our understanding of the possible harmful effects of the NAAQS air pollutants. Once selected as a contaminant of concern, ATSDR then goes on to evaluate the exposures further using other scientific information to determine if harmful effects were possible. Although the public comment version of this health consultation attempted to make it clear that a past exposure was not above the EPA standard in place at the time of the exposure, ATSDR attempted in the

revised health consultation to make it even clearer by adding in information on ATSDR's evaluation process which includes how we used EPA's NAAQS standard as a health comparison values to screen contaminants for further evaluation.

A.1.5. Comment:

Monitoring data not available - There are numerous times the document states that harmful exposures could have occurred where no monitoring data are available to support these conclusions. We think it could be misleading to make conclusions about public health impacts without any (or without sufficient) data to support such statements. We recommend that all such unsupported conclusions be revised or deleted. We recommend that public health exposure statements and potential public health impact conclusions in the document be limited to instances where sufficient monitoring data is available to support them and to not include conclusions where no monitoring data are available.

Response to A.1.5: ATSDR has reviewed the document to make sure there are no conclusions which are not supported by either ambient air monitoring or air modeling. However, we still must point out instances where there is no data but other evidence (e.g., emission data) indicate that at least there is or was a potential for harmful exposures. In one case, primary based on the emissions data, we had concern for current and past exposures to SO_2 being emitted from Ash Grove. ATSDR performed a modeling analysis and has included the results in the revised health consultation.

A.1.6. Comment:

Future Exposures **-** There are places where the document states that future harmful exposures could occur if circumstances change and actions are not taken to reduce emissions. We believe it is scientifically inappropriate for the document to state or imply that future harmful exposures could occur without sufficient data or evidence to support such allegations. We recommend that all instances alleging future harmful exposures be revised in order to avoid the presentation of misleading conclusions. Additionally, we recommend clearly noting that the exposures or effects are potential unless these have been verified with individual exposure assessments or evaluations.

Response to comment A.1.6: ATSDR has revised our conclusions and recommendations in relation to future exposures because we have obtained additional information on actions taken at TXI and Ash Grove to mitigate current and future emissions. In other instances, ATSDR revised our recommendations to the environmental agencies by indicating that applicable NAAQS standards be enforced to prevent future harmful exposures.

A.1.7. Comment:

Data indicating levels above an EPA standard - There are several places in the document where the text states that monitoring data or estimates were above an EPA standard. EPA has very specific regulatory criteria by which an official exceedance or violation of an ambient air quality standard is determined. In places the document, as drafted, appears to take some liberty implying standards were violated when in fact they were not. Please ensure the document is very clear when describing monitored or estimated data that may be at values above some level of comparison. The EPA ambient standard may not have been officially violated or exceeded.

Response to comment A.1.7: See response to comment A.1.4 above.

A.1.8. Comment:
Distribution of Health Education Material - The document states that ATSDR and the Texas Department of State Health Services (TDSHS) will distribute health education material related to exposures to SO_2, $PM_{2.5}$, and ozone specifically for sensitive and potentially sensitive populations. These materials will include information on health effects and ways to minimize harmful exposures to air pollution. The commenter respectfully requests the opportunity to review and provide input on this material before it is provided to the public.

Response to comment A.1.8: Given that we do not believe that harmful SO_2 exposures are currently occurring and that any concern for concurrent exposures were in the past, ATSDR will not be conducting any follow-up health education in relation to the findings of this health consultation.

A.1.9. Comment:
"1. Purpose and Statement of Issues - To evaluate these concerns, ATSDR gathered relevant information on facility emissions, local meteorological conditions, and ambient air monitoring data. The findings in this document are based on all validated ambient air monitoring data and related information available to ATSDR as of late 2011 (except for some SO2 data that became available in 2012). ATSDR accessed information from multiple parties, including the petitioner, local community groups, industry, and consultants; scientists from the University of Texas at Arlington (UT-Arlington); TDSHS; the Texas Commission on Environmental Quality (TCEQ); and the U.S. Environmental Protection Agency (EPA)."

The above statement says the data is validated, but we wonder whether non-governmental third party data is of sufficient quality on which to base environmental or health conclusions. Please provide documentation that the non-governmental third party data or ATSDR used for public health conclusions in the document that confirms these data are as high quality such as regulatory agency data is.

Response to comment A.1.9: All data evaluated for this health consultation (except for the Holcim $PM_{2.5}$ data) were from governmental agencies (primarily TCEQ). We have reviewed the Holcim $PM_{2.5}$ data which was collected and analyzed by Trinity Consultants and reviewed by UT-Arlington and determined them to be of high quality except, as we noted in the document, they were analyzed by using a continuous monitor which may produce negatively biased data. ATSDR does not use these data to make a health conclusion but does indicate the need to make sure that actual $PM_{2.5}$ levels downwind of the Holcim facility do not exceed the new EPA standard. ATSDR also evaluated other qualitative information from the community regarding their observations of emissions, odors, etc. from the plants; however, we have not evaluated any air monitoring data collected or analyzed by the community in relation to this health consultation.

A.1.10. Comment:

<u>Page 10 – Holcim</u> - "In July 2005, following an application to increase nitrogen oxide emissions, Holcim reached a settlement agreement with DFW Blue Skies Alliance and Downwinders at Risk. This agreement led to Holcim funding several projects to reduce emissions and monitor local air quality. For

example, Holcim agreed to continuously measure downwind ambient air concentrations of fine PM—a project that operated from 2006 to early 2010."

We wonder whether non-governmental third party data is of sufficient quality on which to base environmental or health conclusions. Please provide documentation that these data are of confirmed high quality or please revise conclusions about public health impacts accordingly.

Response to comment A.1.10: Please see response above.

A.1.11. Comment:

2.4 Demographics, Page 14, Nearest areas with potential for elevated short-term exposures**. -** "In addition to the residential neighborhoods and areas listed above, ATSDR considered short-term exposures that residents, visitors, and passers-by might experience when they are in close proximity to the four industrial facilities. These short-term exposures can occur at many places, such as along U.S. Highway 67, which passes along the boundary of all four facilities; at recreational facilities near the facility boundaries (e.g., Jaycee Park, Pecan Trails Golf Course, Massey Lake); and at various nearby business establishments."

We do not see how "along Highway 67" is a realistic point of human exposure. Passersby would be in motor vehicles and only by the facilities for very short periods of time. Please revisit and/or consider eliminating this particular exposure scenario from any health impact conclusions.

Response to comment A.1.11: ATSDR agrees with this comment and has revised this section.

A.1.12. Comment:

ATSDR needs to remove from its Draft all conclusions that fail to comply with standards for providing expert opinion. For conclusions that remain, ATSDR needs to provide what standard they applied to the conclusion for inclusion and how the conclusion meets the standard. When making conclusions that recommend future work, ATSDR needs to take into account the current equipment and regulatory situations.

Response to comment A.1.12: See response to next comment.

A.1.13. Comment:

<u>Remove conclusions that lack support</u>:

The Draft fails to meet the minimum requirements for reliability or admissibility of an expert

report under basic judicial criteria.[3] The Draft should apply a common standard to the conclusions. In the event that the authors of the Draft find their Agency guidance fails to provide suitable instructions then they should use Federal Rule 702 (Rule 702).

The Draft blatantly acknowledges that some of the conclusions ATSDR offers lack the minimal criteria for presentation, and instead of removing such conclusions the Draft states in weak prose that such topics cannot be evaluated but the Draft nevertheless proposes the conclusion, the Draft offers statements such as "no measurements are available to support this judgment" (page 19) and "monitoring data are not available to confirm this conclusion." (pages vii and 54) It is impossible to conclude something that begins by saying that one fails to have enough information to know, such a guess is known as making it up, and is not an expert opinion.

Comment A.1.13 has been broken up into the following responses:

Response: The statement on page 19 refers to a qualitative evaluation of background levels of CO in Midlothian (not related to emissions from the industries) as compared to the CO monitoring data for high traffic areas of Dallas-Fort Worth. The conclusion that the contribution by motor vehicles and other sources to background levels in Dallas-Fort Worth are likely to be higher than in the much less populated and traveled Midlothian area is not wild speculation and was intended to provide the reader with some perspective on the levels in a nearby, more heavy populated, area of Texas. No health conclusions were based on this information, and, in fact, we concluded that the CO levels in Midlothian from the facilities, based on ATSDR's modeling results, are not likely to result in harmful effects. The statements on pages vii and 54 were based on the observation that TXI SO_2 emissions prior to 1997 (from 1990 and 1992-1996) were similar or greater, in some years, than the emissions between 1997 and 2008 that potentially produced harmful SO_2 levels in Cement Valley. However, the commenter is correct that we do not have monitoring or modeling data for this period so, these statements have been deleted.

The commenter agrees there is no known or potential rate of error for the type of data examination that ATSDR has performed because it would be impossible to go back in time and collect duplicate samples or run appropriate QA/QC analysis on samples collected. Instead of documenting that limitation, ATSDR speculates, while at the same time, confirms that it has no basis for drawing conclusions. "Gap and Limitations" section on page 46 of the ATSDR Report states that the "discussion does not focus on gaps and limitations for those timeframes in the past where ATSDR will never be able to evaluate exposures." The Draft should use the fact to explain why no defensible conclusion can be offered. Instead the Draft presents suppositions that lack the knowledge required for their defense.

Response: ATSDR is just simply acknowledging and informing the public that there are certain timeframes and areas where this are no monitoring data nor are there adequate data to perform a defensible modeling effort to fill the data gap.

In some cases the Draft creates conclusions and then builds upon them to envision suppositions built upon suppositions. It might be fair in some cases to call these areas of potential study. However, these are not provided as areas of potential study, but instead as what the reader must assume are likely outcomes. In one case, modeled CO emission estimates are based on a hypothetical "worst case" scenario developed by taking the highest emissions rate from each company and treating them as if they occurred at the same time.

ATSDR then failed to examine the data to see if such an occurrence has ever happened. It has not. This made-up value was then used to compare to health standards, instead of using an actual worst case scenario based on data available from over a period of 20 years. Let me say it another way, ATSDR made up a value to evaluate instead of using values from the available 20 years of data to create a CO estimate. No explanation of why, no explanation of how likely the value is to occur.

Response: The commenter has misinterpreted this language and ATSDR's approach for evaluating CO. It is common practice to evaluate a scenario to determine if the worst-case conditions indicate that potential exposures may result in harmful effects and then, if they do, perform a more realistic analysis. In this case, we used what we considered a worst-case approach and then determined that even using this worst-case approach, harmful CO exposures are not evident so there was no need for any further analysis.

In the analysis section of the Draft, titled "Measured and Estimated Air Pollution Levels" there are numerous elementary and pedantic comparisons with little to no scientific meaning upon which to make conclusions such as "in that year, emissions from Midlothian facilities ranked 13th, 28th, 63rd, and 99th when compared to 1600 facilities across the state" (page 17) and "the highest quarterly average concentration at Midlothian City Hall ranked 45th of the 89 stations considered for this analysis." (page 21) Data presented in this manner has no relevance upon health effects.

Response: ATSDR does not make any health conclusions based on this information but provide it to the public so they can see where emissions in Midlothian compare to other parts of the state. No changes were made as the commenter does not provide any data or information to indicate that these rankings are not correct.

Further, there is no indication that the Draft has undergone peer review outside of the ATSDR, with the exception of one individual from Eastern Research Group listed as a technical advisor.

A technical advisor and website publication is not the type of peer review and publication contemplated by Rule 702, which refers to the publication of a peer reviewed scientific journal as providing evidence of reliability.

Even if ATSDR disagrees with the commenter that the Draft being a health consultation it can thereby be issued without the rigor required by ATSDR guidance or common standards for an expert opinion the Draft needs to expressly state the conclusions fall short of expert opinion and do not follow the ATSDR guidance for health assessment conclusions.

Response: This health consultation was reviewed by three independent reviewers and through ATSDR internal review before being released for public comment. ATSDR submitted this health consultation, including public comments, responses, and changes, for external peer review. ATSDR then responded to the peer reviewer comments before finalizing. ATSDR believes that this document does follow ATSDR guidance for health assessment conclusions and the commenter does not provide any specific ATSDR guidance that our conclusions violate.

A.1.14. Comment:

<u>Make recommendations based on current industrial equipment and regulations</u>: ATSDR fails to take into consideration that in 2010, EPA promulgated and Texas Commission on Environmental Quality (TCEQ) adopted new portland cement maximum achievable control technology regulations (40 C.F.R. 63, Subpart LLL) and aggressive new limits for particulate matter, nitrogen oxides, sulfur dioxides in a revision of the New Source Performance Standards for Cement Plants (40 C.F.R. 60, Subpart F). So the Draft recommends, "TCEQ should take action to reduce future SO2 emissions from TXI to prevent harmful exposures" and "TCEQ should take actions to reduce future PM2.5 emissions from TXI and Gerdau to prevent harmful exposures," which EPA and TCEQ have already done. That is, ATSDR made recommendations based on exotic circumstance, select sensitive individuals, located at uncommon locations asking for reductions, even though reductions had already been made to close the gap between what is possible and what is unlikely, that is a serious oversight. It is like saying the old barn's door needs a good looking at after the entire barn has been torn down and the door replaced.

The Draft finds that reductions in contaminants have occurred since 2008 but only presents one reason for the observation, "reductions may be caused, in part, by declining production levels at local industrial facilities. Future harmful exposures in Cement Valley could occur if production rises to at least previous levels..." Each time lower emissions in 2009 and 2010 are referenced; ATSDR follows up with that one and only possible assumption, "this is consistent with the timing of an industry-wide decline in production." Changes in industrial equipment and regulations also drive reductions in emissions, but the Draft fails to acknowledge that possibility, instead it pretends that a vacuum of equipment and regulatory change exists.

On page vii of the summary conclusions as well as on various pages of the Draft when ATSDR discusses their conclusions and recommendations related to sulfur dioxide, they raise a concern that sulfur dioxide levels in the surrounding community could reach a level of concern similar to the pre-2008 levels if production rises after the economic down turn, presumably if emissions from the local facilities increase when their production levels return to pre-2008 levels. Furthermore, the Draft points to a data gap on page 34 and vii due to a lack of sulfur dioxide monitoring stations and data in the areas north of Ash Grove (and Holcim) and that they have no data to evaluate exposure to individuals who live in those areas.

First, the unsupported conclusion is that a return to pre-2008 production levels would result in levels of sulfur dioxide of concern. The Draft clearly states that no data in the past exists to conclude that there were sulfur dioxide levels of concern. If ATSDR does not have data to make conclusions, they clearly have little basis to nevertheless say that there is a concern in the future.

Secondly, the conclusion fails to mention that the Ash Grove Midlothian plant is not going operate in the future in the same way or with the same sulfur dioxide emission limit or levels in the past. That is because the plant is undergoing a modernization project, and will have much lower allowable sulfur dioxide emission and limit.

Obviously the Draft recommendations make no sense without considering the emission reductions, and the replacement of equipment, like Ash Grove operating a new kilns system with new pollution control technology.

Response to comment A.1.14: ATSDR has added in the information regarding the actions planned or taken by TXI and Ash Grove to reduce emissions and make appropriate changes to the recommendations related to future emissions.

A.1.15. Comment:

<u>Provide direct support for all conclusions & state the degree of belief in assumptions</u>:

The Draft fails to provide direct support for many conclusions. The Draft fails to explain many assumptions used to compile data, or to explain the rational for the assumptions. The Draft makes many implicit assumptions.

To suggest that emission levels might return to historical levels, ATSDR must assume that facilities in the Midlothian area would either increase production significantly beyond permitted levels or would be operating illegally outside of recent emission standards set by the EPA and TCEQ. If that is what they think then the Draft contains no explanations or calculations to support it.

To just examine one of many such assumption that lacks a degree of belief , the Draft presents a directly supported conclusion that a reduction in contaminants has occurred since 2008 but then goes on to speculate without providing any degree of ATSDR's belief in the supposition that, "reductions may be caused, in part, by declining production levels at local industrial facilities." Each time lower emissions in 2009 and 2010 are referenced, ATSDR follows up with, "this is consistent with the timing of an industry-wide decline in production." The Draft assumes that increased manufacture of goods leads to an increase in potential health effects.

Conclusions in the Draft need support, not a simple statement that there are numerous unknowns and possibilities that could maybe or maybe not resulted in adverse effects from exposure to combinations of pollutants. It seems that ATSDR is guessing and making too many assumptions in order to conclude what they could not find enough data to support.

Response to comment A.1.15: ATSDR has added in the information regarding the actions planned or taken by TXI and Ash Grove to reduce emissions and make appropriate changes to the recommendations related to future emissions.

A.1.16. Comment:

<u>ATSDR fails to meet the agency's stated purpose for the Draft straying from the fundamental mission of the agency:</u>

Based on the discussion provided in the Draft's foreword, ATSDR scientists reviewed available environmental data to see how much contamination is at a site, where it is and how people may come into contact with it. ATSDR does not collect its own data. Instead ATSDR makes conclusions based upon existing information to determine if health effects may result from exposure and then makes recommendations in a public health action plan to reduce or stop exposure. ATSDR is primarily an advisory agency that generally makes recommendations to other agencies. Essentially, ATSDR takes data that other agencies or entities have collected, summarizes it in a simple comparative fashion often without additional analysis (such as statistical, modeling, etc.) and makes conclusions based on its summary to feed back to the agencies where the data originated. Other than taking data from and making recommendations to other agencies, there is no indication in the Draft of collaboration or discussion with other agency stakeholders to arrive at the conclusions or recommendations.

A great deal of data collection and analysis has already occurred Midlothian, Texas. The Draft needs ATSDR to add a section on ATSDR's collaboration and discussion with other Agencies who have worked on reviews of this area.

In the Draft's foreword, ATSDR states that they conduct public health assessment activities as appropriate when petitioned by concerned individuals, which appears to be the case for the Midlothian study. The foreword states, "the aim of these evaluations is to find out if people are being exposed to hazardous substances and, if so, whether that exposure is harmful and should be stopped or reduced."

Response: This public comment period allows all stakeholders to express their concerns and comment on all aspects of this health consultation. ATSDR has carefully considered all comments and made appropriate revisions where necessary. In addition, once ATSDR completed responding to public comments and making any needed changes to this health consultation, the entire revised document, along with public comments and responses, was sent for comment by external peer reviewers.

ATSDR does not collect its own sampling data, but compiles and reviews previous data provided by “EPA, other government agencies, business, and the public.” There is no discussion in the Report regarding ensuring that the data was collected according to appropriate methods or QA/QC procedures. All data identified from sampling events, monitor stations, and self-reporting are regarded as fact. Each collection effort had a quality objective, but ATSDR does not compile information to learn if it was reached, or to offer an option on an improved goal.

Response: The quality of most data (except for the 5-minute SO_2 data provided by TCEQ) used for this health consultation was evaluated by ATSDR in our first health consultation (ATSDR, 2015). This document has been revised to include a summary of the limitations of these data as provided by TCEQ to ATSDR.

ATSDR compares historical data to current NAAQS levels, stating findings such as, data collected “between 1997 and 2008 would not have met EPA’s current air quality standards, but they met the standard at the time.” Historical data has no relevance to whether people are currently being exposed at levels that should be stopped or reduced.

Response: Evaluating the public health implications of current, as well as the past exposures, is part of ATSDR’s mandate and it is important to the concerned citizens in Midlothian for ATSDR do perform this evaluation. We used current NAAQS standards as they represent the most up-to-date science relating to the potential hazard caused by air pollutants and only as means to screen an air pollutant as a potential contaminant of concern. ATSDR further evaluated the public health implications of all contaminants above a health comparison value using the latest science to make our final determination as to whether a hazard existed. ATSDR attempted in the public comment version, as quoted in the comment, to caveat any comparison to past exposures exceeding the current standard, with a caveat that it met the standard at the time. Please also see response to comment A.1.4 above.

ATSDR makes conclusions that are not decisive, but are rather phrased in weak and irresolute language that do not support that current emission levels should be stopped or reduced. These practices along with methods of data comparison, without further analysis, do not allow ATSDR to determine if people are currently being exposed to hazardous substances at levels that should be stopped or reduced.

ATSDR’s website homepage claims that, “ATSDR serves the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and diseases related to toxic substances.”

- All points from previous comments support that ATSDR is in no way using the best science or providing trusted health information.
- Providing vague recommendations to other agencies such as “TCEQ should take action to reduce future SO2 emissions from TXI to prevent harmful exposures” and “TCEQ should take actions to reduce future PM2.5 emissions from TXI and Gerdau to prevent harmful exposures” do not qualify as taking responsive public health actions.
- None of the findings or recommendations in the Draft are aimed at preventing any current harmful exposures of toxic substances because no current harmful exposures have been identified.

Response to comment A.1.16: ATSDR believes that we have used the best science to make health our determination for this health consultation. The comment refers mostly to recommendations that we have regarding current or future exposures. ATSDR has learned of the actions taken at TXI and Ash Grove and has incorporated those into the revised version of this health consultation and make appropriate revisions to the recommendations. In addition, ATSDR has modeled SO2 emissions from Ash Grove and Holcim and, although the results of this evaluation do not provide any evidence that the community around these facilities are being exposure to harmful levels of SO_2, too much uncertainty exists in the evaluation to make any definitive health conclusions because ATSDR lacked 1-hour SO2 emissions data (see responses to peer reviewer comments). The results of this modeling are included in this revised health consultation and applicable recommendations have been revised.

A.1.17. Comment:

ATSDR appears to presume that it knows better than EPA and TCEQ about how to protect the health of citizens of the State of Texas and its application of the current standards to historical emissions adds no value to the resolution of the perceived environmental issues in Midlothian. As acknowledged by ATSDR repeatedly, the Midlothian facilities were in compliance with the standards promulgated by EPA for the time period over which ATSDR is conducting this review. ATSDR did not offer an opinion to EPA about how to regulate $PM_{2.5}$ and SO_2 during the time period in question even though it was certainly aware of the perceived environmental concerns a small group of Midlothian citizens were expressing at that time. If it believed that the public health was being impacted at that time, why did it not speak up then? Had it done so certainly both the Midlothian industrial community and EPA could have worked to address those concerns.

Response to comment A.1.17: Please refer to comment above regarding ATSDR's use of current EPA standards. No place in this health consultation does ATSDR directly or indirectly infer that EPA or TCEQ were negligent in applying the applicable NAAQS standards in place in the past. Although ATSDR has not commented on exposures to sulfur compounds in the Midlothian community, the Texas Department of Health did express concern about these exposures in a 1994 memo to TCEQ (formerly TNRCC)—see response to comment A.2.7 below for more details.

A.1.18. Comment:

ATSDR makes many overly broad conclusions and statements about the potential health effects from historical emissions, does not adequately analyze the data or explain the basis of its conclusions, and it does not adequately report the uncertainties associated with the studies upon which its guideline levels are based so that the reader can make a contextual judgment about ATSDR's conclusions.

Response to comment A.1.18: Without any specific mention of where the commenter believes ATSDR does not provide adequate uncertainties in its conclusions, it is difficult to address this question. ATSDR attempted to make its conclusions specific to groups, areas, and timeframes of concern for past exposures. Where needed, for example, in the conclusions for past lead exposures and for the overall mixtures exposures conclusion, ATSDR attempted to provide the uncertainty associated with these findings.

A.1.19. Comment:

ATSDR uses the World Health Organization (WHO) guidelines throughout the report. However, the U.S. has not adopted the WHO guidelines as regulatory standards. The reference to the WHO guidelines adds no value to the analysis and should be removed from the report. If ATSDR leaves the WHO guidelines in the report, it should at a minimum explain the differences between those guidelines and the guidelines and standards developed by EPA and ATSDR.

Response to comment A.1.19: World Health Organization guidelines as well as EPA NAAQS standards are used by ATSDR only for screening purposes to determine if further evaluation is necessary in the public health implications section. ATSDR has clarified the use of both the WHO guidelines and the EPA NAAQS standards in this health consultation.

A.1.20. Comment:

The biggest problem with this report is that it is easily misleading to readers who are not toxicologists, who are not dispersion modelers, and who fail to read with a critical eye. Concerns are raised over health effects that could have resulted from ambient concentrations as much as 20 years ago without going far enough to place this speculation in the proper context. In many cases, gaps in the measured concentrations were filled with projections based on inadequate information. One example is the use of guideline values for SO2. The report notes that health effects from exposures to SO2 as low as 400 ppb are limited to some of the sensitive individuals (like asthmatics) in a population while exercising. Exposures to less than 400 ppb may result in symptoms, but the individual won't be aware of them. While the science is uncertain, sensitive people at increased breathing rates may have effects at levels as low as 200 ppb. The "lowest observable adverse effect" in one study was at 100 ppb. ATSDR concluded that it was reasonable to identify a minimal risk level at 1/10 of this level – 10 ppb. Very few readers can place the information on the number of 5-minute exceedances of 10 ppb of SO2 over a 15-year period in the proper context. The many who read only the conclusions section on pp vii - xiii can be expected to walk away with a terribly skewed sense of the Report's content.

Response to comment A.1.20: Part of ATSDR job is to provide the general public, in clear language, our overall public health findings based on a synthesis of all the technical information presented in the body and appendices of the health consultation. Moreover, the comment indicates that that ATSDR's use of guideline values as an example of where the evaluation used projections based on inadequate data. ATSDR does attempt to provide the important details related to our conclusions and basis for those conclusions in the health consultation on the pages mentioned in the comment. Nowhere in the document does ATSDR indicate that 5-minute levels above ATSDR's Minimal Risk Level (MRL) of 10 ppb is a concern as we base our SO_2 health conclusions on the levels mentioned in the comment from the scientific literature. In fact, as levels began to consistently drop below the LOAEL of 100 ppb in 2008, but mostly above the MRL, ATSDR concluded that health effects to both sensitive and the general public were not likely.

A.1.21. Comment:

The Report fails to identify the influences that resulted from highway traffic on the PM2.5 and lead data collected from the ambient air monitor located north of the Gerdau fence line from 1996 through 1998. This monitor was located downwind of, and adjacent to, U.S. Highway 67, a major thoroughfare. For example, the Report notes that leaded gasoline additives continued to be used into the 1990's, but fails to note that EPA continue to allow unleaded gasoline to contain up to 0.05 gram of lead per gallon. The Report also fails to note that trucks and automobiles are sources of PM2.5 emissions.

Response to comment A.1.21: ATSDR acknowledges that the lead and PM_{10} concentrations measured from the ambient air monitor located north of the Gerdau fence line from 1996 through 1998 would be expected to include contributions from traffic on U.S. Highway 67. Therefore, ATSDR has revised the Health Consultation to acknowledge the existence of these contributions. ATSDR also has clarified that it finds that highway traffic emissions from Highway 67 contribute to the study area emissions reflected in the lead and $PM_{2.5}$ data. However, ATSDR believes that lead concentrations attributable to Highway 67 traffic from 1996 through 1998 would be relatively low because the Clean Air Act Amendments issued in 1990 mandated the elimination of lead from all U.S. motor fuel by January 1, 1996. Assuming a gradual elimination of leaded gasoline in vehicles, lead emissions from vehicles would have been significantly reduced by mid-1996 (EPA, 1995). Moreover, the Gerdau facility must be considered one of the major sources of air lead levels detected by the monitor at that time. In fact, emissions from Gerdau Ameristeel did consistently rank high among other industrial facilities in Texas. For example, according to the PSEI data for 1995, lead emissions from Gerdau Ameristeel ranked 2nd out of the 67 facilities statewide with emissions data in the inventory (TCEQ, 2011a).

In regards to $PM_{2.5}$ emissions from Highway 67, these emissions result from a combination of vehicle tailpipe emissions and entrained road dust. Early attempts by US EPA to estimate emission factors (AP-42) and develop a national emissions profile of $PM_{2.5}$ emissions from paved roadways resulted in emission factors that demonstrate road dust emissions comprise about 25 percent and tailpipe emissions comprise about 2 percent of the overall area-wide $PM_{2.5}$ emissions profile. More recent studies have demonstrated that the fraction of area-wide $PM_{2.5}$ emissions resulting from road dust is actually about 20 percent for major highways and arterial roadways. Therefore, ATSDR notes that the contribution from trucks and automobiles traveling on Highway 67 would be about 22 percent of the overall PM2.5 emissions in this area.

Finally, it does not seem logical that TCEQ (then TNRCC) would have placed a monitor in this location to monitor lead and particulate matter coming from Highway 67 if vehicle emissions were considered the primary source of these air pollutants.

Notes: Relevant sources referenced by ATSDR:

1) http://www.epa.gov/ttnchie1/eidocs/pmfinetraining.pdf (Slide 7)

2) http://www.epa.gov/ttnchie1/conference/ei14/session5/pace.pdf

A.1.22. Comment:

The Midlothian area has been extensively studied over the past decades, and a significant volume of environmental data has been developed about the area. Furthermore, the data available as a result of this extensive study is of high quality and is more extensive than that typically available in a majority of other areas previously studied by the ATSDR.

TXI is confident that diligent focus on environmental compliance and the ongoing stringent review of its operations by applicable government agencies, including the EPA, the Texas Commission on Environmental Quality (TCEQ) and its predecessor agencies, and the Texas Department of State Health

Services over the previous years, has consistently indicated that there are no health impacts to the Midlothian community from our emissions.

In keeping with the large volume of data that has already been developed on this area, it remains highly important that ATSDR objectively demonstrate to the citizens of Midlothian, the scientific community and other key stakeholders that all analyses that it performs are being prepared based on appropriate and sound scientific procedures.

In its previous submittal of comments dated June 29, 2012, TXI emphasized that the following

steps be followed:

1) That ATSDR specify in a Protocol or in the Public Health Response Plan (PHRP) exactly how it plans to perform the health consultations so as to provide the public a meaningful opportunity to comment and participate in the process. This will result in the health consultation being completed with the best available science.
2) ATSDR should align its health-based screening criteria with the health-based standards upon which the state and federal regulatory programs are already based.
3) A modeling protocol should be provided for public comment prior to conducting air dispersion modeling.
4) To assist in developing accurate data, TXI should be given the opportunity to review all modeling inputs associated with our facility.
5) In the absence of a protocol, ATSDR should at the very least refer to the refined dispersion modeling that was conducted by the EPA and TCEQ for the pre-2000 time period.
6) TXI urges ATSDR to provide a response to these comments prior to conducting the work so that substantive technical input can be provided to the process.

These points of emphasis remain critical to providing a reasonable, accurate and scientifically sound evaluation of the Midlothian area and TXI continues to urge ATSDR to follow them in its ensuing analyses.

Furthermore, and as outlined in the specific comments relating to Health Consultation 2 (HC2) below, TXI has concerns that they were not followed, with particular reference to number 2 above, resulting in broad, sweeping and inaccurate conclusions being made that do not accurately represent the historical conditions covered in the time period reviewed by HC2. Specific comments relating to HC2 are outlined in more detail in the following sections.

Response to comment A.1.22: ATSDR provided a response to all of the steps suggested in the comment in the previously released health consultation titled "Assessing the Adequacy of the Ambient Air Monitoring Database for Evaluating Community Health Concerns" (ATSDR, 2015). Regarding the specific comments related to this health consultation, ATSDR only used the NAAQS standards, World Health Organization (WHO) values, or other environmental health-comparison values as means to determine which air pollutants to further evaluate. Moreover, ATSDR did not make its final health determination by just looking at any particular health screening value nor did we select any potential contaminant of concern based solely on the WHO values. In some cases (e.g., for 24-hour $PM_{2.5}$ exposures), the area was in compliance (as we point out) but there were days when the levels were numerically above the EPA standard and we determined, by using the EPA AQI estimator, that harmful effects were possible. It is entirely possible that an area is in compliance with an EPA standard but that during certain timeframes,

the levels of a particular air pollutant may be potentially harmful. Finally, this document has been sent to external peer reviewers for comment so that the approach and science used in this document was evaluated. ATSDR has responded to peer review comments and made any changes as needed before the document was finalized.

A.1.23. Comment:

There are a number of general issues that are of concern in the draft health consultation. First, the reader is lead to believe the air quality is causing adverse health effects when air monitoring in the Midlothian area not only indicates acceptable air quality but also better air quality than most monitored areas of the country. This could lead not only to undue anxiety for the citizens of Midlothian, but also to diversion of limited resources from areas where they are needed more urgently.

Response to comment A.1.23: ATSDR goal was not to produce any undue anxiety in the community regarding any past or current exposures. For past exposures, we did attempt to provide both the timeframe, area, and potential populations of concern when we determined a hazard existed. Regarding current and future exposures, ATSDR has received additional information since public comment regarding actions taken at several facilities which have or will result in significant reductions in emissions. ATSDR has factored this information, along with our modeling evaluation of past SO_2 emissions from Ash Grove and Holcim, into the revised version of this health consultation.

A.1.24. Comment:

Second, key conclusions in the draft report were not clearly articulated to the public through the press release and are not adequately emphasized in the draft assessment summary. Namely, that (1) the general public would not be expected to experience adverse health effects from exposure to SO2, particulate matter, ozone, or lead; and (2) ATSDR did not identify any risk, either to the general population or to sensitive subpopulations, from current or past potential exposure to carbon monoxide, nitrogen dioxide, or hydrogen sulfide.

Response to comment A.1.24: ATSDR has evaluated how we present our findings in this health consultation and in any future press releases. However, it should be noted that we captured all findings, including those where we do not expect harmful effects, in the Summary and Conclusions sections of the public comment version of this health consultation and in the press release. In the public comment version of this document, all major conclusions, whether we determined harmful effects were possible or not, were <u>bolded</u> for emphasis.

A.1.25. Comment:

Finally, while ATSDR bases its conclusions on the observation that past concentrations of certain pollutants exceeded current NAAQS standards, the commenter notes that the Midlothian area has been and currently is in compliance for all criteria pollutants except for ozone. While it is true that Ellis County is included in the Dallas/Fort Worth nonattainment area for ozone, the Midlothian (but not all DFW area) ozone monitors have: (1) Met the 1997 ozone standard for the last 8 years; and (2) Met the 2008 ozone standard 4 of the last 5 years.

Response to comment A.1.25: ATSDR has revised the health consultation with some of the information provided to indicate that the Midlothian area has been in compliance with all NAAQS standards except for ozone and that for some years the monitors in Midlothian have not exceeded

the standard. **In addition, ATSDR has updated the health consultation with information regarding EPA's updated ozone standard of 70 ppb.**

A.1.26. Comment:

We also note that the level of any given NAAQS does not constitute a bright line where health effects are expected to occur. On the contrary, these standards are set at a level that protects the general population as well as sensitive subpopulations, incorporating an adequate margin of safety. Therefore, the simple fact that ambient air at a community monitoring site exceeded a given NAAQS level does not indicate (1) that citizens were actually exposed to that concentration, (2) that the concentrations measured at that monitor constitute unsafe exposures, or (3) that health effects would be expected from exposure to that concentration. The TCEQ looks forward to continuing to work with ATSDR to address the findings and recommendations made in this report and to sharing additional data and information that will produce the best possible product for the public and for policymakers.

Response to comment A.1.26: As stated above, ATSDR used NAAQS and other health-based values as environmental screening levels and not as bright lines indicating harmful effects. In all cases where levels were above a certain screening value, whether it was for a NAAQS standard or from another source, ATSDR would then further evaluate the public health implications of exposures to that particular air pollutant before determining if harmful effects were possible. ATSDR understands the limitations of air monitoring data; however, we believe that in most cases where quality air monitoring data in communities exists, it is preferred over air modeling.

A.1.27. Comment:

The terms "exposed" and "exposure" are used throughout the document. This is not appropriate; the data used in this evaluation are ambient air concentrations, not exposure concentrations. Furthermore, exposure characterization is not discussed by the draft consultation, but should be included. Actual exposure will depend on the locations where citizens travel during the day and their physical activity during those times. A considerable amount of research has been conducted which shows that most people typically spend the majority of their day (~90%) inside, not outside, a finding quoted by the EPA when discussing indoor air issues. It has also been shown that indoor air quality is typically worse than that of outdoors. These are important factors that ATSDR should consider.

Response to comment A.1.27: The approach taken by ATSDR to characterize exposure in this health consultation is consistent with ATSDR's method to characterize exposure at other sites where the focus is air exposures. Moreover, several of the monitors used by ATSDR to determine that exposures may have resulted in harmful effects (e.g., the Wyatt Road and Old Fort Worth Road monitors) are or were located in areas where people live.

A.1.28. Comment:

We note that in order to determine whether there is cause for concern, actual exposures, modeled exposures, hazard quotients, and relevant health data such as asthma symptom incidence, hospitalization, blood lead levels, etc., would be necessary. The current qualitative analysis does not provide the necessary level of evidence required to contradict the previous conclusions from multiple agencies based on extensive monitoring data, and therefore cannot conclude that there is or has been a threat to public health. The current analysis concludes that there is cause for concern because monitoring data is not available for all locations and all timeframes. We note that in the May 2010 Health Consultation document, *Assessing the Adequacy of the Ambient Air Monitoring Database for Evaluating*

Community Health Concerns, ATSDR indicated that for years/locations where no measurements were collected, estimates would be derived from other sources of information, including air modeling. TCEQ suggests that this analysis be repeated, using such modeling techniques, and a second draft of the analysis for NAAQS pollutants be released for peer review and public comment.

Response to comment A.1.28: The approach taken to evaluate the public health implications of air exposures from the four facilities in Midlothian is not different than ATSDR's approach for other similar sites (e.g., Mirant Potomac River Generating Station—see ATSDR, 2011b). Any approach mentioned in the comment to determine exposure and possible health outcomes has their own set of limitation and applicability to the exposure scenarios evaluated in this health consultation. ATSDR did not use hazard quotients for this evaluation as they are not yet accepted for NAAQS compounds (Mauderly et al., 2010). ATSDR has evaluated health outcome data to determine if there are any elevations of disease in the community; however, evaluating health outcome data, in general, can be a crude measure of whether harmful exposures have occurred especially if the exposed population is small as is the case with some of the air pollutants evaluated for this health consultation.

ATSDR does not state that there is a concern for the lack of data for all areas and timeframes, but just that we are not able to evaluate exposures without sufficient data and information. In relation to the modeling question, ATSDR did attempt to fill one of the major data gaps identified in this health consultation relating to potential exposures from SO2 emission from Ash Grove and Holcim. ATSDR has included the results of this modeling in the revised health consultation and revised the conclusions and recommendations, as needed.

A.1.29. Comment:

We note that this is a retrospective analysis, and also that the previous ATSDR report, *Assessing the Adequacy of the Ambient Air Monitoring Database for Evaluating Community Health Concerns,* described the limitations of inferring air pollution levels in the past and by extension, potential for health effects. Therefore, we note the tentative nature of findings in the current draft, i.e., that exposures and/or effects "*may have*", "*could have*", "*might have*" occurred. However, these tentative results are inconsistent with the tone of the information provided to the public through the press release and in the consultation summary. Overall, the reader is left with the impression that there is a finding of concern where, in actuality, none exists. In fact, in multiple locations in the report "ATSDR is uncertain whether harmful exposures *actually* occurred"(emphasis added). Furthermore, the overarching conclusion of this report is that, for the general population, the potential exposures described would not be expected to be harmful. Again, this message was not clearly conveyed.

Response to comment A.1.29: ATSDR has reviewed the text, Summary and Conclusions of the public comment draft of this health consultation and the final press release and determined that the same type of language is used in all documents and there is no difference between the way we caveat our health findings. ATSDR typically uses phrases like "could have", "may have", or "is not expected to" in our documents in relation to the overall health conclusions. Regarding the use of the phrase "ATSDR is uncertain whether harmful exposures actually occurred", ATSDR searched the public comment version of this document and determined that this phrase was used correctly each time where we either did not make a health call due to some limitations on the data or in relation to past $PM_{2.5}$ annual average exposures that were estimated from PM_{10} data. ATSDR has completed an additional analysis of the estimation of $PM_{2.5}$ exposures in the past near

the Gerdau monitor and determined that we cannot make a determination of whether these particulate matter exposures were harmful. Please see further details below.

A.1.30. Comment:

The draft consultation utilizes Point Source Emissions Inventory (PSEI) data for multiple pollutants to aid in determining if there is cause for concern. However, the draft fails to put these data into proper perspective. The most recent data from the PSEI indicate that emissions in Ellis County are in fact significantly lower than many other counties in Texas –Ellis County indicated by green arrows). As long as the four companies in question are operating within the parameters of their permits, which were granted after thorough review to ensure protection of public health, there should be no cause for concern. Simply listing the amount of a given substance reported by a given company does not indicate exposure, nor risk. Unfortunately, the way in which this data is summarized and described in the report seems to imply potential risk, where ambient air monitoring indicates that air quality in Midlothian is not only good but substantially better than many other areas of the country.

Response to comment A.1.30: ATSDR did not use emissions inventory data to make any statements regarding exposure nor harmful effects. We did use these data to point out trends in the emission data and for providing some basis for a potential concern where no monitoring or modeling data were available to assist ATSDR. For example, ATSDR compared emissions data from Ash Grove to emissions data from TXI during similar timeframes were ATSDR determined harmful effects were possible in Cement Valley. This comparison was to point out that the Ash Grove emissions were similar to or greater than those from TXI, indicating that there is at least some potential for concern since no monitoring or modeling data were available to ATSDR to help us make a health determination. Subsequent to the release of this document for public comment, ATSDR conducted its own air modeling to evaluate these emissions and the findings have been incorporated into the revised health consultation.

A.1.31. Comment:

The commenter notes that under the Clean Air Act, the State of Texas is required to comply with *current* standards set by EPA. As these standards have changed over time, TCEQ works with local municipalities and industries to bring all areas of the state into compliance with the new standard. Comparing past ambient concentrations with current standards may be informative, but does not provide any evidence of harm to public health. In order to do so, health data such as hospital admissions, disease incidence rates, etc., would have to be correlated with inhaled doses of the pollutants of interest. Because none of this information was supplied, assertions that harm was likely to have occurred are tentative, at best. This type of over-interpretation neither serves to protect nor to educate the citizens of Texas.

Response to comment A.1.31: Please see responses to similar comments above.

A.1.32. Comment:

In numerous places in the document, there are references to DFW as an 11-county ozone nonattainment area. The DFW ozone nonattainment area is made up the following 10 counties: Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall, Tarrant, and Wise.

Response to comment A.1.32: ATSDR has revised the health consultation to address this comment.

A.1.33. Comment:

Page 1: In the callout box, ATSDR says that "Readers should note that ATSDR's role in evaluating ambient air in Midlothian is as a public health agency, which is considerably different from the roles of other agencies, particularly those charged with addressing environmental issues."

It should also be noted that, as the state environmental agency, the role of TCEQ is to protect our state's public health and natural resources . Therefore, TCEQ considers protection of public health not only when evaluating ambient air data, but also when issuing air (or other media) authorizations. We use methods and models that are protective of public health with an adequate margin of safety.

Response to comment A.1.33: Comment noted.

A.1.34. Comment:

Page 6: This section discusses specific information regarding the Ash Grove cement facility located in the Midlothian area. The information about the facility may have been correct at the time the report was written; however, to-date the information is outdated and does not reflect the potential emissions from this site. Ash Grove will decommission Kilns 1 and 2 and will reconstruct Kiln 3. These changes have been reflected in their permit amended in May 2012, which includes fuels that can be burned in Kiln 3.

Response to comment A.1.34: ATSDR has added this information to the revised health consultation and factor this information into its revised evaluations.

A.1.35. Comment:

Page 15**:** In Section 2.6, General Air Quality in Ellis County, the document states that "the DFW area is considered to be in attainment with EPA's health-based air quality standards," including lead.

While this statement is true specific to Ellis County and the majority of the DFW metropolitan area, there is a small portion of Collin County that is currently designated nonattainment for the lead standard.

Response to comment A.1.35: ATSDR has included this information in the revised health consultation.

A.1.36. Comment:

The draft consultation concludes that past potential exposures to CO, NO2, or H2S are not expected to cause harmful effects. We agree that past potential exposures to these three pollutants are not expected to cause harmful effects as levels of these three pollutants were below health protective comparison values developed by EPA, WHO, or ATSDR.

Response to comment A.1.36: Comment noted.

Subsection A.2. Comments on ATSDR's Recommendations and Conclusions:

A.2.1. Comment:

A significant amount of air monitoring has been and continues to be conducted in the Midlothian area. This monitoring not only indicates acceptable air quality but also better air quality than most monitored areas of the country. Specifically, see comparing Ellis County design values for the chemicals of concern identified in the draft assessment to other counties throughout the U.S. While ATSDR recommends the TCEQ evaluate and reduce emissions and exposures to SO2 and PM2.5, TCEQ notes that the Midlothian area has been and currently is in compliance for all criteria pollutants except for ozone. Because Ellis County is included in the Dallas/Fort Worth non-attainment, it is also included in the ozone State Implementation Plan which includes measures for further reducing ozone.

Response to comment A.2.1: Comment noted and some information on ozone has been added to the revised health consultation.

A.2.2. Comment:
"ATSDR recommends that TCEQ should take actions to reduce future SO_2 emissions from TXI to prevent harmful exposures."

The TCEQ finds the first recommendation statement somewhat confusing since both the TCEQ and ATSDR observed that Midlothian SO2 levels after 2008 were observed to be at concentrations not expected to be a risk to either asthmatics or the general population. Furthermore, limiting exposure to emissions is beyond the authority of the TCEQ, as that would require controlling indoor air quality as well as the personal choices of the public. However, it is the TCEQ's responsibility to ensure the ambient air is safe and meets the federal standards.

All areas of the state currently have monitored regulatory design values below the EPA's SO2 standards; however, the EPA has not made designations for the 2010 SO2 standard. As the EPA moves forward to finalize designations and implementation requirements for the 2010 SO2 standard, the TCEQ will continue to take actions necessary to remain in compliance with the applicable Clean Air Act requirements.

Response to comment A.2.2: Subsequent to the release of this health consultation, ATSDR learned the details of the action taken at TXI to reduce emissions. ATSDR has revised this recommendation considering this new information.

A.2.3. Comment:
"ATSDR recommends that TCEQ should take actions to reduce future $PM_{2.5}$ emissions from TXI and Gerdau to prevent harmful exposures."

In January 2013, the EPA finalized revisions to the 2012 annual PM2.5 standard. According to the EPA's own website, this health-based standard was finalized after the EPA examined thousands of studies as part of the review of the standards, including hundreds of new studies published since EPA completed the last review of the standard in 2006.

At this time, all areas of the state are designated as attainment for this health-based standard, just as they were for the 2006 standard. The TCEQ is currently evaluating monitoring data for the entire state to develop designation recommendations for the revised standard. Designation recommendations are due to the EPA by December 13, 2013. Based on currently available monitoring data, the DFW area is anticipated to be designated as attainment for the PM2.5 standard. TCEQ will continue to take actions necessary to remain in compliance with the applicable Clean Air Act requirements.

Response to comment A.2.3: ATSDR has added this information into the revised health consultation.

A.2.4. Comment:
"ATSDR recommends that TCEQ should evaluate and prevent harmful $PM_{2.5}$ and SO_2 exposures from local sources."

Both health-based standards have recently been made more stringent by the EPA and the DFW area is currently in attainment for both the PM2.5 and SO2 standards. These more stringent standards are factored into the state's air permitting requirements to help maintain compliance with the federal standards. TCEQ will continue to take actions necessary to remain in compliance with the applicable Clean Air Act requirements.

Response to comment A.2.4: Comments noted.

A.2.5. Comment:
"ATSDR recommends that TCEQ should continue efforts to reduce regional ozone exposures."

An attainment demonstration state implementation plan (SIP) revision will be developed for the DFW area to address the 2008 eight-hour ozone standard. The SIP revision will be developed with stakeholder input and will undergo separate notice and comment procedures. At that time, the TCEQ will develop rules and control measures as necessary to bring the area into attainment by the appropriate attainment deadline. Again, it should be noted that TCEQ cannot reduce exposures, only ambient concentrations.

Response to comment A.2.5: ATSDR has added this information into the revised health consultation.

A.2.6. Comment:
"ATSDR recommends that TCEQ should ensure that the levels of the air pollutants, carbon monoxide and nitrogen dioxide, do not increase to levels of concern in the future."

All areas of the state are currently in attainment of the carbon monoxide and nitrogen dioxide standards. TCEQ will continue to monitor these and other pollutants in order to maintain compliance with federal requirements.

ATSDR suggests that TCEQ conduct ambient air monitoring to characterize potential exposures to persons downwind of Ash Grove and Holcim facilities. We note that the 1996 EPA multisource and multi-pathway risk assessment indicated that any theoretical exposures resulted predominantly from the Gerdau Ameristeel (formerly Chaparral Steel) Company, not the three cement manufacturing companies. Therefore it is appropriate that monitoring efforts have focused downwind of this source.

Regarding the adequacy of current monitoring; the CAMS 52 monitor on Old Fort Worth Road has been operational for over 15 years, sits downwind of the two largest facilities, captures emissions from both types of industries that are potentially of concern and has spanned years where TXI and Gerdeau Ameristeel have burned various types of fuel. For this reason, it is our professional opinion as toxicologists and risk assessors, that this monitor adequately captures generally worst case exposure scenarios, which have repeatedly been demonstrated to be below levels of concern. Furthermore, because the community of Midlothian is generally not predominantly downwind of any of the four main sources, we would expect the concentrations to be lower in the community than those measured at the monitor, due to normal air dispersion patterns. In fact, this was one of the primary findings in the 2010 special study conducted by TCEQ.

The draft consultation recommends that TCEQ increase monitoring. The TCEQ believes the current amount of monitoring in Midlothian is adequate to characterize ambient air quality given our knowledge of the sources (including total emissions, dispersion characteristics, chemicals emitted), meteorology, and location of residents.

In the *Assessing the Adequacy of the Ambient Air Monitoring Database for Evaluating Community Health Concerns* document, ATSDR outlines two options for the health consultation: (1) make no health conclusions for the issues identified as data gaps or (2) make inferences about air pollution levels based on surrogate information, such as dispersion modeling data or engineering calculations. TCEQ suggests that if ATSDR finds the available data lacking, the second approach should be considered. In addition, there are many factors that go into the placement of TCEQ monitors, including (but not limited to) accessible locations with access to electricity, population density, proximity to sources, and compliance with federal guidelines. The 2010 TCEQ special study in Midlothian found that measured concentrations at the CAMS 52 monitor are a good indicator of measurements across Midlothian and, while this site measures potentially worst-case concentrations of PM10 metals, is a good indicator of air quality around Midlothian, including parks and schools. Furthermore, previous analysis by ATSDR (December 2007) concluded "we expect the levels measured at the 4 primary sampling locations (Tayman Drive Water Treatment Plant, CAMS-94/Midlothian Tower, CAMS-52/ Old Fort Worth Road, CAMS-302/Wyatt Road) to be fairly representative of the upper range of levels to which the majority of the residents of Midlothian would be exposed." Therefore, we would that the recommendation to place additional monitors be removed, or at the very least be changed to a recommendation to better characterize potential exposure, which may include modeling. This is an effective approach that was not only employed by ATSDR in the draft consultation, but also by TCEQ in the past to set standards and in conjunction with monitoring to verify compliance with such standards.

One of the reasons provided for the suggestion that TCEQ increase monitoring was the lack of data for all locations and across all timeframes. Routine VOC monitoring began in the Midlothian area in 1993 and routine metals monitoring has been conducted since 1981. Data gaps notwithstanding, the VOC and metals air monitoring data from the Midlothian area compose an impressively rich dataset. In 1995, DSHS representative Dr. Richard Beauchamp praised the TCEQ (then TNRCC) for the "unprecedented" amount of sampling in Midlothian. Excerpts from their presentation at a TNRCC public meeting in Midlothian on Thursday, November 2, 1995, 7:00 PM follow: "Never before in history has the agency, or its predecessor, the Texas Air Control Board, collected so many environmental samples, from so many different media, from so many sampling locations, analyzing for so many different compounds, and finding so few indications of even the mildest of health concern…They have collected hundreds of air samples…Except for a few isolated and transient samples, these levels have all been below (and, for the most part, far below) their respective ESLs (Effect Screening Levels). The ESLs themselves are levels which are generally 100 fold (or more) lower than the lowest level known to cause the slightest adverse effect or 'Lowest Observable Adverse Effect Level'(LOAEL). Consequently, the contaminant levels observed have been far, far below the lowest level than might potentially cause any adverse health effects." Therefore, the monitoring data from the Midlothian area constitutes an impressively rich dataset that is more than adequate to characterize air quality.

Response to comment A.2.6: ATSDR added the statement regarding TCEQ's continuing to monitor carbon monoxide and nitrogen dioxide in order to maintain compliance with federal regulations to the Public Health Action Plan and delete this recommendation. The comments suggest that ATSDR did not employ modeling in the draft health consultation. However, ATSDR did model carbon monoxide emissions and subsequently conducted modeling to evaluate potential exposures from SO_2 emissions from Ash Grove and Holcim. ATSDR have included these results

and findings and revised the recommendations, as needed. In addition, ATSDR has revised other recommendations to be more generic as to TCEQ characterizing emissions from the facilities to comply with applicable federal requirements. Other comments regarding the 2010 TCEQ Special Study or the draft 2007 ATSDR health consultation are really not applicable to focus of this health consultation as those efforts focused on metals and volatile organic compounds and not the NAAQS compounds (except lead) and hydrogen sulfide.

A.2.7. Comment:
On a final note, the commenter is concerned that the citizens of Midlothian are receiving mixed messages. Documents finding no issues:

- **1996 EPA** *Midlothian Cumulative Risk Assessment:* "Neither available site data or conservative theoretical models show that there are cancer risks or the potential for noncancer health effects above regulatory levels of concern."
- **2005 DSHS** *Summary of Investigations in to the Occurrence of Cancer for Midlothian, Cedar Hill, and Venus, Texas:* "…current information does not indicate exposure at levels for health effects."
- **2007 DSHS/ATSDR** *Midlothian Area Air Quality Part 1: Volatile Organic Compounds and Metals:* "…long-term aggregate exposures to air contaminants in Midlothian are not expected to result in adverse non-cancer or cancer health effects."
- **2010 TCEQ** *Evaluation of the Midlothian, Texas Ambient Air Collection & Analytical Chemical Analysis Data:* "All measured concentrations of VOCs and PM10 metals are not of a health concern."

Documents finding issues:

- **2012 ATSDR** *Assessing the Public Health Implications of the Criteria (NAAQS) Air Pollutants and Hydrogen Sulfide:* "ATSDR believes that sufficient information exists to warrant concern for multiple air pollutant exposures to sensitive individuals, especially in the past…"

This confusing reversal of conclusions does not appear to be based on exposure characterization or health data such as incidence of asthma symptoms, hospitalization, blood lead data, etc. ATSDR should clearly identify the reason for this change.

As the state's environmental protection agency, the TCEQ takes its role in protecting public health very seriously. Based on the abundance of data for the Midlothian area, and in our best professional judgment, the TCEQ does not have concerns regarding air quality in Midlothian. However, even though there is a very robust dataset for Midlothian, citizens of Midlothian may still be concerned about the air quality in their city and the confusing reversal of conclusions regarding potential for adverse health effects due to air quality in Midlothian. Unfortunately, the consultations conducted so far by ATSDR do not provide the assurance the citizens of Midlothian need and deserve based on the wealth of data available in this area over many decades of effort by environmental agencies. However, TCEQ looks forward to continuing to work with ATSDR to address the findings and recommendations made in this report and to share additional data and information that will produce the best possible product for the public.

Response to comment A.2.7: ATSDR's mission is not to provide assurances but to evaluate the past and current exposures, using the most up-to-date science, to determine if harmful effects from exposures are possible. As stated above, the 2010 TCEQ Special Study as well as the 2007

ATSDR Health Consultation, prepared by the Texas Department of Health, did not address the NAAQS and hydrogen sulfide air pollutants (except lead). In addition, the 1996 EPA Midlothian Cumulative Risk Assessment also did not evaluate the NAAQS air constituents, nor hydrogen sulfide. Moreover, the 2007 Texas Department of Health report on cancer incidence also does not apply to the findings of this health consultation as the primary health concerns related to the NAAQS and hydrogen sulfide air pollutants are non-cancer effects, not cancer effects. ATSDR did find a letter from the Texas Department of Health to the TNRCC (currently TCEQ) stating the following regarding sulfur emission in Midlothian (TXDH, 1994):

> ***"Our staff has reviewed TNRCC air and soil monitoring data and finds the only potential health concern may result from sulfur emissions which exceeded the odor threshold. For individuals with reactive air way disease (e.g., asthma, bronchitis, some allergies), exposure to airborne sulfur compounds may exacerbate their respiratory symptoms."***

A.3.1. Comment:

The Draft fails to supply our customers, workers and their families with quality information to understand the work already conducted in the area or to give sound recommendations to other Agencies for follow-up. To provide that information ATSDR should remove from its Draft all conclusions that fail to comply with standards for providing expert opinion. In doing so, ATSDR needs to provide the standard they use and how the conclusion meets the standard. The Draft needs to contain only recommendations for future work that take into account the current equipment and regulatory situations. All conclusions left in the report need direct support. All assumptions need actual examples, if such examples exist, and if they do not then a statement of the degree of belief. As the ATSDR guidance document puts it, "characterize the degree of public health hazard at the site based on the following factors: The existence of past, current, or potential future exposures to site-specific contaminants or physical or safety hazards. The susceptibility of the potentially exposed population. The likelihood of exposures resulting in adverse health effects. "Limit statements to available information. Conclude what poses a hazard, what does not pose a hazard, and where critical information is missing to draw any conclusion. Then take current industrial equipment and regulatory limits into consideration when making recommendation, "in a clear and succinct manner."

The preponderance of information in the Draft shows no health hazards. ATSDR should say that in a clear and succinct manner.

Response to comment A.3.1: ATSDR believes that the draft for public comment version does comply with our guidance and does provide a sound scientific basis based on the information available for review. ATSDR has learned some additional information regarding actions taken or planned in Midlothian to address emission and we have revised this document to reflect those changes. In addition, ATSDR has conducted additional modeling of sulfur dioxide emissions from Ash Grove and Holcim and also re-evaluated some other conclusions and recommendations to reflect the new information and additional analyses.

Section B. Specific Comments on Pollutants

This section presents comments and responses for criteria National Ambient Air Quality Standard (NAAQS) pollutants, including: particulate matter (B.1), ozone (B.2), sulfur dioxide (B.3), nitrogen oxides (B.4), carbon monoxide (B.5) lead (B.6), and hydrogen sulfide (H2S) (B.7). It also addresses comments on mixtures of pollutants (B.8).

B.1 Particulate Matter

B.1.1. Comment:

Particulate Matter Exposures - All particulate matter is not created equal. Not covered herein are toxins (heavy metals, PAHs, VOCs, etc.) attached to these particles. We are confident this will be covered in upcoming consultations.

When assessing industrial impact on public health emissions alone and not factoring in activities such as quarrying, importing materials and exporting products via rail and truck traffic possibly may not give a full public health impact. A closer look at railroad and trucking traffic in Midlothian is warranted.

Exposures occur via inhalation, ingestion or skin contact. Inhaled particles and consequential respiratory and cardiac issues were extensively addressed. Perhaps exposure via these other avenues will be addressed in the upcoming consultations.

Response to comment B.1.1: ATSDR has evaluated exposures to constituents of particulate matter in another health consultation as described in our Midlothian Public Health Action Plan (this evaluation can be found at: http://www.atsdr.cdc.gov/sites/midlothian/health_consultations.html).

B.1.2. Comment:

Particulate Matter (PM) Data Manipulation and Conversion - Interpolating data to either add a "correction factor" or to convert from one particulate size to another are not recommended. Furthermore, the development of a ratio to convert PM10 to PM2.5 may err due to naturally occurring conditions and different loading levels. By using a standard ratio, the PM2.5 levels may be incorrectly identified as being higher than they actually are, thereby possibly leading to incorrect conclusions on exposure and health effects. We recommend these uncertainties associated with these estimates be more strongly reflected in the health impact conclusions.

Response to comment B.1.2: ATSDR has reevaluated these calculations and determined that there is too much uncertainty in estimating from past PM_{10} levels what $PM_{2.5}$ levels might have been in the area of the Gerdau Monitor. ATSDR has revised our conclusions relating to the past exposures to PM2.5 downwind of the Gerdau facility.

B.1.3. Comment:

ATSDR estimates the concentration of PM2.5 at the historic Chaparral Steel monitor based on the ratio of PM2.5 to PM10 at other monitors, yet ATSDR does not discuss why the monitors upon which the ratios are based should have a ratio similar to that of the historic Chaparral Steel monitor. ATSDR also fails to discuss the possible effects of this monitor's location adjacent to, and downwind of, U.S. Highway 67.

Response to comment B.1.3: See response to the previous comment. Also, as previously mentioned, it does not seem logical that TCEQ (then TNRCC) would have placed a monitor in this location to monitor particulate matter coming from Highway 67 if that was considered the primary source of this air pollutant.

B.1.4. Comment:

ATSDR states that it does not know what the contribution of other local and regional sources are to PM2.5 concentrations, and that the estimated impacts around the historic Chaparral Steel monitor in the 1996 – 1998 timeframe are localized. Air dispersion modeling following the same technique described in Appendix A of ATSDR's HC shows that other sources of PM2.5 must be more significant than the industrial sources evaluated by ATSDR before current annual average PM2.5 standards could have been exceeded in the area around the historic Chaparral Steel monitor, and that the potentially impacted area from the industrial sources is so localized that no residential land use is currently or has ever been present in this area.

Response to comment B.1.4: As indicated above, ATSDR has reevaluated the approach used to estimated past $PM_{2.5}$ exposures from PM_{10} data from the Gerdau Monitor and determined that too much uncertainty exists to make a firm conclusion. In response to the comment that no residential land use is currently or has ever been present in the area, ATSDR did obtain a TNRCC Site Characterization Worksheet (TNRCC, 1995) that indicated a single story frame house was located about 450-500 feet west of the Gerdau Monitor. ATSDR also received pictures from TCEQ (formerly TNRCC) that clearly show this house in the background of a picture of the fenced Gerdau monitor.

B.1.5. Comment:

ATSDR states the following on page 30: "ATSDR evaluated concurrent PM10 and PM2.5 data from the Midlothian area and determined that the long-term ratio of PM2.5 to PM10 ranged from about 0.47 to 0.52. Given this, we estimated that annual average PM2.5 levels in the vicinity of the Gerdau Ameristeel monitor, from 1996 to 1998, could have ranged from about 22.6 to 26.4 µg/m3, which is above both the current and proposed EPA standard. Using EPA's approach, the 3-year average level might have been above the NAAQS standard of 15 µg/m3 for these years in the vicinity of the Gerdau Ameristeel monitor."

ATSDR makes determinations about the concentration of PM2.5 at the monitor located on the Gerdau Ameristeel fence line based on a ratio of PM2.5 to PM10 concentrations at other monitors. ATSDR does not state which additional monitors it evaluated to determine the ratios nor does it explain why the ratios at those monitors are reflective of the ratio at the monitor located at the Gerdau Ameristeel fence line.

Response to comment B.1.5: Please response to comments above.

B.1.6. Comment:

ATSDR states the following on pages 37 and 41: "This finding is considerable because much of the monitoring occurred in areas expected to have the greatest air quality impacts; therefore, the data suggest that short-term PM exposures, especially for fine particles, were likely from a combination of regional and local sources with an exact contribution from each uncertain. However, localized PM elevations found north of the Gerdau Ameristeel fence line, during the years 1996–1998, were likely from emissions from Gerdau as a primary contributor (p. 37)."

"Moreover, ATSDR estimates that PM2.5 exposures in a localized area of Cement Valley, just north of Gerdau Ameristeel during 1996–1998, were above the current EPA standard and might have been about twice the proposed EPA standard. In addition, also based on ATSDR estimates of past annual average PM2.5 levels, exposures above the EPA current or proposed standard could have occurred occasionally for several years in the 1990s, especially among people who lived in other areas of Cement Valley, east and south of the TXI property line, and in the Gorman Road area. However, as stated previously, ATSDR is uncertain whether exposures above the current or proposed EPA standard actually occurred in these areas (p. 41)."

Air dispersion modeling was performed for PM10 using the same source characteristics reported by ATSDR in Table A.1 of Appendix A for all four of the industrial sources evaluated by ATSDR, and downwash for the Gerdau melt shop was also considered. The center of the modeling domain was established as the coordinates reported by ATSDR for Gerdau's Baghouse A. The 1997 emissions data used in the modeling were the values reported by ATSDR in Table 6 of its report. The year 1997 was selected because this is the highest year of PM10 emissions for Gerdau Ameristeel. The standard 1 year meteorological data set prepared by TCEQ for Ellis County was used to support the modeling effort. AERMOD Version 12060 was used perform the modeling with a grid spacing of 100 meters out to 3 km from the project centroid, and then 1000 meters out to 10 km. Using ATSDR's approach of estimating PM2.5 concentrations from the ratio of PM2.5 to PM10 at other monitors (which as noted above is poor science, but for purposes of comparison to ATSDR's own data was performed here), a PM2.5 concentration was calculated based on the modeled PM10 concentration by multiplying the PM10 concentration at each modeling receptor by a factor of 0.52. The results of the modeling are shown graphically below.

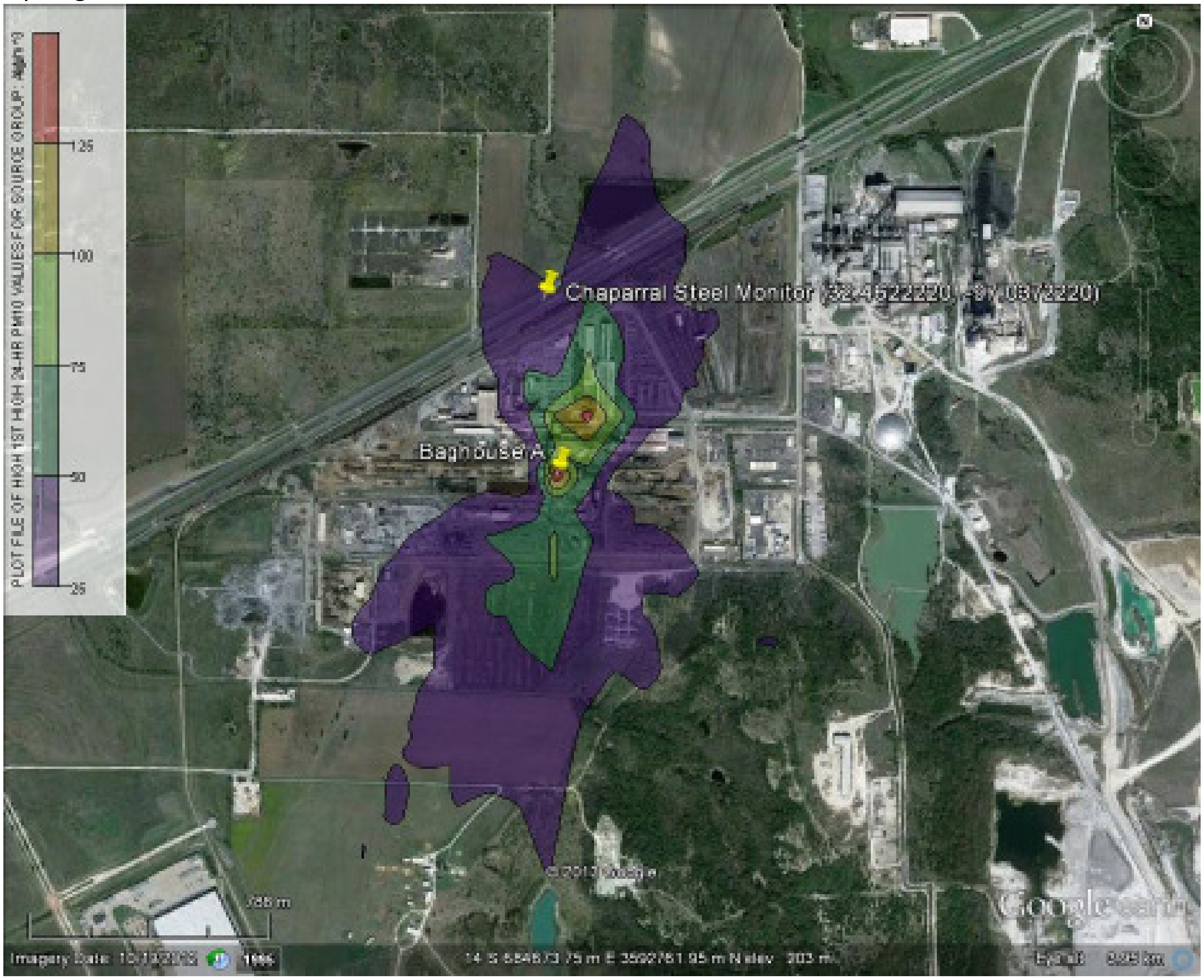


Figure 8: PM10 24-Hr Modeling Results, Highest Impacts from All Sources Evaluated by ATSDR

The modeling results show that none of the receptors exhibited 24-hr average PM10 concentrations above 150 ug/m3 . The highest concentrations occurred on Gerdau's property. The highest off-site concentrations are in the range of 30 to 40 ug/m3 .

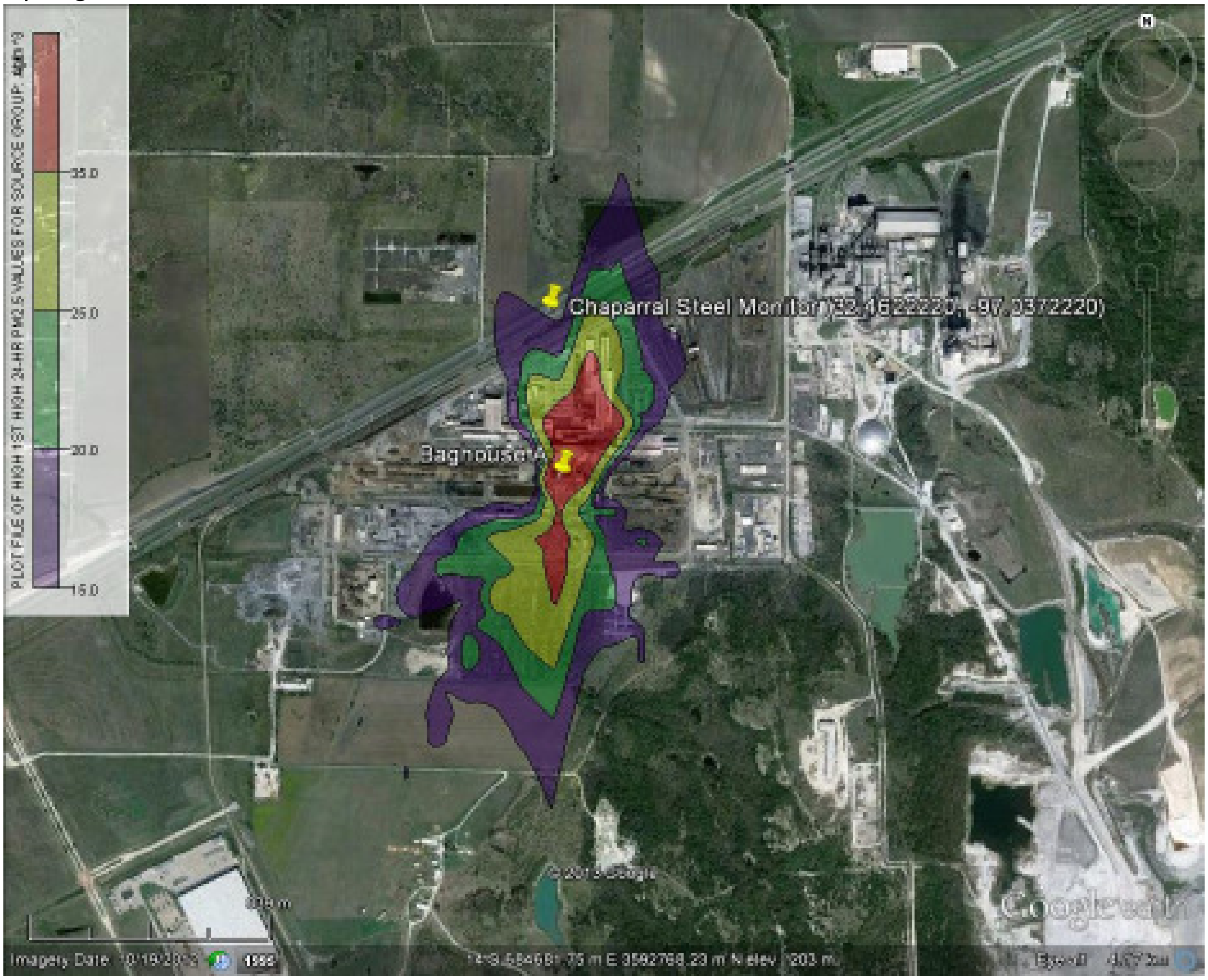


Figure 9: PM2.5 24-hr Modeling Results, Highest Impacts from All Sources Evaluated by ATSDR

The modeling results show that none of the offsite receptors exceed 35 ug/m3 . The highest concentrations occurred on Gerdau’s property. The highest 24-hr average offsite concentrations are in the range of 20 ug/m3 .

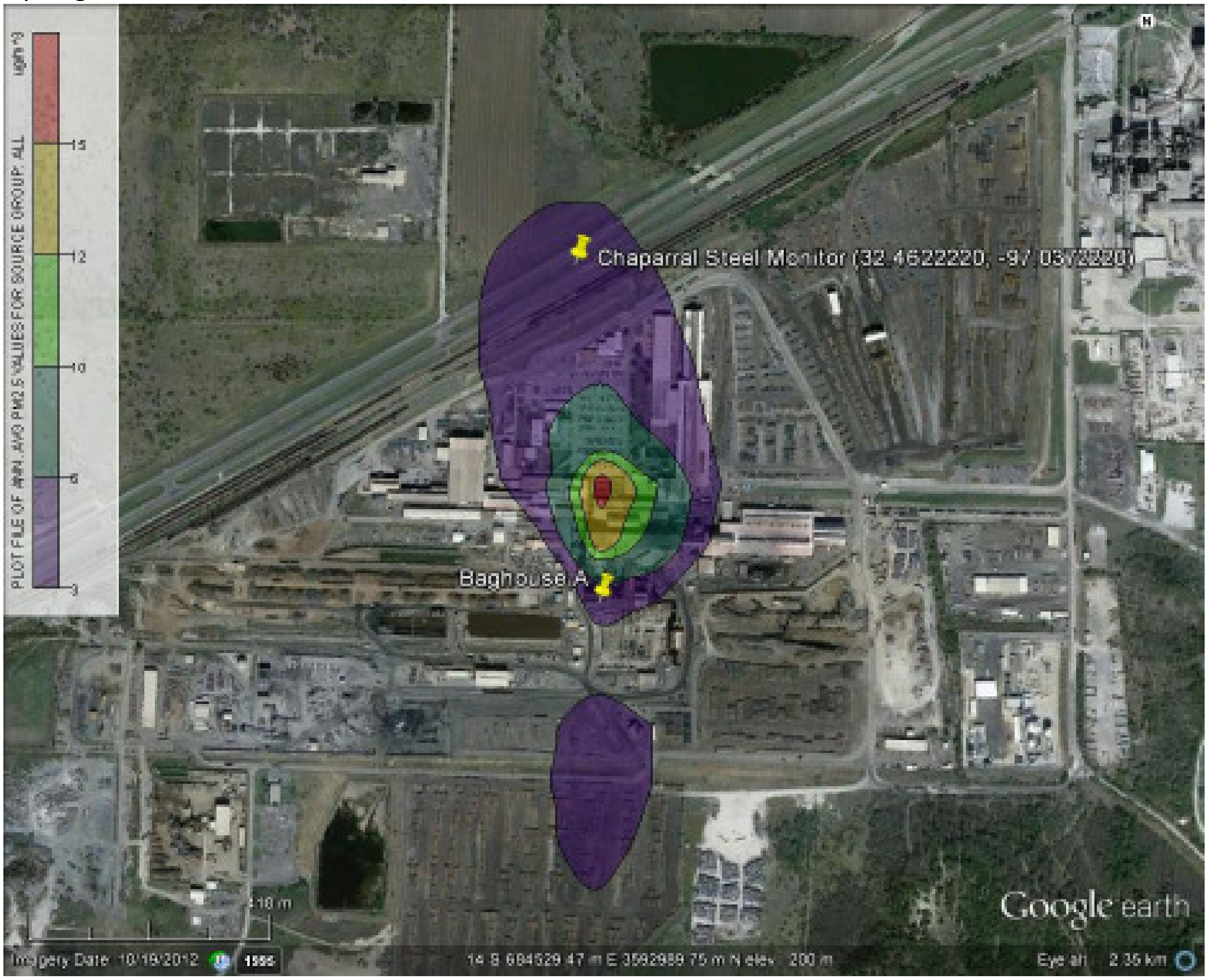


Figure 10: PM2.5 Annual Average Modeling Results, Highest Impacts from All Sources Evaluated by ATSDR

The modeling results show that none of the offsite receptors exceed 12 ug/m3 . The highest concentrations occurred on Gerdau's property. The highest off-site concentrations are in the range of 3 ug/m3 . Thus, with regard to possible annual average PM2.5 offsite concentrations greater than 12 ug/m3, it is clear that the PM2.5 concentrations resulted from sources other than the facilities evaluated by ATSDR.

Finally, to bound the analysis, it is assumed that all of the PM10 emissions are PM2.5. The modeling results based on this assumption are shown graphically in Figure 11.

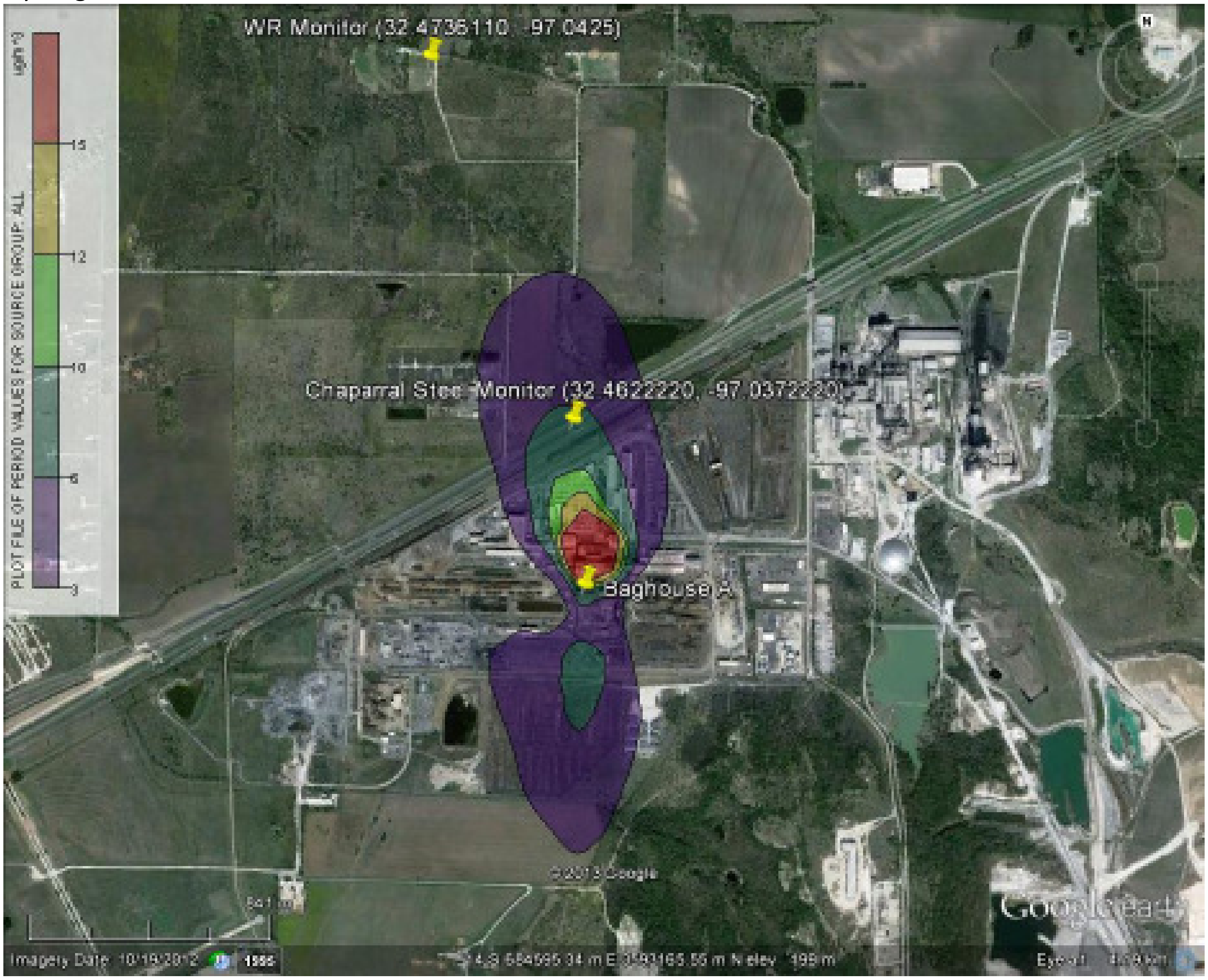


Figure 11: PM10 Annual Average Modeling Results, Highest Impacts from All Sources Evaluated by ATSDR

The modeling results show that even if all of the PM10 emitted by the industrial facilities is present as PM2.5, none of the industrial emissions result in offsite concentrations that are greater than the current ambient air quality standard for PM2.5. Further, because the historic Chaparral Steel monitor is located very close to a major highway, any PM2.5 concentrations greater than the modeled results are likely the result of mobile sources. The dispersion from mobile sources is not expected to result in elevated PM2.5 concentrations very far from the highway.

In summary, ATSDR identified the time period of the 1990's as a period in which sensitive populations may have experienced some health effects associated with long-term exposure to PM, generally limited to an area near the historic monitor that operated on Chaparral Steel's fence line. The modeling results above show that sources other than the industrial sources evaluated by ATSDR are a significant source of PM2.5 concentrations that, based on speculation, may have exceeded the current annual average PM2.5 standard concentration, if this concentration was exceeded at all. Finally, the above modeling results confirm ATSDR's statements that the impacts (if they occurred at all) were indeed highly localized. For example, the estimated annual average PM2.5 concentrations decrease from a high value of 17 ug/m3 in the area of onsite industrial operations to less than 3 ug/m3 over a distance of approximately 1,600 feet. The nearest residential location in the predominate downwind direction from Gerdau is over 5,000 feet from the onsite area of maximum modeled concentration.

Response to comment B.1.6: Please see responses to similar comments above. ATSDR aacknowledges that the PM10 concentrations measured from the ambient air monitor located north of the Gerdau fence line from 1996 through 1998 would be expected to include some contributions from traffic on U.S. Highway 67 and other sources. ATSDR has revised the Health Consultation to acknowledge the existence of these contributions.

B.1.7. Comment:

ATSDR mischaracterizes the potential impacts of mobile sources on the measurements of PM2.5 by the monitors used to collect the data upon which ATSDR relied on to formulate its response.

ATSDR states the following on page 51.

"Therefore, for certain pollutants (e.g., carbon monoxide, nitrogen oxides), transportation sources account for a considerable portion of the emissions in Ellis County; but for other pollutants (e.g., sulfur doxide, particulate matter), transportation sources are less important."

ATSDR makes the above conclusion based on its evaluation of emissions data. The statement is misleading because it leads the reader to conclude that historic long-term PM2.5 concentrations at the location of the historic Chaparral Steel monitor are the result of emissions from the industrial sources. However, as demonstrated by the modeling following the same technique employed by ATSDR in Appendix A to the HC, a significant source of any PM2.5 concentrations that occurred at the Chaparral Steel monitor in the 1990's in excess of the current standards must have been a source other than the industries. Given the location of the monitor, next to a major highway, it is logical to conclude that mobile sources are a significant contributor to PM2.5 concentrations measured by this monitor. (Further, it should be noted that all of the monitors are located next to roads. Thus, although PM2.5 from transportation sources may not be important regionally, they are important for the monitoring locations evaluated by ATSDR.)

Response to comment B.1.7: Please see responses above related to this issue.

B. 1.8. Comment:

ATSDR states the following on page 55: "Breathing air contaminated with PM2.5 downwind of TXI and Gerdau Ameristeel for 1 year or more is not likely to have harmed people's health, except in a localized area just north of the Gerdau Ameristeel fence line during 1996-1998."

And, "Nevertheless, for people, especially those with preexisting respiratory and cardiac disease, who lived in a localized area of Cement Valley (just north of the Gerdau Ameristeel fence line during 1996–1998), public health concern is warranted for adverse health effects from long-term exposure to PM2.5."

The statements are overly broad. As demonstrated in Section B, the area where ATSDR has estimated that historic PM2.5 concentrations could have exceeded the current standard, due to a significant extent from mobile source emissions, is so localized that there are no current or historic residential land uses in that area. If there are no persons living in that area, there can be no public health concern associated with health effects from historic long-term PM2.5 exposure.

Response to comment B.1.8: Please see responses to similar comments above.

B. 1.9. Comment:

ATSDR states the following on page 55: "Short-term potentially harmful levels of PM2.5 have been infrequent in Midlothian. These infrequent exposures could have resulted in harmful cardiopulmonary effects, especially in sensitive individuals, but not the general public."

The statement is both overly broad and is inconsistent with the data. First, the available monitoring data show that there have been a total of 3 instances where the current PM2.5 24-hr average NAAQS standard concentration was exceeded; and, as acknowledged by ATSDR, the current NAAQS standard as defined by EPA has never been exceeded at the 98th percentile. Thus, how can ATSDR opine that these infrequent exposures resulted in some health effect, even for a sensitive person?

Secondly, as demonstrated in Section B, any exceedence of the current PM2.5 24-hr average standard in area of the historic Chaparral Steel monitor was so localized that even if the standard was exceeded, the area where ATSDR estimated it occurred does not now, nor has it ever, supported any type of residential land use. Thus, there is no potential for exposure, and hence, no potential for health effects.

Response to comment B.1.9: ATSDR counted 22 times that the $PM_{2.5}$ levels were numerically above the 24-hour NAAQS HCV (not above the standard as defined by EPA for attainment purposes) with some of these coming from different monitors on the same day. An area being in attainment does not necessarily mean that potential harmful levels might not occur infrequently. As indicated in the draft health consultation on page 42, ATSDR, using EPA's AirNow Calculator, determined that the highest levels of 24-hour $PM_{2.5}$ levels recorded in Midlothian show an increased likelihood of respiratory symptoms in sensitive individuals, aggravation of heart or lung disease and premature mortality in individuals with cardiopulmonary disease and the elderly but not for the general population (EPA, 2012b). However, ATSDR also points out that the occurrence of these levels is very infrequent.

Other comments related to the Gerdau monitor (formerly the Chaparral Steel monitor) were addressed in responses to comments above.

B.1.10. Comment:

There is no discussion about the lack of speciation of the PM_{10} and PM2.5 data, nor are non-industrial sources of fine particulate matter discussed. The health effects of fine particulate on sensitive populations (COPD, asthma, emphysema, etc.) result from small amounts of allergens (dust, molds, spores, grasses, insect parts, pollen), as well as the size and concentration of the particles. Relatively large amounts of inert particulate matter may have little effect, but small amounts of allergens may have great effect. Also, heavy industry is not the only source of fine particulate matter in the atmosphere. In short, ambient particulate data without speciation paints an incomplete picture when it comes to determining exposure vectors, sources, and potential health effects to sensitive populations.

Response to comment B.1.10: ATSDR acknowledged in the draft health consultation that there are likely other sources of $PM_{2.5}$ besides the four industries that are contributing to the levels detected in Midlothian. The commenter mentions several non-industrial sources of $PM_{2.5}$ that may increase the risk of health effects in sensitive populations; however, there are also many industrial sources that could also be listed. ATSDR does not have speciation data for the $PM_{2.5}$

data for all of the constituents mentions so we must rely on how EPA characterizes the risk of 24-hour $PM_{2.5}$ levels with no speciation data (see response above). ATSDR has added in a statement regarding this issue into the revised health consultation.

B.1.11. Comment:

Page 27**:** The draft states: "Table 6 presents PM10 emissions data available from TCEQ's Point Source Emissions Inventory (PSEI) for the four Midlothian facilities from 1990 to 2010. The PM10 emissions listed for these facilities have consistently ranked among the highest for industrial facilities in Ellis County."

It should be noted that based on data retrieved from STARS on December 12, 2012, Owens Corning Insulating Systems LLC was also consistently ranked among the highest for PM10 emissions in Ellis County. In 1994, 1995, 2001, 2002, 2003, 2004, 2005, 2007, 2009, and 2010 Owens Corning Insulating Systems LLC reported the highest PM10 emissions in Ellis County. In 1992, 1993, 1997, 1998, 1999, 2000, 2006, and 2008 Owens Corning Insulating Systems LLC reported the second highest PM10 emissions for Ellis County. Again, we note that emissions data is not informative from a public health standpoint.

Response to comment B.1.11: The information is noted, however, the purpose of this health consultation was to evaluate exposures in Midlothian in relation to the four facilities and not other facilities in Ellis County. ATSDR believes the original statement is still correct as drafted and that this information, although it cannot be used to determine the public health implications of exposures from these facilities or in Midlothian in general, it does provide the public with some perspective as to where the emissions rank countywide.

B.1.12. Comment:

Page 27: The draft states: "Since 1995, estimated annual PM10 emissions from the three cement manufacturing facilities were always higher than those from Gerdau Ameristeel."

It should be noted that based on data retrieved from STARS on December 11, 2012, Holcim reported lower PM10 emissions than Gerdau Ameristeel in 1995.

Response to comment B.1.12: No changes were made to the revised document as the language from the original text does not include the year 1995.

B.1.13. Comment:

Page 27: Under the TSP green paragraph, the draft states: "TSP includes particles up to approximately 40 microns in diameter."

It should be noted that EPA's current definition, as shown on their website, is: "Particles ranging size from 0.1 micrometer to about 30 micrometer in diameter are referred to as total suspended particulate matter (TSP)."

Response to comment B.1.13: Comment noted and text revised to add in this update.

B.1.14. Comment:

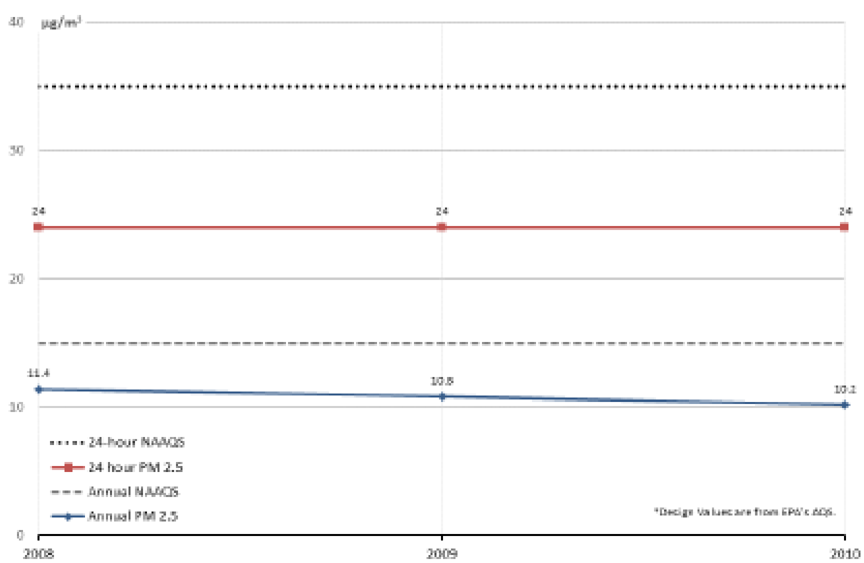
Page 82: In table 15, PM10 is listed as a chemical of concern. However, ATSDR does not evaluate PM10 data, rather they convert it to PM2.5 for evaluation.

Response to comment B.1.14: The commenter is correct that PM_{10} itself is not a contaminant of concern but was used to estimate past $PM_{2.5}$ levels near the Gerdau monitor. Since ATSDR has not used this approach to estimate past $PM_{2.5}$ exposures in the revised health consultation, this table has been corrected.

B.1.15. Comment:

The draft assessment reports that Particulate Matter (PM2.5) concentrations exceeding the current NAAQS for a localized area just north of Gerdau Ameristeel during 1996-1998 were infrequent, but exposures to these concentrations could have resulted in cardiopulmonary effects in sensitive individuals. However, for all other areas, PM2.5 concentrations are not likely to have harmed health of sensitive individuals or the general population. First, we note that the Midlothian area has been and continues to be in compliance with the PM NAAQS (see Figure 3), which is set at a level that protects public health (including sensitive subpopulations) with an adequate margin of safety. Therefore, we disagree with the conclusion that health effects were likely to occur as a result of potential exposure to these levels of PM2.5 on either an annual or a 24-hour basis.

Figure 3: PM 2.5 Annual and 24-hour Design Values at Midlothian OFW.



Response to comment B.1.15: Please see responses to similar comments above.

B.1.16. Comment:

Second, on page 30, concentrations of PM2.5 were estimated from PM10 measurements, based on a conversion factor of 0.47-0.52, with an adjustment of 2 µg/m3 , for data prior to 2005. We note that when assessing potential health effects following this conversion from PM10 to PM2.5, additional uncertainty is introduced into the analysis. This source of uncertainty should be acknowledged in the draft consultation. Furthermore, the available PM10 and PM2.5 measurements were not taken from collocated monitors, but from different sites on the same day. These sites are much farther from potential PM sources than fence-line monitors, such as the one at Gerdau Ameristeel. Consequently, the ratio of PM2.5 to PM10 should be lower nearer to a dust source. In high dust areas throughout Texas, it is not unusual to observe ratios of 0.3 or less. Therefore, the ATDSR estimated PM2.5 levels are likely to be too high for some sites, such as the Gerdau Ameristeel fence-line site. Finally, dust concentrations decrease rapidly with distance from a source; fence-line measurements may significantly over-estimate concentrations that would occur even a relatively short distance away, on the order of a tenth of a mile or more.

Response to comment B.1.16: Please see responses to similar comments above.

B.1.17. Comment:

Some of the conclusions reached by the report for particulate matter (PM2.5) are based on data from monitors not operated by TCEQ. Therefore, we have not verified the quality and accuracy of these estimates. However, we note that the estimates for the non-TCEQ monitor near the Holcim facility were adjusted upwards by 2 µg/m3, the same factor that should be used on the TCEQ data. It is not clear that this adjustment is necessary on non-TCEQ data as ATSDR has no empirical evidence that this is in fact warranted.

Response to comment B.1.17: ATSDR only adjusted the TCEQ data per Personal Communications with Tracie Phillips, TCEQ, in 2012. As noted in Table 10 of the draft health consultation, ATSDR did not do any adjustment for the Holcim $PM_{2.5}$ data.

B.1.18. Comment:

Furthermore, breathing the indicated concentrations (in Table 10 of the draft consultation) would not be expected to result in adverse health effects. This is because the annual average concentrations for all complete years are below the level recently proposed to be protective of public health with an adequate margin of safety (i.e., the newly finalized 12 µg/m3 NAAQS). We agree with ATSDR that uncertainty in the relationship between PM2.5 and adverse health effects increases substantially below 13 µg/m3 and note that this fact is in direct contradiction with the statement on page 42 regarding concentrations as low as 11 µg/m3 . In addition, there is significant uncertainty surrounding the association between low levels of ambient PM2.5 given the observed spatial heterogeneity and concern for residual confounding in these observational epidemiology studies.

Response to comment B.1.18: ATSDR agrees that the annual average $PM_{2.5}$ TCEQ data presented on Table 10 of the draft report do not represent a hazard. However, ATSDR is uncertain about the Holcim $PM_{2.5}$ data relating to how much bias might be present in the data due to using a continuous monitoring method. Regarding the apparent contradiction that the comment suggest in relation to the uncertainty in the relationship between $PM_{2.5}$ and adverse health effects, ATSDR is just referencing two sources that have "weighed-in" on this uncertainty and do not see a contradiction unless the commenter has evidence as to one source providing better information than the other.

B.1.19. Comment:

The draft assessment concludes that health effects may have occurred based on the observation that, although past concentrations of 24-hour measurements of PM2.5 were not above the EPA standard at the time, they were "infrequently" and "slightly" above the current standard . This does not agree with the statement on page 41 indicating that PM2.5 concentrations "might have been about twice the proposed EPA standard." Moreover, this statement does not agree with the results presented in Table 10 of the draft assessment. Given that "ATSDR is uncertain whether exposures above the current or proposed EPA standard actually occurred in these areas" (emphasis added) and that the available data indicates compliance with applicable standards and acceptable air quality, it is unclear how "public health concern is warranted" for long- or short-term exposure to PM2.5 concentrations in Midlothian.

Response to comment B.1.19: The reviewer is mixing up the analysis that ATSDR did to estimate $PM_{2.5}$ exposures from PM_{10} data obtained from the Gerdau monitor in the 1990s with the actual measured $PM_{2.5}$ levels presented in Table 10. As mentioned above, ATSDR has reevaluated the method used to estimate the $PM_{2.5}$ data from PM10 data from the Gerdau monitor and did not make a health determination based on these data.

B.2 Ozone

B.2.1. Comment:

What are the effects of recurrent or long-term exposure to ozone?

Response to comment B.2.1: **Currently, there is not sufficient scientific information to understand what long-term, chronic exposures to ozone may do to the lung. However, repeated, short-term ozone damage to children's developing lungs may lead to reduced lung function in adulthood. In adults, ozone exposure may accelerate the natural decline in lung function that occurs with age. For these reasons, EPA has focused on regulating shorter-term exposures to ozone in an attempt to reduce these risks and others related to harmful effects due to these acute exposures.**

B.2.2. Comment:

"CONCLUSION 3— Ozone Exposures - Ellis County is one of 11 counties that make up the Dallas–Fort Worth ozone non-attainment area, which means that ozone levels in the metropolitan area occasionally exceed EPA's health-based standards. Ozone levels also have exceeded the World Health Organization (WHO) health guidelines. Emissions from industrial sources, mobile sources, and natural sources throughout the area contribute to this problem."

The report states that Ellis County is one of 11 counties in the DFW 8-hour ozone nonattainment area, but the correct number of counties is 10 (not 11), under the 2008 8-hour ozone standard effective April 30, 2012.

Response to comment B.2.2: The health consultation has been revised to address this comment.

B.2.3. Comment:

Page 26: The draft states: "Emissions from the Midlothian facilities certainly contribute to the ozone found throughout the metropolitan area."

In the most recent Dallas/Fort Worth area attainment demonstration State Implementation Plan (SIP), TCEQ included ozone modeling scenarios for a 2009 future case. In this analysis, it was concluded that the rules adopted in conjunction with that SIP revision resulted in roughly 10 NOx tons per day (tpd) of reduction from cement kilns, which resulted in 0.08 ppb ozone average decrease across the nine-county DFW area.

Response to comment B.2.3: Commented noted.

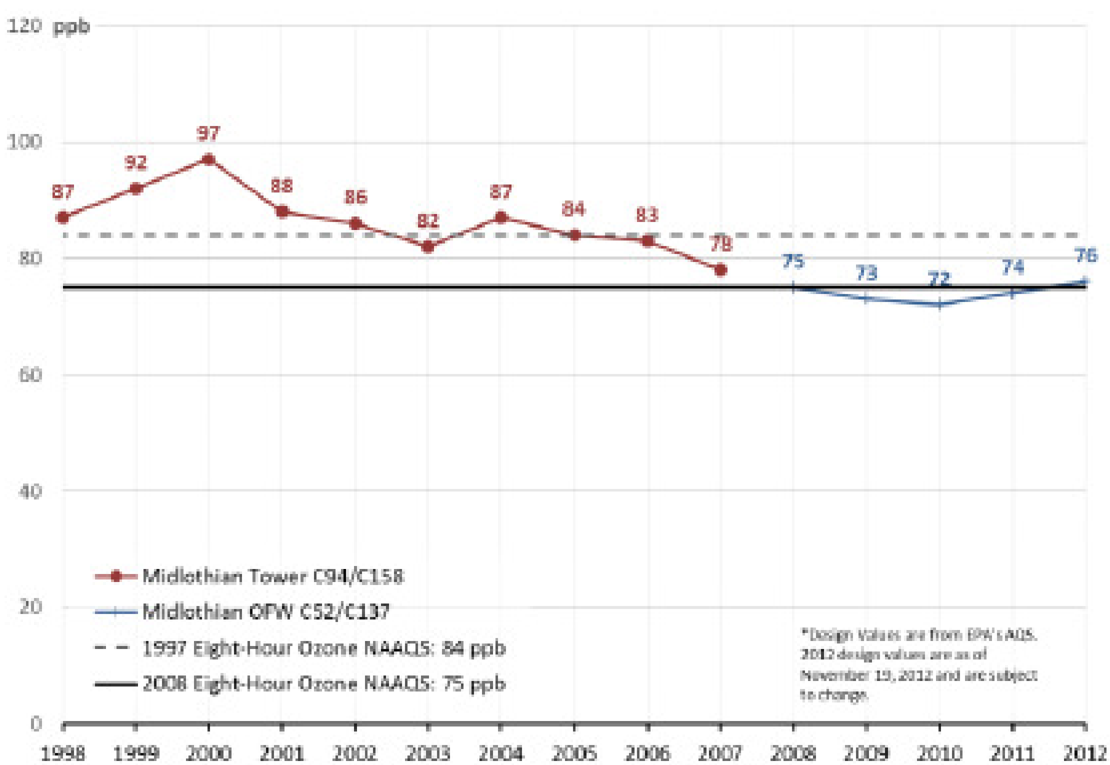
B.2.4. Comment:

The draft assessment states that ozone is a general air quality issue that is only partly affected by emissions from Midlothian facilities. The assessment indicates that because ozone concentrations in Midlothian have occasionally exceeded the 8-hour standard, these levels *may have* caused respiratory effects in sensitive individuals. The general population is not expected to experience effects from exposure to concentrations of ozone measured in the air around Midlothian.

Ellis County is one of 10 counties that make up the DFW ozone non-attainment area. While it is true that Ellis County is included in the Dallas/Fort Worth nonattainment area for ozone, the Midlothian (but not all DFW area) ozone monitors have: (1) Met the 1997 ozone standard for the last 8 years; and (2) Met the 2008 ozone standard 4 of the last 5 years (see Figure 4). Based on this information, it is not clear that ozone concentrations in ambient air, when correctly averaged and reported, have exceeded the 100 ppb level indicated in the text on page 43. However, the draft assessment states that "the 8-hour EPA ozone standard has been exceeded 236 times" at the Midlothian Tower and Old Fort Worth Road sites. This is a misrepresentation of the 8-hour ozone standard, which is not compared to individual measurements.

Furthermore, ATSDR should include the data upon which they rely to make conclusions regarding ozone, however this data is not depicted in any of the tables or graphs within the draft assessment. Furthermore, the text indicates that only on "rare" occasions have ozone concentrations exceeded 100 ppb. It is not clear that this frequency of potential for exposure would realistically result in health effects.

Figure 4. Eight Hour Ozone Design Values at Midlothian.



Response to comment B.2.4: ATSDR has revised the draft health consultation to include some of the information in the comment regarding the attainment status by year for the area. ATSDR did not include the statement indicating that the Midlothian area monitors have not exceeded the 1997 standard for the past 8 years as this standard did not apply for many of those years since the new standard was adopted in 2008. In addition, as indicated above in a previous response, ATSDR has added language to the revised health consultation better defining our use of the EPA NAAQS standards as health comparison values and not that the levels above this value necessarily constitute an exceedance of the standard as defined by EPA. ATSDR also has added a table to summarize the ozone data and comment on the trends in the ozone data. According to the data, 8-hour ozone levels were in the range of 96-115 ppb about 20 times from 1997-2012, with 19 of these occurrences between 1997-2006. According to the EPA AirNow Calculator, when ozone levels are in this range, harmful effects are possible to both sensitive persons and the general public.

B.3 Sulfur Dioxide

B.3.1. Comment:

What are the effects of long term exposure to SO2?

Response to comment B.3.1: There were numerous studies published examining possible associations between long-term SO2 exposure and mortality and morbidity (respiratory morbidity, carcinogenesis, adverse prenatal and neonatal outcomes) endpoints. However, the EPA concluded that the evidence relating long-term (weeks to years) SO2 exposure to adverse health effects was ''inadequate to infer the presence or absence of a causal relationship''. That is, EPA found the long-term health evidence to be of insufficient quantity, quality, consistency, or statistical power to make a determination as to whether SO2 was truly associated with these health outcomes (EPA, 2010e).

B.3.2. Comment:

Conclusion 1 (SO2) page vii - First statement section reading "…limited to areas primarily in Cement Valley and possibly areas east, south, and southeast of TXI."

Would it not be accurate to state "… not only limited to Cement Valley and possibly areas east, south, and southeast of TXI as well as possibly areas downwind of Holcim and Ashgrove since emissions (see chart 11) were similar to, if not greater than, those experienced in Cement Valley. Note Holcim and Ashgrove are in close proximity.

Response to comment B.3.2: Since the release of this health consultation for public comment, ATSDR has performed additional modeling of the SO2 emission from Ash Grove and Holcim. The findings from this analysis have been added to the revised health consultation.

B.3.3. Comment:

Sulfur Dioxide (SO2) Exposures - There are instances in the document which cite long time frames where potentially harmful SO2 exposures could have occurred. As drafted, the lengthy time frames cited for elevated SO_2 short-term exposures could be read to imply long-term effects. There is a lack of sufficient evidence linking long-term SO_2 exposure to adverse health effects. This fact should be made clear to the reader.

Response to comment B.3.3: ATSDR has revised these statement to make it clear that we are referring to the short-term exposures that occurred during the time frames mentioned and not that we are saying chronic exposures represented by these time frames were of concern.

B.3.4. Comment:

"4.1. Sulfur Dioxide - Conclusions for Sulfur Dioxide - EPA's 1-hour standard of 75 ppb is designed to protect people from exposures to high, short-term peaks of SO2 (from 5-minutes to 24-hour exposures). In addition, EPA determined that little health evidence suggests an association between long-term low-level exposure to SO2 and public health effects (EPA, 2010e). ATSDR believes that the best data available for evaluating the health implications of exposure to sulfur dioxide is peak concentrations, such as 5-minute average measurements (measured by TCEQ from 1997 to present). The remainder of this section uses this averaging period, even though EPA's and TCEQ's short-term health-based standards are based on 1-hour average levels."

There are no current violations of SO_2 1-hour NAAQS in the Midlothian area. EPA did not set the SO_2 NAAQS on 5-minute interval, therefore we believe 5-minute data is not advisable for public health purposes at this time. EPA required states to collect short-term (5 minute) data and will evaluate these data in the future.

Response to comment B.3.4: As a screening tool, ATSDR first evaluated the 1-hour levels of SO_2 available in Midlothian in relation to the current EPA standard as it represents the most currently available science on potential levels of concern. Then, ATSDR evaluated the 5-minute data which represents a similar time frame of exposure that was used in many of the clinical studies. ATSDR has taken this approach in other documents; for example, the Mirant Potomac River Generating Station Health Consultation (ATSDR, 2011b). Also, see other responses below in relation to the adequacy of using 5-minute SO_2 data.

B.3.5. Comment:

"SO2 peak (5-minute) exposure summary: 10 ppb - 200 ppb - The 5-minute SO2 level was between ATSDR's chronic MRL of 10 ppb and 100 ppb was 59,820 times at Old Fort Worth Road and Wyatt Road monitors and 22,895 times at the Midlothian Tower monitor."

The comparison of short term (i.e. 5-minute) data values against chronic (long-term) comparison levels could lead to inaccurate exposure conclusions. Any public health impact conclusions from such comparisons may not be scientifically supported. We recommend revisiting this text and revising such comparisons accordingly.

Response to comment B.3.5: The word "chronic" in relation to the MRL is not correct—it should say "acute". This comment has been addressed in the revised health consultation.

B.3.6. Comment:

ATSDR does not provide sufficient context in the discussion to allow a reader to fully understand the uncertainties of the analysis with regards to the population potentially affected and health effects at concentrations less than 200 ppb. For example, it overstates the science with regard to effects on potentially sensitive populations (e.g. those who are obese or who have diabetes) and it uses health guideline values of 100 and 10 ppb based on 5-minute average concentrations, which were not used by USEPA to establish the 1-hr National Ambient Air Quality Standard for SO2.

Response to comment B.3.6: ATSDR is an independent agency that routinely develops its own health comparison values. For sulfur dioxide, ATSDR developed a Minimal Risk Level (MRL) based on the Shepard, et al. (1991) study indicating less serious effects in humans (asthmatics) at 100 ppb (the Lowest-Observed-Adverse-Effect-Level or LOAEL (ATSDR, 1998). ATSDR states in the draft health consultation, in several places, that adverse health effects from exposures to SO_2 concentrations less than 200 ppb are uncertain, but may occur in some people more sensitive or vulnerable than people participating in clinical studies. As 5-minute SO_2 levels began to appreciable drop below the 100 ppb LOAEL after 2008, but still frequently above our MRL, ATSDR determined that harmful effects were not likely. This appears to be consistent with the following from EPA (2009b):

"While there is very strong support for SO2 being causally linked to lung function responses within the range of tested exposure levels (i.e., ≥ 200 ppb) and even down to the 100 ppb level (where SO2 was administered by mouthpiece (Sheppard et al. 1981; Koenig et al., 1990)), there is increasing uncertainty about whether SO2 is causally related to lung-function effects at lower exposure levels below 100 ppb. Since this assessment assumes there is a causal relationship at levels below 100 ppb, the influence of this source of uncertainty would be to over-estimate risk. The SO2-related lung function responses have been observed in controlled human exposure studies and, thus there is little uncertainty that SO2 exposures are responsible for the lung function responses observed for SO2 exposures in the range of levels tested. Given the lack of chamber data at levels below 100 ppb, the uncertainty is rated as medium"

Regarding the comment on ATSDR overstating the science with regard to effects on potential sensitive populations, below is the complete language from the draft health consultation on pages viii, 40, and 54:

> *"People with asthma, children, and older adults (65+ years) have been identified as groups sensitive to the health problems associated with breathing SO_2 (EPA, 2010d; EPA, 2008c). Human health studies (clinical investigations and epidemiologic studies) have provided strong evidence of a causal relationship between SO_2 and respiratory diseases (morbidity) in people with asthma and more limited epidemiologic studies have consistently reported that children and older adults may be at increased risk for SO_2-associated adverse respiratory effects (EPA, 2010e). Potentially sensitive groups to air pollutants include obese individuals, those with preexisting cardiopulmonary disease, and those with a pro-inflammatory condition such as diabetes (EPA, 2008c), but some of these relationships have not been examined specifically in relation to SO_2."*

ATSDR does not believe that our statement on sensitive populations, taken in total, overstates the science.

B.3.8. Comment:

ATSDR incorrectly assumes correlations in the data between emissions and impacts, and production rates and impacts, which do not exist.

Response to comment B.3.8: ATSDR does not make any health determinations based solely on emissions or production rates. The commenter may be referring to ATSDR's use of these metrics to determine if there is a potential for harmful SO_2 exposures downwind of Ash Grove or Holcim which helped inform our decision that this is an important data gap or in our recommendations for reducing future SO_2 emissions from TXI. First, ATSDR has performed its own modeling of SO_2 emissions from both Ash Grove and Holcim so we now have more information to make a determination regarding whether harmful SO_2 exposures downwind of these facilities has or is occurring. In addition, the recommendations for evaluating future emissions were revised due to changes make by TXI and Ash Grove that have or should appreciably reduce SO2 emissions.

B.3.9. Comment:

ATSDR does not describe behaviors that will mitigate impacts such as time spent exercising indoors as opposed to outdoors. ATSDR does not factor into its analysis the fact that the majority of instances where the SO2 concentrations exceed the ATSDR guideline levels occurred at times when most people do not exercise.

Response to comment B.3.9: There are many scenarios that one could develop that would either mitigate or possibly increase the potential for a person to be exposed while exercising. First, exercising could be any activity that increased the ventilation rates (e.g., by climbing stairs, gardening, etc) of a sensitive person. In addition, outdoor SO_2 levels can enter indoor settings, primarily when residents have their windows open. ATSDR has revised the health consultation to indicate when the majority of elevated levels of SO_2 occurred in relation to when most people are likely to exercise; however, elevations above levels of concern also frequently occurred at other times when persons might exercise. Moreover, ATSDR nor the commenter can ever know with certainty the habits of the persons who might have been exposed in relation to when they exercise, garden, open windows, etc.

B.3.10. Comment:

ATSDR does not clearly state the science that defines sensitive populations.

Response to comment B.3.10: ATSDR clearly indicates what sensitive populations would be a concern for SO_2 exposures and does not see why stating the science about what defines a sensitive population would assist the reader in better understanding our findings. Also, see response to similar comments above.

B.3.11. Comment:

ATSDR buries in the Appendices the fact that the studies show that only a portion of the exercising asthmatic population is affected by SO2 concentrations above the ATSDR guideline values.

Response to comment B.3.11: ATSDR has taken some of the information from Appendix B and added it to the text and Conclusions.

B.3.12. Comment:

ATSDR does not fully describe the potential health effects associated with exposures between 100 and 200 ppb.

Response to comment B.3.12: The primary effects for exposures between 100-200 ppb would be asymptomatic increased specific airway resistance (broncho-constriction) to moderately exercising asthmatics which was found in the study by Shepard et al (1991). This information has been added to the text and Conclusions. This is the same study that produced a Lowest-Observed-Adverse-Effect-Level of 100 ppb which was used by ATSDR to develop its MRL of 10 ppb (ATSDR, 1998). Also, see response to comment B.3.6 above.

B.3.13. Comment:

ATSDR incorrectly uses the total number of times the 5-minute guideline values are exceeded as an indicator of the potentially affected population and health effects and does not acknowledge that EPA has stated that health effects from multiple exposures on the same day are not the same as the health effects associated with a single exposure.

Response to comment B.3.13: ATSDR does not use any data on the number of times a 5-minute SO_2 level was above a guideline values on the same day as an indicator of increased concern for harmful effects. However, even so, the comment implies that somehow we know that the same person would be exposed to the same levels on the same day—it is also possible that different people in the same area could be exposed to levels above a guideline at different times during the same day depending on their activities during that day.

B.3.14. Comment:

ATSDR states the following on page 33: "Table 13 shows that the 1-hour measurements at the upwind station (Midlothian Tower) were all lower than the 2010 EPA NAAQS value; however, individual measurements exceeded the standard 24 times between 1997 and 2005. Short-term average concentrations of sulfur dioxide measured at Old Fort Worth Road between 1997 and 2008 would not have met EPA's current air quality standards, but they met the standard at the time. The current EPA 1-hour standard was exceeded 312 times at the Old Fort Worth Road monitor during 1997 to early 2008 and six times at the Wyatt Road station during 2005 to early 2006."

Notwithstanding the fact that the 2010 standard did not apply during the timeframes evaluated by ATSDR, the statement should be amended to add context to the discussion relevant to the timing of the exceedences. Specifically, the majority of the exceedences occurred during times when most people do not exercise as shown in Figure 1 below. The figures show that there are fewer exceedences during the time periods when most people commonly exercise (Morning Work-day – 5 to 7 am, Evening Work-day – 4 to 8 pm, and Weekend – 8 am 4 pm.)[8] Thus, to characterize the impacts prior to 2008 based on the number of times the concentration was above the 2010 standard concentration leads to the above incorrect conclusion in ATSDR's report.

Further, the report does not provide an explanation for why more SO2 concentrations were greater than the 2010 standard concentration in the late evening or early morning hours. In its first Health Consultation (HC), ATSDR determined that "the ambient air monitoring data and facility continuous emission monitoring data provide no evidence that the Midlothian facilities alter their emissions on days when 1-in-6 day samples are collected," which likewise suggests that there is no information to suggest that emissions are altered in the late evening and early morning hours. ATSDR does not explain that meteorology is the reason that concentrations are higher more often in the late evening and early morning hours. Specifically, it is known that stable conditions (when there is little mixing in the atmosphere, and hence less dispersion) occur at night, and that radiation inversions (which limit the mixing height and hence dispersion) are known to occur more often in the late evening and early morning hours.[9]

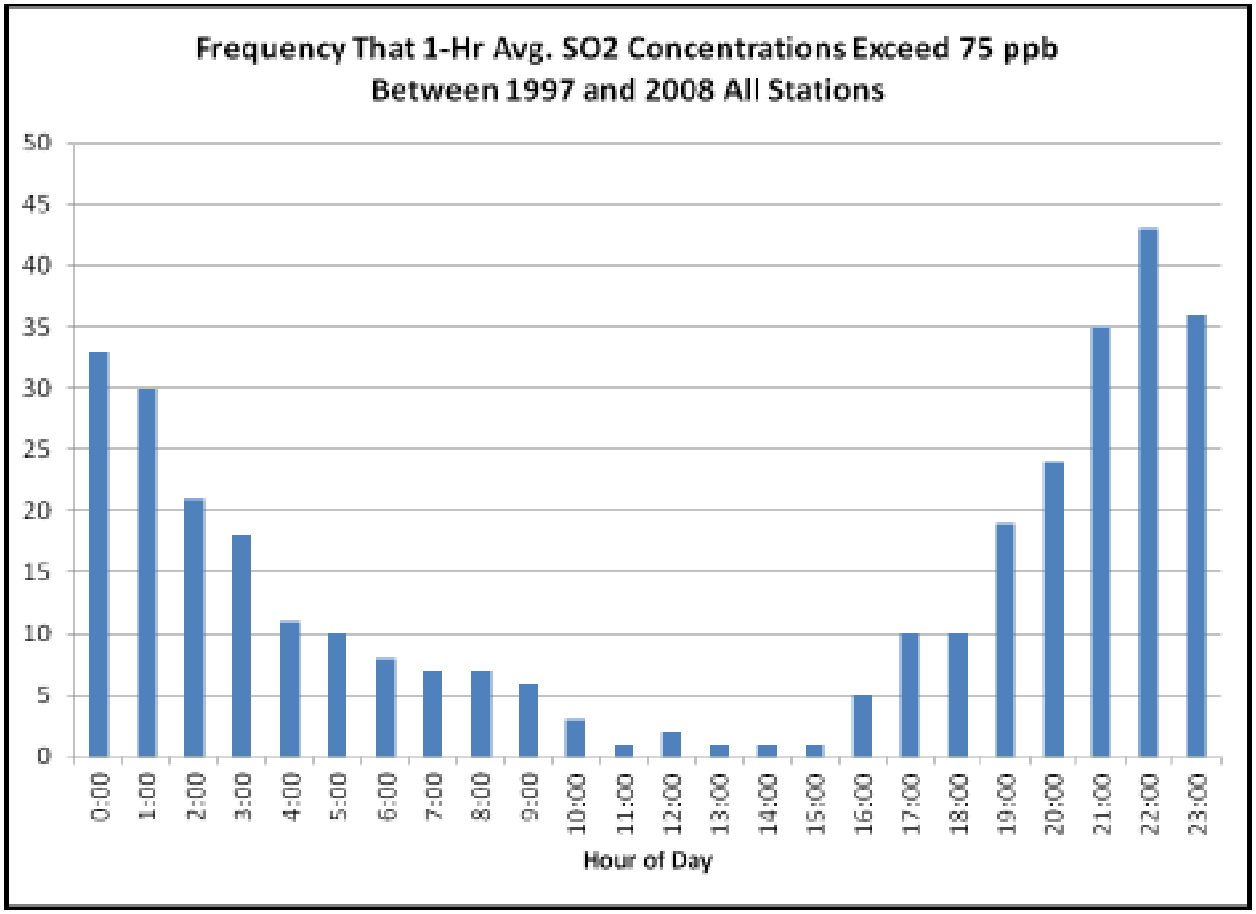


Figure 1: Frequency that 1 Hr Avg SO2 Concentrations Exceed 75 ppb Between 1997 and 2008, All Stations (Source: TCEQ TAMIS, CAMS Stations 52, 160, and 302)

There are a total of 12 years (105,120 hours) during the timeframe referenced by ATSDR. Only 115 hours exceeded the 75 ppb criterion used by ATSDR during peak exercise time periods accounting for data from all three monitoring stations (Midlothian Tower, Old Fort Worth Rd., and Wyatt Road). Thus, the number of times the SO2 concentration was greater than the 2010 standard concentration during periods of exercise represents only 0.1% of the total time period evaluated by ATSDR. Further, since the 2010 NAAQS is designed to protect exercising asthmatics, only some portion of the population in the areas of the monitors may have experienced some effect, and those effects ceased when exercising ceased or the concentration decreased below 75 ppb. ATSDR should at least acknowledge that the preponderance of the concentrations greater than the 2010 standard concentration occurred during the early morning or late evening hours when most people do not exercise.

Response to comment B.3.14: ATSDR did not rely on the number of times the 1-hour SO_2 levels were numerically above the current EPA standard to determine the public health impact. ATSDR relied on our evaluation of the 5-minute SO_2 levels to determine the public health implications of SO_2 exposures. The commenter is correct regarding ATSDR's previous conclusion on the 1-in-6 day sampling issue (ATSDR, 2015) and that it is likely that the levels were affected by metrological

conditions existing in the evening and early morning hours. In this context, ATSDR has simply noted the time of day that SO_2 levels generally began to rise and were at their highest levels.

Regarding the information on the figure depicting the frequency of levels above 75 ppb, besides the response to similar comments above, one could also say that the frequency of levels above 75 ppb was much less during the times when most people might not be at their residence (during normal business hours). However, as stated above, ATSDR, nor the commenter, have perfect knowledge of when people work, exercise, garden, etc. ATSDR has added some additional perspective from this graph and referred to in the revised text.

B.3.15. Comment:

ATSDR states the following on Page 34: "In 2010, 28 sulfur dioxide monitoring stations in Texas were submitting data to EPA's Air Quality System, and 13 of those stations recorded 24-hour average concentrations higher than those at Old Fort Worth Road. Overall, in the years 1999 to 2001, Old Fort Worth Road ranked among the stations with the highest 24-hour average sulfur dioxide concentrations in the state."

The statement should be amended to note that only 0.88% of all hours in the 1999 to 2001 timeframe at the Old Fort Worth Road monitor exceeded the 2010 1-hr regulatory value of 75 ppb for SO2 in order to place this statement in context. ATSDR should also be stated that the majority of these instances occurred between the hours of 9 PM and 4 AM when most people are not exercising as shown below.

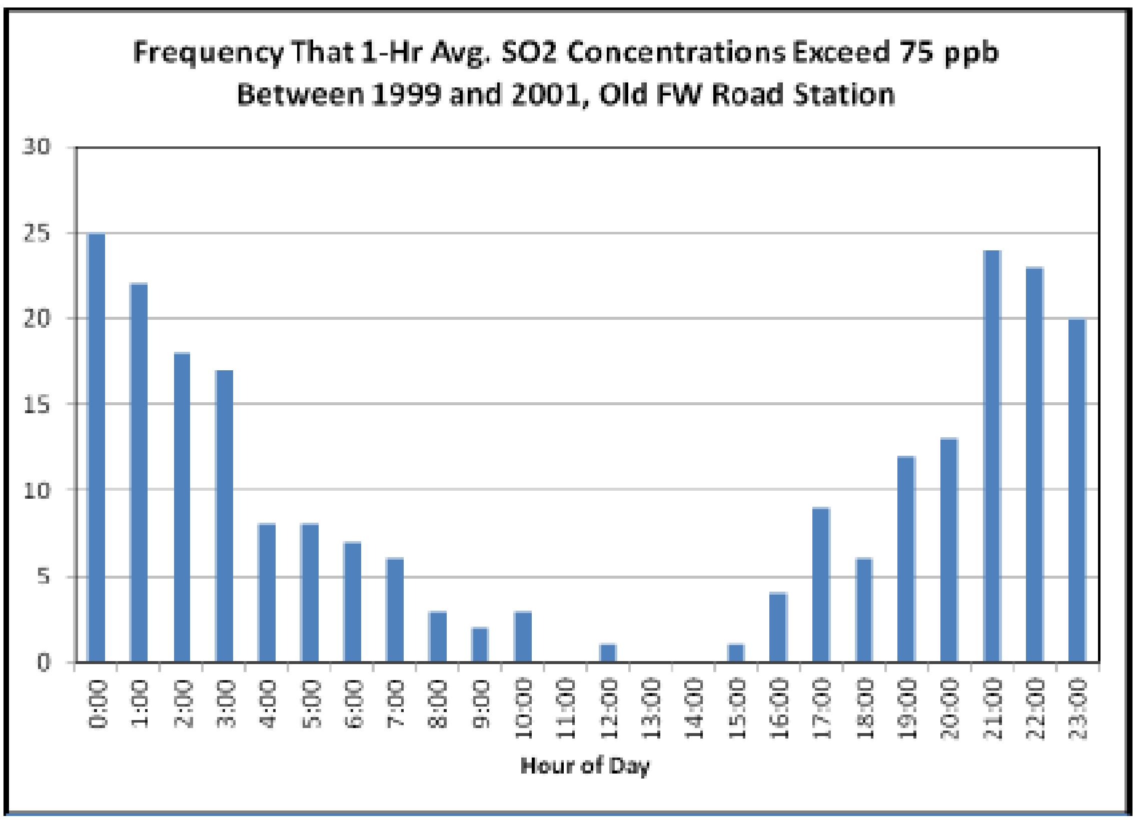


Figure 2: Frequency That 1Hr Avg. SO2 Concentrations Exceed 75 ppb Between 1999 and 2001, Old FW Road Station (Source: TCEQ TAMIS, CAMS Station 52)

Response to comment B.3.15: ATSDR added in a caveat regarding the percentage of time between 1999-2001 that the levels were above 75 ppb. Please see previous responses to similar comments on the timing of elevated levels when people normally exercise.

B.3.16. Comment:

ATSDR states on Page 34: "The highest concentrations were consistently observed at the Old Fort Worth Road monitoring station, which is located immediately downwind from TXI Operations. Sulfur dioxide levels at this station were highest during 1997–2008 and have decreased since then—consistent with the decreasing emissions at the TXI Operations facility."

This statement is misleading because it leads the reader to believe that during the timeframe of 1997 to 2008 the concentration and number of times the concentration was greater than 75 ppb were the same for every year. In fact, the maximum 1-hr average SO2 concentrations and the number times the concentrations were greater than 75 ppb varied considerably (see Table 1). Further, in only one of the years were the SO2 concentrations greater than 75 ppb more than 1% of the time, and as has been previously shown, the majority of those times occurred in the late evening or early morning hours when most people do not exercise.

Table 1: Summary of Maximum 1Hr SO2 Concentrations at OFW Road and Number of Times the Concentration was Greater than 75 ppb

YEAR	MAX 1-HR SO2 CONC. (ppb)	NUMBER OF TIMES > 75 ppb	PERCENT OF TIME CONC. > 75 ppb
1997	116.07	7	0.08%
1998	117.04	23	0.26%
1999	199.55	54	0.62%
2000	202.06	108	1.23%
2001	211.54	71	0.81%
2002	86.14	2	0.02%
2003	134.70	4	0.05%
2004	112.57	3	0.03%
2005	115.06	15	0.17%
2006	153.63	13	0.15%
2007	90.59	11	0.13%
2008	95.03	1	0.01%

Response to comment B.3.16: ATSDR has added in a statement to the revised health consultation explaining that the levels were not the same for every year. Please see response to previous comments on the frequency of levels above 75 ppb and the issue with the timing of the elevated levels in relation to times when persons normally exercise.

B.3.17. Comment:

ATSDR states the following on Page 38: "The measured air quality impacts were consistently highest at the monitoring station directly north of and downwind from—TXI Operations. The concentrations at this station generally tracked with the facility's emissions: air quality impacts were highest in years when emissions were high, and air quality impacts were lowest after the facility's emissions began to decrease."

This statement is not correct. Years in which emissions were lower had similar impacts to other years when emissions were higher as shown in the Figures below. This is because meteorology and emissions both contribute to downwind SO2 concentrations at the monitor. Meteorology (e.g. stable conditions and inversions) cannot be controlled by limiting production. Emissions are a function of production rates, air pollution control equipment, and operational practices. Thus, the data shows that limiting production rates does not necessarily result in lesser downwind impacts due to other controlling factors like meteorology. Emissions are best controlled by the regulations in place (i.e emission limits) at the time the emissions occur and the operational practices and air pollution control technologies of the individual facility.

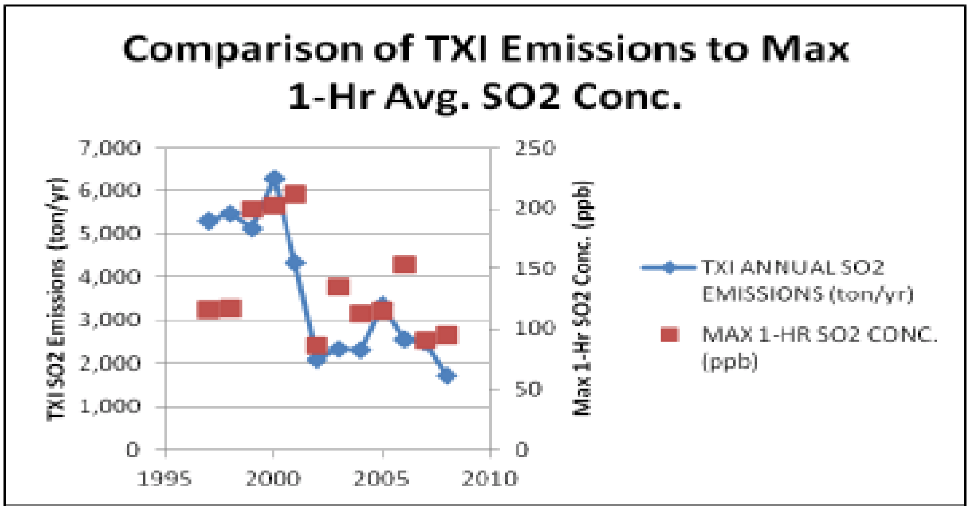


Figure 3: Comparison of TXI Emissions to Max 1-Hr Avg. SO2 Concentration.

(Source: TCEQ TAMIS Data for CAMS Station 52 and SO2 Emissions - Reported by ATSDR for TXI.)

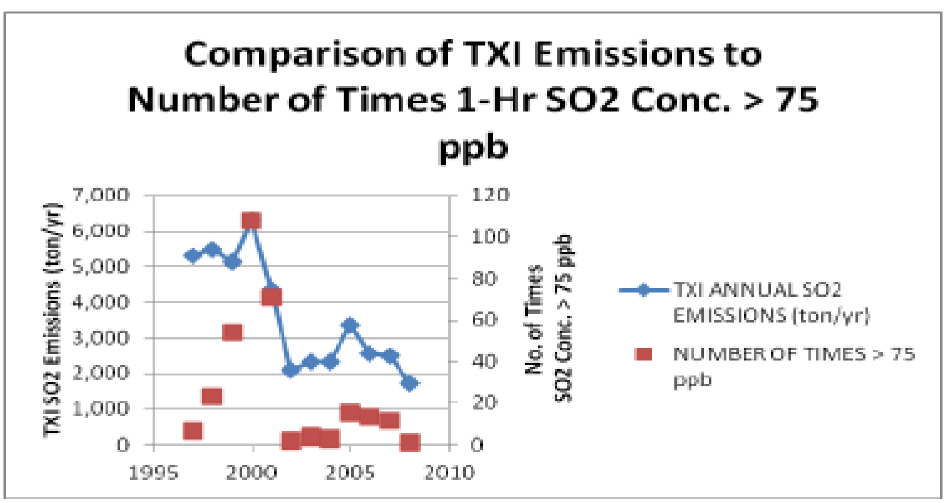


Figure 4: Comparison of TXI Emissions to Number of Times 1-Hr SO2 Conc.>75 ppb.

(Source: TCEQ TAMIS Data for CAMs Station 52 and SO2 Emissions Reported by ATSDR for TXI.)

Response to comment B.3.17: The commenter is correct that the emissions do not directly correlate perfectly to levels downwind of TXI and that meteorology plays a key role in determining the monitored levels along with other factors like the emission rate. ATSDR was trying to make a general observation regarding the overall trends in the emissions data and the levels detected downwind of TXI. In looking at the data, there is a definitive drop off of SO_2 emissions from the 1997-2001 timeframe to the 2002-2008 period and these do correlate with a lowered frequency of elevations above 75 ppb. For the period 1997-2001, emissions averaged about 5,316 tons/year and the frequency of levels above 75 ppb averaged about 53 times per year. For the timeframe 2002-2008, the emissions averaged 2,411 tons/year; with the average number of times above 75 ppb of about 7 times per year. ATSDR has clarified this statement in the revised health consultation.

B.3.18. Comment:

ATSDR states the following on page 39: "Outdoor vs. Indoor Exposures--outdoor SO2 can enter indoor settings, primarily when residents have their windows open. No valid SO2 indoor air monitoring data are, however, available at this site. Indoor air concentrations likely will not exceed the peak outdoor concentrations noted in this section, unless a resident has a substantial indoor source. When windows are open, we expect the same conclusions presented here for outdoor settings to apply to indoor settings."

This statement should be amended to state that indoor SO2 concentrations should be less than outdoor concentrations unless windows are left open or there is a source of SO2 inside the building. EPA's Integrated Science Assessment (ISA) for Sulfur Oxides states the following with regard to expected indoor concentrations of SO2.

- "Because indoor and personal SO2 concentrations are generally much lower than outdoor or ambient measurements, individuals that spend most of their time indoors, such as older adults, are not anticipated to be vulnerable to high SO2 exposures…" (p. 4-11).
- Another factor that potentially alters vulnerability to SO2 is air conditioning use due to the reduced penetration of SO2 into buildings when windows are closed" (p. 4-11).

Response to comment B.3.18: ATSDR has amended this statement and included some additional information presented here. However, it is also possible that for many people living in this part of Texas that they open their windows at night during certain times of the years. Moreover, as stated before, neither ATSDR nor the commenter can have perfect knowledge regarding who in the exposed population actually spends more time indoors vs outdoors and which ones keep their windows open or not.

B.3.19. Comment:

ATSDR states the following on page 40: "Cold and dry air, which occurs in real-world exposure conditions, has been reported to induce effects at lower SO2 concentrations."

ATSDR cited no technical reference in support of this statement. If there are such studies ATSDR should state the SO2 concentrations used in those studies, the cold and dry conditions evaluated in those studies, and whether or not those cold and dry conditions occurred at the same time the SO2 concentrations were greater than the ATSDR guideline levels.

Response to comment B.3.19: The references for this statement, Bethel, et al., (1984) and Linn, et al., (1985), can be found in Appendix B, Sulfur Dioxide Health Evaluation. ATSDR has added these references to the main body of the revised health consultation and main reference section.

B.3.20. Comment:

ATSDR states the following on page 40: "Potentially sensitive groups to air pollutants include obese individuals, those with preexisting cardiopulmonary disease, and those with a pro-inflammatory condition such as diabetes (EPA, 2008c), but some of these relationships have not been examined specifically in relation to SO2."

ATSDR should provide additional information about what the science states regarding the conditions identified from the above statement. In the document cited by ATSDR (EPA's Integrated Science Assessment (ISA) for Sulfur Oxides – Health Assessment), the following statements are made.

- "In conclusion, the very limited evidence examining the susceptibility of individuals with preexisting cardiovascular disease to adverse health effects from ambient SO2 exposures is inconclusive" (p. 4-10).
- "Although data specific to SO2 exposures is lacking for the susceptibility factors listed below, several other potentially susceptible groups deserve specific mention in this document. These include individuals in a chronic pro-inflammatory state (e.g., diabetics),obese individuals, and children born prematurely or with low birth weight" (p. 4-11).

Thus, ATSDR should state specifically that there is no data to show that obese individuals and those with diabetes are more sensitive to SO2 exposures than the general population and that the studies suggesting that those with cardiopulmonary disease are more sensitive are "very limited."

Response to comment B.3.20: ATSDR has added in additional language into the revised health consultation as suggested in the comment.

B.3.21. Comment:

ATSDR compares the 5-minute monitor data from several stations to several different guideline concentrations on pages 40 – 41, and discusses the development of these guidelines in Appendix B.

ATSDR should provide additional information on pages 40 and 41 that at least summarize the basis of the guideline values. For example, ATSDR states in Appendix B that health effects above 400 ppb, but below 500 ppb, are expected to occur in only 20 – 35% of exercising adults with asthma, not everyone. Further, only 5 to 30% of the test subjects in the study used to develop the 200 ppb guideline experienced health effects, not the entire group. Additionally, ATSDR does not report the percentage of the population that demonstrated clinical effects to the mouthpiece SO2 exposure above 100 ppb, but this information would likewise be helpful to place the guideline value in its proper context. (The EPA REA indicates that only two subjects were evaluated in the mouthpiece study cited by ATSDR.) Also, although ATSDR goes to some length to describe that the clinical studies upon which the guideline values are based are derived from adults with only mild to moderate asthma, thus increasing the uncertainty in the values as applied to sensitive populations and people with more severe asthma, it does not discuss the fact that the majority of the data upon which the guidelines are based are derived from data of 10 minute exposures.[10] EPA has opined that this fact could lead to an over-estimation of the health risk associated with being exposed to SO2 concentrations above the guideline values.[11] Finally, the specific health effects associated with exposure of exercising adults to concentrations greater than

100 ppb but less than 200 ppb is not described in the report, but should be to place this information in context.

Response to comment B.3.21: The actual number of persons in the study mentioned in the comment (Shepard, et al., 1981) was 13 and two of these were considered the most responsive subjects that showed slight increased airway resistance. ATSDR has added in the following statement into the revised health consultation:

"Not all persons in the study that was used to derive the LOAEL or other studies experience harmful effects and it is likely that any exposures in Midlothian would be categorized as less serious effects (see Appendix B, particularly Table B-1). Therefore, ATSDR would not expect that all sensitive persons in Midlothian who were exposed to levels between 100-400 ppb and engaged in activities that increased their breathing rate would experience the effects described above."

Regarding the comment on the possible over-estimation of the health risks associated with being using 5-minute data to evaluate exposures to SO_2 concentrations above the guideline values, ATSDR could not specifically find this information in the report referenced (EPA, 2009b). However, ATSDR did find the following quotes from this document:

> *"The ISA concludes that there is sufficient evidence to infer a causal relationship between respiratory morbidity and short-term (5-minutes to 24-hours) exposure to SO2).*
>
> *In large part, this determination is based on the results of controlled human exposure studies in exercising asthmatics demonstrating a relationship between 5-10 minute peak SO2 exposures and decrements in lung function that are frequently accompanied by respiratory symptoms. In fact, the ISA describes the controlled human exposure studies as being the "definitive evidence" for its causal determination between short-term SO2 exposure and respiratory morbidity."*
>
> *"Staff concluded that it was appropriate to consider 5-minute benchmark levels in the range of 100 to 400 ppb in the air quality and exposure analyses."*
> *"Other uncertainties such as the assumption about causality, use of both 5- and 10-minute data to estimate 5-minute effects, the assumption of reproducible responses, use of adult data to estimate exposure-response for children, and influence of exposure history were generally rated as low to medium with respect to knowledge base uncertainty and low or unknown impact on the magnitude of these uncertainties on the lung function risk estimates."*

ATSDR does not see any reason why 5-minute data are not a good metric to compare to health-based comparison values.

B.3.22. Comment:

ATSDR discusses the frequency that 5 minute average concentrations are greater than the various guideline values on pages 40 and 41, and in Table 16 and Figure 10.

However, ATSDR does not discuss when the 5-minute concentrations exceeded the guideline values, or if multiple concentrations greater than the guidelines occurred on the same day. Such a discussion is important for two reasons:

a) The preponderance of the times when the concentrations exceed the guideline values occurred at times when people do not normally exercise. (See the following figures.)
b) There is uncertainty as to whether additional short-term SO2 exposures on a given day would be associated with an additional adverse respiratory outcome.[12]

The fact that the preponderance of the times that 5-minute SO2 concentrations were greater than the guideline value of 100 ppb occurred during hours in which people do not normally exercise is described below.

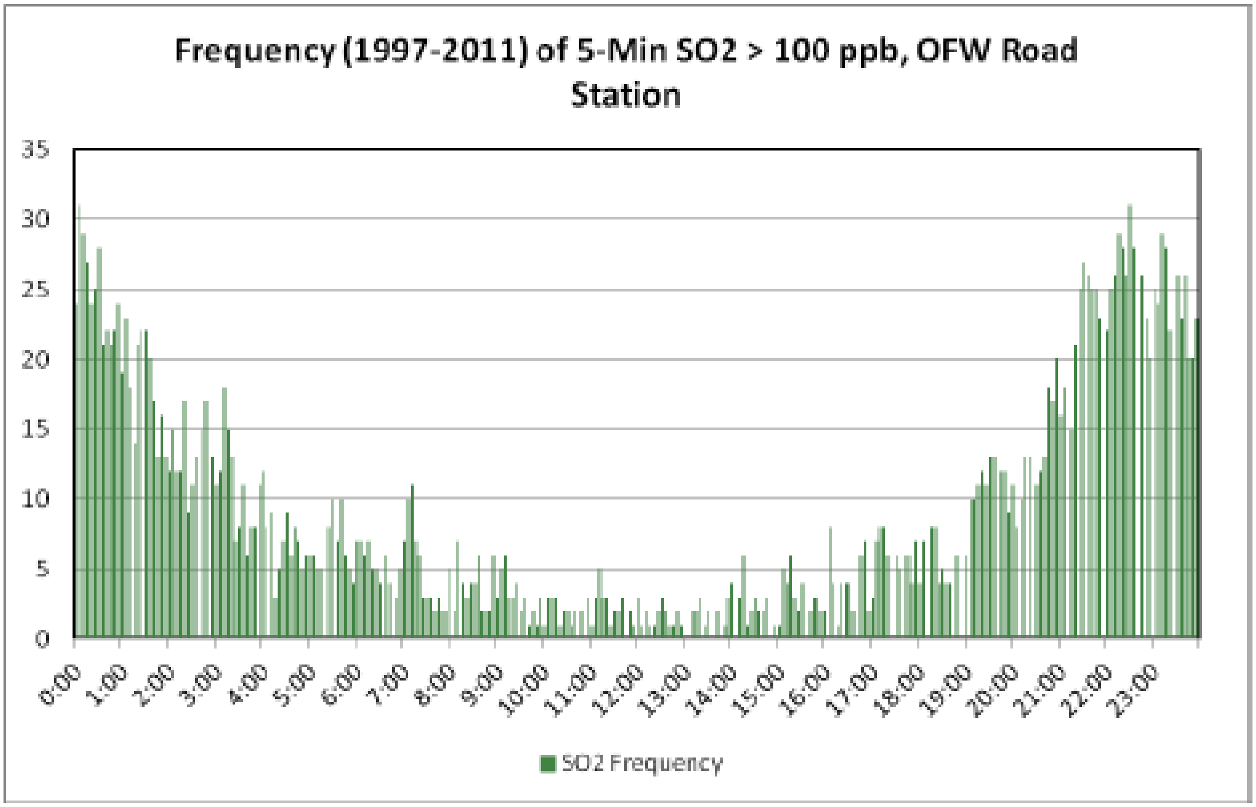


Figure 5: Frequency (1997 – 2011) of 5-Minute SO2 Concentrations > 100 ppb, OFW Road Station

(Source: TCEQ TAMIS, CAMS Station 52).

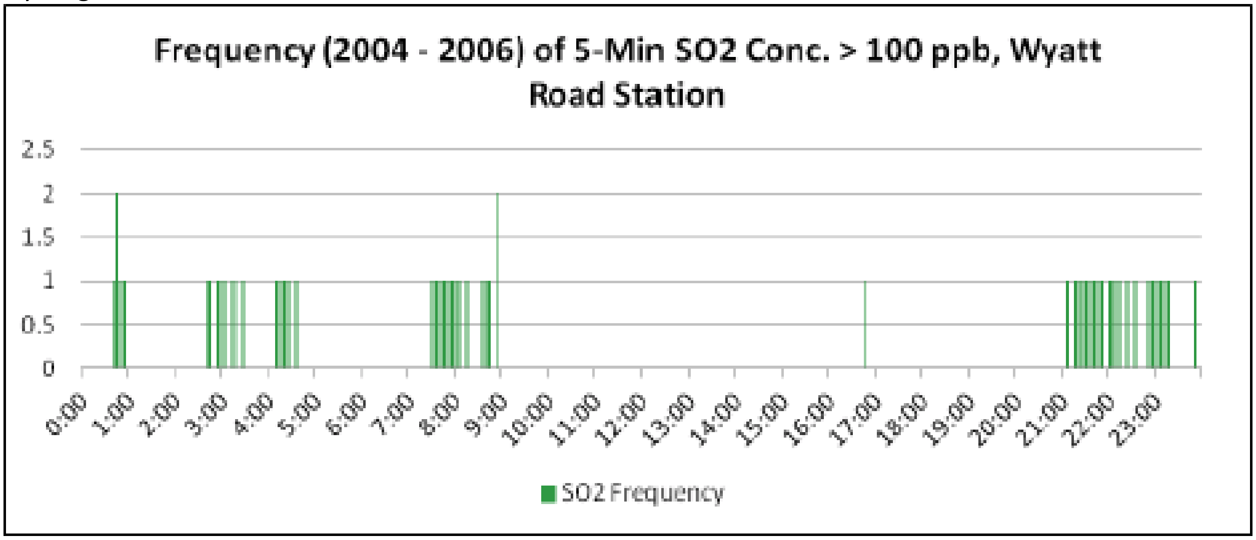


Figure 6: Frequency (2004 – 2006) of 5-Minute SO2 Concentrations > 100 ppb, Wyatt Road Station

(Source: TCEQ TAMIS, CAMS Station 302, All Available Data Was Evaluated.)

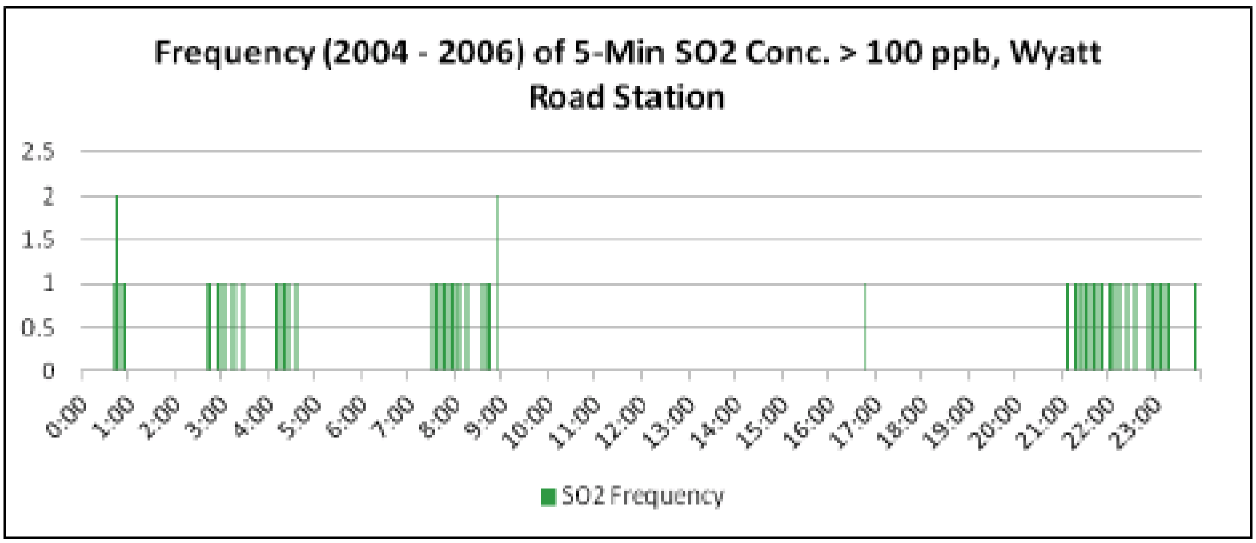


Figure 7: Frequency (1997 – 2007) of 5 Min SO2 Conc. > 100 ppb, Midlothian Tower Station (Source: TCEQ TAMIS, CAMS Station 160)

Further, we cannot confirm a total of five 5-minute SO2 concentrations that exceed 400 ppb as stated on page 40. From the TCEQ 5-minute data, three 5-minute concentrations exceeding 400 ppb occurred between 11:00 pm and 11:10 pm CST (12:00 to 12:10 CDT) on Tuesday, August 2, 2005 at the Wyatt Road monitor at concentrations of 568, 476, and 440 ppb. Conversely, the highest 5-minute SO2 concentration measured by the Old Fort Worth Road monitor was 393 ppb which occurred at 2:00 pm CST on Tuesday, March 4, 2008. The highest 5-minute SO2 concentration measured by the Midlothian Tower monitor was 371 ppb which occurred at 1:10 pm CST (2:10 pm CDT) on Thursday, August 20, 1998. Thus, none of the highest concentrations occurred during time periods in which people normally exercise.

Also, Table 2 shows that in the vast majority of cases, multiple 5-minute SO2 concentrations that exceed the ATSDR guideline values occurred on the same day. As noted by EPA in its Risk and Exposure Assessment to Support the Review of the SO2 Primary National Ambient Air Quality Standards: Final Report, "there is uncertainty as to whether additional short-term SO2 exposures on a given day would be associated with an additional adverse respiratory outcome." Thus, once again, ATSDR's use of the total number of 5-minute concentrations that exceed its guideline values as an indicator that some portion of the sensitive population may have experienced health effects is poor science. In fact, that portion of the population that may have experienced some transient health effect is limited to less than 30% of persons with asthma that were engaged in exercise at the time the first 5-minute SO2 concentration exceeded a guideline value and through the time that both exercise and SO2 concentrations above the guideline value continued. The science is uncertain as to whether health effects would result from additional exercise periods that occurred on the same day and at the time that SO2 concentrations again exceeded a guideline value. However, ATSDR treats such a condition as a certainty by using the total number of guideline exceedences as a benchmark for its evaluation. ATSDR should dramatically narrow its characterization of the population with potential health effects and the number of time those effects may have occurred based on the data.

Response to comment B.3.22: The text has been revised to indicate that there were three instances when 5-minute SO_2 levels exceeded 500 ppb and two instances where it approached 400 ppb. The levels that exceeded 500 ppb were close to midnight on August 2, 2005, which may not be a time when most persons would be conducting activities which may increase their ventilation rates. The comment also indicated that the other two levels that approached 400 ppb occurred during the daylight hours were also times when persons do not normally exercise. As stated above in relation to similar comment, neither ATSDR nor the commenter has perfect knowledge as to the habits of persons who might have been exposed to these levels of SO_2 at these times. However, the revised health consultation does point out that the levels above 500 ppb all occurred around the same time on August 2, 2005. Moreover, ATSDR has added some language indicating that the number of sensitive persons who were exposed to these higher levels may have been limited due to a combination of factors, including:

1) the infrequency of their occurrence;

2) the time of day they occurred; and,

3) the percentage of asthmatics who showed effects in the clinical studies was less than 30%

ATSDR did not use multiple elevated levels of SO_2 on the same day as an indicator of increased concern for harmful effects (please see response to similar comment).

B.3.23. Comment:

ATSDR opines that SO2 concentrations were high enough that some residents could smell an odor even though the accepted, peer reviewed odor threshold for SO2 is significantly greater than the highest 5-minute concentration of SO2 measured by any monitor.

ATSDR states the following on page 50; "Hydrogen sulfide and not SO2 is usually associated with the smell of rotten eggs. Sulfur dioxide odors have been described as having a very pungent smell. ATSDR did not identify hydrogen sulfide levels as a concern but did determine that past sulfur dioxide levels could have harmed the health of some community members. In addition, ATSDR did not identify a major source of hydrogen sulfide but did determine that the local cement industries are major sources of sulfur dioxide emissions. The timing of the concern (sunset) is consistent with when SO2 elevations did begin to occur and it is possible that people are smelling sulfur dioxide and not hydrogen sulfide."

The accepted, peer reviewed odor detection threshold for SO2 ranges from 1,900 ppb to 5,000 ppb. (There is one study that reported an odor detection threshold of 333 ppb, but that study was rejected by the American Industrial Hygiene Association peer review process.) The highest concentration detected by any of the monitors was 568 ppb that occurred at the Wyatt Road monitor on August 2, 2005, and there are only six 5-minute SO2 concentrations reported in all of the data above 300 ppb. There is no data available which suggest that the alleged odors reported by some citizens are in any way related to SO2.

Response to comment B.3.23: ATSDR received input from local Midlothian residents who reported the smell of either rotten eggs or "sulfur odors". The nature and sources of the odors are uncertain. Given that there are no documented major sources of H_2S in the vicinity of the residents, ATSDR acknowledges that this issue may remain unresolved until further data becomes available that may explain the source of the emissions that caused the odor reported by the residents. The text of the Health Consultation has be revised to reflect the uncertainties associated with the odors reported by Midlothian residents.

B.3.24. Comment:

ATSDR states the following on page 54: "In the past (1997–late 2008), breathing air contaminated with sulfur dioxide (SO2) for short periods (5 minutes) could have harmed the health of sensitive individuals (e.g., people with asthma), particularly when performing an activity (such as exercising or climbing steps) that raised their breathing rate."

And "These exposures occurred primarily from about 5 p.m. to 6 a.m."

These statements are overly broad. First, the statement should be refined to discuss that the studies upon which the ATSDR's guideline levels are based did not show that 100% of the subjects experienced adverse health effects. Second, the monitoring data show that the most frequent hours where 5-minute concentrations above the ATSDR guidelines occurred was between the hours of 9 pm and 4 am, a time when most people do not commonly exercise outdoors.

Response to comment B.3.24: ATSDR has added in some qualifying statements regarding the response rate of exercising asthmatics which are shown in the scientific literature. Although the statement regarding the highest frequency of SO_2 levels above 100 ppb did occur between 9 pm and 4 pm, again, ATSDR nor the commenter have perfect knowledge as to when persons who might have been exposed would conduct activities which may increase their ventilation rate (i.e., exercising, climbing stairs, gardening, etc.). As indicated above in a similar comment, one could also interpret the data to indicate that lowest frequency of levels above 100 ppb occurred during hours when most persons were working (the typical 9 am to 5 pm job) and that the frequency of levels above 100 ppb began to increase in the late afternoon and early evening when people might be engaged in some of the activities mentioned above. ATSDR also added language indicating that it is likely that not all of sensitive persons who were exposed to SO_2 above 100 ppb, while engaged in activities that may increase their breathing rate, would have experienced the less serious harmful effects described in the text.

B.3.25. Comment:

ATSDR states the following on page 54: "Future harmful exposures in Cement Valley could occur if production rises to at least previous levels and actions are not taken to reduce SO2 emissions."

This statement is overly broad. As demonstrated in Section A, production rates are not the sole reason that some historical 5-minute downwind concentrations of SO2 exceeded the ATSDR guidelines. All of the industries must comply with current regulations, which by their design are protective for 5-minute SO2 exposures. The methods used by any specific industry to comply with the regulations are the responsibility of the specific industry and may include a variety of techniques. Limiting production rates will not necessarily reduce downwind concentrations.

Response to comment B.3.25: ATSDR did not mean to suggest that any company should limit their production rates but that this could be one reason levels might increase in the future. However, since the release of this health consultation for public comment, ATSDR has learned of the measures taken at TXI to reduce emissions. This information was included in the revised health consultation and changes were made to this conclusion and recommendation.

B.3.26. Comment:

ATSDR states the following on page 54: "When sulfur dioxide concentrations exceed 400 ppb, sensitive individuals may experience symptoms such as coughing, wheezing, and chest tightness. At lower sulfur dioxide concentrations (200 ppb to 400 ppb), sensitive individuals functioning at elevated breathing rates may experience asymptomatic effects (e.g., mild constriction of bronchial passages). Adverse health effects from exposures to sulfur dioxide concentrations less than 200 ppb are uncertain, but may occur in some individuals more sensitive or vulnerable than those participating in clinical investigations."

The statement is overly broad. First, it does not state that only some sensitive individuals may experience health effects at the stated concentrations (typically less than 30% of the sensitive population). Secondly, it does not describe what the potential health effects are below 200 ppb or the percentage of the sensitive population that may experience those effects at those concentrations.

Response to comment B.3.26: ATSDR has revised the health consultation to add in the some qualifying statements regarding the response rate of those who may have been exposed in the 100-200 ppb and 200-400 ppb.

B.3.27. Comment:

ATSDR states the following on page 54: "Potentially sensitive groups to air pollutants include obese individuals, those with preexisting cardiopulmonary disease, and those with a pro-inflammatory condition such as diabetes, but some of these relationships have not been examined specifically in relation to SO2."

The statement is overly broad. ATSDR should clearly state that there are no studies linking increased risk from SO2 exposure to diabetes or obesity, and that the studies linking SO2 exposure to cardiopulmonary disease are very limited.

Response to comment B.3.27: Please see response to similar comment above.

B.3.28. Comment:

ATSDR makes the following statement on page 55: "To reduce current and potential future peak exposures to sulfur dioxide, ATSDR recommends the following:

- Reduce emissions—TCEQ should take actions to reduce future SO2 emissions from TXI to prevent harmful exposures.
- Evaluate and reduce exposures—TCEQ should conduct ambient air monitoring to characterize community exposures to SO2 downwind of the Ash Grove and Holcim facilities and take actions to reduce emissions from these facilities if harmful exposures are indicated."

The recommended actions are unnecessary. First, with respect to TXI, there is no current data that suggest sensitive populations are exposed to SO2 at concentrations that can lead to adverse health effects. For example, there was no exceedence of the ATSDR 5-minute guideline value of 100 ppb at the Old Fort Worth Road monitor in 2009, 2010, or 2011. (The 5-minute SO2 concentrations for 2012 have not been made available as of this writing. However, the 1-hour average concentrations show a maximum value of 23.8 ppb, which is less than 3 times the current NAAQS 1-hr concentration of 75 ppb.)

Secondly, with respect to Ash Grove and Holcim, there is no need for additional monitoring because the EPA already has a process in place to ensure that the new 1-hr SO2 NAAQS is attained. Under that process the TCEQ will be required, through modeling or monitoring, to determine the attainment status of the Midlothian area with respect to the 1-hr SO2 standard (which is designed to be protective against 5-minute exposures.) In the event that TCEQ determines that the standard is not being met it will work with the industry to develop enforceable emissions limitations, timetables for compliance, and appropriate testing/reporting to assure compliance, all under the oversight of EPA. To the extent that Ash Grove's or Holcim's emissions do not meet the current standard, they will be required to develop appropriate techniques to control those emissions. Thus, even if additional monitoring showed that Ash Grove and Holcim do not meet the current 1-hr NAAQS for SO2, there is already a method in place to address that concern.

Response to comment B.3.28: Since the release of this health consultation for public comment, ATSDR has learned of actions taken by TXI and Ash Grove to reduce SO_2 emissions. ATSDR has included this information in the revised health consultation and revised the recommendations accordingly.

B.3.29. Comment:

Page 40: ATSDR states that "Analysis of the sampling conducted during 1997–2011 resulted in the following average exposure estimates by concentration category (see Figure 10 for a scatterplot of peak 5-minute average SO2 data and health endpoints and Table 16 for the percentages of peak [5-minute] SO2 concentrations by monitoring station and year during 1997– 2011)."

and "During this period, 5-minute SO2 concentrations >400 ppb occurred only five times. Of these five occasions, three occurred in 2005 and one in 2008 in Cement Valley and once in the area of the Midlothian Tower in 1997. One 5-minute SO2 detections >500 ppb (Wyatt Road) and four 5-minute

SO2 detections (Wyatt Road, Old Fort Worth Road, and Midlothian Tower) between 400-500 ppb also occurred. None have occurred since 2008."

- The commenter has questions regarding the data "in Cement Valley." We do not have any record of a "Cement Valley"or "Cement Valley Road" site. This appears to refer to a site that was part of the *Critical Evaluation of the Potential Impact of Emissions from Midlothian Industries* (TNRCC 1995). Furthermore, it is unclear how ATSDR obtained raw data for this site as the report only presents a summary of the data. In addition, the "Cement Valley Road" site in this special study was a PM10 monitor, not an SO2 monitor.
- Only three values >400 occurred in 2005 at the Wyatt Road site (481390017); 440.38 ppb, 475.78 ppb, and 568.39 ppb, which were all on 8/2/05. No other values over 400 could be found in any of the data that TCEQ provided.
- Only one value >500 occurred in 2005 at the Wyatt Road site (481390017); 568.39 ppb on 8/2/05. No other values over 500 could be found in the data that the TCEQ provided.
- The highest value found in the data that TCEQ provided for Midlothian Old Fort Worth Road (481390016) was 393.12 ppb and occurred on 3/4/2008. No value over 400 could be found in the data that TCEQ provided.
- The highest value found in the data that TCEQ provided for Midlothian Tower (481390015) was 371.08 ppb and occurred on 8/20/98. No value over 400 could be found in the data that TCEQ provided.
- No value >400 could be found after August 2005 in any of the data that TCEQ provided.

Response to comment B.3.29: ATSDR used the term "Cement Valley" to demarcate the area just north and downwind of TXI and Gerdau Ameristeel—it is not a monitoring site. ATSDR used data from the Wyatt Road and Old Fort Worth Road monitors to evaluate whether harmful effects were possible in this area. ATSDR has made changes to the revised health consultation to address the other comments regarding the number of times SO_2 exceeded 400ppb—please see response to similar comments above.

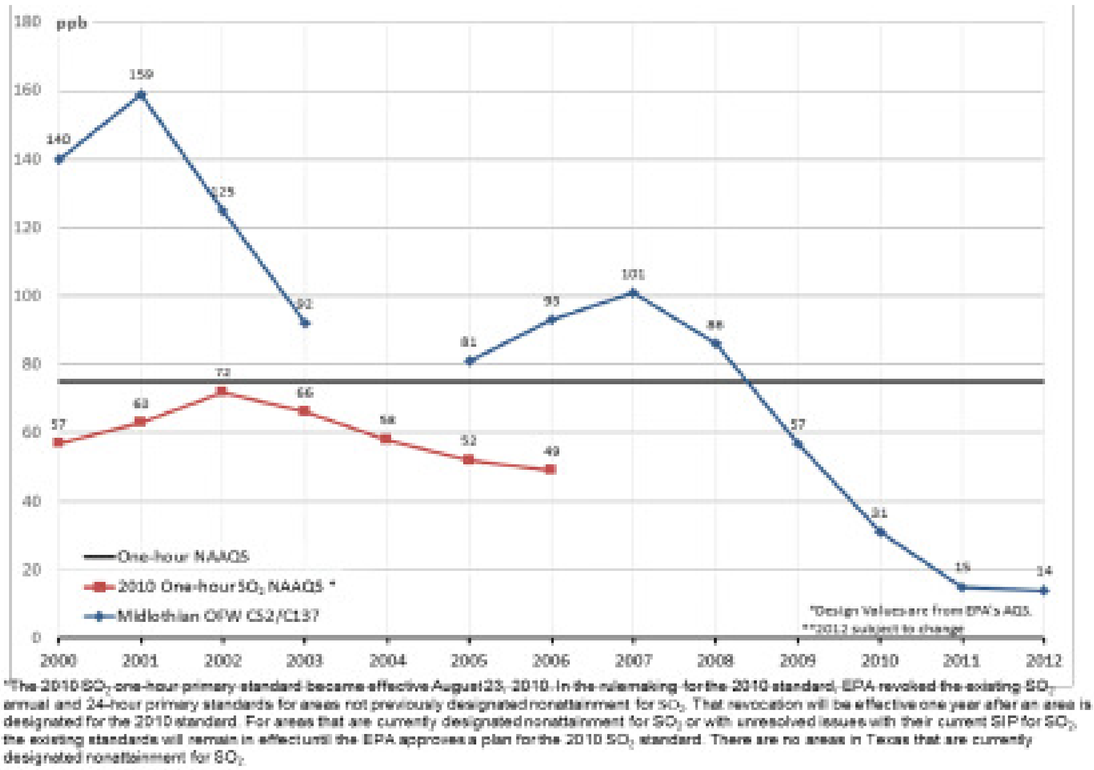
B.3.30. Comment:

In the draft health consultation, ATSDR evaluated sulfur dioxide (SO2) levels observed in this area from 1997 to 2008, concluding that "breathing air contaminated with sulfur dioxide (SO2) for short periods (5 minutes) *could have harmed the health of sensitive individuals (e.g., people with asthma),* particularly when performing an activity (such as exercising or climbing steps) that raised their breathing rate."(emphasis added). The draft document also states that "breathing air contaminated with SO2 in the past (during the period 1997 to late 2008) was not expected to harm the health of the general population." However, the document indicates that if sensitive populations, such as asthmatics, were exposed to 5-minute SO2 peaks over 400 ppb, decrements in lung function may have occurred.

Historical SO2 NAAQS compliance - The SO2 NAAQS are set at a level that includes an adequate margin of safety to protect public health. The phrase margin of safety indicates that the NAAQS must include a safety factor to compensate for the inherent uncertainties in available scientific data, making the level conservative. During the most recent review of the SO2 NAAQs, after extensive consideration of the exposure duration, EPA determined that a 1-h standard was most appropriate. This 1-h standard is considered protective of human populations that are particularly susceptible to health problems associated with breathing SO2.

The Midlothian area has been, and continues to be, in compliance with the applicable SO2 NAAQS (see Figure 2). Thus, SO2 levels in the Midlothian area, as defined by the NAAQS, are not of concern to public health.

Figure 2. One Hour Sulfur Dioxide Design Values at Midlothian.



Response to comment B.3.30: ATSDR concurs that the Midlothian area has and is in compliance with the EPA SO_2 standard and nowhere in the draft for public comment health consultation does it state that the area was not in compliance. ATSDR used the current EPA NAAQS standard for SO_2 as screening tool because it represents the most current science and is intended to protect against shorter-term peak concentrations which may be harmful. ATSDR made its health determinations based on our evaluation of the 5-minute data as compared to various other health comparison values where effects were seen in human clinical studies. In addition, as indicated in the responses to previous comments, ATSDR provided further explanation in the revised health consultation of how we used the current NAAQS standard as a health comparison value (HCV).

B.3.31. Comment:

Respiratory Toxicity of SO2 - Sulfur dioxide readily dissolves into the lining of the respiratory tract. It may react with a variety of cellular targets, including proteins and lipids, resulting in irritation and cellular damage. These effects can happen rapidly, but are highly dependent on exposure concentration and to a lesser extent duration. Inhalation of SO2 causes both irritation and bronchoconstriction. Exposure to lower concentrations of SO2 (e.g., < 1000 ppb) can cause reversible changes in lung function that may not be associated with symptoms. Moderate concentrations of SO2 (5000- 10,000 ppb) can cause nose and throat irritation as well as bronchoconstriction even in healthy individuals. Concentrations above 20,000 ppb cause significant bronchoconstriction and irritation to the eyes and nose. If someone were to be exposed to levels above 50,000 ppb, they could experience immediate closure of the airways. Exposure to SO_2 concentrations above 400,000 ppb could be life-threatening (NAS, 2004).

Normal environmental concentrations of SO_2 fall in the low ppb (<10) range, with rare peaks going into the range of 100-500 ppb (EPA, 2009). Air samples collected over shorter durations (5 min) tend to have more fluctuation than long-term averages. However, higher concentrations that would adversely affect a healthy person are rarely observed. Sensitive populations, such as individuals with pre-existing lung disease, asthmatics, children, and the elderly, can be much more sensitive to the effects of SO_2 exposure. Therefore, these populations require the greatest consideration when deriving a health protective standard for SO_2.

According to the American Thoracic Society (ATS), an adverse effect on the respiratory system may be defined as medically significant physiologic changes generally evidenced by one or more of the following:

- Interference with normal activities
- Occasional respiratory illness
- Incapacitating illness
- Permanent respiratory injury
- Progressive respiratory dysfunction

Furthermore, the ATS recommends that brief loss in lung function with symptoms or impacts on clinical measures, such as hospital visits and medication use, be considered adverse effects (ATS, 1985; EPA 2009). For highly sensitive individuals, lower concentrations (> 100 ppb) have been shown to cause mild decrement in lung function. If an individual has reduced lung function due to concomitant disease, moderate changes in physiological parameters, such as forced expiratory volume in 1 second (FEV_1) and specific airway resistance (sRaw), could result in symptoms or increased consumption of appropriate medications.

A number of studies have investigated the effects of short-term (5-10 min) SO_2 exposure on asthmatics (Balmes et al., 1987; Gong et al., 1995; Linn et al., 1983a; 1983b; 1987; 1988; 1990; Table 3-1). These studies have been used to identify potential health-based benchmark values for SO_2. Key studies are characterized by a number of uncertainties that are difficult to address. Noteworthy considerations include:

- Human study subjects may not be the most sensitive group given that they were characterized as mild to moderate asthmatics.
- The manner in which an individual breathes affects how deeply SO_2 goes into the respiratory tract and subsequent manifestation of symptoms.
    - Nose breathing = mostly reacts in nose causing irritation
    - Oronasal breathing = reacts in nose and lungs causing irritation and some bronchoconstriction
    - Oral breathing = reacts with tissue deeper in lung causing bronchoconstriction
- Humans exposed in clinical studies are often exposed using a breathe-through, a device that delivers SO_2 to both nose and mouth or mouth only, and may not be representative inhalation of ambient air.

- Health effects observed in clinical studies where exercising asthmatics were exposed to SO2 were similar to those asthmatics would experience with a variety of stimuli (e.g., dry or cold air, exercise, physical or mental stress) making it difficult to exclude the impacts of possible confounding factors.
- The SO2 dose-response relationship is poorly characterized (a threshold has not been clearly identified).

From the aforementioned key studies, a number of generalizations can be made regarding the health effects of *short-term (5-10 min)* SO2 exposure in asthmatics. There is very little data to suggest that SO2 concentrations at or below 100 ppb would cause bronchoconstriction in asthmatics. Concentrations of SO2 below 200 ppb have been associated with changes in lung function in 5-30% of asthmatic test subjects. However, these changes are not statistically significant. Exposure at and above 400 ppb has been show to produce some statistically significant changes in lung function among asthmatics. SO2 concentrations at and above 600 ppb show clear, consistent, and statistically significant changes in lung function in asthmatics. These studies are discussed in greater detail in the USEPA Integrated Science Assessment for Sulfur Oxides-Health Criteria (EPA, 2008).

Based on available data, the EPA considers concentrations between 100-400 ppb to be health benchmark values. Importantly, the EPA states that there is “definitive evidence” that SO2 concentrations greater than or equal to 200 ppb could cause decrement in lung function in sensitive asthmatics. They specifically chose 200 and 400 ppb 5-minute bench mark levels “because (1) 400 ppb represents the lowest concentration in human exposure studies where statistically significant moderate or greater lung function decrements are frequently accompanied by respiratory symptoms; (2) 200 ppb is the lowest level at which effects have been observed (and the lowest level tested) for moderate or greater decrements in lung function in free breathing human studies.” (EPA, 2009)

Based on available evidence, we agree that benchmark values set at 200 ppb and 400 ppb have the potential to cause changes in lung function among some asthmatics.

Response to comment B.3.31: The draft for public comment health consultation is generally consistent with the information presented in the comment. However, ATSDR does have a LOAEL of 100 ppb based on the Shepard, et al. (1991) study and believe that less serious harmful effects to some asthmatics in the 100-200 ppb range are possible but there is some uncertainty in this conclusion as stated in the health consultation.

B.3.32. Comment:

Use of 5-minute SO2 data for health effects evaluation - The use of 5-minute samples to characterize ambient air and define health risk is fraught with uncertainty. During the most recent review of the SO2 NAAQS, the EPA extensively evaluated and discussed the utility of 5-min data in risk assessment and as an appropriate averaging time for which a NAAQS could be applied. Available human data indicate that short-term SO2 may induce changes in lung function in some asthmatics at concentrations at or above 200 ppb. However, it is known that SO2 concentrations observed in 5-min intervals fluctuate significantly. From these data, it may be difficult to assess a true concentration without averaging several observations together. The EPA found that “there is a high Pearson correlation between the 5-minute maximum level and the corresponding 1-hour average SO2 concentration”. They further concluded that the generation and application of a standard “with an averaging time of 1-hour will limit both 5-minute peak concentrations within an hour, as well as other peak SO2 concentrations (≥1-hour) that are likely in part, driving the respiratory outcome described in epidemiologic studies” (EPA, 2009).

Despite the aforementioned observations and caveats, on page 39 the ATSDR states that it "believes that the best data available for evaluating the health implications of exposure to sulfur dioxide is peak concentrations, such as 5-minute average measurements (measured by TCEQ from 1997 to present). The remainder of this section uses this averaging period, even though EPA's and TCEQ's short-term health-based standards are based on 1-hour average levels." The commenter does not recommend the use of 5-min SO2 durations to conduct a health evaluation. The commenter has previously communicated with ATSDR the following reasons to not utilize 5-min SO2 data for this purpose:

- Due to the potential for misrepresentation of hourly data, the TCEQ does not usually give out 5-minute data.
- Short sample collection durations (5 minutes) are less likely to be representative of true individual exposure concentrations, meaning risk is more likely to be misinterpreted. This is particularly true for chemicals where the manifestation of adverse effects is dependent on exposure concentration and duration.
- There is an accuracy factor related to time scales--some instruments are less accurate at time scales.
- It is not uncommon to have a single high 5-minute average or large fluctuation in the data during an incomplete hour (i.e., less than nine 5-min averages). This entire hour would be considered invalid.
- The 5-minute data measurements do not necessarily represent the overall air quality for a given hour. For example, there could be an hour in which the 5-minute data has highs and lows, but averages out to an acceptable hourly value.
- There was a procedural change in how the TCEQ collected 5-minute data was handled in 2009. Therefore, it is important to note that the 2009 TCEQ data files contain both validated and non-validated data.
- It is important to note the following flags in the TCEQ 5-minute data: A "V" in the file name indicates that the data has been validated, an "NV" indicates that the data has either not been validated or are mixed validation levels that predate the changes in our validation procedure in 2009.
- Neither EPA nor TCEQ have a basis for comparing health effects or standards to 5-minute data.

For these reasons, and because of the uncertainties inherent in data collected over such a short duration, we do not find it appropriate to utilize 5-minute data for a health consultation.

Response to comment B.3.32: The memo (TCEQ, 2012a) attached to the transmittal of the 5-minute data to ATSDR does not specifically recommend to ATSDR that it not use these data for evaluating health. In addition, besides the list presented in the comment above, the memo from TCEQ includes the following qualifier:

> ***"All of the 5-minute data has been retrospectively screened for outlying values greater than or equal to 70 ppb. For any months in which an outlying value greater than or equal to 70 ppb was measured, the 5-minute data has been reviewed by our technical personnel"***

This statement indicates that TCEQ reviewed the "outlier" values over 70 ppb by their technical personnel—there were no statements in the original memo indicating that ATSDR should eliminate any particular 5-minute value due to quality concerns. ATSDR used the 5-minute data

after our initial screening process where we had calculated the 1-hour average based on EPA's approach for calculating whether the 1-hour values may be a concern (i.e., the 99th percentile of 1-hour daily maximum sulfur dioxide concentrations averaged over 3 consecutive years is not to exceed 75 ppb). The new EPA standard is designed to protect against harmful shorter term peaks in sulfur dioxide concentrations. As seen from Table 13, except for the period 2002-2004, all values were above the current standard (but not the standard in place at that time). Based on this evaluation, we then choose to evaluate the 5-minute sulfur dioxide data as we have done elsewhere (ATSDR, 2011b) to further evaluate the public health implications of these past exposures. Although EPA and TCEQ do not have a basis for comparing health effects to the 5-minute data, ATSDR believes that looking at these data is the best approach for making a final determination as to whether harmful effects are possible as this is a similar timeframe used in the clinical studies which formed the basis for current guidelines and standards. In addition, ATSDR sought further clarification from TCEQ on two of the issues raised by them in the 2012 data transmittal letter to ATSDR. The following are the questions posed by ATSDR and the TCEQ responses (in italics) (Personal Communications, TCEQ e-mail from Tracie Phillips, 11/10/14):

TCEQ Comment from 2012 Memo: There was a procedural change in how the 5-minute data was handled in 2009. The 2009 data files contain both validated and non-validated data.

ATSDR *Question: What specifically was the procedural change in 2009 that made the previous data non-validated and the data afterwards validated?*

> *Prior to 2009, 5-minute data was validated but not routinely marked with a validated flag, except for segments requiring manual correction. If data corrections were not required, the 5-minute data was left as is (i.e. not marked as validated) and only the hourly data was marked with a validated flag. In 2009, a procedural change was made for all 5-minute data to be marked with a validated flag after review, similar to the hourly data. This change did not have a substantive impact on the hourly averages and was implemented to maximize consistency in handling and interpretation of the 5-minute data.*

TCEQ Comment from 2012 Memo: All of the 5-minute data has been retrospectively screened for outlying values greater than or equal to 70 ppb. For any months in which an outlying value greater than or equal to 70 ppb was measured, the 5-minute data has been reviewed by our technical personnel.

ATSDR Question: Can you explain further what was done to review values over 70 ppb by TCEQ technical personal?

> *TCEQ technical personnel used a graphical interface application (LEADS Meteostar Manual Validation) to visually inspect all 5-minute data from the months containing the 5-minute values over 70 ppb to verify that the values were bracketed by passing quality control checks, corresponded with associated meteorological parameters, and otherwise accurately reflected ambient conditions at the time of data collection.*

Based on the above, ATSDR does not see any reason not to use the 5-minute SO_2 data before the TCEQ procedural change in 2009 for the purposes of better defining the public health implications of past exposures to SO_2 for persons living in Cement Valley. However, ATSDR has provided additional information into the text from the above regarding these issues and has provided a limitations statement in the conclusions.

B.3.33. Comment:

Frequency of Observed SO2 Concentrations

For the sake of discussion, we generated summary statistics and distributions of the 5-min SO2 data provided to ATSDR to determine the following:

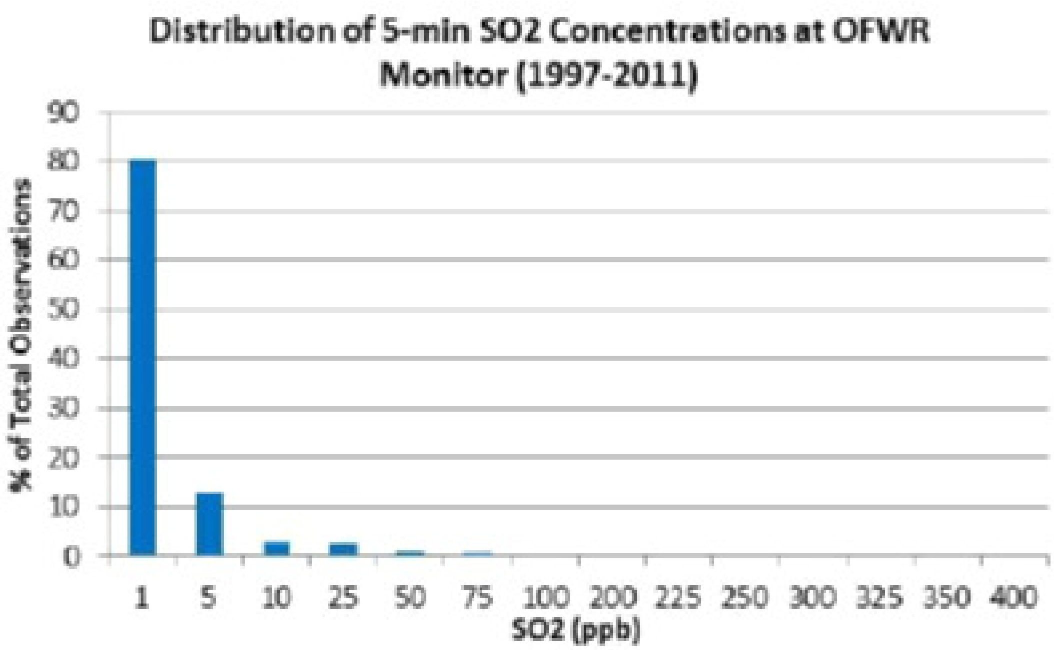
- Frequency of 5-minute samples exceeding the 5-minute benchmarks identified by the EPA (200 and 400 ppb)
- General trends in the 5-minute data

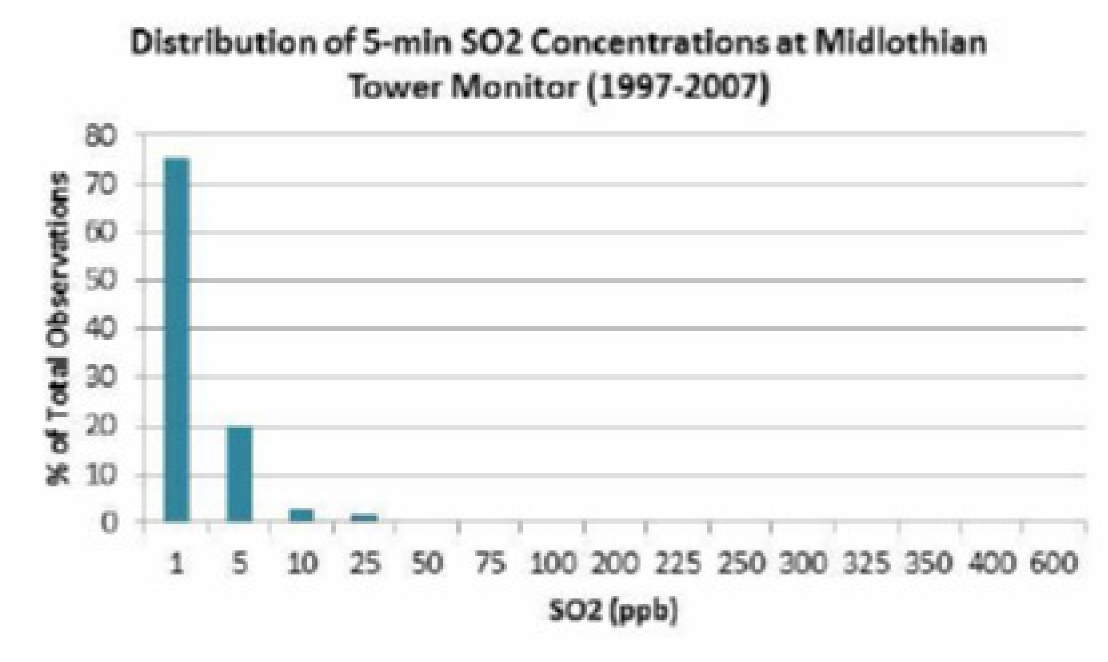
Figure 16 shows distributions of raw 5-minute Midlothian data measured from 1997 to 2011 at the Old Fort Worth Road, Tower, and Wyatt Rd. monitors. Please note that raw data, as currently being reported to EPA, contains negative numbers that would ultimately be reported as an error or as zero, depending on their magnitude of negativity and their frequency.

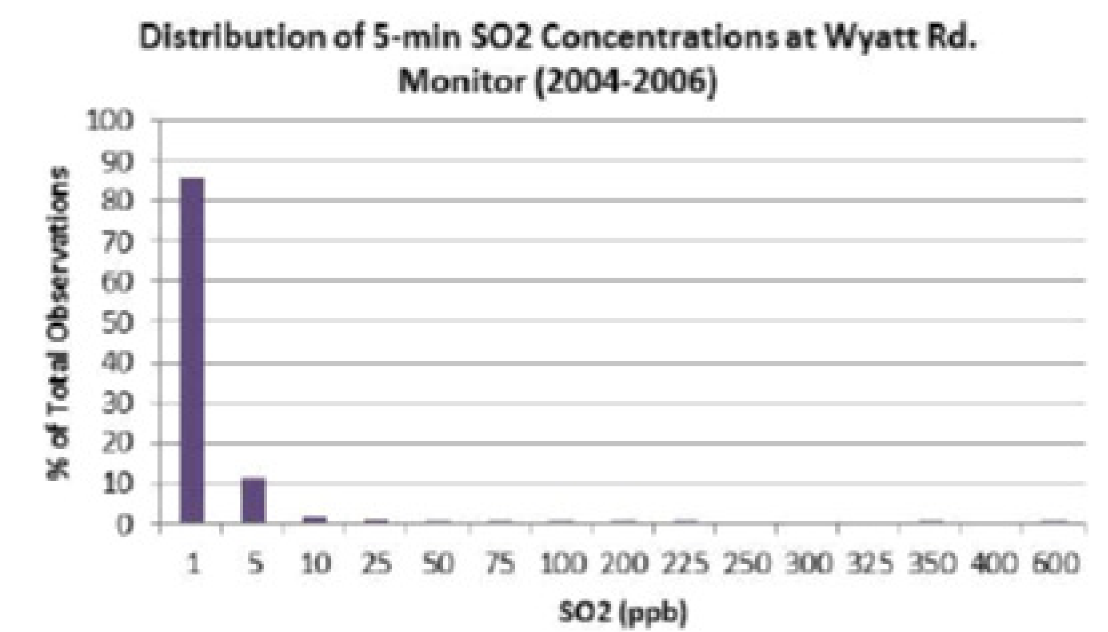
Figure 16 shows distributional analysis of raw 5-min samples collected at the three Midlothian Monitors: A) Midlothian Old Fort Worth Road (OFWR), B) Midlothian Tower, C) Midlothian Wyatt Rd. from 1997 to 2011, or for the duration data were available. These distributional analyses clearly demonstrate that *more than 99% of samples are less than the 1-h NAAQs of 75 ppb.* It also demonstrates the infrequency of exceedances of the EPA-identified 5-min SO2 benchmarks of 200 or 400 ppb.

Figure 16. Distribution of 5-Minute Midlothian SO2 Concentration at Old Fort Worth

Road, Midlothian Tower, and Wyatt Road Monitors.

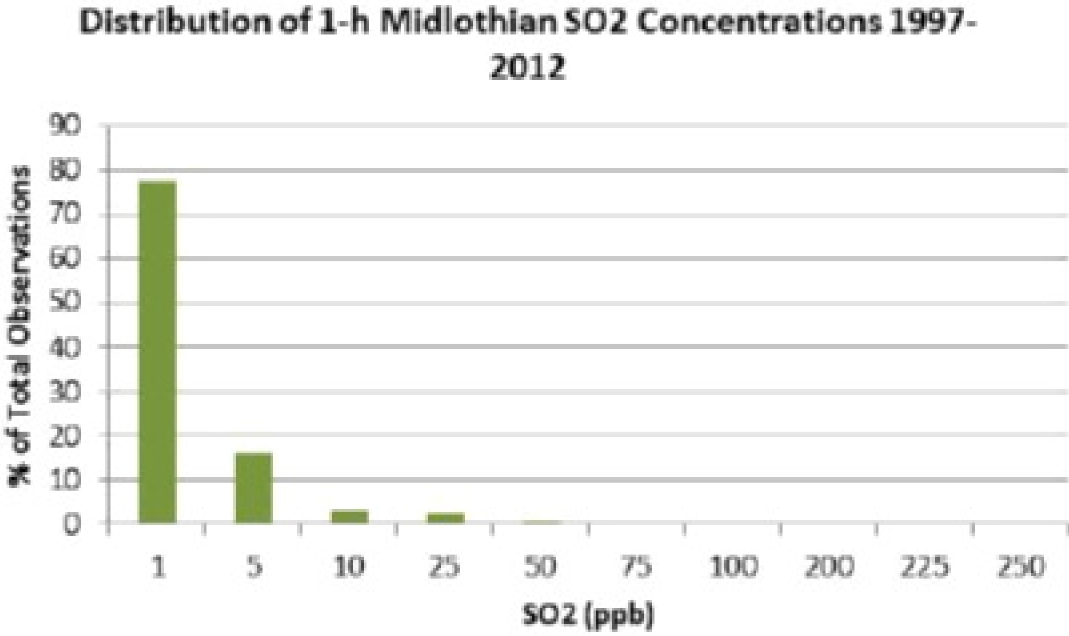






Since the more appropriate NAAQs comparison is to 1-h averaging time samples, we analyzed 1-h SO2 data from the Midlothian area and across the state from 1997 to 2012. At Midlothian monitors, 99.6% of all data was 50 ppb or less (Figure 17). *The current NAAQs of 75 ppb was exceeded less than one percent of the time.* The exceedances of the current NAAQS occurred in years when the previous NAAQS was promulgated. Thus, this data that SO2 levels observed in the Midlothian region have always been in compliance with the applicable NAAQS and > 99% of the time it was in compliance with the current NAAQS.

Figure 17. Distribution of 1-Hour Midlothian SO2 Concentration at OFWR, Tower, and Wyatt Rd. Monitors from 1997 to 2012.



The commenter agrees with the observation that "reductions in SO2 levels…have occurred since late 2008 resulting in exposures to both sensitive individuals and the general public that are not expected to be harmful." In fact, concentrations of SO2 have been steadily decreasing in the Midlothian area and across the state of Texas. As Tables show, there is a significant decrease in mean SO2 concentrations in Midlothian from 2000 to 2012. Similarly, Table 7 shows that other areas of the state, excluding Midlothian, also have SO2 levels that have steadily decreased.

Response to comment B.3.33: First, all of the data presented in this comment relates to monitors that were considered downwind of TXI and not other potential sources of SO_2 in the community such as Ash Grove. Therefore, any statements regarding overall trends in the SO_2 air levels in Midlothian should include an understanding of all major sources of SO_2 . Since no monitoring data are available for off-site areas downwind of Ash Grove, ATSDR has performed additional modeling to try to determine if harmful SO_2 exposures may have been occurring downwind of Ash Grove. The results of this modeling effort have been included in the revised health consultation.

ATSDR agrees that the frequency of 5-minute data between 200-400 ppb or above ATSDR's LOAEL of 100 ppb is small as compared to all of the possible 5-minute levels during the timeframe reported and that the data do show that overall levels downwind of TXI appear to have dropped over the period of 1997-2011. However, the data presented in the comment does include several years of data from the Old Fort Worth Road monitor where the levels of SO_2 downwind of TXI drop appreciably, so including them does skew the frequency calculations somewhat as ATSDR was mostly concerned with the period 1997-2008. As with the 5-minute data frequencies, the 1-hour data showing that greater than 99% were below the current NAAQS of 75 ppb between1997-2011 is helpful to understand how infrequent levels above 75 ppb were in the past. However, as indicated above, this is not the approach that is taken by EPA when calculating

whether the 1-hour NAAQS standard may indicate that potentially harmful shorter-term peaks of SO_2 have occurred. Using the EPA approach to look at 1-hour levels, there was a potential concern for harmful peak concentrations for all time periods between 1997-2008 except for the 3-consecutive year period 2002-2004. ATSDR has revised the draft health consultation to provide some additional perspective on the SO_2 trends downwind of TXI and to provide some additional information on what timeframes between 1997-2008 would have likely produced the highest SO_2 levels and potential for harmful exposures.

B.3.34. Comment:

Population Potentially Impacted - The Centers for Disease Control estimate that approximately 8 to 10%[6] of Americans have asthma. Similarly, the Department of Health and Human Services estimates that 12%[7] of Texans are asthmatic. The EPA reported that SO2 concentrations above 400 ppb have been associated with changes in lung function in asthmatics who are breathing at an elevated rate. The EPA estimates "that between 0.7 and 1.8% of the total asthmatic population potentially could be exposed one or more times annually, while outdoors at exercise to 5-minute SO2 concentrations ≥500 ppb"(EPA, 2009). This data together with the observation that peak 5-minute measurements occurred in the middle of the night, indicate the limited probability that potentially harmful exposures *actually* occurred. In fact, all three of the 5-minute values >400 ppb occurred after midnight:

Monitor Site	Date	Time	5-minute SO2 value
Wyatt Road	8/2/2005	23:00	475.78
Wyatt Road	8/2/2005	23:05	568.39
Wyatt Road	8/2/2005	23:10	440.38

Response to comment B.3.34: ATSDR has revised the draft health consultation to provide additional perspective on the likelihood of asthmatics being exposed to the highest SO_2 levels as reported in this comment. However, there was still amble opportunity for a sensitive person (while engaging in activities that may increase their breathing rate) to be exposed to SO_2 levels above 100 and 200 ppb during other time periods. Please see responses to other similar comments above.

B.4 Nitrogen Oxide

B.4.1. Comment:

Page 24: The draft states: "Table 4 presents nitrogen oxides emissions data available from TCEQ's Point Source Emissions Inventory (PSEI) for the four Midlothian facilities from 1990 to 2010. These four facilities have consistently had the highest nitrogen oxides emissions among the industrial facilities in Ellis County."

It should be noted that based on data retrieved from STARS on December 11, 2012, Owens Corning Insulating Systems LLC and Saint Gobain Containers were also consistently in the top six for nitrogen oxides emissions for Ellis County. For many years between 1993 and 2010, Owens Corning Insulating Systems LLC and Saint Gobain Containers reported higher nitrogen oxides emissions than Gerdau

Ameristeel. The three Midlothian cement facilities consistently reported the top three nitrogen oxides emissions from 1990-2010 for Ellis County. However, emissions data is not informative from a public health standpoint unless it is incorporated into a model to predict potential human exposure. In contrast, ambient air monitoring is more informative when evaluating potential impacts to human health.

Response to comment B.4.1: ATSDR has revised the draft health consultation to add some of the information provided in this comment. ATSDR did evaluate the monitoring data for NO2 and determined that it was unlikely that harmful exposures occurred in Midlothian—we did not use the emissions data alone to make any health conclusions for NO2. ATSDR only reported the emissions data to provide the community with some perspective for how the NO2 emissions in Midlothian compared to other areas in Texas.

B.4.2. Comment:

Page 24: The draft states: "Across all four facilities, the years with the highest total emissions were 1994 to 2005. Of the 20 inventory years shown in Table 4, 2009 and 2010 had the lowest combined nitrogen oxides emissions. The decreased emissions in these years is consistent with the trend for carbon monoxide emissions and again likely results from a decline in production the cement manufacturing industry that occurred during this same time (USGS, 2011)."

It should be noted that reductions in emissions of nitrogen oxides for Holcim and Ash Grove could also be attributed to the installation of selective non-catalytic reduction (SNCR) controls. Ash Grove installed SNCR on kiln 1 in 2007 and on kilns 2 and 3 in 2008. Holcim installed SNCR on kiln 1 and kiln 2 in 2006.

Response to comment B.4.2: ATSDR has revised the draft health consultation to include this information on treatment systems installed at Ash Grove and Holcim.

B.5 Carbon Monoxides

B.5.1. Comment:

Page 17: The draft states: "Modeling results are presented only for the pollutant for which no direct measurements are available (i.e., carbon monoxide)."

Carbon monoxide emissions are presently measured using continuous emissions monitors for the cement kilns and some of the steel furnaces. Based on data retrieved from the State of Texas Air Reporting System (STARS) on December 18, 2012, Gerdau Ameristeel began reporting carbon monoxide from continuous emissions monitoring data in 2000 from three furnaces. Ash Grove began reporting carbon monoxide from continuous emissions monitoring data in 1994 for kiln 1 and in 1995 for kilns 2 and 3. TXI began reporting carbon monoxide from continuous emissions monitoring data from all five kilns in 2001. Holcim began reporting carbon monoxide from continuous emissions monitoring data from kiln 1 in 1999 and in 2000 from kiln 2.

Response to comment B.5.1: Comments noted—no response needed.

B.5.2. Comment:

Page 17: under 3.1 Carbon Monoxide, the draft states: "However, emissions from industrial sources can dominate in areas with extensive manufacturing activity, like Midlothian."

ATSDR should clarify their meaning of "extensive."

Response to comment B.5.2: ATSDR revised the sentence.

B.6 Lead

B.6.1. Comment:

Lead Exposures **-** There are instances where the document implies that harmful lead exposures occurred during times where data is not available or it is not known if children were exposed at all. We recommend revising or deleting these statements to reflect this high degree of uncertainty.

Response to comment B.6.1: ATSDR revised the statements which may imply harmful lead exposures occurred when monitoring data are not available; however, ATSDR also believes that it is important to keep in the statements regarding whether children were exposed to harmful lead exposures since it is an important limiting statement to our conclusions.

B.6.2. Comment:

ATSDR used the highest quarterly and annual average lead concentrations in the USEPA IEUBK lead model. However, the EPA guidance on how the model is to be used states explicitly that only annual average air concentrations should be used, and that those concentrations should be adjusted annually if the data is available to do so.

ATSDR describes the results of its lead evaluation on page 44 and states the following: "Using a combination of default parameters for the IEUBK model and using the highest annual (1995) and quarterly average levels from the Gerdau Ameristeel monitor during 1993–1998, the model estimates children have, on average, about a 18.5-21.4 % risk of having blood lead concentrations between 5 and 10 μg/dL."

ATSDR's evaluation is misleading because it uses only the highest quarterly and annual average concentrations. The IEUBK Users Manual is quite clear that, first, only annual average concentration values should be used, not quarterly average concentrations (see pages 1-18 and 2-27). Secondly, the IEUBK User's Manual states that the annual average concentrations should be varied year by year if that data is available. ATSDR's use of the highest quarterly and annual average air lead concentrations alone is inconsistent with the scientific approach recommended by EPA.

Response to comment B.6.2: The results of running the IEUBK model for the past air lead exposures was not crucial to ATSDR's overall determination that if any young children were exposed to these levels back in the 1990s, in a highly localized area of Cement Valley, just downwind of Gerdau, then it might result in a 1-2 point IQ deficit. As stated on p. 44 of the public comment draft, the EPA NAAQS standard is not based on the IEUBK model but on an evidence-based framework that used a quantitative exposure/risk assessment process that relied on and air to blood ratio (Personal Communications, Mark Follansbee, EPA IEUBK Contractor, March 14, 2012). Based on comments below, ATSDR used more site-specific values for soil lead levels in this area of Cement Valley and we reran the model (see response to comment B.6.7 below).

B.6.3. Comment:

ATSDR acknowledges that lead concentrations near the historic Chaparral Steel monitor are highly localized and further states that the concentrations are the result of emissions from Gerdau Ameristeel. Air dispersion modeling following the same technique described in Appendix A of ATSDR's HC shows that the facility contributed approximately 0.12 ug/m3 to the total offsite annual average lead concentrations during the post 1990 year when its emissions were maximized (at 3 tons/year), and that the potentially impacted area from the facility is so localized that no residential land use is currently or has ever been present in this area.

Response to comment B.6.3: The air dispersion modeling techniques described in Appendix A of the Health Consultation were applied to calculate annual average carbon monoxide concentrations from facility stack emissions. ATSDR notes that using this approach for lead concentrations would exclude any fugitive dust emissions for lead from Gerdau so it likely underestimated the particulate lead emissions in a localized area of Cement Valley just north and downwind of Gerdau.

Based on TCEQ documentation from the time at which the historic Chaparral Steel (now Gerdau) monitor was installed (that is, photographs and notes in files obtained for this Health Consultation), ATSDR observed that a residence was present in or near this localized area in the past (see response to comment B.6.5 below).

B.6.4. Comment:

ATSDR acknowledges on page 26 that lead concentrations in air that exceed the concentration of the current standard occurred at a highly localized area near the Chaparral Steel monitor.

In fact, the area is so localized that there are no current or historic residential land uses in the area where modeled lead air concentrations exceed 0.1 ug/m3 , the level that USEPA has defined as background in its IEUBK model User's Manual. Modeling similar to that completed for PM was also conducted for lead for the Gerdau facility alone using the highest post 1990 emission rate (3 ton/year) reported by ATSDR in Table 2. The modeling results are shown graphically below.

As shown above, the area with concentrations greater than the IEUBK reported U.S.

background of 0.1 ug/m3 is limited to a location where there is no residential land use.

Response to comment B.6.4: Please see responses to similar comments above and below.

B.6.5. Comment:

ATSDR states the following on page 57: "Past lead air exposures during 1993 and 1998, in a localized area just north of the Gerdau Ameristeel fence line, could have harmed the health of children who resided or frequently played in these areas. The estimated health effect of these exposures would have been a slight lowering of IQ levels (1–2 points) for some children living in this area."

The statement presumes that there are children living in the area where ATSDR's improper application of the EPA IEUBK lead model estimates effects from lead using exposure guidelines, (5 ug/dL), that have not been adopted by EPA. Section C of these comments show that there is no residential land use now, nor has there ever been, in the localized area where historic air dispersion modeled impacts from the Gerdau facility occurred.

Response to comment B.6.5: See responses to B.6.2 and B.6.7. Regarding the past land use in the 1990s in this area of Cement Valley, ATSDR reviewed photos and records taken by the Texas Natural Resources Conservation Commission (now TCEQ) that indicated that the nearest house

was 450-500 west of the Gerdau Monitor (TNRCC, 1994; TNRCC, 1995b; TNRCC, 1995c). ATSDR does not know whether any young children resided in the nearest home.

B.6.6. Comment:

ATSDR states the following on page 57: "Using a combination of default parameters for the EPA lead model and using the highest annual and quarterly average air lead levels from the Gerdau Ameristeel monitor from 1993 to1998, the model estimates children in that area of Cement Valley could have had, on average, about an 18%–21% risk of a blood lead level between 5-10 µg/dL caused by breathing outdoor air."

ATSDR improperly applied the model when it used quarterly lead concentrations, and did not vary the annual average lead concentrations based on all of the monitoring data that was available. This statement should be revised to reflect the results of a proper application of the model.

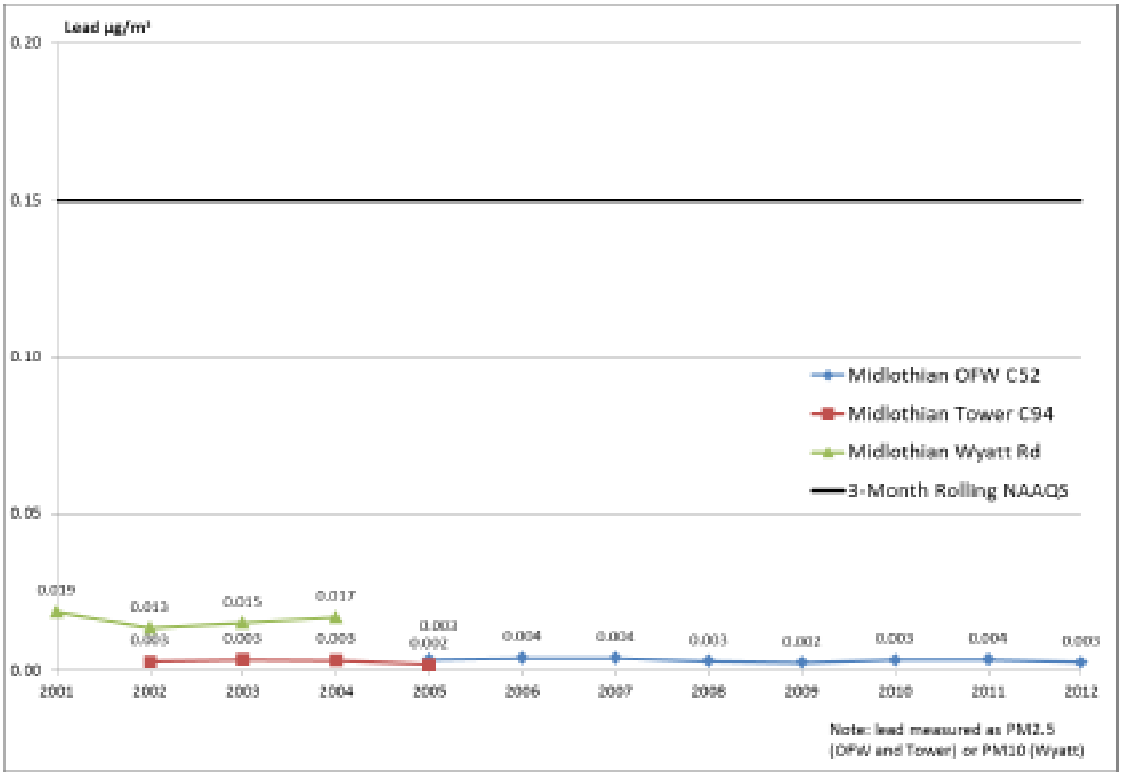
Response to comment B.6.6: **See responses to comments B.6.2 and B.6.7.**

B.6.7. Comment:

The draft consultation indicates that potential exposures to lead from 1993 to 1998 in a localized area just north of the Gerdau Ameristeel fence line could have resulted in blood lead levels that may have been associated with a 1-2 point IQ decrement in children living or frequently playing there.

We note that the Midlothian area has been and continues to be in compliance with the lead NAAQS (see Figure 6). Since 1998, levels of lead in this area have decreased, resulting in estimated blood lead levels below the CDC reference value of 5 µg/dL. This is based on the EPA Integrated Exposure Uptake Biokinetic (IEUBK) model, using the highest quarterly average of 0.443 µg/m3 and a default soil value of 200 mg/kg, however, an appropriate background level for Texas is 15 mg/kg, as outlined in the Texas Risk Reduction Rule 10.

Figure 6. Annual Average Lead Concentrations at Midlothian.



Response to comment B.6.7: Subsequent to the release of this health consultation for public comment, ATSDR reviewed soil sampling data from the area of Cement Valley where the former Gerdau monitor was located to determine average lead soil levels (TACB, 1991, 1993, 1994, and 1995). The use of 15 ppm is not appropriate for this area as the data show that soils were likely contaminated to levels above background. Six soil samples for lead closest to the former Gerdau monitor ranged from 60-85 ppm with and average concentration of 72 ppm. Another 9 samples were taken further north in the Wyatt Road area and lead ranged from 17-27 ppm. ATSDR ran the IEUBK model again using a lead soil level of 72 ppm and using the highest annual average lead (0.255 µg/m3 for 1995). The IEUBK model did not predict that childhood blood levels had an increased probability of exceeding 5 µg/dl (CDC's current reference value). ATSDR has revised the health consultation to reflect these updated findings from the additional IEUBK modeling analysis. Please see the response to comment B.6.2 above as to why this does not change ATSDR's overall conclusion regarding potential past lead air exposures in a localized area of Cement Valley.

B.6.8. Comment:

In addition, we note the highly tentative nature of these findings. The draft consultation states: "Some uncertainty exists with these findings given that we do not know what lead levels in air were downwind of the Gerdau monitor and we do not know if small children were exposed at all in this sparsely populated are of Cement Valley"(emphasis added). It is important to note that monitoring in other areas of Midlothian does not indicate lead levels in air have occurred above the current standard of 0.15 µg/m3 either now or in the past (see Figure 6).

Response to comment B.6.8: For the first part of this comment, please see responses to comments above. Secondly, nowhere in the draft health consultation does ATSDR imply that lead levels in other areas of Midlothian were not compliance with the EPA standards in place at the time of the sampling.

B.6.9. Comment:

Furthermore, the commenter was unable to replicate the findings reported in the draft consultation, utilizing the IEUBK model. In fact, our results differ significantly from the results in this report (see Appendix B). We find that using either the default value for lead in soil (200 mg/kg) or the more appropriate value for Texas background (15 mg/kg) 11 together with the highest quarterly average from the 1993-1998 timeframe (0.443 µg/m3), blood lead levels were not predicted to exceed 3.8 µg/dL, well below the comparison value recently recommended by the CDC (5 µg/dL). In contrast with the reported 18.5-21.4% chance of blood lead levels between 5 and 10 µg/dL, we find that the chance of exceeding 5 µg/dL is 13.9% and the chance of exceeding 10 µg/dL is 0.5%, using a worst-case scenario (0.443 µg/m3 lead in air and default soil value of 200 mg/kg –see Appendix B). Under a more realistic, but still precautionary scenario (0.443 µg/m3 lead in air and a more appropriate soil lead value of 15 mg/kg –see Appendix B) , the chance of exceeding 5 µg/dL is 0.18% and the chance of exceeding 10 µg/dL is less than 0.01%.

Response to comment B.6.9: See responses to comments above.

B.6.10. Comment:

We also note that the results and conclusions presented in this draft consultation differs substantially from the result of the 2007 ATSDR health consultation for Midlothian, where it is stated that: "based on the available toxicological information we would not expect to see adverse non-cancer health effects from either short-term or long-term exposure to lead (TSP) at the concentrations found in Midlothian."

It is unclear why the conclusion has changed given that the maximum quarterly average air lead level observed in Midlothian (0.443 µg/m3) is the same in the 2007 document versus the current draft document.

Response to comment B.6.10: The 2007 draft for public comment health consultation referenced in the comment was issued before EPA finalized its revised lead air standard for lead which was based on more current scientific information and which lowered its standard 10-fold from 1.5 ug/m3 to 0.15 ug/m3. Moreover, the on January 4, 2012, CDC's Advisory Committee on Childhood Lead Poisoning Prevention (ACCLPP) recommended that CDC adopt the 97.5 percentile BLL of children in the United States (ages 1 to 5 years old) as the reference value for designating elevated blood lead levels in children. Based on the latest National Health and Nutrition Examination Survey (NHANES) data, the 97.5% is 5 µg/dL (CDC 2012a). On June 7, 2012, the CDC released a statement indicating concurrence with the recommendations of the ACCLPP (CDC 2012b). CDC now uses the reference value to identify high-risk childhood populations and geographic areas most in need of primary prevention. Yet still, there may be an underestimation of risk for lead because there is no proven safe level of lead in the blood. Therefore, the 2007 health consultation was not informed by the findings from EPA and the CDC ACCLPP.

B.7 Hydrogen Sulfide

No comments specific to hydrogen sulfide only, were identified. Any comments that mention hydrogen sulfide generally or with another pollutant are included in Section A or the appropriate subsection of Section B.

B.8 Mixtures

B.8.1. Comment:

What is the compounding effect of exposures to SO2 and ozone either one at a time or concurrently. Are the effects not compounded?

Response to comment B.8.1: As indicated in the draft for public comment health consultation, ATSDR notes that a limitation in the public health assessment process is that scientists do not have a complete understanding of how simultaneous exposures to several environmental contaminants may cause health effects. ATSDR's conclusions are based on our best professional judgement related to our understanding of the possible harmful effects of air pollutants in Midlothian and our interpretation of the current scientific literature; therefore, our conclusions are presented with some uncertainty. We do know that asthmatics are likely a sensitive population. We also know that exposures to irritant gases (like ozone and sulfur dioxide) exacerbates asthma symptoms. The likely mechanism is that epithelial cells that line the airway passages in asthma (and other respiratory disorders) are damaged and these cells start shedding. The shedding of these cells exposes nerve endings allowing irritant gases access to free nerve endings which in turn aggravates asthma and allergy. Even healthy individuals exposed to polluted environments (e.g., ozone) can experience eptithelial shedding which can last up to 2 weeks or more (Shiffman et al., 2000). Moreover, in a study of exercising allergic asthmatic adolescent subjects, who were exposed to ozone (at 120 ppb) and then sulfur dioxide (at 100 ppb), they found that prior ozone exposures increased bronchial hyperresponsiveness in these subjects such that they responded to an ordinarily subthreshold concentration of sulfur dioxide. Their bottomline findings were that their data suggest that assessment of pulmonary changes to single pollutant challenges overlooks the interactive effect of common co-existing or sequentially occurring air pollutants (Koenig et al., 1990). In a more recent mouthpiece study, Trenga et al. (2001) evaluated a similar scenario as Koenig et al (1990), however, they studied adults and administered a higher level of sulfur dioxide exposure (250 ppb). They showed slight changes in the pre-ozone exposed group as compared to the group with was pre-exposed to filtered air. Regarding SO_2 exposures with particular matter, animal toxicological studies do suggest that SO_2 effects may be potentiated by co-exposure to particulate matter but the relevance of these results to ambient exposures is not clear (EPA 2008c). Therefore, although we do not currently know how to quantify the effect of co-exposures to ozone and sulfur dioxide, we believe that, at the very least, it is possible that the number of sensitive individuals affected may be greater because effects may have occurred at a lower SO_2 concentration when combined with ozone, $PM_{2.5}$ or both. Additional information from the Shiffman et al (2000) and the Koenig et al (1989) articles have been added to the text of the revised health consultation.

B.8.2. Comment:

Mixtures and aggregate exposures - Perhaps it would be premature to evaluate mixtures and aggregate exposures in this consultation since it would not encompass all potential exposures and their compounding impact.

Synergism - It is understandable assessment tools are not yet readily available to assess with 100% certainty whether mixtures and aggregate exposures impact the human body in a synergistic or additive manner. However enough red flags exist that indicate that for most the impact is additive if not synergistic and there is compounding impact on the same body systems being assaulted with varying toxins over a long period – for some prenatally and for a lifetime.

Environmental Behavior and Persistence in the Environment - This is a concern for all toxins released into the environment – how long do they hang around. Are they cumulative? Lead, dioxins, heavy metals – where do they go? How is the accumulation of toxins released into the same environment and cumulative re-exposure assessed?

Take sulphur dioxide as an example - From the Compendium of Environmental Standards

http://ces.iisc.ernet.in/energy/HC270799/HDL/ENV/enven/vol361.htm

Air: Sulphur dioxide binds moisture from the air and forms aerosols of sulphuric and sulphurous acid which are deposited as acid rain. The aerosol formation and its dwell time in air depend on the meteorological conditions and on the presence of catalytic impurities in the air. The average dwell time in the atmosphere is approx. 3 - 5 days. Thus, sulphur dioxide may also be transported over long distances.

Then there is lead which remains in the environment indefinitely and is constantly subject to re-uptake and redistribution – this is particularly true of lead attached to TSP.

http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2627851/

Mauderly Concludes: “Synergisms involving O3 have been demonstrated by laboratory studies of humans and animals. We conclude that the plausibility of synergisms among environmental pollutants has been established, although comparisons are limited, and most involved exposure concentrations much higher than typical of environmental pollutants. Epidemiologic research has limited ability to address the issue explicitly.” http://www.ncbi.nlm.nih.gov/pubmed/19165380

Mauderly concludes that the plausibility of synergisms among environmental pollutants has been established.

There is also an issue with synergy between SO(2) and heavy metals.
http://www.ncbi.nlm.nih.gov/pubmed/21318286 - Effects of sulfur dioxide pollution on the translocation and accumulation of heavy metals in soybean grain. This experimental study has shown SO_2 has a synergistic effect in enhancing the heavy metal contents in above ground tissues of soybean plant. Increased uptake of arsenic by plants and increased arsenic in the food chain has a subsequent impact on public health.

Agriculture, livestock, hay and locally grown foods could be impacted by absorbing heavy metals. Considering the amount of agriculture in the area, should this be addressed?

Sulfur dioxide easily damages many plant species. Has any visible injury to local vegetation due to possible SO_2 exposure been observed in the Midlothian area?

Response to comment B.8.2: The authors are not aware of any visible damage to local vegetation due to SO2 exposures. However, parts of these comments are being forwarded to other ATSDR health assessors who are working on evaluating exposures in Midlothian due to "Other Media'. Regarding the comments on synergistic or additive effects of exposures to SO2 and other air pollutants, please see response to comment B.8.1 above.

B.8.3. Comment:

"CONCLUSION 4— Mixture Exposures" - The document states that "ATSDR believes the severity of health effects from a mixture exposure is not likely to exceed those discussed for SO2, $PM_{2.5}$, or ozone exposure alone."

We request this statement be placed at the beginning of the Conclusion 4 text.

Response to comment B.8.3: This statement referred to in the comment is currently the second sentence in Conclusion 4. ATSDR has changed the order of these sentences to address this comment.

B.8.4. Comment:

"CONCLUSION 4— Mixture Exposures - BASIS FOR DECISION - The current state of the science limits our ability to make definitive conclusions on the significance of simultaneous exposures to multiple criteria air pollutants. ATSDR's conclusions are based on our best professional judgment related to our understanding of the possible harmful effects of air pollutant exposures in Midlothian and our interpretation of the current scientific literature; therefore, these conclusions are presented with some uncertainty."

The document itself says the basis for decision for mixture exposures are uncertain, but the CONCLUSION 4 - Mixture Exposures text begins with the statement that **"**ATSDR believes that sufficient information exists to warrant concern for multiple air pollutant exposures to sensitive individuals, especially in the past." The document is in conflict with itself and any definitive (or implied) conclusions on harmful health effects from mixture exposures do not appear to be sufficiently scientifically supported. Please revise all such statements accordingly.

Response to comment B.8.4: To make more <u>definitive</u> conclusions, ATSDR is normally able to calculate a dose or is able to compare an air concentration with health protective comparison values or levels known to cause harmful effects. However, for exposures to a mixture of NAAQS air pollutants, no such scientifically defensible approach is available to quantify these concurrent exposures. However, we believe that there is enough information to determine a least a concern for concurrent exposures. Also see responses to Comments B.8.1 above and B.8.5 below.

B.8.5. Comment:

"4.5 Mixtures, Sulfur dioxide. - Scientific information is insufficient to allow meaningful quantitative analysis, but is sufficient to warrant concern for sensitive populations, especially those who are at higher ventilation rates (e.g., exercising, etc.)."

If the scientific information is insufficient to allow meaningful quantitative analysis, how can it be concluded that there is a legitimate concern for public health impacts to any segment of the population? Please clarify.

Response to comment B.8.5: Although we cannot currently quantify the risk of mixtures, we believe that there is evidence for concern and that that concern can be expressed in a qualitative way as we have in this health consultation. Also, please see response to Comment B.8.1 above.

B.8.6. Comment:

"ATSDR believes the severity of health effects from a mixture exposure is not likely to exceed those discussed for SO2, PM2.5, or ozone exposure alone. Because, however, effects may have occurred at a lower SO2 concentration, the number of affected individuals might have increased beyond what would be expected from exposure to a single air pollutant."

The last sentence seems speculative and not supported by the prior statement. We recommend removing it from the document.

Response to comment B.8.6: ATSDR has added in additional reference to support this statement. Please see responses to B.8.1 above and other comments.

B.8.7. Comment:

"4.6.3 Mixtures Limitations - ATSDR notes that a limitation inherent in the public health assessment process is that scientists do not have a complete understanding how simultaneous exposures to several environmental contaminants may cause health effects. For the pollutants considered in this analysis especially sulfur dioxide, ozone and particulate matter, however, hundreds of toxicologic and epidemiologic studies have examined how exposures are possibly related to health effects in humans. Therefore, the evaluations of individual pollutants considered in this health consultation are based on extensive scientific research, but the scientific understanding of the health effects of exposures to pollutant mixtures is less advanced. ATSDR's conclusions regarding the health implication of exposures to a mixture of air pollutants is based on our best professional judgment related to our understanding of the possible harmful effects of air pollutant exposures in Midlothian and our interpretation of the current scientific literature; therefore, these conclusions are presented with some uncertainty. As with most site-specific environmental health evaluations ATSDR conducts, the findings and conclusions in this health consultation have some inherent gaps and limitations. But for the reasons cited above, ATSDR concludes that this assessment does not have major limitations that would preclude scientifically defensible conclusions."

ATSDR notes that a limitation inherent in the public health assessment process is that scientists do not have a complete understanding how simultaneous exposures to several environmental contaminants may cause health effects. The document itself concedes that the scientific understanding of the health effects of exposures to pollutant mixtures is less advanced. We therefore do not see how ATSDR can conclude that this assessment does not have major limitations that would preclude scientifically defensible conclusions on mixtures. We recommend removing those types of conclusions from the document.

Response to comment B.8.7: ATSDR has added additional references to support our mixtures statements (please see response to Comment B.8.1 above).

B.8.8. Comment:

ATSDR's conclusion that there could be health effects associated with a mixture of ozone, SO2, and PM2.5 at the concentrations reported by the historical monitoring data is pure speculation. In support of its theory, ATSDR only cited a journal article stating that the science was 10 years away from being able to "advise multipollutant air quality management." The journal article does not even summarize the studies on the potential mixture effects between ozone, SO2, and PM2.5, but is rather "a summary of key issues and information gaps, strategies for filling the gaps, and realistic expectations for progress that could be made during the next decade."[13] The article does state, however, that one of the key gaps in the science is "knowledge of personal exposures of different subpopulations, considering activities and microenvironments." Particularly relevant to ATSDR's mixture assessment in the HC with respect to the journal article statement concerning activities and microenvironments, is that the monitoring data show that the highest concentrations of ozone, SO2, and PM2.5 do not typically occur at the same time, and with respect to ozone and SO2, do not typically occur during periods when people commonly exercise outdoors. ATSDR should take the timing of the monitoring data into account as part of its analysis and should report these facts in its mixture discussion to provide context for the reader.

Response to comment B.8.8: As indicated above, ATSDR has added references to support our mixtures statements. Please see responses below regarding responses to comments relating to the timing of exposures to either ozone, $PM_{2.5}$ or SO_2.

B.8.9. Comment:

ATSDR presumes that there are concurrent exposures to ozone, SO2, and PM2.5 above its guideline values in Cement Valley. The data show that this is not the case for most all of the time that monitoring data is available. For example, in over 11 years of data (1998 – 2008) there were only 14 instances when 5-minute SO2 concentrations above the ATSDR guideline of 100 ppb occurred on the same day that the Ozone AQI was greater than 100, (a value EPA has defined as unhealthy for sensitive individuals), at the Old Forth Worth Road and Wyatt Road monitoring stations. Further, there was only a single instance in this 11 year period when a 5-minute SO2 concentration greater than the ATSDR guideline of 100 ppb occurred during the same hour as the maximum ozone concentration on a day when the Ozone AQI exceeded 100. ATSDR should take these facts into account as part of its analysis and should report them in its mixture discussion to provide context for the reader.

Response to comment B.8.9: ATSDR has reviewed the mixtures analysis provided by the commenter (see Comment B.8.13 below) and the data appear to be accurate. ATSDR has revised the health consultation to indicate that there were only a limited number of days when 5-minute SO_2 levels were above 100 and the ozone AQI was above 100 for the period 1998-2008 based on the ozone standard in place at that time (the number of potential mixtures exposures of concern may be greater if one considers the new 2015 lowered ozone standard of 70 ppb). Moreover, based on the evaluation performed by the commenter, it is noted that 1998-2000 were the years when any potential mixtures exposures of concern would have occurred. This is important because the highest frequency of SO_2 and ozone exposures above the HCVs occurred during this timeframe. This information has been added to the revised health consultation.

B.8.10. Comment:

ATSDR presumes that there is a lag period associated with the health effects from short-term exposures above its guideline levels without reporting the basis for this assumption or what the potential lag time may be.

Response to comment B.8.10: Most epidemiological studies on the effects of exposures to air pollutants report lag effects of zero to several days. For sulfur dioxide, reported lags showing increased effects were reported from zero (same day) to two days and cumulative lags for up to 4-5 days (EPA, 2008c). The text has been revised to include this information.

B.8.11. Comment:

ATSDR does not define when the concentrations of different pollutants above guideline levels occur relevant to another pollutant within its "lag period." Given the short-term nature of the exposures upon which the guideline levels are based (5-minutes to 24 hours), the appropriate lag period should be on the order of hours rather than days. However, even assuming a lag period of 6 days results in an average of 3 potential mixture events per year over the time period of 1998 to 2008 with a maximum of 12 events in 1999. This maximum number of potential events with lag effects in 1999 is reduced to 5 if only 6-day events in which SO2 concentrations occur during normal periods of exercise is considered, and to only 3 events if the lag period is reduced to 1- day and only normal periods of exercise are considered. ATSDR should take these facts into account as part of its analysis and should report them in its mixture discussion to provide context for the reader.

Response to comment B.8.11: The commenter does not provide any support for the use of an hourly lag period; whereas, most epidemiological studies have found lag periods for single-pollutant effects mostly for same day exposures or effects for a day to several days after the exposure (see response above for the lag periods for sulfur dioxide). ATSDR has reviewed the lag evaluation mentioned here and in Comment B.8.13 and agrees with the analysis. The information on the number of days when a potential mixtures effect might occurred has been added to the revised health consultation.

B.8.12. Comment:

ATSDR states the following on page 45.

"Many gaps exist in our understanding of the full range of health impacts of air pollution (i.e., the mixture of pollutants) and scientific and regulatory communities are at least 10 years away from being able to implement changes to address these issues."

And, "Potential effects to a larger sensitive population, especially in the past, may be limited to an exposure to those contaminants present at sufficient concentration during the same time and at the same locations during the warmer months when PM2.5 and ozone levels are generally the highest. In addition, potential effects to this larger sensitive population may also have resulted from multiple exposures occurring during several consecutive days. These conclusions are based on our best professional judgment and ATSDR recognizes the uncertainty associated with them."

ATSDR's statements amount to pure speculation. Even professional judgments must have some basis in the science. ATSDR has cited no study or peer reviewed paper as a basis for its judgment, and has not even hypothesized how the body of a sensitive person could be affected by concurrent exposures to sulfur dioxide, PM2.5, and ozone that would lead to an expansion of the sensitive population. ATSDR's statements regarding mixtures would be dismissed if ATSDR was testifying in court or in some other type of formal venue where opinions must have some foundation in the science before being presented for consideration by a jury or governmental decision making board.

Response to comment B.8.12: See response to Comment B.8.1 and others.

B.8.13. Comment:

ATSDR states the following on page 46; "Taken together, the previous observations suggest that the timeframe of greatest concern for past exposures to mixtures was during the late afternoon hours or early evening hours from late spring to early fall."

ATSDR presumes that concurrent exposures to elevated SO2 concentrations and ozone or PM2.5 occurred at the same time in Cement Valley. As shown in Section A above, the most frequent time period when 5-minute average SO2 concentrations exceed the ATSDR guideline value of 100 ppb was in the late evening or early morning hours. Attachment A shows that during periods of time when the Air Quality Index (AQI) for ozone was greater than 100 (defined by EPA as a condition in which sensitive individuals are most at risk to potential health effects from ozone), SO2 concentrations greater than 100 ppb occurred only 5 times during periods when people commonly exercise (4 pm to 8 pm) on the same day, over the 1998 to 2008 timeframe. Further, Section B above establishes the fact that the industrial sources are not the major contributors to historic annual average PM2.5 concentrations in the Midlothian area, and monitoring data shows that the historic long-term average PM2.5 concentrations are less than the current NAAQS standard.

The frequency that maximum concentrations of ozone, PM2.5, and 5-minute average concentrations of SO2 occurred was plotted to examine this issue further. Figures 12, 13, and 14 below show that a situation where a 5-minute average SO2 concentration greater than 100 ppb occurs at the same time both ozone and PM2.5 concentrations are maximized is rare, and when it does happen it typically occurs in the very late evening or early morning hours at the OFW Road and Wyatt Road monitoring stations (not the late afternoon or early evening). A similar pattern is not observed at the Midlothian Tower monitor. This is most likely because downwind concentrations are significantly influenced by the area meteorology. As explained in Section A, the downwind SO2 concentrations at the Old Fort Worth Road and Wyatt Road monitors are likely affected by common radiation inversions that generally occur in the late evening and early morning hours when the wind is from its predominate downwind direction (the south). The Midlothian Tower site is most likely more affected by frontal inversions that occur when a cold front blows in from the north. (For example, when the Midlothian Tower site showed 5-minute average SO2 concentrations greater than 100 ppb in the year 2000 in the hours of the day that were not late evening or early morning, the months that this occurred were either February, April, November, or December, and the wind direction for most hours in that day was from the north-northwest or north-northeast.) Thus, it can be stated that the situation is very rare where ATSDR's presumed mixture effect associated with an exposure to all three pollutants (SO2, PM2.5, and ozone) occurs, if it occurs at all.

The data also show that a situation in which ozone concentrations are maximized and SO2 concentrations exceed 100 ppb is also rare. Ozone concentrations are most frequently maximized in the hours between 1 and 4 pm. Figures provided show that SO2 concentrations exceeding 100 ppb rarely occur during this timeframe.

Finally, the data does show that SO2 concentrations greater than 100 ppb do occur at the same time PM2.5 concentrations are maximized more often than the ozone/SO2 concentration joint occurrence. However, not a single instance was observed where a PM2.5 concentration exceeding the current 24-hour NAAQS occurred on the same day a 5-minute SO2 concentration exceeding the ATSDR guideline of 100 ppb also occurred. The maximum PM2.5/SO2 combination occurs most often during the late evening and early morning hours when people do not normally exercise outdoors. Thus, the data do not suggest that some type of mixture effect occurred that resulted in more persons being potentially affected, because there were so few opportunities for such a mixture effect to occur (even if it could.)

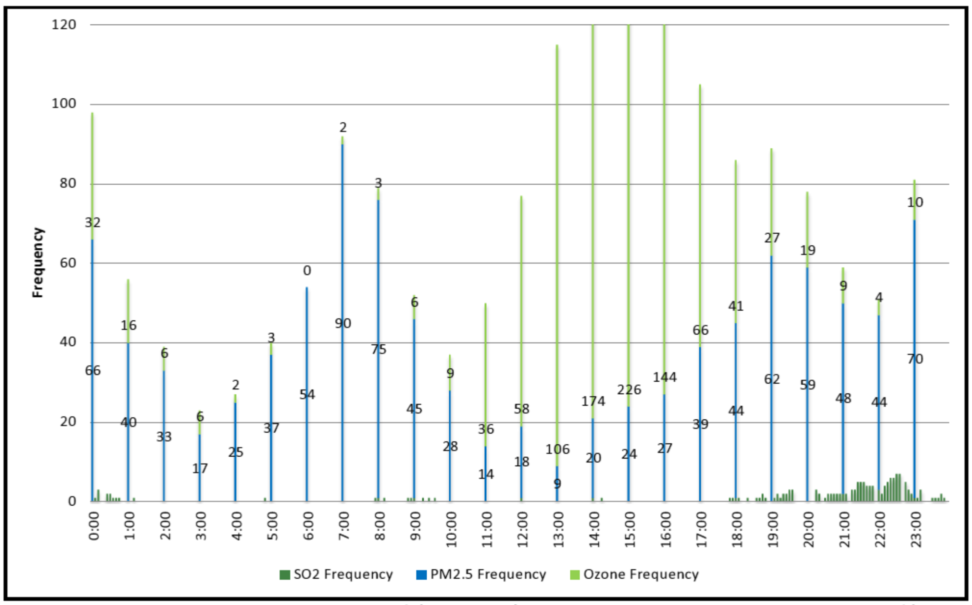


Figure 13: Frequency 5-Minute SO2 Concentration > 100 ppb (2006 – 2008), Frequency 1-Hr PM2.5 Concentration is Maximized (2006 – 2008), Frequency 1-Hr Ozone Concentration is Maximized (2006 – 2008). (Source: TCEQ TAMIS, OFW Road, CAMS Station 52).

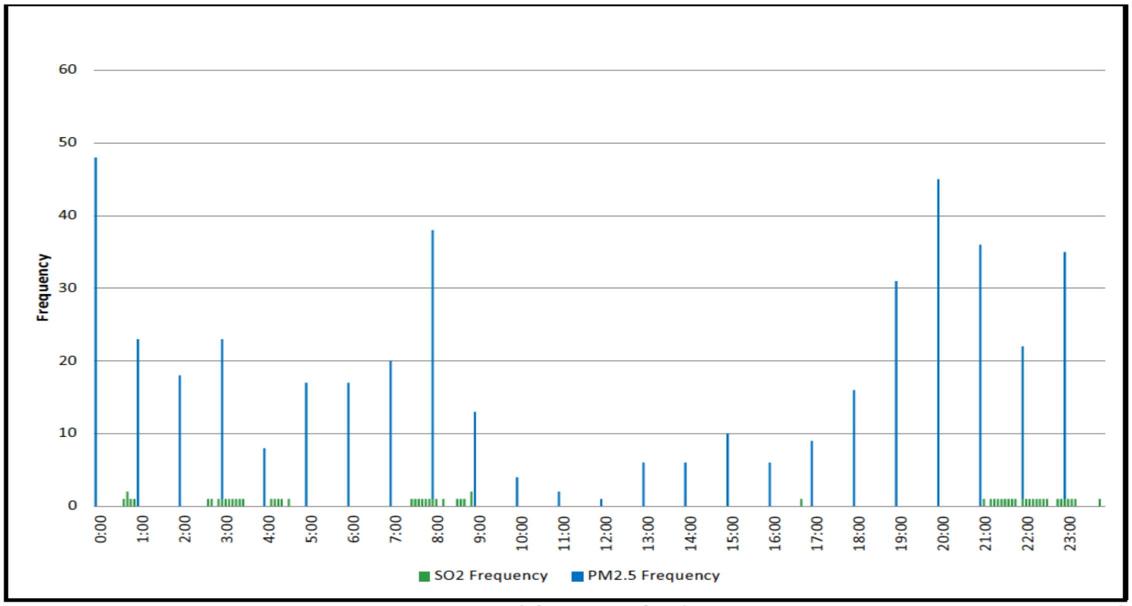


Figure 14: Frequency 5-Minute SO2 Concentration > 100 ppb (2004 – 2006) and Frequency 1-Hr PM2.5 Concentration is Maximized (2004 – 2006), Ozone Data for This Monitor is Not Available. (Source: TCEQ TAMIS, Wyatt Road, CAMS Station 302)

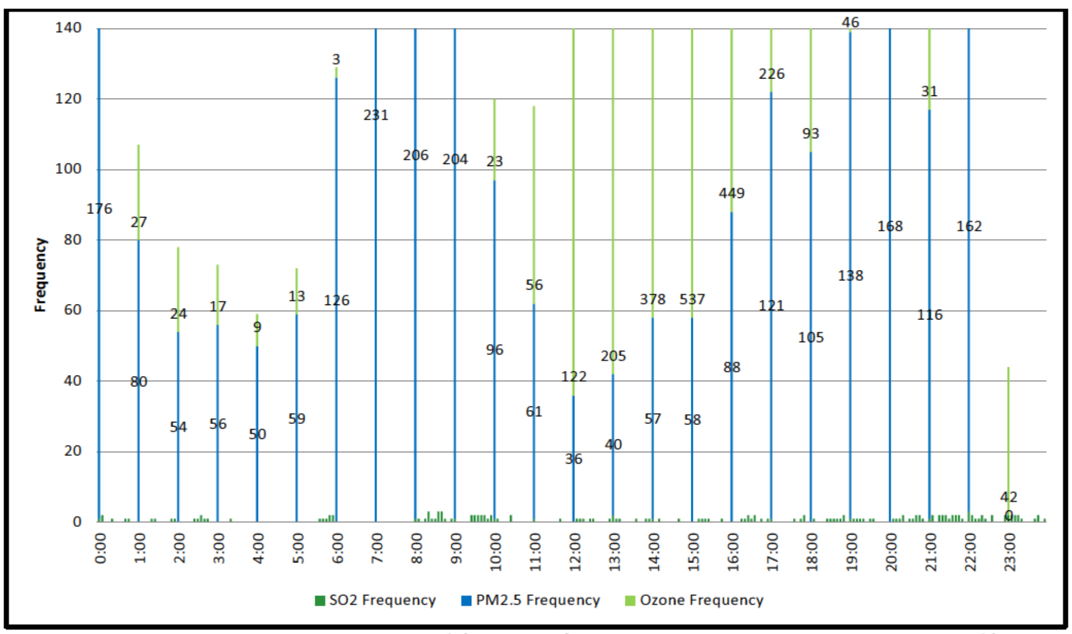


Figure 15: Frequency 5-Minute SO2 Concentration > 100 ppb (2000 – 2006), Frequency 1-Hr PM2.5 Concentration is Maximized (2000 – 2006), Frequency 1-Hr Ozone Concentration is Maximized (2000 – 2006). (Source: TCEQ TAMIS, Midlothian Tower, CAMS Station 160).

Response to comment B.8.13: ATSDR has reviewed the analysis performed by the commenter and agree that, based on available data, concurrent exposures to ozone, $PM_{2.5}$, and SO2 are rare. ATSDR also agrees that the data indicate that there is not a single instance where a 24-hour $PM_{2.5}$ level, above the NAAQS HCV (35 µg/m3), and SO_2 was above 100 ppb on the same day. However, it should be noted that no 24-hour $PM_{2.5}$ data exist for the years 1998-2000 when 5-minute SO_2 levels above 100 ppb were most frequently detected, so we do not know if any concurrent $PM_{2.5}$ /SO_2 exposures of potential concern occurred during this timeframe. ATSDR has added some of this information into the revised health consultation.

B.8.14. Comment:

ATSDR states the following on page 46: "However, the effects of ozone, sulfur dioxide, and PM2.5 may have a lag effect, and a direct relationship to co-exposures around the same hour or on the same day is not likely to tell the whole story regarding the total effects of the past and current mixtures exposures. For example, a sensitive person may be exposed to harmful levels of one NAAQS constituent on one day only but may not exhibit the effect until the next day or several days later. Meanwhile, this person could then be exposed again to harmful levels of the same or other NAAQS constituents during subsequent days."

First, ATSDR should explain the basis of this statement with respect to the pollutants and define the lag period for each of them. The guideline values used by ATSDR for sulfur dioxide are based on the protection of exercising persons with asthma against short-term health effects that stop once the concentration is reduced or exercising is ceased, and ATSDR reported in the HC that "current scientific literature links health effects with short-term exposure to SO2 ranging from 5-minutes to 24-hours" (p. B-2). Likewise, one of EPA's primary means of reporting on the potential for direct health effects associated with ozone, the Air Quality Index (AQI), is based on limiting ozone exposure on the days that ozone concentrations are high. On those days EPA recommends that people reduce their ozone exposure by reducing the time they spend outdoors or by reducing the level or duration of outdoor activity during the times of the day that ozone levels tend to be high. The AQI by its design is protecting for a lag period of hours, not days.

Second, the potential for different pollutant concentrations to occur above the guidelines within the lag period should be discussed so that readers will have a context for how often this supposed mixture effect could have occurred. The frequency that a sulfur dioxide concentration greater than the ATSDR guideline of 100 ppb, a 24-hr PM2.5 concentration greater than 35 ug/m3 , and the occurrence of an Ozone AQI value greater than 100 within 6 days of each other was examined, and the data were provided with the comment.

The data show that such occurrences are rare, and are even rarer when one considers the timing of the SO2 concentrations that are greater than 100 ppb. For example, the 1999 data in Attachment A show that there were twelve 6-day events in which 5-minute SO2 concentrations greater than the ATSDR guideline of 100 ppb occurred within 6 days of a day when the Ozone AQI was greater than 100. However, if the SO2 concentrations greater than 100 ppb are limited to only the time periods when people commonly exercise, the number of 6-day events in which a "lag mixture effect" could occur is reduced from 12 to 5. If the lag period is reduced to 24 hours the total number of events is reduced from 12 (for 6-days) to only 7 (for 1-day), and 1-day events in which the SO2 concentrations occur during normal periods of exercise is reduced to only 3. Further, the number of events in which the 24-hr PM2.5

concentration is greater than 35 ug/m3 within 6 days of an Ozone AQI greater than 100 is limited to a total of 3 events (all of which occurred at the Wyatt Road monitor.) Finally, the data also shows that there are no instances where PM2.5 concentrations greater than 35 ug/m3 occurred within 6 days of a SO2 concentration greater than the ATSDR guideline of 100 ppb. Thus, if these "lag effects" could actually occur, the frequency of such an occurrence is rare and to a significant degree are much more controlled by the number of times the AQI for ozone is greater than 100, which is a regional air pollution issue as acknowledged by ATSDR in the HC.

Response to comment B.8.14: Please see response to the question of lags effects for sulfur dioxide exposures in response to comment B.8.10. Moreover, lag effects have also been demonstrated in epidemiological studies of ozone and various health outcomes. The following is from the US EPA Integrated Science Assessment for Ozone and Related Photochemicals (EPA, 2013b):

The majority of epidemiologic studies that focused on the association between short-term O3 exposure and mortality (i.e., all-cause, respiratory and cardiovascular) examined the average of multiday lags with some studies examining single-day lags. Across a range of multiday lags (i.e., average of 0-1 to 0-6 days), the studies evaluated consistently demonstrate that the O3 effects on mortality occur within a few days of exposure. Epidemiologic studies of lung function, respiratory symptoms, and biological markers of airway inflammation and oxidative stress examined associations with single-day ambient O3 concentrations (using various averaging times) lagged from 0 to 7 days as well as concentrations averaged over 2 to 19 days. Lags of 0 and 1 day ambient O3 concentrations were associated with decreases in lung function and increases in respiratory symptoms, airway inflammation, and oxidative stress. Additionally, several studies found that multiday averages of O3 concentration were associated with these endpoints, indicating that not only single day, but exposures accumulated over several days led to a respiratory health effect. In studies of respiratory hospital admissions and ED visits, investigators either examined the lag structure of associations by including both single-day and the average of multiday lags, or selecting lags a priori. The collective evidence indicates a rather immediate response within the first few days of O3 exposure (i.e., for lags days averaged at 0-1, 0-2, and 0-3 days) for hospital admissions and ED visits for all respiratory outcomes, asthma, and chronic obstructive pulmonary disease in all-year and seasonal analyses.

Therefore, based on data compiled by EPA, it does appear that lag periods of at least a day to several days for exposures to SO2 and ozone have been observed and it is appropriate to consider them in this health consultation.

ATSDR has added information here for the 6-lag analysis described in the analysis and shown in the Attachment A. ATSDR has also acknowledged in the revised health consultation that the number of times a pairwise co-exposure to either ozone, SO_2 or $PM_{2.5}$ was infrequent and most of the co-exposures occurred in the years 1998-2000 when the frequency of elevated 8-hour ozone levels above 75 ppb and SO_2 levels above 100 ppb were much more frequent. However, the number of potential mixtures exposures of concern may be greater if one considers the new 2015 lowered ozone standard of 70 ppb.

B.8.15. Comment:

ATSDR mischaracterizes the data with respect to concentrations of PM2.5 and the time that SO2 concentrations exceeded the ATSDR guidelines.

ATSDR states the following on page 50: "ATSDR believes that current exposures to ozone and infrequent short-term levels of PM2.5 and past exposures to these, long-term levels of PM2.5 and sulfur dioxide could harm the health of sensitive individuals who currently and previously resided in Midlothian. In addition, ATSDR believes that potential future exposures to sulfur dioxide and PM2.5 also could harm the health of sensitive individuals if actions are not taken to monitor and to prevent harmful exposures."

The data do not show that there are current short-term PM2.5 concentrations above the current standards. Further, the data show that past long-term concentrations of PM2.5 above the current standard could not have occurred anywhere except for a highly localized area that does not support a residential land use (if it occurred at all), and that a significant source of those concentrations must have resulted from sources other than the industries evaluated by ATSDR if such a condition existed. Finally, the sensitive population that was potentially exposed to SO2 concentrations above the ATSDR guideline levels should be further limited to those persons with asthma who predominantly exercised in the very late evening or early morning hours.

Response to comment B.8.15: Nowhere in the draft for public comment health consultation does ATSDR indicate the short-term exposures to $PM_{2.5}$ are not in compliance with the current standard. What we have said is that there are some infrequent occasions when the 24-hour $PM_{2.5}$ levels are above the EPA AQI indicating a concern for sensitive populations and that the source of the $PM_{2.5}$ is from both local as well as regional sources. In response to previous comments, ATSDR has re-evaluated our estimation of $PM_{2.5}$ from the PM_{10} data available from the Gerdau Monitor in the 1990's and determined that there is too much uncertainty to make a health determination. ATSDR is concerned about past exposures to sulfur dioxide, primarily in Cement Valley, during most of the years from 1997-2008 with the highest frequency of exposures occurring in the years 1997-early 2002. Comments regarding the timing of exposures, as to when sensitive persons (asthmatics) perform activities that increase their breathing rates, have been addressed in responses to previous comments.

B.8.16. Comment:

ATSDR states the following on pages 56 and 57: "ATSDR believes that sufficient information exists to warrant concern for multiple air pollutant exposures to sensitive individuals, especially in the past (1997 to late 2008) when SO2 levels were higher and when these persons were breathing at higher rates (e.g., while exercising, etc.). ATSDR believes the severity of health effects from a mixture exposure is not likely to exceed those discussed for SO2, PM2.5, or ozone exposure alone. For past SO2 exposures, it is, however, possible that the number of sensitive individuals affected may have been greater because effects may have occurred at a lower SO2 concentration when combined with exposure to ozone, PM2.5, or both."

And, "Potential effects to a larger sensitive population, especially in the past, may be limited to an exposure to those contaminants present at sufficient concentration during the same time and at the same locations during the warmer months when PM2.5 and ozone levels are generally the highest. In addition, potential effects to this larger sensitive population also may have resulted from multiple exposures occurring during several consecutive days."

The statements are overly broad. First, ATSDR has provided no scientific basis for its statement that the number of sensitive individuals affected may have been greater from 1997 to 2008 due to a combined exposure of ozone, SO2, and PM2.5. Secondly, as shown in Section C, the concentrations of all three of these pollutants are rarely maximized at the same point in time. With respect to SO2 and ozone, the time frequency that these two pollutants are at their maximum concentrations is just as rare. There was only a single instance where a maximum 1-hr ozone concentration on a day with an Ozone AQI greater than 100 occurred at the same time a 5-minute SO2 concentration exceeded the ATSDR guideline of 100 ppb, in over 11 years of data. With respect to ozone and PM2.5, or PM2.5 and SO2, a convergence of these two concentration pairs is likewise rare. A PM2.5 concentration greater than the current 24-hr average standard concentration that occurred on the same day an Ozone AQI was greater than 100 happened only 3 times in over 9 years of data. Finally, a 5-minute SO2 concentration greater the ATSDR guideline of 100 ppb never occurred at the same time a PM2.5 24-hour concentration was greater than the current NAAQS standard concentration in over 5 years of data.

Response to comment B.8.16: ATSDR has added in references to provide further support for our concern for co-exposures to ozone and sulfur dioxide as well as for $PM_{2.5}$ and sulfur dioxide. Please see responses above to similar comments on ATSDR's mixtures evaluation.

B.8.17. Comment: [AG-58, GA-52, TXI-51]

ATSDR states the following on page 57.

"To reduce and prevent multiple contaminant exposures, ATSDR recommends the following:

- TCEQ should evaluate and prevent harmful sulfur dioxide and PM2.5 exposures from local sources.
- TCEQ should continue efforts to reduce regional ozone exposures."

The recommendations are unnecessary. TCEQ already implements a regulatory program that includes as part of its primary function exactly the tasks recommended by ATSDR.

Response to comment B.8.17: Given changes to the draft health consultation, which include the results of an ATSDR modeling evaluation of SO_2 exposures to emission from Ash Grove and Holcim and the addition of information regarding that actions taken at TXI and Ash Grove to reduce SO_2 and other air pollutant emissions, ATSDR has revised these recommendations.

B.8.18. Comment:

ATSDR's conclusion that there could be health effects associated with a mixture of ozone, SO2, and PM2.5 at the concentrations reported by the historical monitoring data is pure speculation. In support of its theory, ATSDR cited only a single journal article stating that the science was 10 years away from being able to "advise multipollutant air quality management." Speculation without some level of correlation is of highly questionable value in this Report.

Response to comment B.8.18: See response to Comment B.8.1 above.

B.8.19. Comment:

The draft assessment indicates that exposure to mixtures of SO2, PM2.5, and ozone may have caused a greater number of sensitive individuals to be affected than numbers for each pollutant considered alone. In addition, the severity of health effects from mixture exposure not likely to exceed those discussed for SO2, PM2.5, or ozone. However, this appears to be a qualitative conclusion, based on no quantitative data, and presented with "some uncertainty". Therefore, TCEQ believes this conclusion to be tentative and unsupported by the available air monitoring data and suggests it be removed from the draft assessment.

Response to comment B.8.19: See response to Comment B.8.1 above.

Section C. Editorial/Miscellaneous Comments

This section presents editorial and other comments that are not general or pollutant-specific.

C.1.1. Comment:

Page 39, last paragraph, there is a sentence that reads, "However, the studies did not include children or people with severe asthma or." This sentence stops n. abruptly after the second "or".

Response to comment C.1.1: The health consultation has been revised to address this editorial comment.

C.1.2. Comment:

Page 58. last sentence reads, "TCEQ should insure...". The word that ATSDR may have intended to use is "ensure".

Response to comment C.1.2: The health consultation has been revised to address this editorial comment.

C.1.3. Comment:

Page 27: Under annual average concentrations, it is noted there was a personal communication with Tracie Phillips. The email was sent by Dr. Phillips, but the information came from Bryan Lambeth in Monitoring. He was also listed in the email as the person to contact should they have further questions.

Response to comment C.1.3: Comment noted.

C.1.4. Comment:

Page 27: It is unclear why "Measured" is bolded and italicized in this paragraph.

Response to comment C.1.4: ATSDR could not find reference to this editorial comment on p.27 but did locate it on p. 30 of the draft for public comment version. This word was bolded as ATSDR had also estimated $PM_{2.5}$ levels from PM_{10} data; therefore, ATSDR wanted to emphasize that this was the highest measured value (vs estimated). Since ATSDR has decided to delete the estimated $PM_{2.5}$ values due to the uncertainty in the analysis, the word "measured" was deleted from this paragraph and any other places where it was used.

C.1.5. Comment:

Page 48: There is a typographical error in the third line of the 5th paragraph: "particular matter"

should be corrected to "particulate matter."

Response to comment C.1.5: The health consultation has been revised to address this editorial comment.

C.1.6. Comment:

Page 70: In table 3, Gerdeau Ameristeel is misspelled.

Response to comment C.1.6: The health consultation has been revised to address this editorial comment.

Attachment to Public Comment -

TABLE 1: 1998 MIXTURE ANALYSIS DATA

MONITOR	DATE	TIME	AQI for Ozone	MAX OZONE 1-HR AVG. CONC. DURING DAY (ppb)	SO2 1-HR AVG. CONC. (ppb)	SO2 5-Min AVG. CONC. (ppb)	PM2.5 24-HR AVG. CONC. (ug/m3)
OFW Road (SO2); MT (Ozone)	4/6/1998	1:00	48	62	Not > 75 ppb	Four 5-min concentrations for this hour ranged from 114 to 140 ppb.	No data available
		19:00			104	Max 5-min concentrations for this hour ranged from 100 to 130 ppb.	
		20:00			99	Max 5-min concentrations for this hour ranged from 121 to 155 ppb.	
	4/11/1998	19:00	109	85	None > 75 ppb	None > 100 ppb	
	4/13/1998	0:50	50	62		102	
		1:00			Not > 75 ppb	Three 5-min concentrations for this hour ranged from 110 to 122 ppb.	
		23:00			93	Max 5-min concentrations for this hour ranged from 102 to 110 ppb.	
	4/14/1998	0:00	47	57	88	Max 5-min concentrations for this hour ranged from 104 to 119 ppb.	
OFW Road (SO2); MT (Ozone)	4/25/1998	0:00	64	68	89	Max 5-min concentrations for this hour ranged from 102 to 120 ppb.	No data available
		1:00			Not > 75 ppb	Two 5-min concentrations for this hour were 126 and 153 ppb.	
		13:15				115	
		14:00			Not > 75 ppb	Four 5-min concentrations for this hour ranged from 100 to 139 ppb.	
		15:15				102	
		17:00			Not > 75 ppb	Two 5-min concentrations for this hour were 118 and 149 ppb.	
		19:40				100	
	5/1/1998	15:00	114	89	None > 75 ppb	None > 100 ppb	

Table 1 (page 1 of 3)

TABLE 1: 1998 MIXTURE ANALYSIS DATA

MONITOR	DATE	TIME	AQI for Ozone	MAX OZONE 1-HR AVG. CONC. DURING DAY (ppb)	SO2 1-HR AVG. CONC. (ppb)	SO2 5-Min AVG. CONC. (ppb)	PM2.5 24-HR AVG. CONC. (ug/m3)
OFW Road (SO2); MT (Ozone)	5/15/1998	20:00	101	79	None > 75 ppb	None > 100 ppb	No data available
	5/16/1998	15:00	119	87	None > 75 ppb	None > 100 ppb	
	5/18/1998	14:00	104	81	None > 75 ppb	None > 100 ppb	
	5/19/1998	23:00	93	81	Not > 75 ppb	Four 5-min concentrations for this hour ranged from 112 to 122 ppb.	
	5/20/1998	23:40	84	80		103	
	5/22/1998	1:00	58	68	75	Two 5-minute concentrations for this hour were 103 and 106 ppb.	
		2:00			83	Two 5-minute concentrations for this hour were 102 and 103 ppb.	
	5/23/1998	20:00	46	63	Not > 75 ppb	Two 5-minute concentrations for this hour were 104 and 110 ppb.	
		21:45				104	
OFW Road (SO2); MT (Ozone)	6/9/1998	15:45	35	47		121	No data available
		16:05				102	
	6/10/1998	5:10	19	27		107	
	6/14/1998	16:00	119	94	None > 75 ppb	None > 100 ppb	
	6/16/1998	13:00	116	92	None > 75 ppb	None > 100 ppb	
	6/20/1998	4:00	40	52	Not > 75 ppb	Two 5-min concentrations for this hour were 112 and 134 ppb.	
		17:55				117	
		18:00				100	
		21:20				96	
		23:00				117	
OFW Road (SO2); MT (Ozone)	7/8/1998	0:15	42	56		102	No data available
	7/11/1998	21:50	35	47		117	
	7/12/1998	0:05	36	49		111	
	7/13/1998	13:00	137	97	None > 75 ppb	None > 100 ppb	
	7/14/1998	16:00	132	110	None > 75 ppb	None > 100 ppb	
	7/15/1998	17:00	119	91	None > 75 ppb	None > 100 ppb	
	7/16/1998	15:00	185	130	None > 75 ppb	None > 100 ppb	
	7/17/1998	12:00	142	98	None > 75 ppb	None > 100 ppb	
	7/18/1998	19:00	127	90	None > 75 ppb	None > 100 ppb	

Table 1 (page 2 of 3)

TABLE 1: 1998 MIXTURE ANALYSIS DATA

MONITOR	DATE	TIME	AQI for Ozone	MAX OZONE 1-HR AVG. CONC. DURING DAY (ppb)	SO2 1-HR AVG. CONC. (ppb)	SO2 5-Min AVG. CONC. (ppb)	PM2.5 24-HR AVG. CONC. (ug/m3)
OFW Road (SO2); MT (Ozone)	8/26/1998	14:00	49	73		269	No data available
	8/28/1998	17:00	100	83	None > 75 ppb	None > 100 ppb	
	8/29/1998	14:00	101	95	None > 75 ppb	None > 100 ppb	
	8/31/1998	8:55	77	72		109	
		9:00			Not > 75 ppb	Two 5-minute concentrations for this hour were 124 and 140 ppb.	
	9/1/1998	14:00	129	98	None > 75 ppb	None > 100 ppb	
	9/2/1998	16:00	203	143	None > 75 ppb	None > 100 ppb	
	9/3/1998	16:00	161	105	None > 75 ppb	None > 100 ppb	
	9/4/1998	16:00	137	101	None > 75 ppb	None > 100 ppb	
	9/5/1998	14:00	119	89	Not > 75 ppb	None > 100 ppb during this hour	
		23:00			Not > 75 ppb	Two 5-minute concentrations for this hour were 119 and 130 ppb.	
	9/9/1998	18:00	114	90	None > 75 ppb	None > 100 ppb	
OFW Road (SO2); MT (Ozone)	10/10/1998	13:00	100	80	None > 75 ppb	None > 100 ppb	No data available
	10/15/1998	8:00	58	70	84	Max 5-minute concentrations for this hour ranged from 102 to 115 ppb.	
		9:10				108	
	10/16/1998	15:30	25	36		106	
		16:30				132	

Table 1 (page 3 of 3)

TABLE 2: 1999 MIXTURE ANALYSIS DATA

MONITOR	DATE	TIME	AQI for Ozone	MAX OZONE 1-HR AVG. CONC. DURING DAY (ppb)	SO2 1-HR AVG. CONC. (ppb)	SO2 5-Min AVG. CONC. (ppb)	PM2.5 24-HR AVG. CONC. (ug/m3)
OFW Road (SO2); MT (Ozone)	5/8/1999	12:00	119	91	None > 75 ppb	None > 100 ppb	No data available
	5/14/1999	11:00	54	82	Not > 75 ppb	Max 5-minute concentrations during this hour ranged from 112 to 130 ppb.	
		22:30				102	
OFW Road (SO2); MT (Ozone)	6/16/1999	17:00	150	110	None > 75 ppb	None > 100 ppb	No data available
	6/19/1999	13:00	104	85	None > 75 ppb	None > 100 ppb during this hour	
		7:50				100	
OFW Road (SO2); MT (Ozone)	7/28/1999	22:00	34	45	Not > 75 ppb	Three 5-minute concentrations during this hour ranged from 105 to 127 ppb.	No data available
	7/29/1999	23:00	42	59	Not > 75 ppb	Two 5-minute concentrations in this hour were 101 and 149 ppb.	
	7/30/1999	23:55				180	
	7/31/1999	0:00	40	52	Not > 75 ppb	Three 5-minute concentrations in this hour ranged from 101 to 169 ppb.	
	8/3/1999	12:00	101	87	None > 75 ppb	None > 100 ppb	
OFW Road (SO2); MT (Ozone)	8/4/1999	12:00	172	117	No data reported for August	None > 100 ppb	No data available
	8/5/1999	15:00	166	108		None > 100 ppb	
	8/6/1999	17:00	150	107		None > 100 ppb	
	8/7/1999	16:00	150	111		None > 100 ppb during this hour	
		23:45				Max 5-minute concentrations during this hour ranged from 100 to 245 ppb.	
	8/9/1999	23:00	61	66		124	
	8/10/2009	23:00	51	73		Max 5-minute concentrations for this hour ranged from 120 to 166 ppb.	

Table 2 (page 1 of 7)

TABLE 2: 1999 MIXTURE ANALYSIS DATA

MONITOR	DATE	TIME	AQI for Ozone	MAX OZONE 1-HR AVG. CONC. DURING DAY (ppb)	SO2 1-HR AVG. CONC. (ppb)	SO2 5-Min AVG. CONC. (ppb)	PM2.5 24-HR AVG. CONC. (ug/m3)
OFW Road (SO2); MT (Ozone)	8/11/1999	0:00	47	65	No data reported for August	137	No data available
		23:00				Max 5-minute concentrations for this hour ranged from 101 to 114 ppb.	
	8/12/1999	0:10	45	65		100	
		23:00				Two 5-minute concentrations for this hour were 106 and 121 ppb.	
	8/14/1999	16:00	151	103		None > 100 ppb	
	8/15/1999	15:00	116	85		None > 100 ppb	
	8/16/1999	15:00	124	91		None > 100 ppb	
	8/17/1999	19:00	127	93		None > 100 ppb	
	8/19/1999	15:00	182	128		None > 100 ppb	
	8/20/1999	15:00	156	108		None > 100 ppb	
	8/21/1999	15:00	150	105		None > 100 ppb	
OFW Road (SO2); MT (Ozone)	8/22/1999	14:00	111	85	No data reported for August	None > 100 ppb	No data available
	8/25/1999	12:00	106	81		None > 100 ppb	
	8/26/1999	18:00	90	86		None > 100 ppb	
	8/27/1999	15:00	129	91		None > 100 ppb	
	8/28/1999	10:15	90	76		105	
	8/29/1999	17:00	124	94		None > 100 ppb	
	8/31/1999	11:00	140	95		None > 100 ppb	
	9/1/1999	13:00	111	88	None > 75 ppb	None > 100 ppb	
	9/2/1999	16:00	101	82	None > 75 ppb	None > 100 ppb	

Table 2 (page 2 of 7)

TABLE 2: 1999 MIXTURE ANALYSIS DATA

MONITOR	DATE	TIME	AQI for Ozone	MAX OZONE 1-HR AVG. CONC. DURING DAY (ppb)	SO2 1-HR AVG. CONC. (ppb)	SO2 5-Min AVG. CONC. (ppb)	PM2.5 24-HR AVG. CONC. (ug/m3)
OFW Road (SO2); MT (Ozone)	9/4/1999	21:30	42	55		116	No data available
	9/7/1999	0:00	36	56	Not > 75 ppb	Two 5-minute concentrations during this hour ranged were 109 and 155 ppb.	
		21:00	36	49	Not > 75 ppb	Three 5-minute concentrations for this hour ranged from 101 to 110 ppb.	
	9/9/1999	17:00	145	103	None > 75 ppb	None > 100 ppb	
	9/10/1999	16:00	111	84	None > 75 ppb	None > 100 ppb	
OFW Road (SO2); MT (Ozone)	9/11/1999	23:00	106	94	None > 75 ppb	None > 100 ppb	No data available
	9/12/1999	3:00	58	89	Not > 75 ppb	Two 5-minute concentrations for this hour were 108 and 111 ppb.	
	9/15/1999	15:00	111	93	None > 75 ppb	None > 100 ppb	
	9/16/1999	15:00	106	88	None > 75 ppb	None > 100 ppb	
	9/17/1999	16:00	145	101	None > 75 ppb	None > 100 ppb	
	9/18/1999	15:00	145	104	None > 75 ppb	None > 100 ppb	

Table 2 (page 3 of 7)

TABLE 2: 1999 MIXTURE ANALYSIS DATA

MONITOR	DATE	TIME	AQI for Ozone	MAX OZONE 1-HR AVG. CONC. DURING DAY (ppb)	SO2 1-HR AVG. CONC. (ppb)	SO2 5-Min AVG. CONC. (ppb)	PM2.5 24-HR AVG. CONC. (ug/m3)
OFW Road (SO2); MT (Ozone)	9/19/1999	17:00	137	94	None > 75 ppb	None > 100 ppb	No data available
	9/20/1999	16:00	142	115	None > 75 ppb	None > 100 ppb	
	9/23/1999	16:00	116	93	None > 75 ppb	None > 100 ppb	
	9/24/1999	1:00				111	
		15:00	140	96	None > 75 ppb		
		15:05				110	
		16:55				Max 5-minute concentrations during this hour ranged from 104 to 129 ppb.	
	9/25/1999	4:50	51	63		109	
		5:00			109	Max 5-minute concentrations for this hour ranged from 104 to 158 ppb.	
		5:15				149	
		5:20				158	
		5:25				135	
		5:30				140	
		5:35				134	
		5:40				113	
		5:45				104	
		8:00			79	One 5-minute concentration during this hour was 105 ppb.	

Table 2 (page 4 of 7)

TABLE 2: 1999 MIXTURE ANALYSIS DATA

MONITOR	DATE	TIME	AQI for Ozone	MAX OZONE 1-HR AVG. CONC. DURING DAY (ppb)	SO2 1-HR AVG. CONC. (ppb)	SO2 5-Min AVG. CONC. (ppb)	PM2.5 24-HR AVG. CONC. (ug/m3)
OFW Road (SO2); MT (Ozone)	9/26/1999	2:00	47	62	Not > 75 ppb	Four 5-minute concentrations for this hour ranged from 109 to 134 ppb.	No data available
		3:10				109	
		4:00				103	
	9/27/1999	9:55	47	63		112	
	9/28/1999	0:00	40	64	Not > 75 ppb	Two 5-minute concentrations for this hour were 102 and 127 ppb.	
		1:00			89	Max 5-minute concentrations during this hour ranged from 105 to 115 ppb.	
	10/1/1999	7:00			86	Four 5-minute concentrations for this hour ranged from 107 to 128 ppb.	
		16:00	114	86	Not > 75 ppb	None > 100 ppb during this hour	
	10/2/1999	1:00	106	82	Not > 75 ppb	Two 5-minute concentrations for this hour were 107 and 134 ppb.	
		15:00	106	82			

Table 2 (page 5 of 7)

TABLE 2: 1999 MIXTURE ANALYSIS DATA

MONITOR	DATE	TIME	AQI for Ozone	MAX OZONE 1-HR AVG. CONC. DURING DAY (ppb)	SO2 1-HR AVG. CONC. (ppb)	SO2 5-Min AVG. CONC. (ppb)	PM2.5 24-HR AVG. CONC. (ug/m3)
OFW Road (SO2); MT (Ozone)	10/10/1999	15:00	122	99	None > 75 ppb	None > 100 ppb	No data available
	10/15/1999	1:00	84	76	82	Max 5-minute concentrations during this hour ranged from 111 to 201 ppb.	
		2:00			142	Max 5-minute concentrations for this hour ranged from 102 to 216 ppb.	
		3:00			95	Max 5-minute concentrations for this hour ranged from 102 to 142 ppb.	
		4:00			104	Max 5-minute concentrations for this hour ranged from 103 to 140 ppb.	
		5:00			149	Max 5-minute concentrations for this hour ranged from 101 to 321 ppb.	
		6:00			Not > 75 ppb	Two 5-minute concentrations for this hour were 111 and 144 ppb.	
	10/16/1999	0:00	40	51	92	Max 5-minute concentrations for this hour ranged from 111 to 237 ppb.	
		2:05				128	
		3:00			Not > 75 ppb	Five 5-minute concentrations for this hour ranged from 105 to 159 ppb.	
		4:00			Not > 75 ppb	Three 5-minute concentrations for this hour ranged from 111 to 152 ppb.	
		6:00			93	Max 5-minute concentrations for this hour ranged from 100 to 130 ppb.	
		7:00			127	Max 5-minute concentrations for this hour ranged from 112 to 159 ppb.	
		8:00				116	

TABLE 2: 1999 MIXTURE ANALYSIS DATA

MONITOR	DATE	TIME	AQI for Ozone	MAX OZONE 1-HR AVG. CONC. DURING DAY (ppb)	SO2 1-HR AVG. CONC. (ppb)	SO2 5-Min AVG. CONC. (ppb)	PM2.5 24-HR AVG. CONC. (ug/m3)
OFW Road (SO2); MT (Ozone)	11/10/1999	1:00	43	61	Not > 75 ppb	Two 5-minute concentrations for this hour were 100 and 104 ppb.	No data available
		1:10				104	
		1:20				100	
	11/13/1999	12:00	101	77	None > 75 ppb	None > 100 ppb	
	11/17/1999	15:00	109	87	None > 75 ppb	None > 100 ppb	
	11/22/1999	14:00	33	41	Not > 75 ppb	Two 5-minute concentrations during this hour ranged were 101 and 108 ppb.	

Table 2 (page 7 of 7)

TABLE 3: 2000 MIXTURE ANALYSIS DATA

MONITOR	DATE	TIME	AQI for Ozone	MAX OZONE 1-HR AVG. CONC. DURING DAY (ppb)	SO2 1-HR AVG. CONC. (ppb)	SO2 5-Min AVG. CONC. (ppb)	PM2.5 24-HR AVG. CONC. (ug/m3)
OFW Road (SO2); MT (Ozone)	4/22/2000	11:55	87	76		143	No Data Available
		12:30				156	
	4/23/2000	3:00	61	68	166	Max 5-minute concentrations during this hour ranged from 109 to 296 ppb.	
	4/26/2000	16:00	104	84	None > 75 ppb	None > 100 ppb	
	4/27/2000	2:00	47	71	None > 75 ppb	Three 5-minute concentrations during this hour ranged from 113 to 185 ppb.	
		3:00			75.2	Max 5-minute concentrations during this hour ranged from 113 to 177 ppb.	
	4/29/2000	16:00	109	92	None > 75 ppb	None > 100 ppb	
OFW Road (SO2); MT (Ozone)	5/11/2000	18:10	50	62		100	No Data Available
	5/15/2000	16:00	150	107	None > 75 ppb	None > 100 ppb	
	5/16/2000	14:15	43	56		102	
		0:55				103	
	5/17/2000	1:00	41	52	90	Max 5-minute concentrations during this hour ranged from 112 to 130 ppb.	
		4:00			89	Max 5-minute concentrations during this hour ranged from 103 to 119 ppb.	
		5:00			80	Max 5-minute concentrations during this hour ranged from 105 to 116 ppb.	
		10:55				116	
		16:55				115	
		17:00			98	Max 5-minute concentrations during this hour ranged from 105 to 161 ppb.	
		22:00			85	Max 5-minute concentrations during this hour ranged from 108 to 111 ppb.	

Table 3 (page 1 of 8)

TABLE 3: 2000 MIXTURE ANALYSIS DATA

MONITOR	DATE	TIME	AQI for Ozone	MAX OZONE 1-HR AVG. CONC. DURING DAY (ppb)	SO2 1-HR AVG. CONC. (ppb)	SO2 5-Min AVG. CONC. (ppb)	PM2.5 24-HR AVG. CONC. (ug/m3)
OFW Road (SO2); MT (Ozone)	5/20/2000	16:00	104	86	None > 75 ppb	None > 100 ppb	No Data Available
	5/22/2000	20:00	61	71	Not > 75 ppb	Four 5-minute concentrations during this hour ranged from 118 to 228 ppb.	
		21:00			154	Max 5-minute concentrations during this hour ranged from 100 to 245 ppb.	
	5/23/2000	17:45	49	71		114	
		18:00			81	One 5-minute concentration during this hour was 119 ppb.	
		19:00			105	Max 5-minute concentrations during this hour ranged from 103 to 124 ppb.	
		20:00			Not > 75 ppb	Two 5-minute concentrations during this hour ranged were 106 and 121 ppb.	
	5/24/2000	21:55	45	61		117	
		22:00			130	Max 5-minute concentrations during this hour ranged from 131 to 196 ppb.	
		23:00			91	Max 5-minute concentrations during this hour ranged from 132 to 256 ppb.	
	5/25/2000	0:00	36	50	Not > 75 ppb	Two 5-minute concentrations during this hour ranged were 109 and 155 ppb.	
	5/26/2000	1:00	42	53		102	
		8:10				103	
		9:55				142	
		10:00			84	Max 5-minute concentrations during this hour ranged from 102 to 129 ppb.	
		11:05				149	
		12:55				117	
		13:50				136	
		14:00			Not > 75 ppb	Three 5-minute concentrations during this hour ranged from 101 to 134 ppb.	
		15:00			Not > 75 ppb	Two 5-minute concentrations during this hour were 105 and 155 ppb.	
		16:45				129	

Table 3 (page 2 of 8)

TABLE 3: 2000 MIXTURE ANALYSIS DATA

MONITOR	DATE	TIME	AQI for Ozone	MAX OZONE 1-HR AVG. CONC. DURING DAY (ppb)	SO2 1-HR AVG. CONC. (ppb)	SO2 5-Min AVG. CONC. (ppb)	PM2.5 24-HR AVG. CONC. (ug/m3)
OFW Road (SO2); MT (Ozone)	5/27/2000	6:00	41	60	82	Max 5-minute concentrations during this hour ranged from 104 to 129 ppb.	No Data Available
	5/28/2000	15:00	132	102	None > 75 ppb	None > 100 ppb	
	5/29/2000	17:00	101	82	None > 75 ppb	None > 100 ppb	
	6/2/2000	1:05	42	53		105	
		3:00			Not > 75 ppb	Two 5-minute concentrations during this hour were 125 and 135 ppb.	
		4:00			91	Max 5-minute concentrations during this hour ranged from 107 to 134 ppb.	
		5:00			Not > 75 ppb	Two 5-minute concentrations during this hour were 104 and 110 ppb.	
	6/7/2000	13:00	101	81	None > 75 ppb	None > 100 ppb	
	6/10/2000	12:05	22	29		134	
	6/11/2000	0:00	23	33	103	Max 5-minute concentrations during this hour ranged from 109 to 188 ppb.	
	6/13/2000	2:00	35	44	None > 75 ppb	Two 5-minute concentrations during this hour were 101 and 102 ppb.	
		23:00			93	Max 5-minute concentrations during this hour ranged from 100 to 140 ppb.	

Table 3 (page 3 of 8)

TABLE 3: 2000 MIXTURE ANALYSIS DATA

MONITOR	DATE	TIME	AQI for Ozone	MAX OZONE 1-HR AVG. CONC. DURING DAY (ppb)	SO2 1-HR AVG. CONC. (ppb)	SO2 5-Min AVG. CONC. (ppb)	PM2.5 24-HR AVG. CONC. (ug/m3)
OFW Road (SO2); MT (Ozone)	7/16/2000	0:00	84	76	94	Max 5-minute concentrations during this hour ranged from 114 to 164 ppb.	No Data Available
		20:55				128	
		21:00			126	Max 5-minute concentrations during this hour ranged from 127 to 168 ppb.	
		22:00			123	Max 5-minute concentrations during this hour ranged from 101 to 156 ppb.	
	7/18/2000	23:00	64	76	Not > 75 ppb	Three 5-minute concentrations during this hour ranged from 119 to 126 ppb.	
	7/20/2000	0:00	61	70	Not > 75 ppb	Four 5-minute concentrations during this hour ranged from 114 to 167 ppb.	
	7/21/2000	11:00	104	79	None > 75 ppb	None > 100 ppb	
	7/22/2000	17:00	122	92	None > 75 ppb	None > 100 ppb	
	7/23/2000	14:00	101	86	None > 75 ppb	None > 100 ppb	
	7/25/2000	17:00	122	92	None > 75 ppb	None > 100 ppb	
	7/27/2000	12:00	119	96	Not > 75 ppb	None > 100 ppb during this hour	
		1:00			Not > 75 ppb	Two 5-minute concentrations during this hour were 118 and 119 ppb.	
		2:00			Not > 75 ppb	Four 5-minute concentrations during this hour ranged from 123 to 148 ppb.	
	7/31/2000	16:00	135	105	None > 75 ppb	None > 100 ppb	
	8/1/2000	16:00	182	121	None > 75 ppb	None > 100 ppb	
	8/2/2000	15:00	127	88	None > 75 ppb	None > 100 ppb	

Table 3 (page 4 of 8)

TABLE 3: 2000 MIXTURE ANALYSIS DATA

MONITOR	DATE	TIME	AQI for Ozone	MAX OZONE 1-HR AVG. CONC. DURING DAY (ppb)	SO2 1-HR AVG. CONC. (ppb)	SO2 5-Min AVG. CONC. (ppb)	PM2.5 24-HR AVG. CONC. (ug/m3)
OFW Road (SO2); MT (Ozone)	8/3/2000	17:00	109	89	None > 75 ppb	None > 100 ppb	No Data Available
	8/4/2000	0:00	93	84	Not > 75 ppb	Two 5-minute concentrations during this hour were 116 and 136 ppb.	
	8/5/2000	23:00	39	55	Not > 75 ppb	Three 5-minute concentrations during this hour ranged from 107 to 142 ppb.	
	8/6/2000	0:00	36	48		169	
		23:00			76	Max 5-minute concentrations during this hour ranged from 119 to 164 ppb.	
	8/8/2000	0:00	40	53	86	Max 5-minute concentrations during this hour ranged from 103 to 137 ppb.	
		1:00			101	Max 5-minute concentrations during this hour ranged from 105 to 128 ppb.	
		2:00			Not > 75 ppb	Two 5-minute concentrations during this hour were 100 and 118 ppb.	
		20:55				103	
	8/11/2000	18:00	151	104	None > 75 ppb	None > 100 ppb	
	8/12/2000	18:00	127	91	None > 75 ppb	None > 100 ppb	
	8/14/2000	15:00	145	99	None > 75 ppb	None > 100 ppb	
OFW Road (SO2); MT (Ozone)	8/18/2000	20:00	101	87	None > 75 ppb	None > 100 ppb	No Data Available
		21:55				104	
	8/20/2000	22:00	77	78	Not > 75 ppb	Three 5-minute concentrations during this hour ranged from 166 to 197 ppb.	
		23:00			184	Max 5-minute concentrations during this hour ranged from 151 to 217 ppb.	
	8/21/2000	0:00	67	74	147	Max 5-minute concentrations during this ranged from 116 to 175 ppb.	
		1:00			81	Max 5-minute concentrations during this hour ranged from 114 to 122 ppb.	
	8/22/2000	17:00	116	92	None > 75 ppb	None > 100 ppb	
	8/23/2000	18:00	101	82	None > 75 ppb	None > 100 ppb	

Table 3 (page 5 of 8)

TABLE 3: 2000 MIXTURE ANALYSIS DATA

MONITOR	DATE	TIME	AQI for Ozone	MAX OZONE 1-HR AVG. CONC. DURING DAY (ppb)	SO2 1-HR AVG. CONC. (ppb)	SO2 5-Min AVG. CONC. (ppb)	PM2.5 24-HR AVG. CONC. (ug/m3)
OFW Road (SO2); MT (Ozone)	8/26/2000	23:00	61	73	Not > 75 ppb	Two 5-minute concentrations during this hour ranged were 104 and 106 ppb.	No Data Available
	8/28/2000	0:55	58	70		119	
	8/29/2000	0:00	77	78	84	Max 5-minute concentrations during this hour ranged from 110 to 153 ppb.	
	9/1/2000	0:00			Not > 75 ppb	Two 5-minute concentrations during this hour were 134 and 159 ppb.	
		13:00	122	91	Not > 75 ppb	None > 100 ppb during this hour	
		23:55				104	
	9/2/2000	0:00			Not > 75 ppb	Four 5-minute concentrations during this hour ranged from 120 to 201 ppb.	
		14:00			Not > 75 ppb	Five 5-minute concentrations during this hour ranged from 101 to 155 ppb.	
		16:00	151	128	Not > 75 ppb	None > 100 ppb during this hour	
	9/3/2000	16:00	151	104	None > 75 ppb	None > 100 ppb	
	9/4/2000	15:00	172	116	None > 75 ppb	None > 100 ppb	
	9/5/2000	11:00	137	102	None > 75 ppb	None > 100 ppb	
	9/6/2000	14:00	106	85	None > 75 ppb	None > 100 ppb	
OFW Road (SO2); MT (Ozone)	9/7/2000	14:00	114	87	None > 75 ppb	None > 100 ppb	No Data Available
	9/11/2000	3:00	61	70	85	Max 5-minute concentrations during this hour ranged from 100 to 122 ppb.	
		4:00			Not > 75 ppb	106	
	9/15/2000	14:00	137	101	None > 75 ppb	None > 100 ppb	
	9/16/2000	15:00	124	92	None > 75 ppb	None > 100 ppb	
	9/17/2000	16:00	106	82	None > 75 ppb	None > 100 ppb	

Table 3 (page 6 of 8)

TABLE 3: 2000 MIXTURE ANALYSIS DATA

MONITOR	DATE	TIME	AQI for Ozone	MAX OZONE 1-HR AVG. CONC. DURING DAY (ppb)	SO2 1-HR AVG. CONC. (ppb)	SO2 5-Min AVG. CONC. (ppb)	PM2.5 24-HR AVG. CONC. (ug/m3)
OFW Road (SO2); MT (Ozone)	9/18/2000	9:25				108	No Data Available
		13:00	109	85	Not > 75 ppb	None > 100 ppb during this hour	
		23:55				223	
	9/19/2000	0:00			202	Max 5-minute concentrations during this hour ranged from 141 to 305 ppb.	
		13:00	140	98	Not > 75 ppb	None > 100 ppb during this hour	
		14:40				112	
		15:30				110	
		16:00			Not > 75 ppb	Two 5-minute concentrations during this hour were 104 and 111 ppb.	
		17:15				102	
		22:00			Not > 75 ppb	Three 5-minute concentrations during this hour ranged from 133 to 219 ppb.	
		23:00			198	Max 5-minute concentrations during this hour ranged from 147 to 253 ppb.	
	9/20/2000	0:00	41	53	184	Max 5-minute concentrations during this hour ranged from 107 to 241 ppb.	
		1:00			130	Max 5-minute concentrations during this hour ranged from 120 to 253 ppb.	
	9/23/2000	22:15	33	44		109	

Table 3 (page 7 of 8)

TABLE 3: 2000 MIXTURE ANALYSIS DATA

MONITOR	DATE	TIME	AQI for Ozone	MAX OZONE 1-HR AVG. CONC. DURING DAY (ppb)	SO2 1-HR AVG. CONC. (ppb)	SO2 5-Min AVG. CONC. (ppb)	PM2.5 24-HR AVG. CONC. (ug/m3)
OFW Road (SO2); MT (Ozone)	9/29/2000	12:00	111	84	None > 75 ppb	None > 100 ppb	No Data Available
	9/30/2000	17:00	119	93	None > 75 ppb	None > 100 ppb	
		20:00			122	Max 5-minute concentrations during this hour ranged from 108 to 197 ppb.	
		21:00			159	Max 5-minute concentrations during this hour ranged from 153 to 226 ppb.	
		22:00			Not > 75 ppb	Three 5-minute concentrations during this hour ranged from 130 to 134 ppb.	
	10/1/2000	2:00			82	Max 5-minute concentrations during this hour ranged from 115 to 142 ppb.	
		15:00	124	91	Not > 75 ppb	None > 100 ppb during this hour	
		17:55				116	
		18:00			Not > 75 ppb	Four 5-minute concentrations during this hour ranged from 102 to 131 ppb.	
		19:00			127	Max 5-minute concentrations during this hour ranged from 131 to 209 ppb.	
		20:00			132	Max 5-minute concentrations during this hour ranged from 126 to 234 ppb.	
	10/2/2000	1:00	61	71	80	Max 5-minute concentrations during this hour ranged from 112 to 130 ppb.	
		22:00			96	Max 5-minute concentrations during this hour ranged from 115 to 178 ppb.	
	10/3/2000	2:00	42	54	108	Max 5-minute concentrations during this hour ranged from 108 to 135 ppb.	
		3:00			124	Max 5-minute concentrations during this hour ranged from 108 to 150 ppb.	
		4:00			Not > 75 ppb	Two 5-minute concentrations during this hour were 105 and 116 ppb.	
		15:30				139	
		16:05				115	
Wyatt Road (PM2.5); MT (Ozone)	2000	NA	NA	NA	No Data Available	No Data Available	None > 35 ugm3

Table 3 (page 8 of 8)

TABLE 4: 2001 MIXTURE ANALYSIS DATA

MONITOR	DATE	TIME	AQI for Ozone	MAX OZONE 1-HR AVG. CONC. DURING DAY (ppb)	SO2 1-HR AVG. CONC. (ppb)	SO2 5-Min AVG. CONC. (ppb)	PM2.5 24-HR AVG. CONC. (ug/m3)
OFW Road (PM2.5 and SO2); MT (Ozone)	8/1/2001	1:00	40	53	83	Max 5-minute concentrations during this hour ranged from 112 to 233 ppb.	No Data Available
	8/5/2001	14:00	101	86	None > 75 ppb	None > 100 ppb	
	8/8/2001	21:00	36	54	76	Max 5-minute concentrations during this hour ranged from 102 to 120 ppb.	
		22:00			77	Max 5-minute concentrations during this hour ranged from 107 to 121 ppb.	
OFW Road (PM2.5 and SO2); MT (Ozone)	9/7/2001	21:00	30	38	91	Max 5-minute concentrations during this hour ranged from 105 to 160 ppb.	No Data Available
		22:00			85	Max 5-minute concentrations during this hour ranged from 106 to 121 ppb.	
	9/8/2001	20:00	30	41	Not > 75 ppb	Two 5-minute concentrations during this hour were 101 and 134 ppb.	
		21:00			77	Max 5-minute concentrations during this hour ranged from 122 to 135 ppb.	
	9/12/2001	17:00	104	97	None > 75 ppb	None > 100 ppb	
	9/13/2001	14:00	106	88	None > 75 ppb	None > 100 ppb	
Wyatt Road (PM2.5); MT (Ozone)	2001	NA	NA	NA	No Data Available	No Data Available	None > 35 ugm3

Table 4 (page 1 of 1)

TABLE 5: 2002 MIXTURE ANALYSIS DATA

MONITOR	DATE	TIME	AQI for Ozone	MAX OZONE 1-HR AVG. CONC. DURING DAY (ppb)	SO2 1-HR AVG. CONC. (ppb)	SO2 5-Min AVG. CONC. (ppb)	PM2.5 24-HR AVG. CONC. (ug/m3)
OFW Road (PM2.5 and SO2); MT (Ozone)	2002	NA	NA	NA	NA	NA	No Data Available
The first day of the year the Ozone AQI is greater than 100 is 3/13/2002 and the last day is 9/28/2002. There are no 1-hr average SO2 concentrations above 75 ppb or 5-minute average SO2 concentrations > 100 ppb until December.							
Wyatt Road (PM2.5); MT (Ozone)	7/2-7/7/2002		25 - 64	35 - 69	No Data Available	No Data Available	8 - 26
	7/8/2002	13:00	129	97	No Data Available	No Data Available	36
	7/9 - 7/14/2002		45 - 97	52 - 85	No Data Available	No Data Available	9 - 27
Wyatt Road (PM2.5); MT (Ozone)	9/7 - 9/12/2002		22 - 147	29 - 101	No Data Available	No Data Available	2 - 34
	9/13/2002	16:00	127	93	No Data Available	No Data Available	44
	9/14/2002	11:00	109	81	No Data Available	No Data Available	44
	9/15 - 9/20/2002		31 - 49	40 - 68	No Data Available	No Data Available	3 - 15

Table 5 (page 1 of 1)

TABLE 6: 2003 MIXTURE ANALYSIS DATA

MONITOR	DATE	TIME	AQI for Ozone	MAX OZONE 1-HR AVG. CONC. DURING DAY (ppb)	SO2 1-HR AVG. CONC. (ppb)	SO2 5-Min AVG. CONC. (ppb)	PM2.5 24-HR AVG. CONC. (ug/m3)
OFW Road (SO2); MT (Ozone)	5/28/2003	16:00	135	93	None > 75 ppb within 6 days of an Ozone AQI > 100	None > 100 ppb within 6 days of an Ozone AQI > 100	No Data Available
	5/29/2003	16:00	114	89			
	6/7/2003	14:00	109	88			
	6/9/2003	17:00	127	81			
	6/19/2003	14:00	104	85			
	7/23/2003	16:00	109	106			
	8/6/2003	15:00	135	116			
	8/7/2003	17:00	127	100			
	8/8/2003	16:00	101	91			
	8/11/2003	13:00	132	107			
	9/6/2003	16:00	100	92			
	9/9/2003	10:00	109	85			
	9/26/2003	16:00	106	81			
Wyatt Raod (PM2.5); MT (Ozone)	4/30 - 5/5/2003		31 - 40	42 - 50	No Data Available	No Data Available	10 - 33
	5/6/2003	15:00	40	55	No Data Available	No Data Available	37
	5/7/2003	18:00	45	61	No Data Available	No Data Available	27
	5/8/2003	14:00	47	62	No Data Available	No Data Available	46
	5/9/2003	14:00	47	59	No Data Available	No Data Available	39
	5/10/2003	16:00	47	60	No Data Available	No Data Available	52
	5/11 - 5/16/2003		42 - 64	37 - 71	No Data Available	No Data Available	5 - 24

Table 6 (page 1 of 1)

TABLE 7: 2004 MIXTURE ANALYSIS DATA

MONITOR	DATE	TIME	AQI for Ozone	MAX OZONE 1-HR AVG. CONC. DURING DAY (ppb)	SO2 1-HR AVG. CONC. (ppb)	SO2 5-Min AVG. CONC. (ppb)	PM2.5 24-HR AVG. CONC. (ug/m3)
OFW Road (PM2.5 and SO2); MT (Ozone)	4/8/2004	17:00	104	79	None > 75 ppb within 6 days of an Ozone AQI > 100	None > 100 ppb within 6 days of an Ozone AQI > 100	Data Not Available
	6/23/2004	18:00	104	94			
	7/19/2004	15:00	127	114			
	7/21/2004	15:00	129	92			
	8/5/2004	12:00	104	106			
	8/9/2004	16:00	156	117			
	8/10/2004	16:00	182	119			
	9/10/2004	13:00	106	82			
	9/16/2004	18:00	151	108			
	9/30/2004	15:00	101	79			
Wyatt Road (PM2.5 and SO2); MT (Ozone)	4/8/2004	17:00	104	79	None above 75 ppb within 6 days of an Ozone AQI > 100	None > 100 ppb within 6 days of an Ozone AQI > 100	None > 35 ug/m3
	6/23/2004	18:00	104	94			
	7/19/2004	15:00	127	114			
	7/21/2004	15:00	129	92			
	8/5/2004	12:00	104	106			
	8/9/2004	16:00	156	117			
	8/10/2004	16:00	182	119			
	9/10/2004	13:00	106	82			
	9/16/2004	18:00	151	108			
	9/30/2004	15:00	101	79			

Table 7 (page 1 of 1)

TABLE 8: 2005 MIXTURE ANALYSIS DATA

MONITOR	DATE	TIME	AQI for Ozone	OZONE 1-HR AVG. CONC. (ppb)	SO2 1-HR AVG. CONC. (ppb)	SO2 5-Min AVG. CONC. (ppb)	PM2.5 24-HR AVG. CONC. (ug/m3)
OFW Road (PM2.5 and SO2); MT (Ozone)	7/3/2005	23:00	36	52	105	Max 5-minute concentrations during this hour ranged from 112 to 134 ppb.	No Data Available
	7/4/2005	0:00	30	43	Not > 75 ppb	Two 5-minute concentrations during this hour were 101 and 119 ppb.	
	7/6/2005	16:00	147	111	None > 75 ppb	None > 100 ppb	
	7/11/2005	15:00	106	91	None > 75 ppb	None > 100 ppb	
OFW Road (PM2.5 and SO2); MT (Ozone)	7/30/2005	15:00	104	89	None > 75 ppb	None > 100 ppb	No Data Available
	8/2/2005	22:40	64	74		134	
OFW Road (PM2.5 and SO2); MT (Ozone)	9/8/2005	15:00	109	83	None > 75 ppb	None > 100 ppb	No Data Available
	9/9/2005	11:00	122	87	None > 75 ppb	None > 100 ppb	
	9/13/2005	21:00	32	43	Not > 75 ppb	Two 5-minute concentrations during this hour were 100 and 111 ppb.	
		22:00			77	Max 5-minute concentrations during this hour ranged from 106 to 132 ppb.	
	9/14/2005	23:30	34	46	Not > 75 ppb	103	
	9/15/2005	0:50	24	33	Not > 75 ppb	102	
		1:00			83	Max 5-minute concentrations occurred this hour were both 112 ppb.	
	9/18/2005	23:00	28	38	77	One 5-minute concentration during this hour was 101.	
OFW Road (PM2.5 and SO2); MT (Ozone)	9/25/2005	23:00	38	47	113	Max 5-minute concentrations during this hour ranged from 112 to 270 ppb.	No Data Available
	9/26/2005	0:00			Not > 75 ppb	Four 5-minute concentrations occurred during this hour ranged from 106 to 221 ppb.	
		13:00	100	93	Not > 75 ppb	None > 100 ppb during this hour	
	9/27/2005	16:00	114	96	None > 75 ppb	None > 100 ppb	

Table 8 (page 1 of 2)

TABLE 8: 2005 MIXTURE ANALYSIS DATA

MONITOR	DATE	TIME	AQI for Ozone	OZONE 1-HR AVG. CONC. (ppb)	SO2 1-HR AVG. CONC. (ppb)	SO2 5-Min AVG. CONC. (ppb)	PM2.5 24-HR AVG. CONC. (ug/m3)
Wyatt Road (PM2.5 and SO2); MT (Ozone)	6/20/2005	7:00			86	Max 5-minute concentrations during this hour ranged from 105 to 188 ppb.	None > 35 ug/m3
		8:00				Two 5-minute concentrations occurred during this hour were 102 and 127 ppb.	
		16:00	104	84	None > 75 ppb	None > 100 ppb during this hour	
		17:00		84	None > 75 ppb	None > 100 ppb during this hour	
	6/21/2005	13:00	114	86	None > 75 ppb	None > 100 ppb	
Wyatt Road (PM2.5 and SO2); MT (Ozone)	7/30/2005	15:00	104	89	None > 75 ppb	None > 100 ppb	None > 35 ug/m3
	8/2/2005	22:00	64	74	83	Max 5-minute concentrations ranged from 174 to 337 ppb.	
		23:00			180	Max 5-minute concentrations ranged from 103 to 568 ppb.	

Table 8 (page 2 of 2)

TABLE 9: 2006 MIXTURE ANALYSIS DATA

MONITOR	DATE	TIME	AQI for Ozone	MAX OZONE 1-HR AVG. CONC. DURING DAY (ppb)	SO2 1-HR AVG. CONC. (ppb)	SO2 5-Min AVG. CONC. (ppb)	PM2.5 24-HR AVG. CONC. (ug/m3)
OFW Road (PM2.5, SO2, and Ozone)	6/27/2006	15:00	124	89	None > 75 ppb	None > 100 ppb	None > 35 ug/m3
	6/29/2006	21:55	67	64		104	
		22:00			Not > 75 ppb	116	
	7/1/2006	0:00	43	55	Not > 75 ppb	Four 5-minute concentrations during this hour ranged from 110 to 134 ppb.	
	7/7/2006	14:00	101	89	None > 75 ppb	None > 100 ppb	
	7/13/2006	0:00	36	45	89	Max 5-minute concentrations during this hour ranged from 100 to 116 ppb.	

Table 9 (page 1of 1)

TABLE 10: 2007 MIXTURE ANALYSIS DATA

MONITOR	DATE	TIME	AQI for Ozone	OZONE 1-HR AVG. CONC. (ppb)	SO2 1-HR AVG. CONC. (ppb)	SO2 5-Min AVG. CONC. (ppb)	PM2.5 24-HR AVG. CONC. (ug/m3)
OFW Road (PM2.5, SO2, and Ozone)	4/28/2007	14:00	122	95	None > 75 ppb within 6 days of an Ozone AQI > 100	None > 100 ppb within 6 days of an Ozone AQI > 100	None > 35 ug/m3
	8/14/2007	14:00	142	103			
	8/15/2007	10:00	101	85			

Table 10 (page 1 of 1)

TABLE 11: 2008 MIXTURE ANALYSIS DATA

MONITOR	DATE	TIME	AQI for Ozone	MAX OZONE 1-HR AVG. CONC. DURING DAY (ppb)	MAX SO2 1-HR AVG. CONC. (ppb)	SO2 5-Min AVG. CONC. (ppb)	MAX PM2.5 24-HR AVG. CONC. (ug/m3)
OFW Road (48-139-0016)	4/26 - 5/1/2008	NA	25 - 47	41-64	0.27 - 38	< 100 ppb	6 - 34
	5/2/2008	17:00	64	71	0	< 100 ppb	41
	5/3/2008	15:00	45	58	0	< 100 ppb	36
	5/4 - 5/8/2008	NA	21 - 48	31 - 65	<<<75	< 100 ppb	13 - 20
	5/9/2008	14:00	77	77	0	< 100 ppb	38
	5/10 - 5/15/2008	NA	24 - 46	38 - 61	<<<75	< 100 ppb	8 - 28
	5/20/2008	16:00	80	79	0	< 100 ppb	37
	5/21 - 5/26/2008	NA	19 - 36	26 - 51	<<<75	< 100 ppb	10 - 29
OFW Road (48-139-0016)	6/14 - 6/19/2008	NA	29 - 46	40 - 61	<<<75	< 100 ppb	7 - 15
	6/20/2008	16:00	109	94	0	< 100 ppb	9
	6/21 - 6/26/2008	NA	28 - 93	36 - 84	<<<75	< 100 ppb	9 - 15

Table 11 (page 1 of 1)

Appendix E. ATSDR Response to Peer Reviewer Comments

Assessing the Public Health Implications of the Criteria (NAAQS) Air Pollutants and Hydrogen Sulfide as part of the Midlothian Area Air Quality Petition Response, Midlothian, Ellis County, Texas

PUBLIC HEALTH CONSULTATION

DECEMBER 2014

REVIEWER #1

GUIDE TO REVIEWERS:

The objective of peer review conducted by the Office of Science is to ensure the highest quality of science for NCEH/ATSDR studies and results of research; therefore, your comments should be provided with this goal in mind. Unlike other peer review processes in which you may have participated, the questions to be addressed for NCEH/ATSDR are broadly based so that each reviewer may have a wide latitude in providing his/her comments. Any remarks you wish to make that have not been specifically covered by the General Questions Section may be included under question # 2 in the Additional Questions Section. Please note that your unaltered comments will be sent to the investigator for a response. You should receive a copy of the response to the peer review comments when they are available.

GENERAL QUESTIONS:

1. Does the public health assessment adequately describe the nature and extent of contamination?

The Health Consultation (HC), in general, adequately describes the nature of contamination due to emissions of the selected air pollutants from the four major industries in the study area. However, the HC could be improved in several ways.

a) To show the extent of contamination, the HC includes several maps intended to illustrate areas that may experience SO2 and CO levels that approach or exceed guidelines. However, most of these maps are relegated to Appendix C. As presented, these maps are useful, but their value would be increased by (1) using regularly spaced isopleths (e.g., 50, 100, 150, 200, 250, etc. ppb for SO2) that would better show the distribution of concentrations; (2) identifying locations of homes, schools and other important receptors; (3) identifying locations of SO2 monitoring sites, facilitating a comparison between predicted and observed levels (see below); and (4) including these maps, or the most important ones, in the main part of the HC. Several maps are cited in the 2012 assessment on p. 14 without a specific figure. *Recommendation: The current HC would benefit from improved maps.*

ATSDR Response: For the SO_2 modeling, ATSDR uses four ranges of predicted 1-hour maximum values and associated isopleths on the figures presenting the modeling results. The most important isopleth from a public health perspective (i.e., predicted 1-hour SO_2 levels above the NAAQS standard of 75 ppb or 197 µg/m^3) is shown on the maps. ATSDR added the location of schools in relation to the predicted SO_2 levels on the maps shown in Appendix C—homes

were already shown on Google Earth which was used as the base map for these figures. The monitoring sites are not shown on the maps as there are no SO_2 monitors located near these facilities in the most frequent downwind direction from Ash Grove and Holcim (which was the reason ATSDR conducted the modeling). The closest monitor to Ash Grove and Holcim, with sufficient data to conduct a comparison analysis of the predicted vs. monitored SO_2 levels, is the Old Fort Worth Road (OFWR) monitor which is located about 2-2.5 miles southwest of Ash Grove/Holcim facilities (see Figure 7). This monitor is not ideal for this analysis as the number of SO_2 1-hour exceedances, when the wind is blowing from the Ash Grove/Holcim direction (shown as about 20-60 degrees in Figure 9) is small. However, ATSDR did attempt to use the data from this monitor to perform the analysis suggested by the reviewer. The findings from this analysis are described below in respond to the comment on model performance. ATSDR did not include any major figures or tables in the body of the health consultation; therefore, no figures have been moved.

b) The report depends heavily on monitoring data. Several comments apply.

c)

1) *The HC should more clearly discuss the limitations of monitoring data.* In particular, the spatial representativeness of monitoring data may be very limited, particularly for short-term peaks. The HC should discuss this issue, and present predictions from the dispersion modeling (using isopleths) that better show the spatial variability of concentrations expected over the study region and how well the monitoring sites represent areas and times of impact.

ATSDR Response: ATSDR did not perform modeling in relation to emissions from TXI except that it was included in the modeling conducted to determine worst-case CO levels (see Appendix A for details). The primary air pollutant of concern emitted from TXI in the past was SO2 where continuous 5-minute SO_2 data were available from the OFWR monitoring station and from the Wyatt Road monitor (only for years 2004-2006). When available, ATSDR prefers to use quality monitoring data to evaluate exposures and any possible public health implications of these exposures. This is what ATSDR did in this health consultation. As previously indicated, ATSDR did not have any SO_2 data from areas in the most frequent downwind direction from Ash Grove or Holcim in order to evaluate SO_2 exposures from these facilities--this is the reason ATSDR conducted SO_2 modeling. Therefore, except for the comparison of the predicted SO2 levels based on the Ash Grove/Holcim modeling to the less than ideal SO_2 data from the OFWR monitor (see responses above and below), ATSDR was not able to perform the type of analysis suggested by the reviewer.

2) "Upwind" and "downwind" designations make sense for specific time periods when winds are from a particular direction, but not necessarily for a discussion of long-term or peak short-term concentrations. This terminology is overly simplistic and not always appropriate in the HC. For example, short term peaks of SO2 and other pollutants will likely occur under specific meteorological conditions. (These should be identified as well.) Based on the modeling results provided, e.g., Figure C-5 showing SO2 concentrations for 2007, 1 hr peaks appear distributed in a radially symmetric manner around the source. In contrast, Figure C-7 showing 2008 results gives the more expected pattern with major "lobes" being in the NW direction from the source. Still, these patterns do not correspond to the wind roses, which show the preponderance of southerly winds, and to a smaller extent, northerly winds. Thus, not all short-term peaks will lie in the direction suggested

by the simple wind rose analysis, and thus characterizing the monitoring sites as "upwind" or "downwind" sites is simplistic and inaccurate. Rather, peaks occur from relatively rare events that are not well captured in the wind rose summary. This also applies to questions of schools or other sensitive receptors being characterized as upwind or downwind in the HC. In the comments (e.g., A.1.1), the terminology "primary" downwind direction is introduced, which also is not helpful. *Recommendation: Remove these upwind/downwind terms.* The HC can state that schools are upwind most of the time, but should not simply state that they are upwind. Ditto for monitoring sites, e.g., that are claimed to be in "residential neighborhoods immediately downwind" from emission sources, as stated on p. 26.

ATSDR Response: ATSDR acknowledges that upwind and downwind designations are somewhat general and usually vary depending on seasonal, daily, and other weather-related factors; therefore, these designations may not correlate well with modeled pollutant dispersion patterns. Furthermore, wind roses for the Midlothian area are compiled from a long-term (10+ years) dataset. Modeled sulfur dioxide (SO_2) concentrations also can vary depending on meteorological conditions. In addition, modeled concentrations for a specific year may be modeled with a short term dataset that represents those conditions for a specific year or a few years and may deviate from, or be masked from, the patterns represented in a long-term wind rose.

The difference in wind roses and modeled SO_2 concentrations can also vary depending on when the emissions occurred, the rate of emissions, and the model conditions under which the predicted emissions occurred. ATSDR acknowledges that the dispersion modeling process uses a series of inputs such as weather data, averaged pollutant concentrations, height of stack, number of stacks, emission rates, and other factors, and predicts the pollutant concentrations at a location (or series of locations) on a 2-dimensional grid. There are also a number of assumptions that are incorporated into the model that may deviate somewhat from actual conditions. However, dispersion models are useful tools to develop predictive dispersion patterns of pollutants under specific conditions and are used when actual data may not be available or to compare to monitoring data.

Despite the fact that a wind rose may not always resemble the distribution observed for modeled concentrations, the wind rose and most frequent directions of wind flow do provide useful data. The outputs of air dispersion models are generally not assessed for frequency; instead, the maximum or some other value close to the maximum is generally examined. Although the peak concentrations may be similar in the most frequently upwind direction as the most frequently downwind direction, the highest concentrations in the most frequently downwind direction are expected to occur more frequently than the highest concentrations in the most frequently upwind direction.

Characterizing monitoring sites as purely upwind or downwind is a general statement based on the prevalence of the wind data. Therefore, references to "primary" downwind will be replaced with the term "most frequently."

3) Figures 3 to 8 are helpful in showing locations of the monitoring sites. However, they do not show the location of the point sources responsible for the bulk of SO2, NOx and CO. *Recommendation: Identify stack locations on these maps.*

ATSDR Response: The boundaries for the point sources of these air pollutants are shown on the Figures 3-8 (i.e., Ash Grove, Gerdau Ameristeel, Holcim, and TXI). The primary stack coordinates or stack locations for these facilities, used by ATSDR to model CO or SO2, are shown in Appendices A and C.

4) A portion of the HC is based on the analysis of SO2 levels with respect to the NAAQS. This analysis does not improve the public health relevance of the HC, which is not used to determine NAAQS attainment. Moreover, the NAAQS are formulated to balance several factors, including the ability to obtain reasonably reliable and representative compliance determinations (thus using 3-year averages of 99th percentile values). *Recommendation: The HC might simply state the TCEQ's determination of NAAQS compliance, and then utilize the most health relevant benchmarks.*

ATSDR Response: ATSDR used the NAAQS value for SO2 only in the screening portion of the analysis to determine if SO2 should be further evaluated. Given that the 1-hour NAAQS standard is designed to protect against potentially harmful shorter-term SO2 peaks (in the range of 5-10 minutes) that were evaluated in clinical studies, ATSDR determined that this value was appropriate to use in the screening process. ATSDR did not use the comparison of monitored SO2 values vs. the NAAQS standard to determine if harmful effects were possible; instead, ATSDR evaluated the available 5-minute SO2 data to make this determination.

5) The HC states in many places (e.g., Conclusion 2) that monitoring stations have been placed in high impact areas. *Recommendation: Discuss whether these locations are indicated by air quality modeling, and also discuss the need for other locations that might be appropriate.*

ATSDR Response: Conclusion 2 is related to particulate matter exposures and the statement referenced by the reviewer is only in relation to this air pollutant and PM exposures in the most frequent downwind direction from Gerdau Ameristeel and TXI. In this same conclusions, ATSDR points out the issues related to the PM2.5 data from Holcim and the fact that PM2.5 data are more limited in localized areas in immediate proximity to the cement manufacturing facilities' limestone quarries. ATSDR also makes recommendations in relation to both of these data gaps.

c) ATSDR is to be commended on its use of dispersion modeling to complement the monitoring data. The model selection is appropriate. However, several concerns exist with respect to the modeling employed.

1) The presence of local quarries, large buildings and other features may affect dispersion and at least the sensitivity to surface roughness should be verified. (The modeling used roughness appropriate for rural/suburban areas.) In addition, further detail regarding the proximity and height of nearby structures would be useful in verifying whether downwash is possible. Was stack tip downwash considered? While ATSDR's approach of modeling facility emissions (from multiple stacks) as a single stack is likely to be conservative, it is

unclear why this was done (only some minor computational efficiency would be achieved.) ATSDR could run a test case to demonstrate whether this approach was realistic.

ATSDR Response: Given the site conditions, ATSDR determined that the medium surface roughness was the most appropriate selection to make. The receptors are fairly well buffered from the facilities. TCEQ had differing surface roughness characteristics for the meteorology set – ranging from low to high – ATSDR ran all data sets and it did not make an appreciable difference in the modeling results.

2) The modeling appears to have used the annual average emission rate. This is acceptable for estimating annual average concentrations, but not short-term peaks. Emission rates vary, and in fact will be on higher on average than the average spread over 8760 hours per year due to facility downtime. In addition, rates fluctuate due to process and upset conditions. More appropriate approaches to estimate peak 1 hr concentrations would be to use: (i) actual hourly data (preferred, as CEM data are available); (ii) the maximum hourly permitted emission rate; (iii) the actual maximum hourly emission rate based on the CEM source data, or (iv) a conservative estimate based on likely variation and the operating schedule. The difficulty in revising modeling runs is recognized. Thus, *at a minimum, the HC should discuss these issues*. (The argument that the modeling is conservative and accounts for these errors should be considered largely irrelevant since this is not always true and inappropriately mixes different sources of uncertainty and variability. The HC's discussion that "short-term fluctuations in emissions and resulting concentration changes are not captured in the modeling analysis" is true, but the *HC should indicate that this might underestimate predictions*.

ATSDR Response: In general, ATSDR concurs with this comment. However, in relation to the CO modeling, ATSDR believes that we used worst-case assumptions (assuming the highest level CO emissions from each of the four facilities occurred all during the same year—see Section 3.1 and Appendix A) to predict CO 1-hour and 8-hour concentrations. Even with these worst-case assumptions, the predicted maximum values were between 15-30 times lower than the EPA 8-hour or 1-hour NAAQS CO standard, respectively.

However, after further analysis of the modeling performed to evaluate possible SO_2 exposures from Ash Grove/Holcim, ATSDR determined that these results are too uncertain to base a health conclusion. In contrast to the CO modeling, which resulted in predicted maximum values well below the NAAQS standard (using worst-case assumptions), the SO_2 predicted modeled values, for the years 2006-2010, indicated that levels approaching or exceeding the NAAQS standard may have occurred near the Ash Grove fence line or, in some cases, outside the fence line (although no residences, playgrounds or schools are located within this area). ATSDR attempted to obtain 1-hour CEMS data in order to conduct the modeling suggested as the preferred approach by the reviewer. ATSDR was not able to obtain these data for Ash Grove (which is the primary emitter of SO_2 compared to Holcim for the years the modeling was performed). Therefore, ATSDR will not be able to make any firm health conclusions based on the SO_2 modeling results for past exposures to SO_2 emitted by Ash Grove and Holcim.

3) Possibly the biggest deficiency in the modeling is the absence of any evaluation of the model performance. While the spatial coverage of the SO2 monitoring sites is limited, the

utility of data provided by the model would be enhanced if we knew that the model matched the distribution of observations at the local monitoring sites. This would also valuable for addressing comments made in the comment above. An appropriate model evaluation effort would include both measures of peak concentrations as well as lower percentile levels. Unfortunately, monitoring data likely to capture impacts from Holcim and Ash Grove are unavailable, still, it would be useful for TXI and Gerdau/Chaparral Steel.

ATSDR Response: As indicated above, ATSDR used the quality SO_2 data available from OFWR monitor in Cement Valley to evaluate SO_2 exposures to persons residing in this area and we did not rely on modeling for our evaluation. In response to this comment, ATSDR did compare hourly SO_2 measurements from the OFWR monitor with the results from the ATSDR's SO_2 model runs for 2006-2010 for Ash Grove and Holcim. As indicated above, this analysis was not ideal as this monitor was not located in the most frequent downwind direction from the two facilities. The analysis showed that when the data are aggregated over the five years of the modeling (2006-2010), the model was in general agreement with the observed data. However, on a per hour basis, our evaluation indicated the model-measurements did not agree well (most hourly predications were off by more than a factor of two). As indicated above, ATSDR attempted to obtain the hourly SO_2 emission rates for this period to address the commenter's remarks about using hourly emission rates; however, we were not successful. Our evaluation of the model performance was similar to Zhu et. al (2010) who found that the SO_2 modeling results (using the 2002 National Exposure Inventory emissions) were lower than the monitoring data from the OFWR monitor on an hourly basis; however, the model performance improved with increasing averaging time. The Zhu et al. (2010) article can be found at:

http://www.utb.edu/vpaa/csmt/chemenv/Documents/pubs/18ZOU_WILSON_2010_AERMOD.pdf

Based on this analysis and other comments from the peer reviewers, ATSDR will not make any definitive conclusion regarding whether harmful effects were possible from past exposures to SO_2 emission from Ash Grove as it was the primary emitted or SO_2 compared to Holcim.

4) While emission data for local facilities prior to 1990 are unavailable from State of Texas sources (p. 36), the HC does not consider or attempt to use emission factors (e.g., AP-42), activity data, or other approaches to estimate emissions, nor does it discuss the likelihood that emissions and concentrations might have been higher in earlier year, and possibly much higher.

The potential for considerably higher emissions in earlier years is real and relevant. EPA's analysis of national trends (based on 47 sites) shows that that the 99th percentile of the daily 1 hr maximum SO2 concentration was 32% higher in 1980 compared to 1990, and that the 90th percentile (of reporting stations) was 50% higher. (Analysis of data from http://www.epa.gov/airtrends/sulfur.html) Of course, site-specific data is needed for the Midlothian HC, and national trends may not apply to Midlothian. However, data regarding fuel quality, emission controls, and kiln activity/production may or should be available and should be in the permit record to allow relevant local estimates of SO2 emissions, concentrations and exposures, or at least bound the possible levels. *The HC should attempt* *to estimate emissions, discuss these or other trends, or indicate that this is beyond the scope or resources.*

ATSDR Response: ATSDR acknowledges that SO2 emission rates may have been higher in the 1980s, but site-specific data are not available and it would not be appropriate to estimate facility-specific emission rates using AP-42 without considerable research on facility-specific production rates, equipment specifications, and effectiveness of pollution control devices. ATSDR concurs with the reviewer that using AP-42 emission factors would likely provide higher emissions estimates, the approach is beyond the scope and resources for this HC and might not present information appropriate to the specific facility, equipment, and operation levels during the period of interest.

5) Does ATSDR believe that SO2 "hotspots" can be identified by dispersion modeling? This could be useful to prioritize monitoring and surveillance needs, and to estimate the numbers of individuals potentially exposed. The use of isopleths on the modeling outputs could also serve this purpose.

ATSDR Response: In general, assuming emissions are fairly constant and the inputs to the model are reasonable, then ATSDR believes that alongside monitoring data, that modeling can be used to help identify potential exposure "hotspots". Specifically in relation to SO2 monitoring conducted by ATSDR for the Ash Grove and Holcim facilities, ATSDR is uncertain if anyone has been exposed to harmful levels given the limitations of using annual average emissions data in the model (see response to other comment above) and given that no monitoring data are available for areas in the most frequent downwind directions from these facilities (especially Ash Grove).

2. Does the public health assessment adequately describe the existence of potential pathways of human exposure?

With the exception of lead, the relevant exposure pathway is inhalation, and the HC provides an adequate description in this regard. There are several comments, however, that apply to the pathway question.

a) The HC appears largely dismissive of the potential for indoor exposures. ATSDR is correct that the sheltering provided by the limited air exchange ranges in buildings will reduce peak indoor concentrations. However, individuals opening windows may experience SO2 exposure, particularly in the evening when they are home and when higher SO2 concentrations are more likely.

ATSDR Response: The information presented in the text box at the beginning of the Public Health Implications section for Sulfur Dioxide (section 4.1) is not inconsistent with what the reviewer presents in the comment.

b) The box on p. 42 should provide a citation for the statement that indoor and personal exposures are generally much lower than ambient measurements.

ATSDR Response: The reference provided at the end of the last paragraph in the text box addresses the question of sulfur dioxide (SO2) and its relative concentrations in indoor air relative to ambient outdoor air. Specifically, Section 2.6.3.1 of that reference (EPA, 2008c)

shows evidence that indoor air concentrations are generally lower than ambient air concentration.

This reference also discusses the relationship between personal exposure concentrations and ambient concentration. Specifically, Section 2.6.3.2 shows evidence that personal exposure concentrations are generally lower than ambient concentration.

Based on its review of the HC content and the review comment, ATSDR finds that the included citation is appropriate.

c) Midlothian residents have been known to keep windows closed to mitigate odors and symptoms they associate with industrial air pollutants. *ATSDR should address the potential for behavioral changes and the associated potential health impact.* This encompasses the physiological issues related to not exercising (due to air pollution alerts or perceptions of pollution), and the psychological impacts related to stress.

ATSDR Response: Although some residents may keep their windows closed to mitigate odors or symptoms or alter their habits in relation to exercising, ATSDR has no knowledge that this is a widespread practice. ATSDR has recognized that certain environmental odors can result in stress and other effects. ATSDR has launched a website that addresses some of these issues and a link to the site has been added to Community Concerns section in relation to comment six (6) on odors.

d) In 2.4 Demographics on p.14, the HC should not state that "All four main industrial facilities in Midlothian own large tracts of land which helps ensure that no one lives in immediate proximity to the facilities' main industrial operations, where air quality impacts from some emission sources would be greatest." The three objectionable issues are that: i) Immediate proximity is undefined; ii) impacts from elevated sources may not occur immediately proximate to the source; and iii) this suggests a management strategy that is outside the scope of the report or public health action plan. *This material should be deleted or revised.* If the use of expanded buffers is seen as an appropriate response, then this can be included in the public health action plan.

ATSDR Response: ATSDR agrees with the reviewer's comments that this information does not add anything to the overall understanding of exposures to the Midlothian community so it will be deleted.

e) In 2.4 Demographics on p. 14, in response to comments, ATSDR has removed traveling on US-67 from consideration as a "nearest area with potential for elevated short-term exposure". Exposure on roads, both for occupants of vehicles, as well as pedestrians, cyclists, and others is possible, and this area has public access. *Recommendation: state that exposure to those on US-67 would not normally be considered a concern due to the short time expected in this zone. (underlined text suggested)*

ATSDR Response: ATSDR agrees with this comment and has revised the sentence as suggested by the reviewer.

3. Are all relevant environmental, toxicological, and radiological data (i.e., hazard identification, exposure assessment) being appropriately used?

In general, the Health Consultation (HC) uses appropriate data. A few omissions and points are noted.

a) Most of the conclusions related to O3 utilize the current NAAQS of 75 ppb. The HC should refer and address the current (dated 12-17-14) proposed rule by US EPA to lower the O3 NAAQS to 65 to 70 ppb. EPA has noted the hundreds or thousands of studies suggesting O3-related health effects in the range of 60 to 70 ppb. While the HC correctly states that the industrial facilities in Midlothian are not the principal contributors to O3 pollution, which is a regional problem, the presence of elevated levels of O3 will affect the analyses related to mixture exposures stated in Conclusion 4 and elsewhere. *Recommendation: determine historical frequency of O3 levels above 60, 65 and 70 ppb, and revise conclusions related to mixture exposures.*

ATSDR Response: ATSDR agrees with the comments; however, additional mixtures analyses were not performed. ATSDR did add in a statement indicating that the number of concurrent opportunities for co-exposures to other air pollutants, namely SO2, could have been higher if compared to the frequency of 8-hour ozone levels given that the U.S. EPA has changed the ozone standard to 70 ppb.

b) Ozone exceedances in the study area have historically occurred from April to October. (http://www.tceq.state.tx.us/cgi-bin/compliance/monops/8hr_4highest.pl, also as acknowledged on p. 27). These are not always the warmer months of the year as stated on p. xi, 51, and 65 (i.e., peaks occur on roughly half of the year). Also, please note that until recently, O3 monitoring has been limited to 6-months of the year in most areas, and this limitation appears to apply to the Texas dataset. *Recommendation: Remove language referring to "warmer months" and investigate/acknowledge limitations of the O3 data*. Also, the HC should note that high SO2 levels can fall into the high O3 period.

ATSDR Response: The U.S. Environmental Protection Agency's (EPA's) nation-wide implementation of the ozone (O3) monitoring program initially focused on the historically warmer months of the year from April–October and May–September. The historical O3 monitoring period for Texas was April-October. However, available O3 data, coupled with seasonal climate shift and complex atmospheric chemistry demonstrated that year-round O3 monitoring was warranted. Therefore, EPA revised the O3 monitoring program in 2011 to monitor all months (January–December).

For 2011-2014, ATSDR reviewed Texas Commission on Environmental Quality (TCEQ) data for the Midlothian Old Fort Worth Tower location to identify the number of days and months where the 8-hour average high for ozone readings, equaled 76 parts per billion or greater. The following table summarizes the results.

Year	Number of Days with 0_3 Exceedances*	Months of Exceedances
2011	**7 days**	**August and September**
2012	**6 days**	**May, June, and August**
2013	**3 days**	**August and September**
2014	**0 days**	**Not applicable**
2015	**0 days**	**Not applicable (note: data through April 9)**

***An exceedance is defined as a day where the 8-hour average high for 0_3 was 76 ppb or greater.**

It appears that exceedances at this location did not occur in winter months during 2011-2014. Therefore, for this period, ATSDR finds that O3 data supports the conclusion that the majority of O3 exceedances are during warmer months; this finding is consistent with the ultraviolet (UV)-driven reaction that forms O3. However, ATSDR acknowledges that certain atmospheric conditions such as stagnant air masses and low level inversions combined with high concentrations of O3 precursor pollutants [for example, high nitrous oxide (NOX) and/or volatile organic compounds (VOC)] can lead to elevated concentrations of surface level O3.

SO2 has been monitored continuously at the TCEQ Old Fort Worth Road site from 1997-2014 and the historical data supports the conclusion that although elevated SO2 concentrations have occasionally been recorded concurrent with time periods with elevated O3 concentrations, and this can sometimes occur outside the warmer months, concurrent elevated concentrations do occur most commonly in the warmer months. The text will not be revised.

c) The period used for data collection and analysis is up to 4+ years old. For example, p. 8, 10 and 12 state that ATSDRs ran queries for health complaints up to 2010. Emission and ambient monitoring data goes to 2010, 2011 or 2012 (e.g., Table 4). *Recommendation: update through 2014.*

ATSDR Response: ATSDR has reviewed and included updated data, as available through 2015. ATSDR notes that updated data are not available for all parameters; footnotes with these tables provide updated data sources, where appropriate. The following updated tables are included with this response to comments:

- **Table 1. Estimated Annual Carbon Monoxide Emissions from Midlothian Facilities**
- **Table 2. Estimated Annual Lead Emissions from Midlothian Facilities**
- **Table 3. Summary of Ambient Air Monitoring Data for Lead, 1981-2015**
- **Table 4. Estimated Annual Nitrogen Oxides Emissions from Midlothian Facilities**
- **Table 5. Summary of Ambient Air Monitoring Data for Nitrogen Dioxide, 2000–2014**
- **Table 6. Estimated Annual PM10 Emissions from Midlothian Facilities**
- **Table 7. Summary of Ambient Air Monitoring Data for PM10, 1991-2004**
- **Table 8. Annual Average PM10 Concentrations at Selected Monitoring Stations**
- **Table 9. Estimated Annual PM2.5 Emissions from Midlothian Facilities**

- **Table 11. Estimated Annual Sulfur Dioxide Emissions from Midlothian Facilities**
- **Table 12. Annual Average Sulfur Dioxide Concentrations, 1997-2014**
- **Table 13. Additional Trends in 1-Hour Average Sulfur Dioxide Monitoring Data**
- **Table 14. Summary of Ambient Air Monitoring Data for Hydrogen Sulfide, 2000-2014**

d) Did or does the TXI facility monitor opacity? (p. 12) If so, then the relationship between opacity and PM emissions should be discussed.

ATSDR Response: It is likely that TXI measures opacity as part of their normal metrics used to evaluate their emissions. ATSDR does not believe that an evaluation of opacity and PM emissions will provide any useful information to help better understand the public health implications of PM exposures to the Midlothian community.

e) As noted in the HC, the clinical studies used to establish concentration-response relationships did not include individuals with severe and persistent asthma (e.g., p. 43). These individuals would be at increased risk and who might represent the most sensitive group. This somewhat offsets the caveats on p.44 where it is implied that only 25-35% of individuals with asthma would show effects. *Recommendation: Discuss that low exposures might cause health effects in certain susceptible individuals, the classification of asthma, and the expected incidence of moderate, severe and persistent asthma.*

ATSDR Response: ATSDR reviewed the language in the body of the health consultation regarding the issues contained in this comment and determined the Public Health Implications (Section 4.1) adequately addresses this issue. However, this point is not mentioned in the conclusions as an additional caveat to the issue of exposure to sensitive person; therefore, language from the Public Health Implications section was added to the Summary and Conclusions.

4. Does the public health assessment accurately and clearly communicate the health threat posed by the site?

The Health Consultation (HC) provides an adequate description of the nature of health effects that are possible due to emissions of air pollutants from the four major industries in the study area. However, risk communication could be improved.

a) The HC might benefit from a summary of the health impact assessment techniques available and then a description to justify the approach(es) selected. This information would be useful in understanding, for example, why a quantitative risk assessment, epidemiological approach, or health impact analysis was not used to evaluate the public health impacts of exposure to contaminants from the industrial facilities in Midlothian. This would also be an opportunity to discuss the pros and cons of the available and applicable methods. *Recommendation: Discuss these items.*

ATSDR Response: The approach used in the health consultation follows ATSDR's guidance for evaluating community exposures as detailed in the 2005 ATSDR Public Health Assessment Guidance Manual (ATSDR, 2005). ATSDR has discussed with the community the various types of evaluations we can conduct and determined jointly a Public Health Response Plan (PHRP).

This health consultation is not an evaluation of health outcome data; however, as part of the PHRP, ATSDR has reviewed health outcome data for the Midlothian area and released the findings for public comment in August 2015. This document and others can be found at:

http://www.atsdr.cdc.gov/sites/midlothian/health_consultations.html)

b) The HC's major deficiency regarding the nature of health threat posed by local industry is the lack of information regarding the existing and historical health status of the Midlothian population. The HC does not present or discuss health surveillance data for asthma symptom incidence, hospitalizations, medication use, disease incidence, lead concentrations in blood (although this will be examined in some future HC according to p. 50), other diseases, or quality of life measures. Available (statewide) data show, for example, that 7.8% of children and 6.8% of adults in Texas have asthma.

It is well known that rates of many diseases can vary substantially by location, age, race, gender and income, and that susceptibility to pollutants depends on many factors. For example, the EPA O3 Integrated Science Assessment (2013) summarizes that for O3: "The populations and lifestages identified in this section that have "adequate" evidence for increased O3-related health effects are individuals with certain genotypes, individuals with asthma, younger and older age groups, individuals with reduced intake of certain nutrients, and outdoor workers." Table 8-6 in the ISA identify other features of susceptible subgroups that have less evidence. The 2008 ISA for SO2 provided a less thorough examination of susceptibility, but summarized that: "subgroups considered to be potentially susceptible and/or vulnerable include children and older adults; people with other respiratory disease; genetic factors; SES; and populations experiencing heightened exposure levels (e.g., those living near roadways or other "hot spots" or engaged in outdoor work or exercise). Also of concern are individuals who generally may not be inherently susceptible to SO2-related health effects but may experience transient increases in airways sensitivity to SOX induced by other respiratory irritants such as recent viral respiratory infection (Stempel and Boucher, 1981). These groups comprise a large fraction of the U.S. population. Given the heterogeneity of individual responses to air pollution, the severity of health effects experienced by a susceptible subgroup may be much greater than that experienced by the population at large (Zanobetti et al., 2000)." These comments should be updated in the HC.

In response to comment A.1.28, ATSDR states they are evaluating health outcome data to see if disease rates are elevated in the community. In a presentation dated 1/21/2010, ATSDR provides a list of community concerns in the August 2005 petition, which include birth defects, cancer, respiratory issues, autoimmune disease, and odors. ATSDR does utilize TCEQ complaint data, but population-based data are lacking. While the HC acknowledges that several of these concerns may be unrelated to the pollutants examined in this HC, respiratory and potentially other diseases and symptoms may be relevant. *The HC should discuss the appropriateness and value of surveillance and epidemiological analyses, present an analysis of the numbers of susceptible individuals, and determine whether rates of diseases plausibly linked to industrial emissions are elevated in the community. The limitations of such analyses should be discussed.*

ATSDR Response: The recommended actions by the reviewer are not within the scope of this health consultation. As indicated above, ATSDR has evaluated health outcome data for the Midlothian community and released the finding for public comment in August 2015 (see link above).

c) While the HC very appropriately discusses exposure to pollutant mixtures and sensitive groups, and also commendably consider lags and low SO2 exposures, the conclusions and discussion related to mixtures could be improved.

1) In response to a comment (B.8.3), the HC increased the emphasis of the statement "ATSDR believes that the severity of health effects from a mixture exposure is not likely to exceed those discussed for SO2, PM2.5, or O3 exposure alone." (Stated in Summary, p. 52, and possibly elsewhere. The response to comment B.8.1 was more appropriate, that current knowledge is very limited on the effects of mixtures or co-exposures, and indicating one-way or another is unwarranted. *Recommendation: Delete the former sentence.*

ATSDR Response: This analysis and conclusion is based on work conducted by one of ATSDR toxicologists for the Mirant Potomac River Generating Stations which had a similar mixture of air pollutants and underwent public comment and peer review. This document can be found at:

http://www.atsdr.cdc.gov/HAC/pha/MirantPotomacRiver/MirantPotomacRiverGSFinalHC03212011.pdf

The same author for the Mirant Potomac River Generating Station Health Consultation also reviewed the finding of this health consultation. No changes have been made to the document.

2) The analysis is based, in large part, on the joint likelihood of SO2, PM and SO2 being above specified levels. First, as noted, the O3 level of concern should be lowered. Second, the HC should discuss the limitations of air quality monitoring data, in particular, the analysis does not indicate how likely it would be that the few monitors present for SO2 and PM would or would have detected peaks, and the issue that a large portion of the study area does not have monitoring data. (This analysis could be conducted using the dispersion model -- instead, only monitoring data was used. The HC expresses the limitations of monitoring, stating it is preferred to modeling in most cases; A.1.26 comment). The HC could help address these gaps by using modeling results. *Recommendation: Revise analysis.*

ATSDR Response: In response to a previous comment, ATSDR will add in a statement in the mixtures analysis about the current science that supports EPA's lowering the ozone level to 70 ppb. The primary mixtures analysis in this health consultation used data from monitors located in Cement Valley (north of TXI) where the most abundant SO2 and PM2.5 data were available. For some years and locations, ATSDR believes that these monitors could have captured these peaks given that they operated on a continuous basis. However, the reviewer is correct that this analysis does breakdown for other years in this area and does not include any potential mixtures exposures related to Ash Grove or Holcim because of the lack of monitoring data—this language will be added to the Mixtures section (4.5) of the health consultation. ATSDR did attempt to perform modeling to evaluate potential SO2 exposures from Ash Grove and Holcim; however, the modeling results were limited because ATSDR did not have hourly emissions data from Ash Grove. Therefore, ATSDR cannot

use the SO2 modeling to evaluate the mixtures further in relation to potential exposures to Ash Grove and Holcim air pollutants.

3) The HC suggests a low likelihood of mixture exposures above levels of concern. p. 34 reports that the highest 1 hr SO2 concentrations tended to be in the evening; and April, May, and October have the highest frequencies. The HC might note that there is some overlap between the highest O3 and SO2 levels (found from April to October), that people would tend to be at home in the evening, that windows might be open at this time, and that the potential of mixture exposures can occur at other times.

ATSDR Response: ATSDR agrees with the comment and it will be added to Section 4.5 (Mixtures).

4) In the box on p. 51 and on the bottom of p. 52 (and perhaps elsewhere), the HC states (referencing mixtures): "These conclusions are based on our best professional judgment and ATSDR recognizes the uncertainty associated with them." *Recommendation: Delete this unnecessary sentence.*

ATSDR Response: ATSDR believes that this is a necessary statement in relation to our mixtures evaluation—see response to comment above. No changes were made.

d) ATSDR should improve the presentation regarding the communication of risks and the limitations of the analysis. Please see the comments below

1) When discussing past, current and future risks, ATSDR attempts to provide balance and nuance, recognizing the limitations of the data, analysis, and statistical factors. Unfortunately, phrases like “may have”, “could have”, “might have”, and “is not expected to”, are ambiguous, easily misinterpreted, and are not clear and succinct (e.g., see comments A.1.29, A.3.1).

ATSDR Response: These are commonly used phrases in ATSDR’s assessments to help caveat the limitations and uncertainty in our documents—no changes were made.

2) Conclusions are written in a confusing manner. For example, starting with the first conclusion, the bolded text states first that there was potential for harm. The text then limits this conclusion to specific locations, specific time periods, and then specific (some sensitive) individuals. Lastly, this paragraph concludes that effects would be “less” serious. Less is comparative, but there is no reference.

ATSDR Response: ATSDR attempted to provide the public with the “headline” conclusion in bold and then further explain the conclusion and the basis for it in our normal message mapping format. The difficulty here in is trying to convey the nuance of a health message that is related to time, space and by other specifics. The phrase “less serious effects” comes from ATSDR’s Toxicological Profile for Sulfur Dioxide (ATSDR, 1997). This term and the range of SO2 exposures associated with this phrase are shown

in Appendix B, Table B-1. ATSDR has added in reference to the 1997 ATSDR Toxicological Profile within Section 4.1 for Sulfur Dioxide.

3) As stated above for SO2 (but also applicable to Pb and O3), the presentation would be clarified by simply stating the TCEQ's determination of NAAQS compliance, and then utilizing the most health comparison levels (thus removing language that refers to NAAQS attainment status for both older (superseded) and current standards throughout the HC. If there is a NAAQS compliance issue, then this can go into the public health action plan. This would more clearly separate the science and health assessment from policy/mitigation considerations. In fact, the HC defines ATSDR's role as a public health agency (and not as a regulatory agency) in the call-out box on p. 1. However, the HC states in numerous places considerable descriptions or caveats on the analysis related to NAAQS compliance determinations.

ATSDR Response: ATSDR attempted to address several public comments, where necessary, in relation to this peer reviewer comment. ATSDR provided caveats in the revised health consultation on how we used the NAAQS standard as a health comparison value and noting that the previous NAAQS standard, in place at the time of the past potentially harmful exposures to SO2 occurred, was not exceeded and that the Midlothian area was in compliance for this air pollutant. ATSDR believes that we based our health conclusions on the best science which the current NAAQS standard is based. As previously stated above, we used the NAAQS standard as a health comparison value only in the initial screening process—the final health determination was based on and evaluation of the 5-minute SO2 data and the levels found in clinical studies of exercising asthmatics.

4) The use of bold and italicized fonts in the Summary and elsewhere is distracting and unnecessary. This formatting is not in line with the previous Midlothian HC (2012).

ATSDR Response: The authors of the report believe the bolding helps to emphasize the primary, overall, conclusions for a particular air pollutant, timeframe, and location. ATSDR health assessors have the discretion to craft health messages, within the message mapping format, as they deem appropriate so comparison to another health consultation may not be appropriate. Moreover, the 2012 draft document (finalized in 2015) referred to in the comment was not a typical health consultation in that did not make health determinations as this document does. The 2012 ATSDR was evaluating the adequacy of the air pollutant database in Midlothian to determine what data and information are available for ATSDR to make health determinations as we did in this health consultation.

5) The HCV terminology is confusing (and jardon-laden). Table 15 provides three sets of HCVs (from EPA, WHO and ATSDR). Reference to the NAAQS HCV basically just means the NAAQS. It would be simpler, more consistent, and more scientific for ATSDR to select a single HCV or level of concern for selected health endpoints. Alternatively, the HC should indicate the rationale and the definition of the HCV, and why multiple HVCs are necessary.

ATSDR Response: In an effort to be transparent, ATSDR provided the public with all health comparison values considered by ATSDR in our screening process. As indicated before, the ATSDR screening process is only intended to determine which contaminants to further evaluate in the public health implications section and were not used in the final determination of whether harmful effects are possible.

5. Are the conclusions and recommendations appropriate in view of the site's condition as described in the public health assessment?

a) The summary on p. vii states that "it is likely that <SO2> levels from Ash Grove have or will be substantially reduced ... ". Later, p. xii states that permitted emission limits "will be reduced at Ash Grove by 98% after upgrades have been completed." Similar language is stated on p. 68. *Recommendation: The language should be clarified (e.g., "likely" is objectionable, and the TCEQ permit or other authoritative source should be referenced.*

ATSDR Response: ATSDR did provide references to two personal communications with TCEQ (who is an authoritative source) regarding the upgrades planned for Ash Grove (Section 2.2.1 of the health consultation). After peer review, TCEQ provided ATSDR with additional information regarding the status of the upgrades at Ash Grove and this information was included in the final health consultation.

6. Are there any other comments about the public health assessment that you would like to make?

a) The Summary's Introduction states that the overall goals of the investigation by the ATSDR and TDSHS are to determine if chemical releases from local industrial facilities could affect or have affected public health and animal health. However, the scope of this HC is more limited. *Recommendation. Begin with a description of the current report and place the overall goals in a separate section.*

ATSDR Response: ATSDR will reorder the Summary to first state the goals of this health consultation and then the overall goals of the Midlothian Project.

b) The same section indicates that this report, or perhaps the series of reports envisioned, is by both ATSDR and TDSHS. However, the authorship of the report is by ATSDR. *Recommendation: The HC should clearly identify and define roles of agencies and authors.*

ATSDR Response: Yes, the reviewer is correct that this health consultation and others are being authored by ATSDR; however, our partners at the TDSHS are assisting in a supportive role. This has been clarified in the Summary.

c) The foreword indicates that this HC is one of six HCs being prepared for this site. The summary notes the 2012 HC (examining community members' concerns about air pollutant measurements). On p. xiii, two further HC planned are noted (addressing the toxicity of cement kiln dust (CKD), and extent of contamination of CKD). On p. 50, the text states that "evaluation of the actual childhood blood lead data in the Midlothian area will be conducted in a future ATSDR Health Consultation." A box on p. 55 identifies that future ATSDR evaluations will examine concerns related to other pollutants, and animal concerns. The schedule and scope of these HCs are unclear, although perhaps they will follow the form of presentation from 2102 (Midlothian TX HC Public Meeting Presentation v7 5-23-12). *Recommendation: The HC should clarify ATSDR's work in Midlothian, provide a synopsis of the prior HCs, identify the relationships of proposed HCs and other studies, identify any portions of prior HCs that are no longer relevant, and provide the schedule for these investigations. This material should be placed in a single, clearly marked section of the HC.*

ATSDR Response: The scope of these other ATSDR activities are described in the Public Health Action Plan (http://atsdrappdev.cdc.gov/sites/midlothian/index.html). The Summary has been revised to indicate where the public can find this action plan.

d) The description of air emissions is incomplete. *Recommendations: On p. 3-4, please note that (1) clinker is ground (a process that produces PM emissions and which is normally controlled), (2) clinker is mixed with gypsum and other materials, and (3) identify potential emissions sources associated with wastes used as fuels (e.g., evaporative emissions of VOCs, metals). On p. 5, for steel mills, please identify the type of VOCs and inorganics expected.*

ATSDR Response: The last sentence on page 4, paragraph 1 of the HC has been revised to several sentences as follows:

"When the raw materials are heated to the temperatures achieved in the kilns, they form a material known as "clinker," which is the solid output from the kilns. The clinker is cooled and then ground [a process that produces particulate matter (PM) emissions and which is normally controlled]. The clinker is then mixed with gypsum and other materials to form the cement product."

A sentence has also been added to the end of the paragraph to discuss emissions from fuel materials:

"Combustion of fuels in the kilns may produce evaporative emissions of volatile organic compounds (VOC) and trace metals."

ATSDR notes that a specific discussion of VOC and metal emissions from steel mills is beyond the scope of this HC, which focuses on NAAQS Air Pollutants and Hydrogen Sulfide; VOC and metal emissions are discussed in a separate ATSDR HC (this document is available at: http://www.atsdr.cdc.gov/sites/midlothian/health_consultations.html).

e) p. 6 indicates that "Short-term events may have occurred at the facilities of interest but were never reported to TCEQ; however, the environmental impacts of these events would likely be detected by nearby offsite monitoring devices, especially those that operate continuously." Continuous emission monitoring systems (CEMS) are more likely - or should - detect releases for monitored pollutants. Ambient monitors may detect short-term releases but very often do not detect releases. Non-detects appear more frequent then detects. *Recommendation: revise this text.*

ATSDR Response: The text will be revised as follows:

"Short term events may have occurred at the facilities of interest that were not reported to TCEQ. These events would likely have been confirmed by continuous emissions monitoring system (CEMS) data, and might have been detected by nearby off-site monitoring devices (provided that the wind direction was from the source to the off-site monitoring device). However, the most frequent wind patterns, duration of event, and extent of the event might preclude detection by off-site monitors."

f) p. 8 discusses excess opacity events at Ash Grove. *Recommendation: The HC should indicate that opacity is an indicator of PM emissions. Also, other types of air emission events should be noted.*

ATSDR Response: ATSDR will indicate that opacity is and indicator of PM emissions on the page indicated by the reviewer.

g) *The Public Health Action Plan (and elsewhere in the report) should describe, for the pollutants of concern in this HC, the applicable emission limits (expressed as tons/year to be compatible, and also as short-term limits where applicable) that have applied historically and that are anticipated in the future.* This information is useful to show trends and improvements to the public.

ATSDR Response: ATSDR did not report emissions limits, however, we do report the actual emissions of all air pollutants evaluated in this health consultation (for the years available). These data provide ATSDR and the public with and understanding of the actual trends in emissions from the facilities.

7. Does the health determination for past sulfur dioxide exposures and ATSDR's use of both the 1-hour and 5-minute data appear appropriate?

The use of both 1 hour and 5-min data is appropriate.

ATSDR interpretations of concentration-response effects for SO2 draw mainly on EPA's 2008 Integrated Science Assessment (ISA) document, which indicates 5-min concentrations between 200 and 400 ppb have the potential to cause change in lunch function among some asthmatics, and that values in the 100 - 200 ppb range serve as a LOAEL where health effects are possible. The use of screened 5 min monitoring data is appropriate with the caveats that are described in the HC.

The modeling predictions in the HC use 1-hour averaging times, which are compared to the SO2 NAAQS, not the 5 min levels just cited. (Also see comments B.3.31 and B.3.32.) The HC might discuss the relationship between 1 hour and 5 min data, but ultimately, the dispersion model used is unable to predict 5 min concentrations, and empirical relationships established using one dataset may not be valid in other circumstances.

The HC might more clearly address the need for several averaging times.

ATSDR Response: ATSDR agrees with the reviewer's comments that even using 1-hour emissions data, modeling would not be able to predict 5-minute average SO2 levels. As previously stated, ATSDR used the 1-hour EPA NAAQS as our screening value and then further evaluated the public health implications of SO2 exposures using the 5-minute data; therefore, ATSDR has used different averaging times in its evaluation of SO2 exposures in

Midlothian. In addition, ATSDR does report other averaging times for SO2, but we point out that the current scientific literature indicates the need to protect against shorter-term peak exposures which the EPA 1-hour standard is designed to accomplish.

8. Do you agree with the determination that 5-minute data collected by TCEQ prior to their procedural change in 2009 is appropriate for use by ATSDR for the intended purposes stated?

The procedure appears to be appropriate. ATSDR recognizes and has appropriately evaluated the potential issues involved in this decision.

ATSDR Response: No response needed.

ADDITIONAL QUESTIONS:

1. Are there any comments on ATSDR's peer review process?

No.

ATSDR Response: No response needed.

2. Are there any other comments?

p. 8. In the description of sources, perhaps it should be stated that prior to 2007, Chaparral Steel was a wholly owned subsidiary of TXI. In 2007, Chaparral merged with Gerdau Ameristeel.

ATSDR Response: This information was added to the revised health consultation.

p. 18. The CO levels reported in the 1999 WHO reference and the 2000 EPA are old and not altogether appropriate for the US, particularly those for roads, given the widespread use of emission control technology.

ATSDR Response: A sentence has been added to the first paragraph ending on page 18 of the HC:

"Trends in ambient outdoor concentrations of carbon monoxide (CO) are decreasing over time, likely resulting in part from the widespread use of emission control technology. EPA monitoring data indicate that CO concentrations decreased over the period 1980 to 2013 nationally and in the Southern region of the U.S. (including Texas) by a factor of about two to four (EPA 2015a)."

The EPA 2015a reference has been added to the HC. This is the EPA Carbon Monoxide Air Trends page accessed at: http://www.epa.gov/airtrends/carbon.html.

p. 17. Typo: "Moreover, the only NAAQS air pollutant that has <been> above the EPA standards."

ATSDR Response: "Been" has been added to this sentence.

p. 27: Typo: "teneded"

ATSDR Response: The typo has been corrected.

p. 24. "Cement manufacturing and steel mills are known to emit NOx." Just say that they emit NOx.

p. 27. NOx emissions of 529 tons/day in the Dallas Fort-Worth non-attainment area seems low, especially for 2006. A more recent TCEQ assessment also provides a comparable emission rate, so this is comment need not be responded. However, the TCEQ 2011b citation could not be found using the URL cited. *Recommendation: Provide correct citation.*

ATSDR Response: The sentence on page 24 will be revised as suggested:

"Cement manufacturing and steel mills emit nitrous oxides (NOx)."

ATSDR will revise the URL as recommended. The correct URL is:

http://www.tceq.texas.gov/assets/public/implementation/air/sip/dfw/ad_2011/10022SIP_ado_111811.pdf

p. 28. The HC might opine on the significance of stack and other point sources of PM, mining and fugitive emissions, and discuss whether monitoring and source apportionments to identify sources are warranted or should be recommended for future evaluations.

ATSDR Response: ATSDR believes that the health consultation does discuss the significance of stack, mining and fugitive emissions as sources of potential exposures. ATSDR does make a recommendation for exposures to residents located near the facilities' limestone quarries. ATSDR does not perform nor does it normally recommend a source apportionment be conducted—this is at the discretion of the appropriate regulatory agency.

p. 29. The box describing PM should note that EPA has regulated PM for more than 40 (not 30) years.

ATSDR Response: The first sentence of the "PM: Particle Size and Public Health" box has been revised to read:

"For more than 40 years,…"

p. 29. What is the reference for TSP's size range? EPA notes that the TSP samplers collect PM under 100 um. There is no lower limit. See the compendium: http://www.epa.gov/ttnamti1/files/ambient/inorganic/mthd-2-1.pdf

ATSDR Response: Samples less than 0.1 micrometer (um) may not be collected by the high volume samplers because the glass fiber filter pore size is approximately 0.1 um, and smaller particles can pass through the filter (see section 3.2 of the method cited by the commenter). However, it is recognized that the sizes below 0.1 um are not excluded in the definition of TSP. The final sentence of the TSP section in the PM: Particle Size and Public Health text box in the HC will be revised to read:

"Particulates up to 100 micrometer in diameter are referred to as total suspended particulate (TSP) matter; however, samples below 0.1 micrometer in diameter are not normally collected by the methods used to sample particulate matter (EPA 1999)."

The reference to the TSP sampling method (link in comments) has been added to the reference list (as provided by the reviewer).

p. 30. What does the sentence mean the "No PM10 monitoring data was identified for earlier years, which most likely indicates that air pollution levels of this pollutant were not regulated at the federal level until 1987." Most likely indicates what? PM10 NAAQS were established in 1987. Just state when TNRCC or TCEQ established monitoring sites and required collection of emissions data. The same statement is made on p. 31 for PM2.5.

ATSDR Response: The third sentence of the first paragraph of page 30 will be revised to read:

"Monitoring sites were not established and emissions data for PM10 was not required to be collected until PM10 NAAQS were established in 1987."

The third sentence of the first paragraph of Section 3.5.3 on page 31 will be revised to read:

"Monitoring sites were not established and emissions data for PM2.5 was not required to be collected until PM2.5 NAAQS were established in 1997."

p. 31. The paragraph starting "Most of the data" is conflating monitoring, modeling, short-term levels, long-term levels, EPA standards, WHO standards, and other aspects. The discussion should be clarified. The use of source apportionment techniques using archived PM10 and PM2.5 filters could be discussed, particularly since signatures from the steel mill would be relatively easy to distinguish.

ATSDR Response: Regarding source apportionment, please see response to peer reviewer comment on page 28. ATSDR does not believe that this paragraph "conflates" these issues; however, we believe that this is a good summary of the various lines-of-evidence that helps support our conclusion regarding past exposures to PM as measured by PM10 monitoring.

p.32. What does the following sentence mean? "Although EPA scientific staff concluded that consideration should be given to revising the former annual average PM2.5 standard of 15 µg/m3, they also concluded that support for revising the current 24-hour PM2.5 standard level (EPA, 2011b) is limited." Rather, scientific support is increasing, including at EPA and WHO, that there is a continuous (not threshold) relationship between concentrations and effects. In any event, this cited sentence is unnecessary and misleading.

ATSDR Response: ATSDR agrees and has deleted the sentences.

p.38. Possibly a pollutant rose analysis for H2S would be revealing, and support the conclusion.

ATSDR Response: All evidence indicates that H2S is not a major contaminant of concern in the Midlothian area in relation to the facilities evaluated for this health consultation; therefore, ATSDR does not believe that a pollutant rose for H2S is needed.

p.44. Possible typo. The heading should be 100 - 200 ppb.

ATSDR Response: The heading is correct as this section discusses SO2 levels from 10 ppb (ATSDR's MRL level) to 200 ppb.

p. 58. In the section Health Effects of Air Quality, the HC should make it clear that the scope is limited to certain ambient air pollutants. The key response should be whether adverse health impacts are expected, rather than compliance issues.

ATSDR Response: ATSDR has made it clear that our responses to this community concern only applies to the air pollutants evaluated in this health consultation. ATSDR attempted to provide context for both health impacts as well as whether levels have been or ever were above EPA standards.

p. 68. In the Public Health Action plan, nothing is stated regarding continued SO2 and PM monitoring, or potential future studies to apportion sources of these (or other) pollutants. Also, this might be an appropriate place to refer to the future or ongoing health evaluations.

ATSDR Response: ATSDR's recommendations regarding PM monitoring downwind of the Holcim facility or in areas in immediate proximity to the facilities' limestone quarries are captured in the Summary and in the Conclusions and Recommendations section. ATSDR supports continued monitoring of sulfur dioxide in Cement Valley to verify that SO2 exposures remain below levels of health concern—this will be added to the Summary and Conclusions and Recommendations. As previously indicated, no air monitoring is available in the most frequent downwind directions from Ash Grove and, to ATSDR's knowledge, none is currently planned. However, Ash Grove has completed significant upgrades to their monitoring and emission controls to comply with the U.S. EPA's Portland Cement requirements. ATSDR has added in a recommendation that TCEQ evaluate the 2015 annual SO2 emissions from Ash Grove to verify that substantial emission reductions have been achieved.

Reviewer #2

General Questions:

1. Does the public health assessment adequately describe the nature and extent of contamination?

Yes. The coverage of air pollutants in addition to those included in the U.S. EPA National Ambient Air Quality Standards (NAAQS), as well of consideration of air pollutant combinations is both necessary and important.

Although natural biological aerosols, such as pollen, bacteria, viruses, and aerosolized plant and animal components, are not covered, there is inadequate monitoring and coupled human effects data available for health assessments. Such lack of data can only be noted in the report. But the public should understand that control of industrial pollutants alone will not solve the rare adverse health effects associated with breathing.

ATSDR Response: No response needed.

2. Does the public health assessment adequately describe the existence of potential pathways of human exposure?

Yes. The dominant route of exposure is clearly inhalation, and that pathway is covered extensively. It is good to see that exposure times (e.g. hours when people are sleeping indoors, versus times when students are exercising outdoors) are thoroughly treated. Also, the proximity to local emission sources, and inclusion of distributed sources of air pollutants, is a strength of the assessment.

ATSDR Response: No response needed.

3. Are all relevant environmental, toxicological, and radiological data (i.e., hazard identification, exposure assessment) being appropriately used?

Yes. The risk analysis appears to be as complete as our existing knowledge allows.

ATSDR Response: No response needed.

4. Does the public health assessment accurately and clearly communicate the health threat posed by the site?

Yes. The health threats are generally minor for healthy persons. Potentially sensitive sub-populations are described and it is acknowledged that they may have significant health risks. Such sub-populations probably cannot be protected completely, so they must take individual precautions such as avoiding outdoor exercise and taking physician recommended medications to prevent and control adverse responses.

ATSDR Response: No response needed.

5. Are the conclusions and recommendations appropriate in view of the site's condition as described in the public health assessment?

Yes. The thorough analysis of environmental air-pollutants and population exposures support the conclusions and recommendations.

ATSDR Response: No response needed.

6. Are there any other comments about the public health assessment that you would like to make?

Yes. Although the data are scant and largely indirect, persons with concurrent respiratory infections (e.g., colds and the flu) could be hyper-sensitive and have exaggerated responses to levels of air pollutants that are beyond the levels that can be controlled by any available means.

ATSDR Response: No response needed.

7. Does the health determination for past sulfur dioxide exposures and ATSDR's use of both the 1-hour and 5-minute data appear appropriate?

Yes, given the available data and risk assessment methodology.

ATSDR Response: No response needed.

8. Do you agree with the determination that 5-minute data collected by TCEQ prior to their procedural change in 2009 is appropriate for use by ATSDR for the intended purposes stated?

Seeing no better approach, this reviewer has no suggestion for improvement.

ATSDR Response: No response needed.

__Additional Questions:__

1. Are there any comments on ATSDR's peer review process?

The process used and the qualifications of the report's author are most certainly state-of-the art.

ATSDR Response: No response needed.

7. Are there any other comments?

Yes. A recent report from the National Council (NRC) of the National Academies; "Science and Decisions: Advancing Risk Assessment" (Washington, DC: National Academies Press, 2009) stressed among other things that risk assessments should be more focused on evaluating the *relative merits of options for managing risk, instead as an end in itself*. In other words a risk analysis should be focused on the *decisions* made to control risks rather than just evaluating the risks posed by *individual* chemicals. For example, health risks can include those associated with economic factors, such as the cost and availability of jobs, goods, and services. Over-regulation that increases risks is possible. It is important that the public understand this point.

Breathing in any air, no matter how clean will adversely affect some people.

ATSDR Response: No response needed.

Reviewer #3

__General Questions:__

1. Does the public health assessment adequately describe the nature and extent of contamination?

Yes, the report adequately describes the nature of the issues and concerns of the local community, but I would not state that there is air pollution <u>contamination</u> in Midlothan, Texas. The area is in compliance with all NAAQS except ozone. In that case, the extent of non-compliance is driven by regional photochemical smog pollution, e.g. traffic precursor emissions and is typical for smog related ozone pollution. Within the analyses, the ATSDR did attempt to specifically address emissions from local sources that were of concern to the community. Included were very short term exposures to SO_2 for sensitive individuals. Again, the results indicated no current contamination issues or impact. However, there was a suggestion of short-term impacts prior to 2008. No results were provided to support this agreement, and I would drop it from the discussions. It borders on speculation. The modeling completed for SO_2 and CO were adequate for discussions on impact throughout the report but I would recommend reporting SO_2 results in ppb rather than ug/m^2 to maintain consistency.

ATSDR Response: ATSDR was confused over the response to this question from the reviewer. ATSDR asked the reviewer the following question as a follow-up to this comment:

The comments seems to agree that the data suggest no current SO2 exposures of concern but then says that the conclusion in the ATSDR HC that harmful SO2 exposures before 2008 borders on speculation. Since ATSDR relied on the same abundance of data (5-minute and 1-hour averages) and evaluation approach to determine that harmful effects are not likely after 2008 as well as our conclusion that harmful effects to sensitive persons were possible before 2008 (actually 1997-2008), why does the reviewer believe this is speculation?

The reviewer responded as follows:

Because there is no health related data to support the conclusion. ATSDR suggests that may have happened but is there any evidence? I think you are stretching the utility of information too far.

Further ATSDR Response: Evaluating environmental exposure data and determining whether these exposures may be harmful, as we did in this health consultation, is consistent with ATSDR's mandate and guidance. Evaluating health outcome data is a crude tool to determine if a population has a greater excess of disease in relation to exposure from a source or release, especially if the potentially exposed population is small as is the case in Midlothian. ATSDR does not believe that our conclusions regarding past SO2 exposures are speculation as they were based on good exposure data (i.e., a robust 5-minute dataset) and science that supports the health effects noted and susceptible population at risk.

ATSDR also reported in this final health consultation the modeling results in ppb to be consistent with the rest of the document.

2. Does the public health assessment adequately describe the existence of potential pathways of human exposure?

The focus of this assessment was exclusively on the air pathway. Further, it targeted criteria air pollutants plus hydrogen sulfide. As a consequence these analyses were directed at inhalation exposure, and comparisons with known health standards, the NAAQS, or other guidelines to determine the significance of observed levels on human health risk. There were no analyses directed at the dermal or ingestion pathways in the community. Further, the primary targets of the air pathway analyses were four major sources in the area associated with Midlothian, TX. Finally, there were PM_{10} samples collected and analyzed for concentration patterns and levels. There were no violations of the PM_{10} standard which would also demonstrate that there would be minimal deposition on soil, which could lead to ingestion. Thus, the focus on the air pathway was very reasonable.

ATSDR Response: No response needed.

3. Are all relevant environmental, toxicological, and radiological data (i.e., hazard identification, exposure assessment) being appropriately used?

This is a very confusing question. The ATSDR did not explicitly use or present much of the toxicological literature. This would have been a daunting task which would have been of minimal us by the community. In contrast, the ATSDR used appropriate benchmarks for health to assess the public health implications of NAAQS violations. The ATSDR selection of multiple guideline values for the comparison was a reasonable and logical approach to the health assessment. Thus, the ATSDR met what I thought was the appropriate level of health based information needed for the analyses, and achieve the goal of the public health assessment. The environmental data was gathered from ambient measurements, and where necessary, supplemented by modeling results. The analyses did not do a partitioning of outdoor and indoor exposures since the focus was on outdoor air sources. Based upon the scope of the study, there were no radiological data needed.

ATSDR Response: No response needed.

4. Does the public health assessment accurately and clearly communicate the health threat posed by the site?

The assessment is clear in its analysis of the historical and current air pollution conditions at the town of Midlothian, TX. It addressed the issues raised by the local community associated with local emission sources, control strategies, and air pollution levels for the criteria pollutants and hydrogen sulfide. However, the phrasing of the question is misleading, and statements like "on page xi - Past lead air exposures during the period of 1993 – 1998, could have harmed the health of the children" are not supported by past or present facts. In addition, trying to detect a 1-2 point decrease in IQ is almost impossible in such a localized populations. The ATSDR must rethink this point and other qualifying statements in the conclusions, to make sure they are supported by data.

ATSDR Response: ATSDR believes that the conclusions regarding where harmful exposures may have occurred are supported and limitation and uncertainties are addressed. For the conclusion regarding exposure to lead in a localized area just north of the Gerdau Ameristeel plant during the period 1993-1998, ATSDR is not implying that we can detect a 1-2 point decrease in IQ in any population of children who might have been exposed to the levels of lead detected in the air during this period. We are merely pointing out that, based on the science used by the U.S. EPA to set the current lead air standard, the levels of lead in the air in this area and during this timeframe could have resulted in this IQ drop if children were exposed chronically. ATSDR provides the appropriate limitation to this health conclusion in the Summary and Conclusions section of this document.

5. Are the conclusions and recommendations appropriate in view of the site's condition as described in the public health assessment?

The statements without some of the speculative qualifiers are appropriate. As I said in my answer to question #4: please make sure all concluding statements are supported by facts. The recommended actions or "no action" are appropriate for the conditions encountered in Midlothian, TX

ATSDR Response: No response needed.

6. Are there any other comments about the public health assessment that you would like to make?

No other comments are required on the document.

ATSDR Response: No response needed.

7. Does the health determination for past sulfur dioxide exposures and ATSDR's use of both the **1-hour and 5-minute data appear appropriate?**

Yes, based upon local concerns for asthma. I appreciated the efforts to couple monitoring and modeling data to complete the assessment for short-term exposures to SO_2, see Appendix C.

ATSDR Response: No response needed.

8. Do you agree with the determination that 5-minute data collected by TCEQ prior to their procedural change in 2009 is appropriate for use by ATSDR for the intended purposes stated?

Yes, procedural changes to deal with change in the standard do not alter the utility of previously collected and validated data. This is confirmed by the modeling conducted and presented in Appendix C. Including annual averages over a much longer period of time increases our understanding on the source changes that have been made to improve air quality.

ATSDR Response: No response needed.

<u>Additional Questions:</u>

1. Are there any comments on ATSDR's peer review process?

No

Are there any other comments?
No

ATSDR Response: No response needed.

Greetings,

You are receiving a document from the Agency for Toxic Substances and Disease Registry (ATSDR). We are very interested in your opinions about the document you received. We ask that you please take a moment now to complete the following ten question survey. You can access the survey by clicking on the link below.

Completing the survey should take less than 5 minutes of your time. If possible, please provide your responses within the next two weeks. All information that you provide will remain confidential.

The responses to the survey will help ATSDR determine if we are providing useful and meaningful information to you. ATSDR greatly appreciates your assistance as it is vital to our ability to provide optimal public health information.

https://www.surveymonkey.com/r/ATSDRDocumentSatisfaction

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