Health Consultation

PUBLIC COMMENT VERSION

Assessing the Adequacy of the Ambient Air Monitoring Database for Evaluating Community Health Concerns

MIDLOTHIAN AREA AIR QUALITY

MIDLOTHIAN, ELLIS COUNTY, TEXAS

MAY 10, 2012

COMMENT PERIOD ENDS: JUNE 22, 2012

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

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 concludes the health consultation process for this site, 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.

You May Contact ATSDR Toll Free at
1-800-CDC-INFO
or
Visit our Home Page at: http://www.atsdr.cdc.gov

HEALTH CONSULTATION

PUBLIC COMMENT RELEASE

Assessing the Adequacy of the Ambient Air Monitoring Database for Evaluating Community Health Concerns

MIDLOTHIAN AREA AIR QUALITY

MIDLOTHIAN, ELLIS COUNTY, TEXAS

Prepared By:

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

FOREWORD

The Agency for Toxic Substances and Disease Registry, ATSDR, was established by Congress in 1980 under the Comprehensive Environmental Response, Compensation, and Liability Act, also known as the *Superfund* law. This law set up a fund to identify and clean up our country's hazardous waste sites. The Environmental Protection Agency, EPA, and the individual states regulate the investigation and clean-up of the sites.

Since 1986, ATSDR has been required by law to conduct public health assessment activities at each of the sites on the EPA National Priorities List. 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. If appropriate, ATSDR also conducts public health assessments when petitioned by concerned individuals. Public health assessments are carried out by environmental and health scientists from ATSDR and from the states with which ATSDR has cooperative agreements. The public health assessment program allows the scientists flexibility in the format or structure of their response to the public health issues at hazardous waste sites. For example, a public health assessment could be one document or it could be a compilation of several health consultations - the structure may vary from site to site. Nevertheless, the public health assessment process is not considered complete until the public health issues at the site are addressed.

Exposure: As the first step in the evaluation, ATSDR scientists review environmental data to see how much contamination is at a site, where it is, and how people might come into contact with it. Generally, ATSDR does not collect its own environmental sampling data but reviews information provided by EPA, other government agencies, businesses, and the public. When there is not enough environmental information available, the report will indicate what further sampling data is needed.

Health Effects: If the review of the environmental data shows that people have or could come into contact with hazardous substances, ATSDR scientists evaluate whether or not these contacts may result in harmful effects. ATSDR recognizes that children, because of their play activities and their growing bodies, may be more vulnerable to these effects. As a policy, unless data are available to suggest otherwise, ATSDR considers children to be more sensitive and vulnerable to hazardous substances. Thus, the health impact to the children is considered first when evaluating the health threat to a community. The health impacts to other high risk groups within the community (such as the elderly, chronically ill, and people engaging in high risk practices) also receive special attention during the evaluation.

ATSDR uses existing scientific information, which can include the results of medical, toxicologic and epidemiologic studies and the data collected in disease registries, to determine the health effects that may result from exposures. The science of environmental health is still developing, and sometimes scientific information on the health effects of certain substances is not available. When this is so, the report will suggest what further public health actions are needed.

Conclusions: The report presents conclusions about the public health threat, if any, posed by a site. When health threats have been determined for high risk groups (such as children, elderly, chronically ill, and people engaging in high risk practices), they will be summarized in the conclusion section of the report. Ways to stop or reduce exposure will then be recommended in the public health action plan.

ATSDR is primarily an advisory agency, so usually these reports identify what actions are appropriate to be undertaken by EPA, other responsible parties, or the research or education divisions of ATSDR. However, if there is an urgent health threat, ATSDR can issue a public health advisory warning people of the danger. ATSDR can also authorize health education or pilot studies of health effects, full-scale epidemiology studies, disease registries, surveillance studies or research on specific hazardous substances.

Community: ATSDR also needs to learn what people in the area know about the site and what concerns they may have about its impact on their health. Consequently, throughout the evaluation process, ATSDR actively gathers information and comments from the people who live or work near a site, including residents of the area, civic leaders, health professionals and community groups. To ensure that the report responds to the community's health concerns, an early version is also distributed to the public for their comments. All the comments received from the public are responded to in the final version of the report.

Comments: If, after reading this report, you have questions or comments, we encourage you to send them to us.

Send comments to: ATSDRRecordsCenter@cdc.gov, or mail to:
ATSDR Records Center
Attn: Rolanda Morrison
re: [Midlothian Area Air Quality – PHC #1]
4770 Buford Highway, NE (MS F-09)
Atlanta, Georgia 30341

Table of Contents

Abbreviations

ATSDR	Agency for Toxic Substances and Disease Registry
CARB	California Air Resources Board
DRI	Desert Research Institute
EPA	U.S. Environmental Protection Agency
ERG	Eastern Research Group, Inc.
^{o}F	degrees Fahrenheit
GC/MS	gas chromatography with mass spectrometry detection
ICP/MS	inductively coupled plasma/mass spectrometry
LP	limited partnership
NCDC	National Climatic Data Center
NEI	National Emissions Inventory
PAC	polycyclic aromatic compound
PAH	polycyclic aromatic hydrocarbon
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
QAPP	quality assurance project plan
SNCR	selective non-catalytic reduction
sVOC	semi-volatile organic compound
TACB	Texas Air Control Board
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
UT-Arlington	The University of Texas at Arlington
VOC	volatile organic compound
XRF	x-ray fluorescence

SUMMARY

INTRODUCTION

The Agency for Toxic Substances and Disease Registry (ATSDR) and the Texas Department of State Health Services (TDSHS) are conducting 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 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. This Health Consultation documents ATSDR's findings from the first project: assessing the adequacy of the ambient air monitoring database for evaluating community health concerns.

ATSDR decided to address this issue first after recognizing that community members have many concerns about the various air pollution measurements that have been collected in Midlothian since 1981. The purpose of this first Health Consultation is to take a very careful look at the available monitoring data and determine which measurements are—and are not—suitable for use in ATSDR's future health evaluations. This Health Consultation identifies 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.

By design, this first Health Consultation does not include evaluations of human health or animal issues. ATSDR remains committed to addressing those very important concerns and will do so in future documents. As ATSDR's Public Health Response Plan indicates, the future documents will address environmental data, health outcome data, and animal issues and concerns. The review of air pollution measurements in this document is the first of four Health Consultations that will evaluate environmental data and is intended to serve as a foundation for ATSDR's future evaluations.

CONCLUSIONS	ATSDR reached a main conclusion and six additional conclusions in this Health Consultation:
MAIN CONCLUSION	The available ambient air monitoring data for the Midlothian area are sufficient to support public health evaluations for numerous pollutants of concern and for many years that local industrial facilities operated. However, the monitoring data also have some limitations identified in the remaining six conclusions. For pollutants with little or no available environmental monitoring data, ATSDR believes there is utility in modeling worst-case air quality impacts to determine if additional sampling is warranted. The modeled data cannot be used to definitively determine if the potential exposure was, or is, a public health hazard.
BASIS FOR DECISION	ATSDR evaluated six key issues to reach this conclusion: • the pollutants monitored (see Conclusion 1) • the methods used to measure air pollution (see Conclusion 2) • the quality of these measurements (see Conclusion 3) • the time frames that monitoring occurred (see Conclusion 4) • the frequency and duration of monitoring (see Conclusion 5) • the monitoring locations (see Conclusion 6)
NEXT STEPS	ATSDR proposes continuing its evaluations of environmental data, bearing in mind the limitations in the ambient air monitoring data identified in this Health Consultation. The health evaluations will consider exposure to individual pollutants and the overall mixture of air pollutants observed in the Midlothian area.

QUESTION 1	Has ambient air monitoring been conducted for all pollutants expected to be released from cement kilns and steel mills?
CONCLUSION 1	Air monitoring has occurred for some, but not all, of these pollutants: • Some monitoring data are available for every inorganic pollutant (e.g., metals and elements) included in facility emission reports, except for hydrochloric acid, sulfuric acid, and vapor-phase mercury. ATSDR has identified gaps in the available environmental monitoring data because of a lack of air measurements for these three pollutants.. • For volatile organic compounds (VOCs), monitoring has occurred for the subset of pollutants that the facilities have released in greatest quantities. Monitoring is far less extensive or not available for VOCs that the facilities released in smaller quantities. • No ambient air monitoring has occurred for semi-volatile organic compounds including dioxins, furans, and polycyclic aromatic hydrocarbons (PAHs). ATSDR has identified this lack of information as a gap in the available environmental monitoring data. • Ambient air monitoring data are available for all criteria pollutants directly emitted by the facilities (lead, nitrogen dioxide, particulate matter, and sulfur dioxide) except for carbon monoxide.
BASIS FOR DECISION	These findings were determined by comparing the pollutants identified in the facilities' emission reports to the pollutants considered across all monitoring programs. Pollutants for which monitoring data were lacking are considered by ATSDR as identified gaps in the environmental monitoring data. For pollutants with little or no available environmental monitoring data, ATSDR believes there is utility in modeling worst-case air quality impacts to determine if additional sampling is warranted. Section 4.2 documents in greater detail ATSDR's basis for reaching this conclusion.
NEXT STEPS	ATSDR will proceed with evaluating the health implications of the measured concentrations, considering the findings outlined in Tables 13 to 16 of this Health Consultation. The lack of air measurements for certain VOCs, hydrochloric acid, sulfuric acid, vapor-phase mercury, dioxins and furans, PAHs, and carbon monoxide are gaps in the available environmental monitoring data. ATSDR will use models and other site-specific information in its future Health Consultations to examine these pollutants further. The

future Health Consultations will also consider the need for additional measurements of these pollutants in water, surface soil, and food items.

QUESTION 2

Is monitoring being conducted using scientifically defensible methods?

CONCLUSION 2

Nearly all monitoring in Midlothian has been conducted using scientifically defensible methods that are sensitive enough to measure air pollution at levels of potential health concern. However, there are important exceptions:

- Before 2001, air samples for inorganics (metals) were collected in 1981 and between 1991 and 1994. These samples were analyzed using a method that was commonly applied at the time, but later found to potentially understate air pollution levels. This finding does not apply to lead, because the methods used to measure airborne lead were well established during this time frame.
- The method that has been used to measure inorganics is known to underestimate concentrations of nitrates.
- The ambient air monitoring methods used in the Midlothian area have generally been sensitive enough—that is, they have detection limits low enough—to measure ambient air concentrations at levels of potential health concern. The only exceptions are that the methods used to measure air concentrations of arsenic, cadmium, 1,2-dibromoethane, and hydrogen sulfide did not always achieve the sensitivity ATSDR would prefer to have for making health conclusions. However, there is no evidence that the Midlothian facilities use, process, or release 1,2-dibromoethane.

BASIS FOR DECISION

ATSDR identified every monitoring method that has been used in Midlothian since 1981 and compared those to both (1) methods that were widely used at the time and (2) methods that are currently documented in peer-reviewed and well-established guidance documents published by the U.S. Environmental Protection Agency (EPA). Section 4.3 documents in greater detail ATSDR's basis for reaching this conclusion.

NEXT STEPS

- ATSDR's future Health Consultations will: 1) use data generated by valid methods for health evaluations. However, metals data before 2001 and all nitrate data will be used with caution. 2) evaluate the valid measurements of certain VOCs, arsenic, cadmium, and hydrogen sulfide and that evaluation will consider the fact that some of those measurements were not capable of measuring air pollution levels at concentrations near the most health-protective screening values.

QUESTION 3	Are the monitoring data collected in the Midlothian area accurate, reliable, and of a known and high quality?
CONCLUSION 3	For the data generated using defensible methods, nearly all measurements were found to be reliable and to have met standard data quality objectives. The only exceptions are: • Two types of monitoring devices have been used in Midlothian to measure air pollution levels for fine particulate matter ($PM_{2.5}$). The concentrations measured by the continuous monitoring device are consistently lower than the measurements made by the more reliable non-continuous device. • Several inorganics (barium, total chromium, copper, manganese, molybdenum, and silver) were consistently detected in filter blank samples during certain studies. This means that measured air pollution levels for these pollutants are sometimes higher than actual air pollution levels.
BASIS FOR DECISION	This conclusion is based on various data quality indicators that ATSDR obtained for every monitoring program that has been conducted in Midlothian. The difference between the continuous and non-continuous $PM_{2.5}$ measurements was determined by evaluating a large set of concurrent side-by-side measurements that were made using the two devices. Section 4.4 documents in greater detail ATSDR's basis for reaching this conclusion.
NEXT STEPS	When interpreting the continuous $PM_{2.5}$ monitoring data in future Health Consultations, ATSDR will consider the fact that these devices were underestimating ambient air concentrations. When evaluating any data for inorganics, ATSDR will consider the possibility of "false positive" detections due to metals naturally found in the filters used to collect the air samples. This issue, known as blank contamination, will most likely affect the measurements of barium, total chromium, copper, manganese, molybdenum, and silver.

QUESTION 4	Are valid monitoring data available for the time frames of greatest interest?
CONCLUSION 4	The answer to this question depends on the pollutant category. The time frames for which at least some valid air pollution measurements are available through calendar year 2010 follow: • Particulate matter: 1981-1984 and 1991-2010 • Lead: 1981-1984, 1992-1998, and 2001-2010 • Inorganics (other than lead): 2001-2010 • Volatile organic compounds: 1993-2010 • Sulfur compounds: 1985 and 1997-2010 • Nitrogen oxides: 2000-2010 • Ozone: 1997-2010 Gaps in the available environmental monitoring data that are most important because they cannot be reliably filled by estimates made using surrogate sources of information are: • No ambient air monitoring data are available before 1981. • No air monitoring data were collected in the vicinity of Ash Grove Cement during the years that the facility burned hazardous waste.
BASIS FOR DECISION	This conclusion is based on the years for which valid measurements are available. The conclusion excludes data that ATSDR determined were not suitable for health assessment purposes (see Conclusion 2).
NEXT STEPS	In its future Health Consultations, ATSDR will evaluate the health implications of the measured air pollution levels for all years when ambient air monitoring data were collected. For years when no measurements were collected, ATSDR will consider deriving estimates of air pollution levels from other sources of information, such as facility specific fuel usage statistics, emission rates, efficiency of air pollution controls, and air models. All such estimates will be thoroughly documented.

QUESTION 5	Is ambient air monitoring being conducted at appropriate frequencies and durations?
CONCLUSION 5	The monitoring frequency in Midlothian ranges from sampling that occurs continuously to sampling that occurs every 6 days. The duration of individual samples for most pollutants ranges from 1-hour averages to 24-hour averages; and 5-minute average measurements are available for sulfur dioxide. These frequencies and durations are consistent with monitoring methodologies commonly used throughout the country. The available air pollution measurements and facility-specific emission measurements provide no evidence that the Midlothian facilities alter their emissions on days when 1-in-6 day samples are collected. Data collected in Midlothian show that 1-in-6 day sampling schedules adequately characterize air pollution levels over the *long term*, such as annual average concentrations. On the other hand, a 1-in-6 day sampling schedule generally does not capture the highest *short term* air pollution levels, unless the day with the highest air pollution levels happened to coincide with a sampling date. For particulate matter, data from Midlothian indicate that the highest 24-hour average measurement from a 1-in-6 day sampling schedule could be as much as 44 percent lower than the highest 24-hour average air pollution level that actually occurred.
BASIS FOR DECISION	This conclusion is based on a detailed evaluation of several different types of air pollution measurements and facility-specific air emission estimates. Section 4.6 documents in greater detail the specific data sources that ATSDR considered and how they were evaluated in order to reach this conclusion.
NEXT STEPS	In its future Health Consultations, ATSDR will consider the limitations posed by a 1-in-6 day sampling schedule. In those documents, ATSDR will fully describe uncertainties associated with using 1-in-6 day sampling schedules to assess *short term* air pollution levels.

QUESTION 6	Are the monitoring stations placed in locations that adequately characterize outdoor air pollution?
CONCLUSION 6	The number and placement of air monitoring stations in Midlothian has varied greatly by pollutant and year. The locations of monitoring stations in Midlothian were chosen for different reasons. Some monitors were placed in locations to capture the highest levels of air pollution anticipated for the area or to measure air pollution in areas with the most citizen complaints. These monitors were placed at or near locations where an EPA modeling study predicted the highest air quality impacts would occur. Three monitors were located south of the TXI Operations facility: the Midlothian Tower station, the Mountain Creek station, and the Mountain Peak Elementary School station. These locations are typically upwind from the main sources of air pollution in Midlothian. While measurements from these monitors are valid, they are not reasonable indicators of the worst-case air pollution levels. Several monitors have operated in the area immediately north of Gerdau Ameristeel and TXI Operations. The two monitors that have been operating the longest are at Old Fort Worth Road and at Wyatt Road. Air pollution levels tended to be higher at Old Fort Worth Road. This station's measurements are a reasonable indicator of air quality in the residential neighborhoods along Cement Valley Road and Wyatt Road even if the Old Fort Worth Road monitor is due east of this area. 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, the most 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 would be expected to have the greatest air quality impacts.
BASIS FOR DECISION	This conclusion is based on ATSDR's review of multiple sources of information: the rationale that different parties provided for selecting monitoring locations; outputs from modeling studies; and observed changes in Midlothian's air pollution levels over relatively short distances. Section 4.7 documents in greater detail how ATSDR arrived at this conclusion.
NEXT STEPS	In future Health Consultations, ATSDR will interpret data collected at the various monitoring locations, recognizing that some of the monitors

	were placed in areas typically upwind from the facilities of interest. In those documents, recommendations for future sampling may be included.
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.

1.0 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 many concerns outlined in the original petition. Many comments were received on the draft Health Consultation.

Purpose of this Document
ATSDR prepared this Health Consultation to evaluate the utility of the ambient air monitoring data currently available for the Midlothian area for public health assessment purposes.

This document identifies pollutants, time frames, and locations for which the available data provide a sufficient basis for reaching health conclusions. This document also identifies gaps in the available data set and addresses community concerns specific to the air monitoring network.

This document ***does not*** present any public health evaluations of the ambient air monitoring data. After this document is finalized, ATSDR will evaluate the public health implications of exposures to environmental contamination in the Midlothian area and document those findings in future Health Consultations.

During the process of evaluating these comments, the ATSDR and National Center for Environmental Health Director requested that the ATSDR and TDSHS team take a more comprehensive look at the site. Specifically, this new evaluation would review the initial petitioner's concerns which questioned whether or not the data generated by air monitors was 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 2011], ATSDR will complete this reevaluation in a series of projects.

This ATSDR Health Consultation was developed to assess 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). The technical evaluations in this document are organized into six sections:

1. Pollutants monitored
2. Monitoring, sampling, and analytical methods used
3. Data quality of the air pollution measurements
4. Time frames covered
5. Monitoring frequencies and durations
6. Monitoring locations

To evaluate these issues, ATSDR first 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 October 31, 2011. 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).

2.0 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 4 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 Emission Sources

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.

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 are also identified and discussed.

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

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 of interest. 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.

2.2.1 Air Emissions from Cement Kilns

Cement is a commercial product that is used to make concrete. While cement manufacturing facilities employ various production technologies to make their products, 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 materials into kilns that operate at very high temperatures, typically at least 2,700 ^{o}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 that is cooled and mixed with gypsum to form the cement product.

Though the main product from the kiln is clinker, many by-products are also 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 in 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).

Besides their kilns, cement manufacturing facilities have many other operations that process materials. These may include mining for limestone at on-site quarries, crushing and blending of 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.

Table 1 identifies general categories of pollutants typically emitted from cement kilns and explains the origin of these emissions. 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, as well as 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 contents are poured into a mold, in which the molten steel gradually cools and takes it 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.

Overall, 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 inorganics.

2.3 Air Emissions Sources in Midlothian

For each facility of interest, this section summarizes the industrial processes and air emissions (among other factors) to provide context for this document's technical evaluation. When preparing this document, ATSDR accessed and thoroughly reviewed extensive additional information on each facility's history, although every observation is not documented in this section. TCEQ is the regulatory permitting authority for all four facilities, and that agency's records document the history of these facilities' air permits and compliance status. The following information is reviewed in Sections 2.3.1 through 2.3.4 for the four facilities of interest:

- **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. This section also documents the number and nature of community complaints regarding facility operations that residents filed with TCEQ between January 2002 and June 2010. (Table B-1 in Appendix B documents every complaint specific to the Midlothian facilities for this time frame, based on information accessed from a TCEQ online database of facility-specific complaints.) This time frame was selected because it represents the entire history of information available from TCEQ's online compilation of complaints at the time ATSDR gathered these data.

- **Annual estimated air emissions.** The facilities' self-reported estimated annual air emissions are summarized, using data that the facilities submitted to EPA's Toxics Release Inventory (TRI) and to TCEQ's Point Source Emissions Inventory.

  TRI data provide insights on facility-specific *air toxic* emissions. Taken together, the four facilities have submitted hundreds of annual emission estimates to TRI over the past 20 years. This section uses three different approaches to summarize these data, although ATSDR fully evaluated the trends and patterns among the complete set of data when preparing this report [EPA 2010a]. First, this section summarizes total annual air emissions (i.e., summed across all pollutants) reported by the facilities of interest over all years for which TRI data are available (1988–2010). Second, this section identifies the pollutants accounting for the majority of facility emissions between 2000 and 2010. This particular time frame was selected because changes to the reporting requirements that became effective in 2000 resulted in many industrial facilities disclosing information on emissions that they had not disclosed previously. Third, this section identifies any pollutants for which the individual facilities' self-reported emissions for 2008 rank among the nation's top 100 facilities in terms of air emissions reported to TRI; 2008 was selected for this analysis because that was the most recent year of TRI data available when ATSDR began evaluating these data. ATSDR used the TRI data as a qualitative indicator of facilities' emission data, although this limited presentation of information does not account for finer nuances in facility emissions (e.g., relatively small emissions

of extremely toxic pollutants can be more significant than larger releases of more benign pollutants). Detailed quantitative analyses of these data are not included here for various reasons, one of which being that all TRI data are self-reported and many of the data points are estimated and cannot be readily validated.

TCEQ's Point Source Emissions Inventory 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). This section summarizes annual emission data from 2000 to 2009. The year 2000 was selected as a starting point because it is the first year in which fine PM emission rates (i.e., $PM_{2.5}$) were included in this inventory; and 2009 is the most recent year for which inventory data were available at the writing of this report. As with the TRI data, the criteria pollutant emission data in the Point Source Emissions Inventory are also 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.

While much of this section will focus on facility-specific information, ATSDR ultimately evaluates the public health implications of exposure to environmental contamination levels, which reflect contributions from all local sources combined. This distinction will be acknowledged in ATSDR's future Health Consultations, which will present the agency's health interpretations of the environmental monitoring data.

- **Short-term estimated air emissions.** This section summarizes the frequency and magnitude of certain short-term air 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) as well as *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 in turn makes these emission event reports publicly available in summary form on its website. 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. Appendix B lists the reported emission events for the four Midlothian facilities of interest. It is possible that elevated short-term events 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.

  Understanding the short-term 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 may mask important peaks in facility releases. Therefore, this document and ATSDR's future Health Consultations consider the implications of both short-term and long-term air pollution levels.

2.3.1 Ash Grove Cement

- **Overview.** Ash Grove Texas L.P. (referred to in this document as "Ash Grove Cement") is a Portland cement manufacturing facility located north of Midlothian. The parent company of this facility is Ash Grove Cement Co., and the facility was formerly named North Texas Cement Company and 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 1995]. Cement is manufactured by feeding limestone, shale, and other raw materials into the rotary kilns, which operate at temperatures reaching 4,000 degrees Fahrenheit (^{o}F). 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—known as clinker—is subsequently ground together with gypsum to make Portland cement.

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 should not be viewed as comprehensive summaries of the individual facilities and their histories.

While this section, by design, focuses on the individual facilities separately, ATSDR's final evaluations for this site—both in this document and in future health evaluations—consider the combined air quality impacts from all four facilities, as well as additional air emission sources throughout the Midlothian area.

Ash Grove Cement has used various fuels over the years to fire its kilns. The kilns were originally fired with natural gas, coal, and petroleum coke. From 1986 to 1991, Ash Grove Cement was also 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, Ash Grove Cement reported that it burned 55,000 tons of hazardous waste for purposes of energy recovery; and in 1991, the facility reportedly burned 14,200 tons of hazardous waste [EPA 2010b]. The facility's practice of burning hazardous waste ceased in 1992, however, after a series of stack tests (or trial burns) revealed that emissions from the kilns were not meeting newly promulgated federal requirements for waste combustion.

In 1995, Ash Grove Cement 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 2009a]. 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

The previous compilation of 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 coal, petroleum coke, new or used oil, wood chips, tire chips, and natural gas.

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. These air pollution controls collect a large portion of the kiln's emissions, including cement kiln dust, but are not 100 percent 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 has occasionally changed its fuel sources and design of its unit operations; new equipment has been added over the years, while 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 (Table 2) [TCEQ 2010b].

- **Annual estimated air emissions.** Figure 2 shows the long-term trend of air emissions that Ash Grove Cement reported to TRI. For each year between 1988 and 2010, the figure displays the total air emissions on the facility's TRI forms. For the years in which Ash Grove Cement reported to TRI, total air emissions summed across all pollutants ranged from 1,923 pounds to 140,463 pounds. From 2000 to the present, stack emissions of sulfuric acid aerosols have accounted for more than 98 percent of the total air emissions that Ash Grove Cement has reported to TRI. Other pollutants reported most frequently since 2000 include various metals—compounds of chromium, lead, manganese, and mercury—and dioxin and dioxin-like compounds. For every pollutant

that Ash Grove Cement reported to TRI in 2008, the facility's annual air emissions did not rank among the top 100 emitters in the nationwide database.

Table 3 presents the criteria pollutant emission data that Ash Grove Cement submitted to TCEQ's Point Source Emissions Inventory between 2000 and 2009, the years during which the inventory covers the most complete list of pollutants of interest. As the table shows, year-to-year changes in emission rates occurred for many pollutants, with both increases and decreases occurring in the overall time frame. For one out of the seven pollutants listed in Table 3, Ash Grove Cement's annual emissions in 2007 ranked among the top 25 facilities in Texas: the facility's sulfur dioxide emissions were the 19th highest among the more than 2,000 industrial facilities that submitted data to this statewide inventory.

- **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 (Table 2). Of these, 87 were scheduled maintenance, startup, or shutdown activities. The remaining 170 events were excess opacity events and emission events. Only one of these event reports included a pollutant-specific emission rate, however. 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.

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 1995] 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. Note that this facility does not operate coke ovens to generate energy; therefore, coke oven emissions will not be considered in this investigation.

  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 are also equipped with air pollution controls. For example, the slag crusher and alloy handling 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.

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 between 2002 and 2010 (Table 2) [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 general complaints about excessive industrial activity. Nearly every complaint specific to Gerdau Ameristeel occurred during nighttime hours.

- **Annual estimated air emissions.** Figure 2 shows the long-term trend of Gerdau Ameristeel's TRI air emissions. For each year between 1988 and 2010, the figure displays the total air emissions (summed across all pollutants) on the facility's TRI forms. For the years in which Gerdau Ameristeel reported to TRI, total air emissions summed across all pollutants ranged from 8,809 pounds to 208,388 pounds. From 2000 to the present, air emissions of zinc compounds have accounted for 63 to 73 percent of the total air emissions that the facility reported to TRI. Other pollutants reported most frequently during this time frame are metals—compounds of cadmium, chromium, copper, lead, manganese, mercury, and nickel. For two pollutants, Gerdau Ameristeel's reported emissions in 2008 ranked among the top 100 facilities nationwide: total air emissions of cadmium compounds ranked 20th highest among the nation's facility-specific TRI submissions, and mercury compounds ranked 34th.

  Table 3 presents the criteria pollutant emission data that Gerdau Ameristeel submitted to TCEQ's Point Source Emissions Inventory between 2000 and 2009. For each of the pollutants shown in the table (carbon monoxide, lead, nitrogen oxides, PM, sulfur dioxide, and VOCs), annual emissions in 2009 were lower than those reported for 2000. For lead, Gerdau Ameristeel's annual emissions in 2007 ranked 10th among the industrial facilities that submitted data to the statewide inventory. For the remaining pollutants, Gerdau Ameristeel's emissions did not rank among the highest 25 facilities in the state, according to TCEQ's Point Source Emissions Inventory.

- **Short-term estimated air emissions.** Between 2003 and 2011, Gerdau Ameristeel submitted 30 air emission event reports to TCEQ (Table 2): 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 due 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 Holnam Texas LP, which was also formerly known as Box Crow Cement Company. Holcim operates two dry kilns: the first began operating in 1987 and the second in 1998. An onsite quarry provides limestone and other raw materials used to feed the rotary kilns, which operate at temperatures reaching 3,000 ^{o}F.

Some quarried materials are crushed and milled onsite prior to 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 considerably from one year to the next [TCEQ 2009a]. Annual statistics for the facility's usage of tire-derived fuel follow [TCEQ 2009a, 2010e]:

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, and petroleum coke. The facility's emissions likely change as a function of the composition of the fuels used, but a detailed breakdown of fuel use by day is not publicly available.

Holcim's cement manufacturing operations emit air pollutants from multiple sources, and various measures are in place to reduce facility emissions. One of the kilns now operates 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 August 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 install SNCR technology onto its newer kiln to decrease nitrogen oxide emissions [TCEQ 2009a] and to continuously measure downwind ambient air concentrations of fine PM—a project that has been operational since 2006 (see Section 4.1).

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 (Table 2) [TCEQ 2010b]. Five of these complaints were filed between May 2005 and 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.** Figure 2 shows the long-term trend of air emissions that Holcim reported to TRI. For each year between 1988 and 2010, the figure displays the total air emissions on the facility's TRI forms. For the years in which Holcim reported to TRI (2000 to 2010), total air emissions summed across all pollutants ranged from 35,247 pounds to 254,195 pounds. From 2000 to the present, the pollutants most frequently reported on Holcim's TRI reports were benzene, toluene, several metals (compounds of chromium, lead, mercury, and zinc), and dioxin and dioxin-like compounds. Over the history of Holcim's TRI reporting, benzene and toluene accounted for the largest portion of emissions, followed by sulfuric acid aerosols and xylene. The profile of pollutants included in Holcim's TRI reports has changed from year to year. For example, sulfuric acid aerosols were reported every year from 2000 to 2003 and not in the following years, while ammonia (a byproduct of the SNCR process) was reported from 2006 to 2010 and not in earlier years. For all pollutants that Holcim reported to TRI in 2008, only one ranked among the nation's top 100 facilities in terms of total air emissions: Holcim's benzene emissions were the 31st highest among industrial facilities nationwide that submitted data to TRI.

  Table 3 presents the criteria pollutant emission data that Holcim submitted to TCEQ's Point Source Emissions Inventory between 2000 and 2009. Annual emissions for the individual pollutants varied from one year to the next. For carbon monoxide, nitrogen oxides, PM, sulfur dioxide, lead, and VOCs, annual emissions in 2009 were lower than their corresponding 2000 levels. For three out of the seven pollutants in Table 3, Holcim's annual emissions in 2007 ranked among the top 25 facilities in Texas: the facility's carbon monoxide emissions ranked 12th statewide; nitrogen oxides emissions ranked 23rd; and fine PM emissions ranked 21st.

- **Short-term estimated air emissions.** Between 2003 and 2010, Holcim submitted 17 air emission event reports to TCEQ (Table 2). Of these, six were scheduled maintenance, startup, or shutdown activities. The remaining 11 events were excess opacity events and emission events. All but one of these were of relatively short duration (i.e., roughly between 5 minutes and 2.5 hours long); 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 operates five cement kilns that came online in 1960, 1964, 1967, 1972, and 2002. Four of these are "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.

TXI Operations has used multiple fuels to fire its kilns. The kilns were originally fired with 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. Currently, the four wet kilns are 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. Though 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 between 1991 and 2007. The facility reportedly stopped burning hazardous waste altogether some time in 2008, even though the facility's permit allows this practice.

TXI Operations has many air emission sources that are typically found at cement manufacturing facilities. Exhaust air from the five kilns passes through baghouses to reduce emissions of PM and wet scrubbers to reduce emissions of sulfur dioxide, nitrogen oxides, and other pollutants. Finally, some exhaust gases pass 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, in which TXI Operations continuously monitors emissions of several pollutants, including carbon monoxide, nitrogen oxides, and sulfur dioxide. The specific monitoring requirements vary across the kilns. In addition to pollution controls for kiln emissions, the facility has equipped a number of 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 2010b]. 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 between 1989 and 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:[1]

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		

[1] 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.

On average, across the years listed in the previous compilation, TXI Operations burned approximately 56,200 tons of hazardous waste annually for purposes of energy recovery [EPA 2010b]—an amount roughly equivalent to burning more than 150 tons of hazardous waste per day, assuming continuous operations. 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.

TCEQ's Web site documents 84 complaints that residents submitted to the agency between 2002 and 2010 regarding TXI Operations' air emissions (Table 2) [TCEQ 2010b]. More than half of these complaints were filed due to 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 mostly pertained to 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.** Figure 2 shows the long-term trend of air emissions that TXI Operations reported to TRI. For each year between 1988 and 2010, the figure displays the total air emissions on the facility's TRI forms. For the years in which TXI Operations reported to TRI, total air emissions summed across all pollutants ranged from 60 pounds to 1,274,852 pounds. Between 2000 and 2010, TXI Operations submitted TRI reports to EPA for 64 different pollutants. Of these, the following pollutants were reported every year between 2000 and 2010: sulfuric acid aerosols; and compounds of chromium, manganese, and nickel. In terms of the magnitude of pollutant emissions, sulfuric acid aerosols consistently accounted for more than 97 percent of the total air toxic emissions disclosed on the facility's forms during this time frame, except for 2008, when this proportion dropped to 91 percent. Other pollutants with the highest quantity of emissions between 2000 and 2010 include several VOCs (e.g., benzene, naphthalene, styrene, toluene, xylene isomers), metals (e.g., compounds of chromium, manganese, nickel, and zinc), and hydrochloric acid aerosols. For all pollutants that TXI Operations reported to TRI in 2008, only sulfuric acid aerosols rank among the nation's top 100 facilities in terms of total air emissions. Specifically, the facility's estimated sulfuric acid emissions were the 82nd highest among reporting industrial facilities nationwide.

  Table 3 presents the criteria pollutant emission data that TXI Operations submitted to TCEQ's Point Source Emissions Inventory between 2000 and 2009. For lead, TXI Operations' facility-wide emissions in 2009 were higher than its emissions in 2000; for all other pollutants shown in Table 3, the facility's emissions in 2009 were less than or equal to emissions in 2000. For nitrogen oxides, TXI Operations' annual emissions in 2007 ranked 21st among the industrial facilities that submit data to the statewide inventory. For the remaining pollutants shown in Table 3, the facility's emissions did not rank among the highest 25 facilities in the state.

- **Short-term estimated air emissions.** Between 2003 and 2011, TXI Operations submitted 36 air emission event reports to TCEQ (Table 2). Thirty-five were excess opacity events and emission events and the other 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 a large number of 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 smaller 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), as well as aircraft and recreational watercraft. The following paragraphs briefly review information on emissions from sources other than the four facilities of interest, because all of these emission sources combined affect Midlothian's air quality.

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 percent of the sulfur dioxide and 60 percent of the nitrogen oxides released to the air throughout all of Ellis County; and they account for approximately 20 percent of the countywide emissions of carbon monoxide and fine PM [EPA 2010c]. 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. While the NEI data suggest that sources other than the facilities of interest may account for the majority of countywide emissions for certain pollutants, that 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 close proximity. Thus, the remainder of this Health Consultation focuses on the Midlothian industrial facilities' air quality impacts, while acknowledging that area sources and mobile sources also contribute to the levels of air pollution measured throughout Ellis County.

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 (age 6 years and younger), women of childbearing age (between ages 15

and 44 years), and the elderly (age 65 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.** Figure 3 summarizes demographic data for areas within 3 miles of the property boundaries of the four industrial facilities of interest, based on information compiled in the 2000 U.S. Census. Overall, an estimated 38,908 persons live within 3 miles of any of these facilities, with some individuals being life-long residents. The main population center of Midlothian is located between the facilities of interest, although several residential developments and individual property owners are located throughout the area shown in Figure 3. According to the Census data, approximately 11 percent of the population within 3 miles of these facilities is children; 6 percent is considered elderly; and 22 percent is women of childbearing age.

- **Residents closest to the facilities.** All four main industrial facilities in Midlothian own relatively large tracts of land (see Figure 1), 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. Observations from site visitors and review of aerial photographs, however, 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 also has nearby residential receptors, with the closest ones living 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 also considered whether the monitoring stations in the Midlothian area adequately reflect 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.

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 relatively 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. Between 1971 and 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. A wind rose displays the statistical distribution of wind speeds and directions observed at a meteorological station. These two stations were selected because they were the only stations with nearly complete records of wind observations for a recent 5-year period (2002–2006). Figure 4 shows the wind rose generated for 5 years of data collected at a meteorological station along Old Fort Worth Road, located north of Gerdau Ameristeel and TXI Operations; Figure 5 shows the wind rose for 5 years of data from the Midlothian Tower meteorological station, which is located on TXI Operations' property, but south of the facility's main industrial operations. The wind roses in Figures 4 and 5 indicate that the prevailing wind direction in the Midlothian area is from south to north, although pronounced contributions are also observed from north to south and from southeast to northwest. Later sections of this document revisit this issue, particularly when commenting on the placement of the monitoring stations.

ATSDR also examined the extent to which prevailing 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 hours (2:00 to 4:00 p.m.); wind speeds at both stations tended to be lightest around sundown (6:00 to 8:00 p.m.) and sunup (4:00 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 a NAAQS, 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, the Dallas-Fort Worth area is currently designated 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. 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 from any single source to elevated ozone levels is difficult to assess.

ATSDR's future Health Consultations will comment on the public health implications of concurrent exposure to site-related air pollution and elevated levels of ozone.

- **Other pollutants.** For the remaining 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. 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 2010d].

3.0 Community Concerns

Concerns Addressed in This Document
This Health Consultation addresses community concerns regarding the adequacy of the past and ongoing ambient air monitoring in the Midlothian area. Future Health Consultations will address the residents' concerns regarding human and animal health and other issues pertaining to the Midlothian facilities.

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 held 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.

This Health Consultation addresses the following community concerns specific to the adequacy of the monitoring network:

- Has ambient air monitoring been conducted for all pollutants expected to be released from cement kilns and steel mills?
- Is monitoring being conducted using scientifically defensible methods?
- Are the monitoring data collected in the Midlothian area accurate, reliable, and of a known and high quality?
- Are valid monitoring data available for the time frames of greatest interest?
- Is ambient air monitoring being conducted at appropriate frequencies and durations?
- Are the monitoring stations placed in locations that adequately characterize outdoor air pollution?

4.0 Discussion

Topics covered in this section
Background – Section 4.1
Pollutants monitored – Section 4.2
Monitoring methods – Section 4.3
Data quality – Section 4.4
Time frames covered – Section 4.5
Monitoring frequencies – Section 4.6
Monitoring locations – Section 4.7
Summary – Section 4.8

This section presents ATSDR's evaluation of ambient air monitoring in the Midlothian area. Background information on the various monitoring programs implemented over the years is reviewed first (Section 4.1), followed by detailed evaluations of the six main categories of community concerns that residents have expressed to the agencies (Sections 4.2 to 4.7).

Note: Sections 4.2 to 4.7 review each concern *individually*. Section 4.8 then integrates the findings from these individual topics into ATSDR's *overall conclusions* regarding the utility of the existing ambient air monitoring data set for public health assessment purposes.

4.1 Air Monitoring Programs in Midlothian

Background
This section describes the different ambient air monitoring programs that have occurred in the Midlothian area, without interpretation. Sections 4.2 through 4.8 present ATSDR's findings regarding these monitoring programs.

Routine ambient air monitoring in the Midlothian area dates back to 1981. Since then, the ambient air monitoring in the area has varied greatly in terms of pollutants measured, methods used, monitoring frequencies, and monitoring locations. Figure 6 shows the location of every ambient air monitoring station that has operated in the area over the last 30 years, and Table 4 identifies the pollutants that these stations measured and the time frames over which they operated. Although monitoring has occurred at numerous places and times, most monitoring can be classified into five categories, which ATSDR defined for purposes of the data quality reviews (see Section 4.4). The following paragraphs describe these monitoring efforts, with more detailed information and interpretations presented later in this section.

- **Holcim settlement agreement monitoring.** From 2006 to the present, continuous ambient air monitoring for fine PM has occurred along Holcim's northern property line (station 4 in Figure 6). As noted previously, Holcim conducts this monitoring to fulfill terms of a settlement agreement reached between the facility, DFW Blue Skies Alliance, and Downwinders at Risk. Trinity Consultants, Inc., an environmental consulting company, installed and operates the continuous PM monitor and submits quarterly results to representatives of and technical advisors for Holcim, Downwinders at Risk, and UT-Arlington. Researchers from UT-Arlington then further evaluate the monitoring data in technical memoranda submitted periodically to Downwinders at Risk. ATSDR has obtained copies of all quarterly reports and UT-Arlington technical memoranda issued as of March 1, 2010.

- **Midlothian Ambient Air Collection and Analytical Chemical Analysis.** To fill gaps in the available environmental monitoring data identified in the public comment Health Consultation issued by TDSHS in December 2007, TCEQ recently funded additional ambient air monitoring in the Midlothian area. The main goal of this year long monitoring effort was to further characterize air quality in the Midlothian area by (1) measuring pollutants that had not been evaluated previously (e.g., hexavalent chromium)

and (2) monitoring at locations of potential exposure that had not been evaluated previously (e.g., several schools and parks). TCEQ, in coordination with Midlothian residents, designed the monitoring program, and URS Corporation, an environmental consulting company, implemented the program. This monitoring effort included four locations (stations 5, 6, 12, and 16 in Figure 6) where five VOC and inorganic samples were collected quarterly, and four additional locations (stations 8, 11, 15, and 20 in Figure 6) where five VOC and inorganic samples were collected during a single calendar quarter. Every sample collected during this program was a 24-hour average sample, and no continuous monitoring took place. All laboratory analyses were conducted by Eastern Research Group, Inc. (ERG)[2]. ATSDR has accessed the entire set of concentration measurements from this monitoring program and the quarterly data summary reports prepared by URS Corporation.

- **TCEQ's routine criteria pollutant monitoring.** Since the 1970s, Texas environmental agencies—the Texas Air Control Board (TACB), the Texas Natural Resources Conservation Commission (TNRCC), and now TCEQ—have managed the state's ambient air monitoring network of criteria pollutants. TCEQ currently operates dozens of criteria pollutant monitoring stations statewide. Two general types of criteria pollutant monitoring have occurred in Midlothian in recent years: continuous monitoring and periodic sampling. For sulfur dioxide, ozone, nitrogen oxides, and fine PM, TCEQ has operated continuous ambient air monitors that directly measure ambient air concentrations in the field, without the need for laboratory analysis. For PM and lead, the agency has conducted integrated sampling at regular frequencies: 24-hour average integrated samples are collected on filters every 6th day, and the sampling filters are sent to a contractor's laboratory to determine the PM and lead concentrations.[3] This sampling frequency (1-in-6 day sampling) is routinely applied in ambient air monitoring programs nationwide, in part because it ensures that sampling events occur on every day of the week over the course of a monitoring program. TCEQ provided ATSDR an electronic database of its entire history of criteria pollutant monitoring data for the Midlothian area.

- **TCEQ's monitoring for inorganics.** In addition to the recent measurements conducted as part of the Midlothian Ambient Air Collection and Analytical Chemical Analyses (as described earlier in this list), TCEQ has monitored for inorganics at multiple locations. As noted later in this report, the coverage of these monitoring stations varied with time: just one station operated in 1981, five stations operated for different periods between 1991 and 1993, and two stations operated for most years since 2002. At all of these locations, airborne inorganics in particulate matter—both PM_{10} and $PM_{2.5}$—were collected over 24-hour average sampling periods onto filters. No continuous monitoring for constituents of particulate matter has occurred, but continuous monitoring methods are not widely available for these pollutants. For nearly all of this time frame, TCEQ shipped the collected samples to contract laboratories for analysis, with the majority of filters analyzed by either Research Triangle Institute (RTI) or Desert Research Institute

[2] ERG also holds a mission support contract with ATSDR and provided technical assistance with interpreting data for this Health Consultation.

[3] In the Midlothian area, TCEQ has conducted both continuous monitoring and periodic sampling for PM. Note that continuous PM measurements are only available for fine particulate matter ($PM_{2.5}$).

(DRI). TCEQ provided ATSDR an electronic database of its entire history of monitoring data for inorganics collected in the Midlothian area.

- **TCEQ's VOC monitoring.** In addition to the recent VOC measurements conducted as part of the Midlothian Ambient Air Collection and Analytical Chemical Analysis (as described earlier in this list), TCEQ has conducted VOC monitoring at multiple locations (stations 5, 12, 14, and 19 in Figure 6) in the Midlothian area since 1993. At all of these locations, integrated canister samples were collected for either 1-hour or 24-hour averaging periods. No continuous ambient air monitoring has occurred for VOCs in the Midlothian area. TCEQ personnel oversee sample collection and samples are analyzed at a central TCEQ laboratory. TCEQ provided ATSDR an electronic database of its entire history of VOC monitoring data for the Midlothian area.

The remainder of this Health Consultation focuses on the four general categories of ambient air monitoring data listed above. ATSDR acknowledges that some additional short-term sampling efforts have been conducted in the Midlothian area, but these typically involved collecting a small number of samples over a very short time frame. Those results will be considered in the subsequent Health Consultations, but are not reviewed here because they account for such a small fraction of the overall set of air pollution measurements.

4.2 Pollutants Monitored

The ambient air monitoring programs in the Midlothian area have measured various pollutants since 1981. Taken together, these programs have generated ambient air monitoring data for more than 160 individual pollutants, including numerous pollutants (e.g., PM, inorganics, VOCs) expected to be emitted from cement kilns and steel mills.

As one indicator of the coverage of the pollutants measured to date, ATSDR compared the list of monitored pollutants to those that the facilities of interest have included in their TRI emission reports to EPA.[4] Table 5 lists every pollutant for which any of the four facilities included on TRI reports between 1988 and 2010. The table breaks this list of pollutants into those that have been included in some monitoring effort (Table 5A) and those for which no air pollution measurements are available (Table 5B).

The comparison shown in Table 5 reveals several notable findings, organized below by groups of pollutants. The text box on this page briefly summarizes these findings, and more detail on this assessment follows:

- **Inorganics.** The available ambient air monitoring data include measurements for more than 20 different inorganics. Some ambient air monitoring has occurred for every metal and metal compound category included on the Midlothian facilities' TRI forms between 1988 and 2010. Most of these data were collected in the respirable range ($PM_{2.5}$ and PM_{10}). All of this monitoring has been conducted by collecting airborne PM on filters and then analyzing the collected material for metal content. This is

Main Findings

The available ambient air monitoring data include measurements for some, but not all, of the pollutants emitted from the facilities of interest:

- At least some air monitoring has occurred in the Midlothian area for 32 percent of the pollutants documented on any of the four facilities' TRI reports over the entire history of reporting.

  Some monitoring data is available for every ***inorganic*** pollutant included in the facilities' emission reports, except for hydrochloric acid, sulfuric acid, and vapor-phase mercury.

  For ***VOCs***, monitoring has occurred for nine out of the ten pollutants that the facilities emitted in greatest quantities (e.g., toluene, benzene, and xylenes), based on their annual TRI emission reports. Numerous other VOCs—primarily those on emission reports submitted by Ash Grove Cement and TXI Operations—have never been monitored (e.g., formaldehyde). More than 2/3 of these pollutants were released in relatively small quantities (i.e., <200 pounds across all four facilities' entire history of TRI reporting).

- No ambient air monitoring has occurred for ***semi-volatile organic compounds*** (sVOCs), which include several groups of toxic chemicals reported in facility emissions (e.g., dioxins, furans, polycyclic aromatic hydrocarbons [PAHs]).

- Monitoring has occurred for several ***criteria pollutants and other substances*** that do not fall under the previous categories, including some known odorous pollutants and irritants. These include PM and sulfur compounds. Carbon monoxide is the only criteria pollutant that has not been monitored in the Midlothian area.

For the pollutants with limited or no environmental monitoring data,, ATSDR believes there is utility in modeling worst-case air conditions to determine if additional sampling is warranted. ATSDR will consider other sources of information (e.g., modeling data, engineering calculations) when evaluating their public health implications in future Health Consultations.

[4] ATSDR considered every chemical listed on the facilities' TRI reports, including those that have total air emissions of 0 pounds for a given year.

a fairly standard measurement approach for characterizing potential air quality impacts for most inorganics, but mercury presents an exception. In comparison to other metals, mercury has a much lower vapor pressure, which means a greater portion of mercury will be emitted in the vapor state and not bound to particulate matter. Some of the vapor phase mercury may eventually bind to airborne particles downwind from the facilities, but the extent to which this occurs is not known [EPA 1997a]. Therefore, because it is all based on particle-bound measurements, the available ambient air monitoring data for mercury in the Midlothian area likely understates actual airborne concentrations. Future Health Consultations will model mercury emissions and determine whether additional mercury sampling in other environmental media is warranted.

Another issue of concern regarding these data is the availability of data on different forms of chromium. This concern stems from the fact that airborne chromium exists in multiple forms, with some forms having a significantly different toxicity than others. The most common forms of chromium found in ambient air are trivalent chromium and hexavalent chromium. Trivalent chromium is an essential nutrient for humans and is relatively benign. Hexavalent chromium, on the other hand, is considerably more toxic, both for cancer and non-cancer health effects. Many of the commonly used sampling and analytical methods for metals measure ambient air concentrations of total chromium, without determining the relative quantities of the trivalent and hexavalent forms. However, the recent air monitoring study in Midlothian sponsored by TCEQ included methodologies suitable for quantifying the levels of airborne hexavalent chromium. Thus, some monitoring data are available for hexavalent chromium. Section 4.5 indicates the time frame for which the hexavalent chromium data are available, and the limitations associated with the temporal coverage of this monitoring.

Table 5 lists two additional inorganic pollutants—sulfuric acid and hydrochloric acid—that are included in some of the facilities' TRI forms that have not been measured in air monitoring studies. To evaluate "sulfuric acid," it is important to consider the various different chemical forms of sulfur expected to be found in stack emissions and ambient air. Sulfur is found in most fossil fuels. When the fuels are burned, the sulfur is initially released to the air primarily as sulfur dioxide or sulfur trioxide, but sulfur trioxide reacts quickly with airborne water to form sulfuric acid [EPA 1998a]. Therefore, industrial facilities that burn fossil fuels often times report air emissions of sulfur dioxide, sulfuric acid, or sometimes both pollutants. In ambient air, away from release sources, the chemical forms most commonly found are sulfur dioxide (a gas) and sulfate ion (found in fine PM) [EPA 2008]. Ambient air monitoring for both of these chemical forms has occurred in the Midlothian area; however, modeling of these constituents will be conducted in future Health Consultations to better understand air quality impacts from sulfur emissions.

In the case of hydrochloric acid, emissions most likely occur due to the combustion processes. Fuel sources at the cement kilns contain chlorine, and fossil fuel combustion and combustion of wastes typically releases hydrochloric acid [EPA 1999a]. All three cement kilns in Midlothian have disclosed hydrochloric acid emissions on TRI forms at some point over the past 20 years. However, TXI Operations is the only facility that included this pollutant on its most recent forms that were available when ATSDR first

began the present evaluation (i.e., for reporting year 2008). However, this facility's estimated hydrochloric acid emissions in 2008 were more than 10 times lower than the facility's estimated sulfuric acid emissions. Once in ambient air, the hydrochloric acid would most likely be found in fine PM as chloride ion. However, no chloride ion measurements have been made in the various monitoring programs in Midlothian. Given that hydrochloric acid emissions have been consistently lower than the cement kilns' sulfuric acid emissions, ATSDR's future Health Consultations will use the measured sulfate concentrations as an extreme upper bound estimate of the potential chloride ion levels in the Midlothian ambient air, while recognizing that the actual air concentrations of chloride ion are likely considerably lower.

- **VOCs.** The available ambient air monitoring data include measurements for dozens of different VOCs. Many of the VOCs that were monitored (see Table 5A) are also known to be emitted by the facilities of interest in Midlothian. To examine this issue further, ATSDR summed TRI air emissions data across all four facilities and all reporting years (1988 to 2008) to identify the toxic VOCs emitted in greatest quantities. The ten VOCs that accounted for the highest area-wide emissions on the TRI forms were, in decreasing order of air emissions: toluene, benzene, xylene (all isomers combined), 1,3-butadiene, naphthalene, styrene, chlorobenzene, ethylbenzene, 1,1,1-trichloroethane, and methyl ethyl ketone. As Table 5A shows, ambient air monitoring has occurred for nine of these ten VOCs, with no data currently available for naphthalene. Therefore, even though ambient air monitoring may not have been conducted for a large portion of the VOCs that the Midlothian facilities documented on their TRI forms, ambient air monitoring data are available for the VOCs that were emitted in the greatest quantities.

  As Table 5B notes, no monitoring data are available for several dozen VOCs identified on at least one of the Midlothian facilities' TRI forms (e.g., formaldehyde). Closer examination of Table 5B reveals that the overwhelming majority of these VOCs were included on TRI reports for either Ash Grove Cement or TXI Operations, most likely due to the quantities of these substances in the hazardous waste that the facilities have burned. Further, for the overwhelming majority of VOCs listed in Table 5B, the total emissions across all four facilities and all available TRI reporting years are less than 200 pounds. Thus, while no ambient air monitoring data are available for dozens of VOCs emitted by some Midlothian facilities over the past 20 years, the overwhelming majority of these pollutants have been released in relatively small quantities, based on the facilities' TRI forms.

  In summary, the VOC monitoring data available for the Midlothian area generally cover the specific toxic pollutants that the facilities have emitted in greatest quantities. While many additional VOCs that some facilities emitted over the years were never monitored, most of these pollutants appear to have been released in relatively small quantities. ATSDR's future Health Consultations will use modeling and other site-specific information to evaluate VOCs for which no ambient air monitoring data are available.

- **Semi-volatile organic compounds (sVOCs).** To date, no ambient air monitoring for sVOCs has been conducted in the Midlothian area. sVOCs are organic chemicals that have higher boiling points than VOCs. Due to this and other differences, ambient air

concentrations of sVOCs and VOCs typically cannot be measured reliably with a single sampling and analytical method and therefore must be measured separately.

At cement kilns, sVOCs are emitted to the air as products of incomplete combustion, and publicly available emission data and EPA guidance confirm that the facilities of interest release sVOCs into the air. For instance, all four facilities have reported air emissions of "dioxin and dioxin-like compounds" to TRI at least once since reporting year 2000. This TRI listing, by definition, is comprised of 17 individual pollutants that include both dioxins and furans [EPA 2000b]. Further, all four facilities likely emit polycyclic aromatic hydrocarbons (PAHs). This statement is based on the fact that one facility (TXI Operations) has included polycyclic aromatic compounds (PACs), a subset of PAHs, on its recent TRI forms. Also, EPA emission estimation guidance indicates that PACs tend to be released into the air from combustion of coal and fuel oil [EPA 1998b, 2001][5].

To assess the significance of this gap in the available environmental monitoring data, ATSDR will conduct dispersion modeling to evaluate the facilities' air emissions of dioxins, furans, and PAHs. Future Health Consultations will also determine whether additional sampling is warranted to look for these compounds in other environmental media (e.g., soil, water, food products).

- **Criteria pollutants and hydrogen sulfide.** In addition to the three main categories of pollutants listed above, ambient air monitoring in Midlothian has occurred for several other pollutants that all four facilities of interest are known to release into the air, including some odorous pollutants and known irritants. These pollutants include sulfur dioxide, ozone, hydrogen sulfide, nitrogen oxides, and three different types of PM defined by particle sizes: (1) total suspended particulate (TSP), which contains a wide range of particles, including some that are so large that they typically are not inhaled by humans; (2) particulate matter with diameters of 10 microns or less (PM_{10}), which are particles with sizes that can pass through the nose and throat and enter the lungs in humans; and (3) particulate matter with diameters of 2.5 microns or less ($PM_{2.5}$), which can penetrate deep into the lungs. Particulate sampling should detect airborne cement kiln dust.

  The only criteria pollutant directly emitted by the facilities for which no ambient air monitoring data are available is carbon monoxide. In future Health Consultations, ATSDR will use modeling and other site-specific information to evaluate this pollutant.

In summary, this evaluation suggests that at least some ambient air monitoring has been conducted in the Midlothian area for most metals of interest (though measurements of vapor-phase mercury have not been collected), for the VOCs that the facilities appear to emit in greatest quantities, and for selected gases (e.g., sulfur dioxide, nitrogen oxides, and ozone). No monitoring data are available for sVOCs, hydrochloric acid, or sulfuric acid.

The previous evaluation was intended to assess whether monitoring has been conducted for the pollutants of greatest interest. Using comparisons to TRI reports has limitations, because

[5] "PACs" is a chemical category listing in EPA's TRI reporting requirements. This category includes a subset of 21 PAHs selected for special consideration due to their persistence and toxicity.

facilities may emit pollutants that do not appear on the TRI forms.[6] However, the available monitoring data include measurements for many inorganics and VOCs in addition to those listed in Table 5. Thus, it is likely (particularly for the metals and elements) that monitoring has been conducted for pollutants released by the facilities but not disclosed on their TRI reporting forms.

[6] There are many reasons why the facilities might emit chemicals not included on the TRI forms. For instance, some emitted chemicals may not be reportable to TRI, and the facilities might use and emit certain chemicals in quantities below the TRI reporting thresholds.

4.3 Monitoring, Sampling, and Analytical Methods Used

From 1981 to the present, ambient air monitoring in the Midlothian area has been conducted using many different methodologies. During this same time, considerable progress has been made in the underlying science of air pollution measurements. This section identifies the various methods that have been used over the years, whether for continuous monitoring of air pollution or for integrated sampling followed by laboratory analysis. This section also presents ATSDR's evaluation of the methods used to date.

Main Findings

Methods. Nearly every air monitoring, sampling, and analytical method that has been used in the Midlothian area is well established, peer-reviewed, and capable of generating data of known quality. EPA currently uses several of these same methods in its various nationwide monitoring programs.

In short, ATSDR has confidence in the reliability of the various monitoring methods, with two exceptions:

- The metals samples collected in 1981 and between 1991 and 1993 were analyzed using a method that was commonly used at the time, but later found to potentially underestimate ambient air concentrations. This limitation will be considered in future Health Consultations. (Note: The lead sampling data from these time frames were collected using standard methodologies.)
- The method used to measure inorganics is known to significantly underestimate concentrations of nitrates.

Measurement sensitivity. For many pollutants, the ambient air monitoring methods used in the Midlothian area are sensitive enough to measure ambient air concentrations at levels of potential health concern. Meaning, the detection limits are either below or on the same order of magnitude of the most health-protective comparison values.

As the exceptions, the detection limits achieved by Desert Research Institute for arsenic and cadmium, the detection limits achieved by TCEQ for certain VOCs, and the detection limits for some of the hydrogen sulfide monitoring are not sensitive enough to measure concentrations at levels of potential health concern—a fact that ATSDR's future Health Consultations must take into account when interpreting data for these chemicals. Those documents will also consider the fact that these methods can report valid concentrations at levels below the detection limits.

- **Inorganics.** Every PM sample that was analyzed for inorganics (i.e., metals, elements, and inorganic compounds) in the Midlothian area shares some common features: the samples were collected by passing ambient air through sampling filters for 24 hours; the filters were removed from their high-volume measurement devices and sent to laboratories for analysis; and the laboratories measured the amounts of selected metals, elements, and inorganic compounds collected on the filters. Other than these general similarities, the individual monitoring programs differed in the measurement methodologies as follows:
    - During the 2008-2009 Midlothian Ambient Air Collection and Analytical Chemical Analysis Special Study, sampling and analysis of metals and elements in PM_{10} was conducted according to EPA Method IO-3.5 [URS 2009a]. This particular method involves collecting PM on quartz filters and analyzing the filters with inductively coupled plasma/mass spectrometry (ICP/MS). This sampling and analytical method has been extensively peer reviewed [EPA 1999b], and it is the same method that EPA currently uses in its National Air Toxics Trend Stations monitoring network and in its Schools Monitoring Initiative.

Table 6 lists the method detection limits reported for several inorganics. The method detection limits for EPA Method IO-3.5 are typically at least an order of magnitude—and often more than two orders of magnitude—lower than the detection limits achieved by the other methods described later in this section.

The 2008-2009 study also included monitoring for hexavalent chromium, which was conducted using a modified form of California Air Resources Board (CARB) Method 039 [URS 2009a]. While the CARB method involves collection of TSP on filters, the method used in this program collected a smaller particle size fraction (PM_{10}) on cellulose filters followed by analysis with ion chromatography. Except for the fact that the method used in the 2008-2009 study focuses on respirable particles as opposed to total particles, the method is identical to what EPA currently uses in its National Air Toxics Trend Stations monitoring network. The hexavalent chromium sampling and analytical method used in the Midlothian area achieves a method detection limit of 0.0000065 $\mu g/m^3$. This detection limit is low enough to measure ambient air concentrations of hexavalent chromium at levels of interest for public health assessment purposes. In other words, this detection limit is lower than ATSDR's most protective health-based comparison value for hexavalent chromium (0.00008 $\mu g/m^3$).

- From 2002 to 2009, TCEQ collected 24-hour average PM samples at its routine monitoring sites in the Midlothian area. These samples were collected for two different sizes of particles: PM_{10} and $PM_{2.5}$. The $PM_{2.5}$ samples collected between 2002 and 2004 were analyzed by Research Triangle Institute, and samples collected between 2004 and 2009 were analyzed by Desert Research Institute (DRI). The PM_{10} samples were analyzed by the TCEQ Houston Laboratory. Over the entire time frame, the $PM_{2.5}$ samples were collected on Teflon filters, and the PM_{10} samples were collected on quartz filters. The $PM_{2.5}$ samples were subsequently analyzed using energy dispersive x-ray fluorescence (XRF), following procedures consistent with those outlined in EPA Method IO-3.3. This sampling and analytical method has also been extensively peer reviewed [EPA 1999b] and is currently used to analyze samples collected under EPA's nationwide Chemical Speciation Network. The PM_{10} samples were analyzed using inductively coupled plasma spectroscopy, another well established and peer reviewed method.

  While the method has been shown to generate highly accurate and precise results, particularly for pollutants found at higher concentration, it has also been reported to "significantly underestimate" ambient air concentrations of non-volatile nitrate [Tropp et al. 2007]. Though nitrate data are included in the final database of measurement results, ATSDR will use caution when interpreting these data in future Health Consultations.

  Table 6 lists the average method detection limits that DRI has reported between 2004 and 2009. While these detection limits are higher than those reported for the 2008-2009 study, the method is still sensitive enough to measure ambient air

concentrations of metals and elements at levels of potential health concern, with the exceptions of arsenic and cadmium.

- In 1981 and from 1991 to 1993, the Texas state environmental agencies at the time used what was then a fairly standard methodology for measuring ambient air concentrations of PM: high-volume samplers were used to collect airborne particulates on quartz filters. After the samples had been collected and weighed to determine ambient air concentrations of PM, some of the quartz filters were sent to a laboratory for metals analysis by XRF. The 1981 sampling was for TSP and the 1991-1993 sampling was for PM_{10}.

  While this sampling and analytical approach was widely used at the time, research published since 1993 has suggested that analyses by XRF are not appropriate for samples collected on pure quartz filters. For instance, a widely-cited publication on particulate matter measurements does not list XRF as a compatible analytical method for particles collected on pure quartz filters [Chow 1995]. Based on this and other research, EPA's Compendium of Methods for the Determination of Inorganic Compounds in Ambient Air, which was first published in 1999, also does not list XRF as a compatible analytical method for particles collected on pure quartz filters [EPA 1999b]. The incompatibility results from the fact that particles can penetrate quartz filters at depths that the XRF analyses cannot resolve. It is for this reason that other filter types (e.g., Teflon) have been used more widely in recent years when conducting laboratory analyses using XRF.

  Given the incompatibility between the filter medium (quartz) and analytical method used (XRF), ATSDR concludes that the metals data collected in Midlothian in 1981 and between 1991 and 1993 are of unknown quality, and may underestimate actual ambient air concentrations. These data will be used for screening purposes, but not for drawing health conclusions in subsequent health consultations.

- **VOCs.** All VOC measurements in the Midlothian area have been collected since 1993. This timing is significant because EPA published the first edition of its compendium of sampling and analytical methods for organic compounds in 1988 [EPA 1988]. Thus, widely accepted sampling and analytical methods have been available for the entire time frame that VOC monitoring has occurred in Midlothian. The majority of VOC measurements during this time frame were made from 24-hour average samples, though some 1-hour average samples were also collected.

  The VOC monitoring during the 2008-2009 Midlothian Ambient Air Collection and Analytical Chemical Analysis has been conducted according to EPA Method TO-15 [EPA 1999c]. By this method, ambient air is drawn into a stainless steel canister, and the sampling container is analyzed by a laboratory using gas chromatography with mass spectrometry detection (GC/MS). This is the method that EPA currently uses in its National Air Toxics Trend Stations monitoring network and was used in its Schools Monitoring Initiative. TCEQ has historically used stainless steel canister sampling for its

routine VOC monitoring. The agency's current standard operating procedures are publicly available [TCEQ 2010c].

Table 7 lists the detection limits for selected VOCs achieved by the laboratories that have been analyzing the overwhelming majority of VOC samples collected in the Midlothian area. Two sets of detection limits are reported. The first set pertains to the detection limits reported for the 2008-2009 sampling effort. For this study, the analytical laboratory achieved detection limits for almost every pollutant either below or on the same order of magnitude of the health-based comparison values, indicating that the methods achieve adequate sensitivity for health assessment purposes. In the case of 1,2-dibromoethane, the detection limits are more than 30 times higher than the lower health-based comparison value. However, there is no evidence that the Midlothian facilities use, process, or release 1,2-dibromoethane.

The second set of detection limits shown in Table 7 are those reported by TCEQ's analytical laboratory [TCEQ 2010c]. These detection limits apply to the VOC data collected in Midlothian before the 2008-2009 study. As the table shows, this second set of detection limits is not as sensitive as those achieved in the 2008-2009 study. There can be many reasons why detection limits vary from one laboratory to the next, even when they follow the same sampling and analytical method. For every pollutant listed in Table 7, TCEQ's detection limit is at least ten times higher than the corresponding detection limit reported for the 2008-2009 study. Further, for the majority of pollutants listed in the table, TCEQ's detection limits are greater than the health-based comparison values, indicating that these laboratory analyses do not always achieve the sensitivity that would be desired for assessing these pollutants—a fact that ATSDR will consider in its future Health Consultation that interprets the health implications of exposures to VOCs. Although the published detection limits are higher before 2008, it is important to note that TCEQ routinely reported data below the detection limit and down to the reporting limit of 0.01 ppb. These data are still useful for evaluating exposures, and ATSDR will consider these measurements in future documents. Readers interested in more information on the TCEQ detection limits for VOC are referred to the agency's standard operating procedures for EPA Method TO-15 [TCEQ 2010c].

- **Criteria pollutants.** Since 1981, ambient air monitoring for criteria pollutants in the Midlothian area has occurred for different size fractions of PM, lead, sulfur dioxide, ozone, and nitrogen oxides. For these pollutants, EPA publishes and frequently updates a list of federal reference methods and automated equivalent methods [EPA 2010e]. EPA assigns this distinction to scientifically rigorous methods that have been shown to be capable of generating highly accurate and precise measurements at concentrations comparable to the agency's health-based air quality standards.

  With one exception, all monitoring of criteria pollutants in the Midlothian area has been conducted using one of these EPA-approved methods. Specifically, the devices used to measure nitrogen oxides (Teledyne Advanced Pollution Instrumentation model 200E), ozone (Teledyne Advanced Pollution Instrumentation model 400E), and sulfur dioxide (Teledyne Advanced Pollution Instrumentation model 100E) all appear on EPA's most recent listing of federal reference methods and automated equivalent methods [EPA

2010e]. For these three pollutants, measurements occur continuously and the devices record and output 1-hour average concentrations; for sulfur dioxide, concentrations are also available for 5-minute averaging periods.

The exception is that continuous $PM_{2.5}$ monitoring in Midlothian is conducted using a rigorous and widely-used technology (Thermo Scientific tapered element oscillating monitor), but the measurements are not used to assess compliance with the federal health-based National Ambient Air Quality Standards. ATSDR found that measurements using this device correlated well with measurements conducted using the federal reference method. ATSDR therefore concludes that the monitoring methods that have been used in Midlothian to measure criteria pollutants are suitable for health assessment purposes. However, as described in the next section, the continuous $PM_{2.5}$ monitoring data were found to have a slight negative bias.

- **Hydrogen sulfide.** The previous discussion comments on every ambient air monitoring method that has been used in the Midlothian area, except for the method used to measure hydrogen sulfide. ATSDR reviews the hydrogen sulfide monitoring methodology separately, because hydrogen sulfide is not designated as a criteria pollutant. Therefore, EPA has not published any lists of required or recommended methods for continuous hydrogen sulfide measurements.[7] The overwhelming majority of hydrogen sulfide monitoring data for the Midlothian area is generated using a Teledyne Advanced Pollution Instrumentation model 101E hydrogen sulfide analyzer. This device measures ambient air concentrations of hydrogen sulfide continuously and outputs 1-hour average values. The method typically achieves hydrogen sulfide detection limits lower than ATSDR's Minimal Risk Level and has been successfully applied in other ambient air monitoring programs. ATSDR believes this method is capable of generating data of a known and high quality. However, two limitations are noted: (1) monitoring results from the Cedar Drive monitoring station are not being considered, because they were collected using a highly 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, which is acceptable for evaluating short-term exposures but is not sensitive enough to measure concentrations that may be of interest for long-term exposures. ATSDR's future documents will consider this finding when interpreting the hydrogen sulfide data collected prior to 2000.

[7] No "federal reference methods" or "automated equivalent methods" have been developed for hydrogen sulfide. However, some of EPA's automated equivalent methods for sulfur dioxide can be operated in a manner to measure hydrogen sulfide concentrations.

4.4 Data Quality of the Air Pollution Measurements

Main Findings
ATSDR reviewed various data quality indicators from the ambient air monitoring programs that have been conducted in the Midlothian area. Overall, except for the special considerations listed below, these indicators suggest that the air pollution measurements are of a known quality and suitable for health assessment purposes.

Special considerations for ATSDR's future Health Consultations are:

- The continuous $PM_{2.5}$ monitoring devices used in Midlothian appear to be systematically understating ambient air concentrations. At the Old Fort Worth Road monitoring station, for instance, concentrations measured by the continuous device are consistently lower than those measured by the federal reference method monitor. This slight negative bias, which varies across years and seasons, will be accounted for in the future Health Consultation on criteria pollutants.
- Ambient air concentrations for inorganics have been shown to be highly precise, but measurement precision decreases as concentrations becomes less than the limit of quantitation and near the substances' detection limits (as occurs for most ambient air sampling and analytical methods).
- Some inorganics reported in the monitoring data are also found in trace levels in the sampling filters. Measured concentrations comparable to levels found in field blanks should be interpreted with caution.

Community members have expressed concern to ATSDR about the validity of the ambient air monitoring data that have been collected in the Midlothian area over the years. This section presents ATSDR's evaluation of data quality of the various monitoring efforts. Separate data quality evaluations were performed for the five different monitoring programs identified in Section 4.1. In these evaluations, ATSDR considered many different indicators of data quality, such as completeness (the fraction of scheduled sampling events that resulted in a valid measurement), precision (the repeatability of measurements), and accuracy (the extent to which monitoring data represent the actual air pollution levels).

- **Holcim settlement agreement monitoring.** ATSDR based its data quality evaluation for the continuous $PM_{2.5}$ monitoring on information documented in the quarterly reports prepared by the consultant that oversees this program. When ATSDR first drafted this Health Consultation, nearly every quarterly report from 2006 to 2009 was available for review [Trinity Consultants 2006-2010]. The quarterly reports document the completeness for 3-month time frames. Between January 2006 and June 2009, the monitor successfully operated 91 percent of the time. Gaps in the available environmental monitoring data occurred for various reasons. For example, short-term data gaps on the order of a few hours tended to result from power outages, inclement weather, and unit maintenance. Five data gaps of 1 week or longer have also occurred, and these were typically due to malfunctioning equipment. The quarterly reports document various calibrations, audits, and other procedures that have been conducted to ensure the monitoring equipment operated according to manufacturer specifications.

  Based on the information documented in the quarterly reports, ATSDR finds the data generated by the continuous $PM_{2.5}$ monitor to be suitable for health assessment purposes.[8]

[8] Researchers from UT-Arlington have issued several technical memoranda reviewing the ambient air concentrations reported by this continuous monitor [UT-Arlington 2008-2010]. None of these memoranda raise concerns about the quality of the monitoring data that have been generated to date.

For the five extended time frames when the monitor was not operating, insights on potential $PM_{2.5}$ air pollution levels can be evaluated based on a review of Holcim's continuous emission monitoring data.

- **Midlothian Ambient Air Collection and Analytical Chemical Analysis.** ATSDR based its data quality evaluation for the recent 2008-2009 monitoring in Midlothian on the four summary reports that URS issued for this program [URS 2009b,c,d,e]. This program followed quality control procedures outlined in the monitoring program's Quality Assurance Project Plan [URS 2009a]. Sampling and analysis for VOCs and metals followed the performance guidelines specified in the peer-reviewed EPA methods. As noted in the document, the parties that implemented this monitoring program conducted extensive quality control activities before any samples were collected.

  TCEQ's contractor has also tracked several data quality indicators. The measurement completeness for metals and hexavalent chromium was 100 percent, which means that every single scheduled sampling event resulted in a validated measurement. The measurement completeness for VOCs was just below 100 percent: one sample out of 260 scheduled samples did not result in a valid measurement . These high completeness fractions suggest that the program was implemented effectively.

  The quarterly data reports also provide insights on measurement precision, as gauged by analyses of duplicate samples. The monitoring program's data quality objectives indicate that measurement precision for VOCs and hexavalent chromium should fall within 30 percent and measurement precision for metals should fall within 20 percent [URS 2009a]. For most of the target VOCs listed in Table 7, the percent difference in concentrations measured in duplicate samples was lower than 30 percent, consistent with the program's data quality objectives. Poorer precision was observed for the two trimethylbenzene isomers, methylene chloride, and xylene isomers. For the trimethylbenzene isomers the poorer precision most likely occurred because ambient air concentrations for these pollutants were very close to the detection limit, where measurement variability is known to be greater. For m,p-xylene, the average relative percent difference observed across the program was 83 percent. The principal investigators of this program concluded that the poor precision for xylene and that measurements for this pollutant do not appear to reflect large systemic laboratory errors [URS 2009e]. For metals, the initial duplicate sample collected during the first quarter did not show good agreement for several pollutants [URS 2009b]; however, the program average precision estimates were all near or below the program's data quality objectives [URS 2009e]. The measurement precision was worst for silver, cadmium, and mercury, but the observed relative percent differences for these pollutants are within ranges that ATSDR views as acceptable for health assessment purposes (especially considering the magnitude of the concentrations measured). It should be noted that ATSDR will use the highest concentration reported between duplicate samples to provide a health-protective approach to exposure assessment.

  The quarterly data reports also present data on VOCs and metals found in field blanks. Several metals were found in at least two field blanks at concentrations greater than five times their detection limits: barium, total chromium, copper, manganese, molybdenum, and silver [URS 2009b,c]. This is significant because it suggests that the measured

concentrations for these metals are likely overestimates, because some of the metals identified in these samples may have originated in the filters themselves and not in the ambient air that was being tested. ATSDR's future Health Consultations will consider all field blank results when interpreting measured ambient air concentrations of metals and elements.

Overall, ATSDR finds the ambient air monitoring data collected during the Midlothian Ambient Air Collection and Analytical Chemical Analysis project to be of a known and high quality.

- **TCEQ's routine criteria pollutant monitoring.** ATSDR considered two sources of information when reviewing the quality of TCEQ's routine criteria pollutant monitoring data, as documented below:

    - *Data quality indicators reported to EPA.* In addition to submitting measured ambient air concentrations to EPA, state environmental agencies that are responsible for routine criteria pollutant monitoring must generate and submit data quality indicators to EPA regarding those measurements. Examples of the type of information that agencies must report include outputs from concentration audits, outputs from flow rate audits, and concentrations measured by co-located samplers. To examine TCEQ's performance in criteria pollutant monitoring, ATSDR accessed the most recent annual data quality indicator reports posted to EPA's Ambient Monitoring Technology Information Center website [EPA 2010e]. This review indicated that TCEQ meets its requirement to report data quality indicators to EPA and the reported indicators for the Midlothian area monitors meet the corresponding guidelines that EPA has established.

    - *Inter-method comparisons.* In recent years, TCEQ has simultaneously operated two different $PM_{2.5}$ monitoring devices at the same monitoring location. This occurred both at the Midlothian Tower and the Old Fort Worth Road monitoring stations (see Table 4). At both locations, two different measurement devices were used. The first is a federal reference method $PM_{2.5}$ monitor, in which ambient air is drawn through a filter for a 24-hour period and the filter is later weighed in a laboratory to measure the $PM_{2.5}$ concentration. These samples are collected once every six days. The second monitoring device is a continuous $PM_{2.5}$ monitor, in which ambient air passes over a filter cartridge that collects the airborne $PM_{2.5}$ and constantly weighs the mass of material collected. The air stream in the continuous device is heated to 50 degrees Celsius before sampling, and this heating may volatilize some compounds before measurement occurs. This continuous device outputs measured concentrations on an hourly basis.

      In theory, the federal reference method $PM_{2.5}$ measurements and the continuous $PM_{2.5}$ measurements for the same time frames should be identical. However, slight differences in the underlying sampling technologies leads to slight differences in the measured concentrations, even for the same time frame. Because TCEQ simultaneously operated federal reference method devices and continuous devices, ATSDR could quantify the differences between the

measurements for the specific dates when the two devices generated valid results. Such calculations are known as inter-method comparisons.

Table 8 compares the $PM_{2.5}$ measurements generated by the two different methods. In general, the 24-hour average concentrations for the federal reference method and the continuous $PM_{2.5}$ monitors were highly correlated; however, the federal reference method, on average, reported $PM_{2.5}$ concentrations that were 13 percent and 23 percent higher than those reported by the continuous monitor; the two different percentages correspond to the data sets for the two different monitors shown in Table 8. Given that the federal reference method is often viewed as the "gold standard" for $PM_{2.5}$ measurements, it is likely that the continuous $PM_{2.5}$ monitors understate actual ambient air concentrations by as much as 23 percent—an observation that will be factored into ATSDR's future Health Consultations. The negative bias in this particular type of continuous $PM_{2.5}$ monitor is consistent with findings that have previously been reported in the peer-reviewed literature [e.g., Allen et al. 2007]. The magnitude of the negative bias does vary from year to year and also across seasons.

- **TCEQ's monitoring for inorganics.** As noted previously, TCEQ currently sends its PM filters collected in Midlothian to DRI for laboratory analysis. DRI carries accreditation by the National Environmental Laboratory Accreditation Conference for analyzing these samples. This accreditation was issued after DRI passed proficiency tests coordinated by the accrediting body. DRI's laboratory supports many environmental monitoring efforts, including EPA's nationwide Interagency Monitoring of Protected Visual Environments network.

  ATSDR considered multiple information sources when evaluating the quality of analytical data generated by DRI. ATSDR first accessed two memos documenting EPA audits of DRI's laboratory, both of which were conducted as part of the agency's quality assurance oversight for the nationwide Chemical Speciation Network [EPA 2005, 2007]. After considering multiple analytical procedures at DRI, the audits concluded that the laboratory's XRF analyses followed "good quality control practices," and EPA did not identify any deficiencies regarding the XRF analyses [EPA 2007].

  ATSDR also evaluated documents provided by DRI. Of note, DRI's quality assurance project plan (QAPP) requires that replicate analyses of a filter occur with each set of ten filters. Should measured concentrations of selected elements in these replicate analyses differ by more than 10 percent, DRI reanalyzes the entire batch of filters until acceptable consistent results are achieved [DRI 2009]. Similarly, ATSDR considered scientific publications issued by DRI researchers. One such publication, for example, evaluated a large database of co-located samples and reported generally good comparability between measurements, except when concentrations approached the detection limits [Tropp et al. 2007]. This publication also emphasized the need to consider field blank data when interpreting measured concentrations of metals and elements, because some of these pollutants are commonly found at trace levels in certain filter media.

- **TCEQ's monitoring for VOCs.** All VOC canister samples that TCEQ collects in the Midlothian area are analyzed by the agency's Air Laboratory. The Air Laboratory is accredited through the National Environmental Laboratory Accreditation Program for this analysis. These samples are analyzed according to the agency's standard operating procedure #AMOR-06, which is a modified form of EPA Method TO-15 [TCEQ 2010c]. TCEQ's analytical procedures document and discuss all deviations from the EPA method. ATSDR has reviewed these deviations and has no reason to believe they affect the quality of the VOC measurements. TCEQ's standard operating procedures document numerous quality control checks that must be passed for the VOC samples. For instance, the laboratory periodically will conduct "duplicate measurements" of VOCs in a canister. In a duplicate measurement, the laboratory will measure the amount of VOCs in a sample and then make another measurement from the same sample; the two sets of measurements are then compared to assess the precision of the method. At TCEQ's laboratory, duplicate analysis of VOC samples occurs at least once out of every 20 samples that are analyzed, and compounds found above the detection limit must be measured within 25 percent precision. In addition, to assess measurement accuracy, laboratory control samples are analyzed once in every batch of 20 samples and the measured concentrations must fall within 30 percent of the known values. Through these and other measures, TCEQ ensures that its VOC measurements are highly precise and accurate at concentrations above the limit of quantitation. (Note: In cases where sampling events have duplicate analyses, ATSDR will choose the higher measurement for health evaluation purposes, which is a protective approach.)

  Quantitative indicators of TCEQ's laboratory performance are available from a recent sampling program, in which the agency collected four "split samples" that were analyzed both by TCEQ and by an external laboratory (Test America). ATSDR evaluated the differences between TCEQ's measurements and the external laboratory's measurements, based on the raw data that the two laboratories reported [TCEQ 2010d]. Across the four split samples, ATSDR computed concentration differences for the pollutants that both laboratories detected. In most cases, the two laboratories' measured concentrations differed by less than 30 percent, indicating good agreement for this method. In 16 instances, the measured concentrations differed by more than 30 percent. However, in 13 out of 16 of these instances, TCEQ's laboratory measured a concentration higher than the external laboratory. This comparison suggests that the TCEQ laboratory likely does not have a systematic negative bias in its measurements.

4.5 Time Frames Covered by Monitoring Programs

Main Findings
Prior to May 1981, no ambient air monitoring data are available for the Midlothian area. Since 1981, validated ambient air monitoring data suitable for health assessment purposes are available for several time frames, but the availability of validated data varies by pollutant and changes from one year to the next.

The time frames up through 2010 for which at least some valid measurements are available follow:

- PM: 1981-1984 and 1991-2010
- Metals (except lead): 2001-2010
- Lead: 1981-1984, 1992-1998, and 2001-2010
- VOCs: 1993-2010
- Sulfur compounds: 1985 and 1997-2010
- Nitrogen oxides: 2000-2010
- Ozone: 1997-2010

Environmental monitoring data clearly are not available for all pollutants, over all time frames, and across all locations of interest. The most important data gaps are (1) the lack of any monitoring data before 1981 and (2) the lack of data in the vicinity of Ash Grove Cement during years when the facility burned hazardous waste.

One of this document's objectives is to specify the time frames for which available ambient air monitoring data are suitable for health assessment purposes. Though the response to this question varies by pollutant and location in the Midlothian area, this section documents the time frames over which validated ambient air monitoring data are available for at least one monitoring station in the Midlothian area. The findings that follow are also depicted in the time line shown in Figure 7 and in the station-specific data availability shown in Table 4. This section considers monitoring data available through calendar year 2010. Some monitoring stations in Midlothian continue to operate into 2011.

- **PM data availability.** As Figure 7 shows, PM monitoring data were first collected in Midlothian in 1981. From 1981 to 1984, the PM monitoring measured ambient air concentrations of TSP, as was standard practice during this time.

  Routine PM monitoring in the Midlothian area did not continue again until 1991, when PM_{10} monitors were installed in the area. Monitoring for this particle size fraction continued through 2004.

  With a growing body of scientific research linking exposure to fine particulate matter ($PM_{2.5}$) and health effects, environmental regulatory agencies began launching $PM_{2.5}$ monitoring networks in the late 1990s. Consistent with this trend, ambient air monitoring for $PM_{2.5}$ in Midlothian has occurred between 2000 and 2010.

- **Inorganics data availability.** Referring again to Figure 7, ambient air monitoring for inorganics first occurred in Midlothian in 1981. However, for reasons outlined in Section 4.3, the methodology that the Texas environmental agencies used to measure ambient air concentrations of inorganics (except for lead) during and prior to 1994 is not suitable to use to draw health conclusions. These data will, however, be used for screening purposes and to help understand ambient trends over time. The first ambient air monitoring data for metals useful for health assessment purposes were generated in 2001.

  Lead is an exception because EPA had already published rigorous sampling and analytical methodologies prior to 1981, and these methodologies were followed whenever ambient air monitoring for lead was conducted in the Midlothian area. Therefore, for lead, at least some valid measurements are available for a longer time frame than for the other metals and elements.

- **VOC data availability.** As Figure 7 shows, some VOC ambient air monitoring has occurred in the Midlothian area between 1993 and 2010, but no monitoring was conducted prior to 1993.

- **Sulfur compound data availability.** Ambient air monitoring for sulfur compounds—sulfur dioxide and hydrogen sulfide—occurred in 1985 and 1986 and again from 1997 to the present. No data are available for these pollutants for other years.

Overall, this section is only meant to identify (1) the time frames during which any ambient air monitoring occurred in Midlothian and (2) the time frames when no monitoring took place. Later sections of this Health Consultation evaluate the spatial coverage of monitors for the time frames when monitoring occurred.

For years in which no monitoring took place, ATSDR may still be able to make inferences about public health implications of exposure. Such inferences will have to be based on multiple factors, including the nature and extent of facility operations, the amounts and types fuels used (e.g., coal, tires, hazardous waste), installation and operation of air pollution controls, and changes in meteorological conditions. When making inferences based on these and other factors, ATSDR will thoroughly document all assumptions in its Health Consultations and comment on uncertainties associated with reaching health conclusions for time frames when ambient air monitoring did not occur.

4.6 Monitoring Frequencies and Durations

Main Findings
This section documents ATSDR's review of the monitoring schedules and explains why the agency reached the following conclusions:

- The monitoring frequencies and durations used in the Midlothian area vary from one pollutant to the next, and are consistent with monitoring methodologies commonly used throughout the country.

  Depending on the pollutant, concentration data are reported either entirely as 1-hour average values (hydrogen sulfide, nitrogen dioxide, ozone, sulfur dioxide), entirely as 24-hour average values (inorganics), or as a combination of the two averaging times (PM, VOCs). These averaging times are adequate for evaluating the implications of short-term and long-term exposures.

- 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.

- Trends among the Midlothian monitoring data indicate that 1-in-6 day sampling schedules are sufficient for characterizing air pollution levels over the long term (e.g., for periods of 1 year and longer) and for characterizing 90th percentile concentrations in 24-hour average concentrations.

- Trends among the Midlothian monitoring data confirm that 1-in-6 day sampling schedules may not capture the days with the highest air pollution levels. $PM_{2.5}$ monitoring data suggest that the maximum concentrations from 1-in-6 day sampling can understate the actual highest 24-hour average air pollution levels by as much as 44 percent. Therefore, for pollutants that are not monitored continuously (inorganics and VOCs), there is a greater likelihood that peak air pollution levels are not being characterized. This is simply due to the greater probability that higher concentrations occur on non-sampling days, and not due to any evidence of facilities altering their emissions based on the sampling schedule.

Several community members asked ATSDR to comment on the durations and sampling frequencies that have been used in the Midlothian area. The duration of samples refers to the amount of time over which air is sampled to measure a concentration. Some durations for Midlothian are as short as one hour, while other measurements are based on 24-hour average samples; and for sulfur dioxide, measurements are available for 5-minute averaging times. Sampling frequencies refer to how often measurements are made. Some monitors in the Midlothian area report ambient air concentrations continuously (e.g., every hour of the day, every day of the week), while others collect samples at set frequencies (e.g., one 24-hour average sample collected every sixth day).

Overall, the duration and frequency of sampling used in the Midlothian area are fairly standard for ambient air monitoring programs. Nonetheless, ATSDR conducted several quantitative analyses to evaluate specific community concerns regarding the timing of the monitoring and sampling activities. The remainder of this section addresses these specific community concerns.

- **Do facilities intentionally lower emission rates when 1-in-6 day samples are scheduled?** At several public meetings, community members have voiced concern to ATSDR about the utility of 1-in-6 day sampling because local facilities know in advance when these samples are being collected. Some community members have suggested that the facilities might be intentionally adjusting (i.e., lowering) their emissions on days when the 1-in-6 day samples were collected to avoid having their emissions detected. If this were the case, then ATSDR would expect to see elevated air pollution levels on the continuous real time monitors and higher facility emission rates on dates when 1-in-6 day samples *were not* collected. ATSDR evaluated

continuous PM ambient air monitoring data and continuous emission monitoring data to evaluate this concern:

- *Evaluation of continuous ambient air monitoring data.* Two ambient air monitoring stations—Old Fort Worth Road (station 12 in Figure 6) and Midlothian Tower (station 19 in Figure 6)—were previously equipped with both a continuous PM monitor and a 1-in-6 day sampling device. The continuous PM monitoring data from these sites can therefore be used to compare PM levels on days when 1-in-6 day samples were collected to levels on days when these samples were not collected. Table 9 presents this comparison.

  As the table shows, ambient air concentrations of $PM_{2.5}$ at both the Old Fort Worth Road and Midlothian Tower monitoring stations are virtually no different between days when 1-in-6 day samples were collected and days when no sampling occurred. For example, the average $PM_{2.5}$ levels were higher on days when 1-in-6 day sampling occurred as compared to days when no sampling occurred, but this concentration difference was marginal (5.3 percent at the Midlothian Tower site and 1.0 percent at the Old Fort Worth Road site) and not statistically significant, which means the concentration difference could have been by chance.

  ATSDR repeated this evaluation for hydrogen sulfide and sulfur dioxide, because these pollutants are also measured continuously south of Midlothian and are emitted by the facilities of interest (particularly sulfur dioxide). As Table 9 indicates, concentrations for these two pollutants also were, on average, highly similar between days when 1-in-6 day air samples were collected in the area and days when no samples were scheduled.

  Thus, whether looking at $PM_{2.5}$, hydrogen sulfide, or sulfur dioxide, the continuous monitors upwind and downwind from the Gerdau Ameristeel and TXI Operations facilities provide no evidence of considerably higher or lower air pollution levels on the specific days when 1-in-6 day samples were being collected. Otherwise stated, the continuous $PM_{2.5}$, hydrogen sulfide, and sulfur dioxide ambient air monitoring data provide no evidence of Gerdau Ameristeel or TXI Operations considerably altering their emissions to obscure trends in off-site ambient air monitoring data.

- *Evaluation of continuous emission data.* As noted previously in this Health Consultation, three of the four Midlothian facilities are required to continuously monitor air emissions of several pollutants. ATSDR could not conduct similar evaluations for Gerdau Ameristeel, because the facility's air permit does not require any continuous emission monitoring. For the remaining three facilities, the continuous emission monitoring data provide another opportunity to assess whether the facilities intentionally alter emissions on days when air samples are scheduled. To investigate this issue, ATSDR compared measured pollutant-specific emission rates on days when 1-in-6 day samples were collected to

measured emission rates on days when no sampling occurred. Table 10 presents this comparison.

As Table 10 indicates, over a recent 3-year period (September 2005 to December 2008), TXI Operations' emissions of four pollutants—carbon monoxide, nitrogen oxides, sulfur dioxide, and total hydrocarbons—were virtually no different on days when 1-in-6 day PM samples were collected at nearby offsite air monitors as compared to days when offsite samples were not collected. The differences in emission rates shown in Table 10 were minimal (not more than 2.4 percent for the pollutants considered) and not statistically significant, which means the differences could have been by chance.

Therefore, TXI Operations' continuous emission monitoring data confirm that the facility's stack emissions of several major pollutants, on average, were not systematically and significantly higher or lower on days when 1-in-6 day samples were collected at the offsite ambient air monitors. This finding is consistent with the analyses of continuous ambient air monitoring data, described above and presented in Table 9.

To examine this issue further, ATSDR also considered whether air emissions from Ash Grove Cement and Holcim exhibited any signs of increased emissions when 1-in-6 day samples were not collected, even though these facilities are located further away from the air monitors with the longest period of record for 1-in-6 day sampling. Table 10 presents those analyses for every pollutant that is monitored continuously in Ash Grove Cement's and Holcim's kiln stacks. As the table shows, emission rates of carbon monoxide, nitrogen oxides, and sulfur dioxide from Ash Grove Cement's and Holcim's main stacks have minimal differences between days when 1-in-6 day air samples were collected in the Midlothian area and days when these samples were not scheduled. Further, these differences in emission rates were not statistically significant, which means the minimal differences may be due to chance alone.

Taken together, ATSDR's evaluation of continuous ambient air monitoring data (Table 9) and continuous emission monitoring data (Table 10) found no evidence of systematic bias in the 1-in-6 day ambient air sampling schedule. Whether looking at PM air pollution levels or at the most relevant continuous emission data available for analysis (i.e., from TXI Operations and Ash Grove Cement), there are no notable differences between days when offsite samples are collected and when no sampling occurs.

While ATSDR was completing the draft of this Health Consultation, TCEQ published its interpretation of monitoring data collected during the 2008-2009 Midlothian Ambient Air Collection and Analytical Chemical Analysis. One of the goals of TCEQ's study was to assess whether industry changed its operations based on knowledge of when 1-in-6 day samples were being collected. Based on its review of the monitoring data, TCEQ concluded "…there is no difference between a regulatory every 6th-day sampling day and the other sampled days during this study" [TCEQ 2010f]. In short, TCEQ reached the

same conclusion as ATSDR, even though TCEQ's evaluation was based on an entirely different data set.

- **How effective are 1-in-6 day sampling schedules for characterizing *long-term* exposures?** Several community members have voiced concern to ATSDR about the utility of 1-in-6 day sampling schedules for public health assessment purposes. This section uses continuous ambient air monitoring data from the Midlothian area to evaluate the utility of the 1-in-6 day measurements for characterizing *long-term* exposures.

  Three ambient air monitoring stations in the Midlothian area are (or have been) equipped with continuous $PM_{2.5}$ monitors. That means these monitors are constantly measuring ambient air concentrations of $PM_{2.5}$. With these continuous results, ATSDR could actually quantify the effectiveness of 1-in-6 day sampling by constructing some "what if" scenarios. This was done as follows: For a given station, ATSDR first compiled a time series of the 24-hour average $PM_{2.5}$ concentrations measured by the continuous monitor. With this time series, ATSDR calculated the average concentration over the entire period of record. ATSDR then used data from these three stations—more than 5,500 24-hour measurements in all—to examine the utility of 1-in-6 day sampling. This was done by comparing (1) the average concentrations for each station's entire time series of monitoring data to (2) average concentrations calculated from every sixth day of measurements from these stations. Table 11 presents these results.

  As the table shows, at all three monitoring stations with continuous data, the average $PM_{2.5}$ concentrations calculated from every sixth day of measurements were virtually no different[9] from the average $PM_{2.5}$ concentrations calculated based on the continuous set of data. This observation indicates, at least for particulate matter measurements, that 1-in-6 day sampling is adequate for reliably characterizing air pollution levels over the long term (i.e., time frames of 1 year or longer).

  This sufficiency of 1-in-6 day sampling for assessing annual average concentrations of particulate matter has also been documented in other publications. EPA guidance indicates that 1-in-6 day sampling is adequate for air monitoring to assess compliance with the agency's annual particulate standards [EPA 1997b], though more frequent monitoring is necessary to capture episodic events. The adequacy of 1-in-6 day sampling for characterizing annual average $PM_{2.5}$ concentrations has also been reported in the scientific literature [Rumburg et al. 2001]. Specifically, this research reported that annual average concentrations computed from 1-in-6 day sampling schedules are not more than 7.7 percent different from the annual average values calculated from daily sampling.

  Based on this information, ATSDR concludes that the 1-in-6 day sampling schedule for particulate matter is clearly sufficient for evaluating the public health implications of exposures for time frames of 1 year or longer. ATSDR believes this conclusion also holds for the metals and elements because they are constituents of particulate matter. The trends

[9] More precisely, the differences in average concentrations between the time series of continuous $PM_{2.5}$ measurements and the every sixth day data set were all less than 5 percent, indicating a high level of agreement.

in continuous emissions monitoring for total hydrocarbons suggest this is also the case for VOCs.

- **How effective are 1-in-6 day sampling schedules for characterizing *short-term* exposures?** ATSDR also considered the adequacy of 1-in-6 day sampling schedules for evaluating *short-term* exposures. In general, as sampling frequency decreases, the likelihood that a monitor collects a sample on the day with the highest concentrations decreases. The significance of the sampling frequency ultimately depends on site-specific conditions. For example, in areas where air pollution levels do not vary greatly from one day to the next, the highest concentrations measured using a 1-in-6 day sampling schedule can provide a reasonable estimate of the maximum 24-hour air concentration. On the other hand, in areas with highly variable air pollution levels, the highest 24-hour measurement from a 1-in-6 day monitor can be considerably lower than peak air pollution levels.

  To characterize this issue further, ATSDR again referred to the continuous $PM_{2.5}$ monitoring data to assess the effectiveness of 1-in-6 day sampling for characterizing short-term exposures. In this case, ATSDR first compiled a timeline of daily $PM_{2.5}$ measurements for the three monitoring stations listed in Table 11 and identified the maximum 24-hour average concentrations as determined by the continuous monitors. ATSDR then determined from the timeline what the highest 24-hour average concentrations *would have been* had these stations instead operated on a 1-in-6 day sampling schedule. This assessment was conducted by covering all possibilities of 1-in-6 day sampling (i.e., assuming the first 1-in-6 day sample was collected on January 1, then assuming the first 1-in-6 day sample was collected on January 2, and so on).

  This evaluation revealed the potential utility of 1-in-6 day sampling for capturing the highest 24-hour average $PM_{2.5}$ concentrations in Midlothian. As the best case scenario, if a 1-in-6 day sample were to have occurred on the date with the worst air pollution levels, the 1-in-6 day sample would be considered adequate for assessing short-term exposures. However, as Table 11 indicates, the available monitoring data indicate that it is possible that 1-in-6 day sampling might understate the highest 24-hour average $PM_{2.5}$ concentrations by as much as 44 percent. ATSDR will consider this issue when evaluating acute exposure scenarios in its future Health Consultations.

- **What inferences about less-than-daily exposures can be gleaned from 24-hour average samples?** The available monitoring data characterize air pollution levels for different durations. For hydrogen sulfide, sulfur dioxide, ozone, and nitrogen oxides, continuous air pollution measurements are available on an hourly basis; and for sulfur dioxide, 5-minute average concentration data are available. Some hourly data are also available for $PM_{2.5}$ and VOCs. The availability of hourly measurements for these pollutants results primarily from two factors: (1) well established real-time monitoring methods are available for these pollutants, and these methods have been proven to measure short-term concentrations both accurately and precisely; and (2) these pollutants all have federal or state air quality standards pertaining to durations shorter than 24 hours. For these pollutants, the available hourly data are at adequate temporal resolution for public health assessment purposes.

For the remaining pollutants (i.e., PM, inorganics, VOCs), the overwhelming majority of air pollution measurements are 24-hour average concentrations. While many of these pollutants are known to exhibit acute toxicity, these pollutants generally do not have published health-based air quality standards for averaging periods shorter than 24 hours. Nonetheless, when evaluating the public health implications of exposures to these pollutants, ATSDR will consider the possibility of less-than-daily air concentrations being higher than the measured 24-hour average values. ATSDR will explore various options for conducting these evaluations, such as using dispersion models or reviewing temporal variability in the facilities' continuous emission monitoring data. ATSDR's future Health Consultations will fully document the agency's assumptions for assessing less-than-daily exposures for pollutants that only have 24-hour average air quality measurements.

4.7 Monitoring Locations

Community members have voiced concern to ATSDR about the placement of ambient air monitoring stations in the Midlothian area. Some residents have questioned whether the air concentrations measured at these locations represent actual air pollution levels throughout the Midlothian area and have asked ATSDR to comment on whether these stations have been "optimally placed." This section presents ATSDR's evaluation of the monitoring locations.

Main Findings

The number and placement of ambient air monitoring stations in the Midlothian area has varied by pollutant and year. Specific findings regarding the monitoring locations follow:

- Tables 13-16 and Figures 10-13 describe how the coverage of monitors changed with time for each pollutant group. Important gaps in the monitoring networks are noted.
- Over the years, monitoring locations were selected for various reasons. These include: to characterize facility-specific air quality impacts; to measure air pollution levels in areas with the most citizen complaints; to assess exposures at schools and parks; and to understand the "background" levels of air pollutions that are moving from the south into the Dallas-Fort Worth metropolitan area. ATSDR will consider the rationale for selecting monitoring locations when interpreting the data generated at each site.
- The monitors immediately downwind (north) of Gerdau Ameristeel and TXI Operations were placed in very close proximity to locations predicted to have the greatest air quality impacts from these facilities' emissions. Data from these stations should offer a reasonable indication of the highest air pollution levels south of Midlothian.
- The monitors, by design, measure outdoor air pollution at fixed locations. Monitoring data from these locations provide insights on air quality impacts at fixed locations and have traditionally been used as an indicator of exposure to outdoor air pollution. Residents' actual exposure will depend on the locations where they travel during the day and their level of physical activity during those times.
- For some pollutants and years, ambient air monitoring data are available for a single location, yet community members have expressed concern over air pollution levels for a larger geographic area. In these cases, ATSDR will evaluate the broader set of ambient air monitoring data to determine if the monitoring results for a single location are reasonable indicators for air quality at other locations.

- **General information on selecting monitoring locations.** Historically, ambient air monitoring programs throughout the United States have been conducted for many different reasons. For instance, monitoring has been conducted to assess compliance with environmental regulations, to characterize worst-case air pollution levels where people live, to measure "background" concentrations of air pollutants, and to provide insights on community-wide air pollution levels.

  A monitoring program's objectives typically dictate where monitoring stations are located. When determining the ideal monitoring locations for a given program and purpose, principal investigators typically rely upon some combination of air dispersion models, analyses of prevailing wind patterns, professional judgment, and community input. Logistical concerns—such as equipment security and ready access to electricity and property—are also considered when determining the actual monitoring locations used.

For ambient air monitoring programs designed to characterize air quality impacts from a particular facility, the type of facility emission sources must be considered when deciding where monitors should be placed. Figure 8 displays typical profiles of air quality impacts as a function of downwind distance for stack sources and ground-level emission sources:

- *Stacks.* As Figure 8A shows, emissions from *stack sources* tend to have no impact on air quality at the base of the stack itself (i.e., downwind distance equal to zero). Estimated air quality impacts then gradually increase to a point of maximum concentration. The distance to this point is determined by many factors including stack height, emission exit velocity and temperature, and local meteorological conditions. Ambient air concentrations then gradually decrease with further downwind distance.

- *Ground-level, passive releases.* Figure 8B depicts a typical dispersion pattern for emission sources at ground-level with little or no appreciable exit velocity. These can include emissions of wind-blown dust and evaporation emissions from tanks. In general, air quality impacts from these sources are greatest at locations alongside the sources themselves and then tend to decrease sharply with downwind distance.

These general insights are useful for evaluating the placement of monitoring stations in Midlothian. However, the four Midlothian facilities all have many different types of emission sources, including several stacks of various size and design and numerous ground-level sources. In such cases, scientists typically use models to understand how air pollution levels likely vary from one location to the next.

- **Rationale for placement of monitors in Midlothian.** Before evaluating the adequacy of the monitoring locations in Midlothian, ATSDR first contacted the various parties that implemented ambient air monitoring programs to better understand why monitors have been placed at their existing or former locations. The following discussion presents the reasons that were provided to ATSDR for placing monitors at particular locations:

  - *Holcim settlement agreement monitoring.* The location of this continuous $PM_{2.5}$ monitor (station 4 in Figure 6) was selected by Holcim, with concurrence from the other parties involved in this settlement agreement [Holcim 2005]. This particular location was selected for monitoring for several reasons: modeling results suggest that the location would capture emissions from the kiln stacks; the monitoring location is in close proximity to areas where concerned residents live; and the location meets many EPA siting criteria.

  - *Midlothian Ambient Air Collection and Analytical Chemical Analysis.* The 2008-2009 monitoring in Midlothian included numerous monitoring locations. The exact locations were selected for multiple purposes, and input from selected community members was considered in the design of this network [URS 2009a]. The locations of the fixed monitors, for instance, were selected primarily because they were directly downwind of one of the facilities [URS 2009b] and were in close proximity to residences. The locations of this program's temporary monitors

were placed to meet a program objective of evaluating air quality close to parks and schools.

- *TCEQ's routine criteria pollutant monitoring.* TCEQ, like most other state environmental agencies, conducts routine ambient air monitoring for criteria pollutants for multiple reasons. In most cases, this monitoring is conducted in fulfillment of EPA regulations (i.e., to assess attainment with the agency's National Ambient Air Quality Standards), and EPA guidance sets minimum criteria for siting ambient air monitors. For instance, guidelines specify the minimum number of monitors for a given metropolitan area and the minimum distance required between monitors and certain emission sources, roadways, and obstructions in air flow. Consequently, these monitors tend to provide insights on community exposures, without intending to capture the maximum impacts from a given source.

  However, TCEQ has also placed criteria pollutant monitoring devices in certain Midlothian localities that have been the focal point of citizen complaints. For example, the PM_{10} and $PM_{2.5}$ monitors at CAMS 302 - Wyatt Road (station 14 in Figure 6) were intentionally placed in an area where residents complained about exposure to facility emissions.

- *TCEQ's monitoring for inorganics.* TCEQ monitored ambient air concentrations of inorganics in multiple studies. An overview of the 2008-2009 study is presented earlier in this section; and, as Section 4.3 explains, ATSDR will only be using the metals data (except for lead) that were collected during and prior to 1994 for screening purposes. The only other locations where TCEQ measured ambient air concentrations of metals and elements were at: Midlothian Tower (station 19 in Figure 6), Old Fort Worth Road (station 12 in Figure 6), and CAMS 302 - Wyatt Road (station 14 in Figure 6). Monitoring at these particular locations was conducted to bracket the emission sources at Gerdau Ameristeel and TXI Operations that were subject of the most citizen complaints.

- *TCEQ's VOC monitoring.* Outside of the 2008-2009 study (reviewed above), TCEQ has conducted VOC monitoring at four locations in Midlothian. Three of these locations were selected to measure potential air quality impacts downwind of cement kilns. The Tayman Drive Water Treatment Plant station (station 5 in Figure 6) monitored VOCs downwind of Ash Grove Cement from 1993 to 1997. These measurements provide insights on air quality impacts during a time when the facility burned tires, but does not overlap with the time when the facility burned hazardous waste. Additionally, VOC monitoring occurred downwind of Gerdau Ameristeel and TXI Operations at the Old Fort Worth Road site (station 12 in Figure 6) and at the CAMS 302 - Wyatt Road site (station 14 in Figure 6). The VOC monitoring conducted at Midlothian Tower (station 19 in Figure 6) was conducted in part to characterize air pollution levels moving into the Dallas-Fort Worth metropolitan area, and not necessarily to capture facility-specific air quality impacts in Midlothian.

- **ATSDR's assessment of monitor placement.** The following paragraphs review ATSDR's evaluation of the placement of monitors in the Midlothian area. When assessing this issue, ATSDR first considered findings from a 1996 modeling study conducted by EPA as part of a multi-pathway risk assessment evaluating air emissions from the Midlothian facilities [EPA 1996]. ATSDR considered this particular modeling study (as opposed to facility-specific studies found in TCEQ permitting files) to be significant because it was the only published report found in the site records that modeled air quality impacts from all four facilities of interest.

  The modeling was based on emissions data from the mid-1990s. This timing is important because it reflects conditions when Ash Grove Cement and TXI Operations were burning hazardous waste. However, the modeling does not consider changes that have occurred since 1996, such as increased production rates at some facilities and the installation of newer kilns at Holcim and TXI Operations. Figure 9 shows the specific points where EPA's modeling study predicted maximum annual average air concentrations for selected pollutants and maximum deposition of multiple pollutants. As expected, these points of maximum impact were downwind of the facilities, based on two of the most dominant wind directions found in the Midlothian area (i.e., from south to north and from north to south). ATSDR considered these findings when evaluating the placement of the monitoring stations.

  Another consideration in ATSDR's evaluation was a screening modeling analysis that the agency performed to assess the furthest reaches of maximum ground-level impacts from the Midlothian facilities. This analysis was designed to establish the potential area of impact, which the agency considered the area within which it could be reasonably confident that the highest ambient air concentrations due to facility emissions are found. Appendix C documents ATSDR's modeling which was used to construct the potential area of impact shown in Figure 9. This area represents the locations where ATSDR believes that the highest ground-level impacts at any given time may be expected to occur, and this area remains the focus of the evaluation of monitoring locations. Note that the figure *is not meant* to imply that air emissions from the facilities have no impact beyond the lines shown in Figure 9. Pollutants released by the facilities do reach locations beyond the potential area of impact, but most likely not at levels higher than the maximum concentrations observed at monitors within this boundary.

  Finally, ATSDR considered observed spatial variations in air pollution levels when evaluating monitor placement. Community members have voiced concern over this issue, particularly questioning whether monitors downwind from Gerdau Ameristeel and TXI Operations are truly capturing the highest air quality impacts. The available monitoring data provide useful insights into this issue, because concurrent monitoring has occurred at two locations downwind from these facilities: the Old Fort Worth Road site (station 12 in Figure 6) and at the CAMS 302 - Wyatt Road site (station 14 in Figure 6).

  To assess spatial variations in this part of the Midlothian area, ATSDR compared measurements from these two locations for the only pollutants that were measured concurrently: nitrogen oxides, sulfur dioxide, and PM_{10}. Table 12 presents the comparison, which shows that ambient levels of PM_{10} were virtually identical across the

two sites, ambient levels of nitrogen oxides were slightly higher at the Old Fort Worth Road site, and ambient levels of sulfur dioxide were considerably higher (except for the peak value) at the Old Fort Worth Road site. Thus, even though the CAMS 302 - Wyatt Road monitoring station is located closer to the industrial facilities of interest, the measured concentrations at Old Fort Worth Road for these three pollutants are all comparable or higher. Therefore, for the numerous years when no monitors were located at CAMS 302 - Wyatt Road, ATSDR will use the nitrogen oxides, sulfur dioxide, and PM_{10} measurements from the Old Fort Worth Road monitoring station as an indicator for air quality in the neighborhoods near the CAMS 302 - Wyatt Road station, such as the homes along Cement Valley Road. The comparisons in Table 12 suggest that this approach will likely be health-protective (i.e., it will not underestimate ambient air concentrations of these pollutants at this particular location).

While certain pollutants clearly had higher or comparable concentrations at the Old Fort Worth Road monitoring station when compared to the Wyatt Road monitoring station[10], TCEQ's recent analyses of the 2008-2009 monitoring program demonstrates that other pollutants—primarily inorganics—exhibit the opposite pattern. Specifically, for 20 out of the 22 inorganic pollutants considered, the highest concentrations were observed at Wyatt Road [URS 2009e]. Further, for cadmium, lead, manganese, and zinc, the average levels at Wyatt Road were at least three times higher than those measured at the same time at Old Fort Worth Road. These observations indicate that monitoring data at Old Fort Worth Road for these inorganic pollutants likely understate the pollution levels that would have been observed at Wyatt Road.

ATSDR considered EPA's modeling, the delineation of the potential area of impact in Figure 9, and other factors when evaluating the placement of monitoring locations. Following are ATSDR's findings, organized by pollutant category and time frame:

- *PM.* Of the four pollutant categories considered in this section, PM has the greatest number and spatial coverage of monitoring stations. Prior to 1991, only a single PM monitor operated in the area: TSP monitoring occurred from 1981 to 1984 at Midlothian City Hall. Though the monitoring data from this station appear to be valid and of a known and high quality, two important considerations will factor into ATSDR's evaluation of these data: (1) TSP includes larger particles that are not respirable, limiting the utility of these data for health assessment purposes; and (2) this monitoring location is more than 2 miles away from the facilities of interest and is not commonly directly downwind from the facilities.

  Starting in 1991, coverage of PM monitoring devices increased considerably (see Figure 10). Almost continually from 1991 to the present, ambient air monitoring for PM—whether PM_{10} or $PM_{2.5}$—has occurred at locations immediately upwind and downwind of Gerdau Ameristeel and TXI Operations. Moreover, these monitors were placed at, or in very close proximity to, the nearest residents and

[10] In this paragraph, the "Wyatt Road" monitoring station refers to station number 16 in Figure 6. This station is different from the CAMS 302 – Wyatt Road station discussed in earlier paragraphs.

the locations where EPA's modeling predicted maximum air quality impacts would occur. This placement of monitors likely provides a reasonable portrayal of the PM ambient air concentrations that nearby residents were exposed to in the vicinity of these facilities. However, the monitors may not adequately characterize PM levels for all residents located immediately adjacent to certain onsite operations, such as limestone quarry activity. This gap in the available environmental monitoring data is identified in Section 4.8.

PM monitors were also placed immediately downwind of Ash Grove Cement and Holcim, but these monitors operated for only part of the time between 1991 and the present. Specifically, the PM monitors downwind from Ash Grove Cement operated in 1992-1996 and again in 2008-2009; and the monitors downwind from Holcim operated in 1993-1995 and again in 2006-2010. While this monitoring effort is useful for assessing air quality impacts near these facilities, ATSDR notes that no PM monitoring occurred downwind from Ash Grove Cement during the time that the facility burned hazardous waste.

Table 13 briefly summarizes how ATSDR plans to use the PM monitoring data in future public health assessment activities.

- *Inorganics.* As Figure 11 illustrates, the spatial coverage of ambient air monitoring for inorganics in the Midlothian area has also varied with time. The following paragraphs first evaluate the coverage of monitors for multiple inorganics, and then present some additional insights on monitoring for lead.

  Prior to January 2001, ambient air monitoring for inorganics within particulate matter occurred at several locations. However, as Section 4.3 indicates, these measurements were collected using methods commonly applied at the time, but later found to potentially underestimate ambient air concentrations. Therefore, ATSDR will use data for metals and elements (except for lead, which is discussed below) that were measured prior to January 2001 for screening purposes only.

  Between 2001 and 2005, ambient air monitoring for inorganics occurred at two locations. At the Midlothian Tower (station 19 in Figure 6), $PM_{2.5}$ samples collected every 6 days from May 2002 to August 2005 were analyzed for inorganic constituents. At the CAMS 302 - Wyatt Road site (station 14 in Figure 6), PM_{10} samples collected every 6 days between January 2001 and June 2004 were also analyzed for inorganic constituents. The 1-in-6 day monitoring at these locations was found to be of a known and high quality. Further, the monitoring is likely representative of highest air pollution levels, as supported by the fact that EPA's previous modeling predicted that some peak air concentrations would occur near these monitoring locations (see Figure 9).

  At the end of August 2005, the monitoring device used to measure inorganics at the Midlothian Tower station was shut down and moved to the Old Fort Worth Road station (station 12 in Figure 6), where it began operating the following month. From September 2005 through November 2008, this was the only

monitoring station in the Midlothian area that measured ambient air concentrations of inorganics within PM, specifically $PM_{2.5}$. ATSDR found these data to be of a known and high quality and will use them for health assessment purposes. This station is in close proximity to a location where EPA's earlier modeling analysis predicted maximum deposition of multiple air pollutants released by Gerdau Ameristeel and TXI Operations (see Figure 9). As discussed previously, ATSDR found evidence suggesting that air concentrations of three pollutants measured at the Old Fort Worth Road monitoring station are reasonably representative of, and if anything higher than, those that occurred at the CAMS 302 - Wyatt Road monitoring station (see Table 12). However, for most inorganics, ambient air concentrations were highest at the near-field Wyatt Road monitoring station. ATSDR will draw upon the entire set of monitoring data for the locations downwind from Gerdau Ameristeel and TXI Operations when making conclusions about inorganics in future Health Consultations.

From December 2008 to July 2009, the Midlothian Ambient Air Collection and Analytical Chemical Analysis measured ambient air concentrations of metals and elements at eight locations throughout the Midlothian area. This monitoring occurred at residential locations immediately downwind from most of the facilities of interest, and the measurements were found to be of a known and high quality. ATSDR will use these data for health assessment purposes. However, interpretations will acknowledge that facility operating conditions during this time frame were not representative of earlier years. For example, TXI Operations was not burning hazardous waste in 2009; Ash Grove Cement's annual usage of tire-derived fuel in 2009 was considerably lower than in previous years; and production levels at other facilities might not have been representative of trends over the longer term.

Table 14 briefly summarizes how ATSDR plans to use the monitoring data for inorganics in future public health assessment activities.

Note: The previous discussion indicates that ATSDR's future Health Consultations will only use data for inorganics that were collected prior to January 2001 for screening purposes and trend analysis. However, this statement does not apply to lead. The lead measurements collected in Midlothian between 1981 and 1985 and starting again in 1993 are all of a known and high quality, largely because EPA published federal reference methods for lead long before the agency issued its compendium of approved methods for inorganic compounds.

- *VOCs.* Figure 12 shows the history of VOC monitoring in the Midlothian area. This monitoring first began in January 1993, when a single monitoring location operated along the northern border of Ash Grove Cement (station 5 in Figure 6). The monitor was placed between the facility and the nearest offsite neighborhood, and east of a location that EPA's previous modeling study predicted would have the highest facility-related air quality impacts (see Figure 9). This monitor collected 1-in-6 day samples between January 1993 and March 1997, using

methods known to generate data of a known and high quality. ATSDR will use this monitoring to evaluate potential air quality impacts during a time when Ash Grove Cement burned tires as a fuel, though data presented earlier in this document (see Section 2.3.1) indicate that this facility's annual tire usage rate more than doubled after this VOC monitoring ceased. Additionally, the data cannot be used to assess air quality impacts from the time when the facility burned hazardous waste, because that practice ended before this monitoring began.

At the end of March 1997, the VOC monitoring device north of Ash Grove Cement was shut down and moved to the Old Fort Worth Road station (station 12 in Figure 6), where it then began operating. VOC monitoring continued at this station, with 24-hour average samples collected once every 6 days, through December 2008.[11] This monitoring occurred downwind of the Gerdau Ameristeel and TXI Operations facilities, near a location where EPA's earlier modeling analysis predicted maximum deposition of multiple air pollutants released from these facilities (see Figure 9). ATSDR will use these data for health assessment purposes, because they are of a known and high quality and are indicative of outdoor air pollution levels in the areas north of these two facilities. As noted previously, ATSDR found that measured concentrations of other pollutants (see Table 12) tended to be higher at the Old Fort Worth Road monitoring station than at the Wyatt Road monitoring station. Therefore, to a first approximation, ATSDR will assume that the measured VOC concentrations at Old Fort Worth Road, on average, are reasonably representative of air pollution levels in neighborhoods surrounding the Wyatt Road monitoring station.

From December 2008 to July 2009, the Midlothian Ambient Air Collection and Analytical Chemical Analysis measured ambient air concentrations of VOCs at seven locations throughout the Midlothian area. This monitoring occurred at residential locations immediately downwind from most of the facilities of interest, and the measurements were found to be of a known and high quality. ATSDR will use these data for health assessment purposes. However, interpretations will acknowledge that facility operating conditions during this time frame were not representative of earlier years. For example, TXI Operations was not burning hazardous waste in 2009; Ash Grove Cement's annual usage of tire-derived fuel in 2009 was considerably lower than in previous years; and production levels at other facilities might not have been representative of trends over the longer term.

Table 15 briefly summarizes how ATSDR plans to use the VOC monitoring data in future public health assessment activities.

- *Sulfur compounds.* As Figure 13 indicates, continuous monitoring of selected sulfur compounds—hydrogen sulfide and sulfur dioxide—has occurred during different time frames at four locations around the Gerdau Ameristeel and TXI

[11] Between November 2004, and March 2006, no VOC monitoring took place at Old Fort Worth Road, because this monitoring device was temporarily moved to the Wyatt Road monitoring station during this time frame.

Operations facilities. The data are of a known and high quality and will therefore be used in future ATSDR Health Consultations. Although the monitoring data were collected during certain time frames, ATSDR will consider trends in continuous emission data and annual emission estimates to make inferences about air pollution levels during other years and at other locations in the Midlothian area. The approaches and assumptions that ATSDR uses to make these inferences will be fully documented in the future Health Consultations.

Table 16 briefly summarizes how ATSDR plans to use the sulfur compound monitoring data in future public health assessment activities.

- *Other pollutants.* The other pollutants not covered by the previous evaluation are ozone, carbon monoxide, and nitrogen oxides. As Section 2.6 explains, ozone is a regional air quality issue in the vicinity of Dallas and Fort Worth. ATSDR's future Health Consultation will consider the ozone levels that have been measured at the Old Fort Worth Road monitoring station, as well as those observed elsewhere in the non-attainment area. The placement of ozone monitors throughout the metropolitan area appears to be adequate for determining whether the region's air quality meets EPA's health-based air quality standards.

  For carbon monoxide, a previous section of this document (Section 4.2) notes that no ambient air monitoring for this pollutant has occurred in the Midlothian area. Therefore, in its future Health Consultations, ATSDR will use modeling and other site-specific information to assess emissions of carbon monoxide.

  Finally, for nitrogen oxides, continuous monitoring at Old Fort Worth Road, CAMS 302 - Wyatt Road, and Midlothian Tower—the sites that bracket the Gerdau Ameristeel and TXI Operations facilities—has occurred at different times between 2000 and 2009. These monitoring data should form a sufficient basis for reaching conclusions on these facilities' air quality impacts during this time frame. ATSDR will consider continuous emission monitoring data and annual emission inventory data when deciding if conclusions can be reached for years before the nitrogen oxides monitoring first occurred.

4.8 Summary

Between 1981 and the present, the extent of ambient air monitoring programs in the Midlothian area has varied widely. In some years, extensive monitoring occurred for numerous different pollutants and at several locations of interest; but, in other years, no ambient air monitoring occurred at all. Additionally, some of the older monitoring data were conducted using methods that have since been found to potentially understate air pollution levels.

As a result of these observations, ATSDR's conclusions regarding the utility of the monitoring data for health assessment purposes vary by pollutant, by year, and by location. Tables 13-16 summarize the availability of data and how ATSDR intends to use them for evaluating the health implications of exposure to air pollution in future Health Consultations.

The available monitoring data characterize air quality at different times and locations and for different pollutants throughout the Midlothian area, but several gaps in the available environmental monitoring data exist. The more important data gaps that will affect the conclusions that can be drawn follow:

- Prior to 1981, no monitoring data are available for the Midlothian area, and between 1981 and 1988, data are limited to just a few pollutants. Moreover, between 1981 and 1988, facility-specific air emission data and facility-specific fuel usage statistics are also very limited. Thus, not only are there few direct measurements of air pollution levels during this time frame, but limited surrogate information for inferring what air pollution levels might have been. Efforts to infer past air quality levels are complicated by the fact that air pollution controls have become more effective over time.

- No ambient air monitoring data were collected in the vicinity of Ash Grove Cement during the years that the facility burned hazardous waste.

- VOC monitoring in the vicinity of TXI Operations occurred during several years when the facility burned hazardous waste. However, the sampling and analytical method used for much of this time frame (1997 to 2008) was not sensitive enough to measure ambient air concentrations at levels near ATSDR's health screening values. While the monitoring that occurred in 2008-2009 achieved considerably lower detection limits, TXI Operations was not burning hazardous waste during much of this time.

- Several monitoring stations in the Midlothian area were placed near or at locations believed to either have high air quality impacts from facility operations or a high potential for exposure. Ambient air monitoring data are more limited for the residential neighborhoods in immediate proximity to the cement manufacturing facilities' limestone quarries.

- For VOCs and inorganics, most monitoring followed 1-in-6 day sampling schedules. Data analyses demonstrate that these schedules are adequate for characterizing long-term average air pollution levels, but provide less confidence in characterizing short-term or episodic pollution events.

The significance of these gaps in the available environmental monitoring data will be discussed further in ATSDR's future Health Consultations.

5.0 Conclusions

Monitoring of outdoor air pollution levels in the Midlothian area first started in 1981. Since then, the nature and extent of the monitoring has varied greatly by pollutant category, location, and year. Tables 13-16 of this Health Consultation document ATSDR's findings regarding the utility of the available monitoring data sets for health assessment purposes.

For the various pollutants, time frames, and locations identified as gaps in the available environmental monitoring data, ATSDR's future Health Consultations may either (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. When such inferences are made, ATSDR will thoroughly document all assumptions and characterize the level of confidence associated with any conclusions that are not based directly on ambient air monitoring data. ATSDR will also make recommendations for additional sampling, where warranted.

The following text presents ATSDR's findings for the main criteria considered when evaluating the utility of the available ambient air monitoring data:

Main Conclusion

The available ambient air monitoring data for the Midlothian area are sufficient to support public health evaluations for numerous pollutants of concern and for many years that local industrial facilities operated. However, the data also have some limitations identified in the remaining six conclusions. For pollutants with little or no available environmental monitoring data, ATSDR believes there is utility in modeling worst-case air quality impacts to determine if additional sampling is warranted. The modeled data cannot be used to definitively determine if the potential exposure was, or is, a public health hazard.

Question 1: Pollutants Monitored (Section 4.2)

- Some ambient air monitoring data are available for every *inorganic pollutant* included in the facilities' annual emission reports, except for hydrochloric acid, sulfuric acid, and vapor-phase mercury.

- For VOCs, ambient air monitoring has occurred for the subset of pollutants that the facilities have released in greatest quantities.

- No ambient air monitoring has occurred for *semi-volatile organic compounds*, which include dioxins, furans, and polycyclic aromatic hydrocarbons.

- Ambient air monitoring data are available for all criteria pollutants directly emitted by the facilities (lead, nitrogen dioxide, particulate matter, and sulfur dioxide) except for carbon monoxide.

Question 2: Monitoring, Sampling, and Analytical Methods Used (Section 4.3)

- Nearly every ambient air monitoring, sampling, and analytical method that has been used in the Midlothian area is well established, peer-reviewed, and capable of generating data of a known and high quality. The following points identify exceptions to this conclusion.

- The PM samples collected in 1981 and between 1991 and 1994 were analyzed for inorganics by a method that was commonly used at the time, but was later found to potentially understate actual ambient air concentrations. This finding does not apply to lead, because the methods used to measure airborne lead were well established during this time frame.

- The method that has been used to measure ambient air concentrations of nitrates in PM samples has also been found to understate actual air pollution levels.

- The ambient air monitoring methods used in the Midlothian area have generally been sensitive enough—that is, they have detection limits low enough—to measure ambient air concentrations at levels of potential health concern. The only exceptions are that the methods used to measure air concentrations of arsenic, cadmium, hydrogen sulfide, and 1,2-dibromoethane did not always achieve the sensitivity ATSDR would prefer to have for making health conclusions. However, there is no evidence that the Midlothian facilities use, process, or release 1,2-dibromoethane. For arsenic, cadmium, and hydrogen sulfide, other considerations will have to factor into the evaluation of potential exposures.

Question 3: Data Quality of the Air Pollution Measurements (Section 4.4)

- ATSDR reviewed various data quality indicators for the available ambient air monitoring programs in the Midlothian area. Except for the special considerations listed below, these indicators suggest that the air pollution measurements are of a known and high quality and suitable for health assessment purposes.

- The continuous $PM_{2.5}$ monitoring devices used in the Midlothian area consistently measured slightly lower concentrations than more rigorous monitoring methods, suggesting that the continuous devices have a slight negative bias in their measurements.

- For metals and elements, measurements near the detection limits must be interpreted with caution because measurement precision is lowest in this range. Further, filter blank data should be considered when interpreting any of the data for metals and elements. These issues apply to most any ambient air monitoring program for metals and elements, and should not be interpreted as a criticism of the monitoring programs implemented in the Midlothian area.

Question 4: Time Frames Covered by the Monitoring Programs (Section 4.5)

- Prior to May 1981, no ambient air monitoring data are available for the Midlothian area. Since 1981, validated ambient air monitoring data suitable for health assessment purposes are available for several time frames. The availability of validated data varies by pollutant and year. Tables 13-16 address this issue in greater detail.

- Monitoring data clearly are not available for all pollutants, over all time frames, and across all locations of interest. However, the available monitoring data can be used to make inferences about air pollution levels during time frames when—and at locations where—no monitoring occurred. When ATSDR makes such inferences, the future Health Consultations will document all assumptions used and characterize the confidence in those findings.

Question 5: Monitoring Frequencies and Durations (Section 4.6)

- The monitoring frequencies and durations used in the Midlothian area vary from one pollutant to the next, but are generally consistent with monitoring methodologies commonly used throughout the country.

- 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.

- Trends among the Midlothian monitoring data indicate that 1-in-6 day sampling schedules are sufficient for characterizing PM exposures over the long term (e.g., for periods of 1 year and longer) and for characterizing 90^{th} percentile concentrations.

- Trends among the Midlothian monitoring data confirm that 1-in-6 day sampling schedules may not capture the days with the highest air pollution levels, simply because there is a greater probability of the highest concentrations occurring on days when samples are not collected. Specifically, the maximum 24-hour $PM_{2.5}$ concentrations from monitors that follow 1-in-6 day sampling schedules can understate the actual highest 24-hour average air pollution levels by as much as 44 percent.

Question 6: Monitoring Locations (Section 4.7)

- The number and placement of ambient air monitoring stations in the Midlothian area has varied by pollutant and year. Tables 13-16 describe how the coverage of monitors changed with time for each pollutant group and important gaps are noted. For many years and pollutants, monitoring occurred at or near locations that EPA previously identified as having the greatest air quality impacts from at least some of the Midlothian facilities.

- The specific monitoring locations used in the ambient air monitoring programs were selected for various reasons. These reasons include: to characterize facility-specific air quality impacts; to measure air pollution levels in areas with the most citizen complaints; to assess exposures at schools and parks; and to understand the "background" levels of air pollution that is moving from the south into the Dallas-Fort Worth metropolitan area. ATSDR will consider the rationale for selecting monitoring locations when interpreting the data generated at each site.

- For some pollutants and years, ambient air monitoring data are available for a single location, yet community members have expressed concern over air pollution levels for a larger geographic area. In these cases, ATSDR will evaluate the broader set of ambient

air monitoring data to determine if the monitoring results for a single location are reasonable indicators for air quality at other locations.

6.0 Public Health Actions Planned

General:

- ATSDR proposes continuing its evaluations of environmental data, bearing in mind the limitations in the ambient air monitoring data identified in this Health Consultation. The health evaluations will consider exposure to individual pollutants and the overall mixture of air pollutants observed in the Midlothian area. Readers should refer to ATSDR's Public Health Response Plan for a complete listing of the upcoming health evaluations that the agency will be conducting.

- For the known gaps in the ambient air monitoring data (see Section 4.8), ATSDR's future Health Consultations should either document health evaluations using other information sources (e.g., dispersion models, engineering calculations) or conclude that not enough information is available to make defensible conclusions. Whichever approach is taken, the rationale should be thoroughly documented and take into account year-to-year changes in meteorology, production levels, types of fuel used, and design and operation of air pollution control equipment. Further, ATSDR's evaluations should identify sources of uncertainty and characterize the level of confidence associated with the health conclusions.

Pollutants monitored:

- ATSDR will proceed with evaluating the health implications of the measured concentrations, considering the findings outlined in Tables 13 to 16 of this Health Consultation.

Monitoring methods:

- ATSDR's future Health Consultations will use data generated by valid methods for health evaluations. However, metals data before 2001 and all nitrate data will be used with caution.

- ATSDR's future Health Consultations will evaluate the valid measurements of certain VOCs, arsenic, cadmium, and hydrogen sulfide, and that evaluation will consider the fact that some of those measurements were not capable of measuring air pollution levels at concentrations near the most health-protective screening values.

Data quality:

- When interpreting the continuous $PM_{2.5}$ monitoring data in future Health Consultations, ATSDR will consider the possibility that these devices were underestimating ambient air concentrations.

- When evaluating any data for inorganics, ATSDR will consider the possibility of "false positive" detections due to metals naturally found in the filters used to collect the air samples. This issue, known as blank contamination, will most likely affect the measurements of barium, total chromium, copper, manganese, molybdenum, and silver.

Time frames:

- In its future Health Consultations, ATSDR will evaluate the health implications of the measured air pollution levels for all years when ambient air monitoring data were collected.

- For years when no measurements were collected, ATSDR will consider deriving estimates of air pollution levels from other sources of information, such as facility specific fuel usage statistics, emission rates, efficiency of air pollution controls, and air models. All such estimates will be thoroughly documented.

Monitoring frequency and duration:

- In its future Health Consultations, ATSDR will consider the limitations posed by a 1-in-6 day sampling schedule. In those documents, ATSDR will fully describe uncertainties associated with using 1-in-6 day sampling schedules to assess *short term* air pollution levels.

Monitoring locations:

- In future Health Consultations, ATSDR will interpret data collected at the various monitoring locations, recognizing that some of the monitors were placed in areas typically upwind from the facilities of interest. In those documents, recommendations for future sampling may be included.

Authors, Technical Advisors

Primary Authors:

Michelle Colledge, PhD, ATSDR

Greg Ulirsch, PhD, ATSDR

Technical Advisors:

John Wilhelmi, ERG

Andrew Adelfio, ERG

References

Allen G, Sioutas C, Koutrakis P, Reiss R, Lurmann FW, Roberts PT. 1997. Evaluation of the TEOM method for measurement of ambient particulate mass in urban areas. J Air Waste Manag Assoc 47(6):682-689.

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.

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

J Chow. 1995. Measurement Methods to Determine Compliance with Ambient Air Quality Standards for Suspended Particles. J Air & Waste Manage. Assoc. 45:320-382.

[DRI] Desert Research Institute. 2009. DRI Quality Assurance Project Plan: $PM_{2.5}$ Lab Support for TCEQ. Region 0. December, 2009.

[DRI] Desert Research Institute. 2010. Spreadsheet of method detection limits for metals and elements provided by Dr. Richard Tropp. April 22, 2010.

[EPA] US Environmental Protection Agency. 1988. Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air. EPA 600/4-89-017. June 1988.

[EPA] 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.

[EPA] US Environmental Protection Agency. 1996. Midlothian Cumulative Risk Assessment. Multimedia Planning and Permitting Division; EPA Region 6. EPA-906-R-96-001. January 31, 1996.

[EPA] US Environmental Protection Agency. 1997a. Mercury Study Report to Congress. Volume II: An Inventory of Anthropogenic Mercury Emissions in the United States. EPA-452/R-97-004. Available from: http://www.epa.gov/mercury/report.htm.

[EPA] US Environmental Protection Agency. 1997b. Waivers for PM_{10} Sampling Frequency. Letter from William Hunt, Director, Emissions, Monitoring, and Analysis Division. December 2, 1997.

[EPA] US Environmental Protection Agency. 1998. Emergency Planning and Community Right-to-Know Act, Section 313: Guidance for Reporting Sulfuric Acid (acid aerosols including mists, vapors, gas, fog, and other airborne forms of any particle size). EPA-745-R-97-007. March 3, 1998. Available from: http://www.epa.gov/tri/guide_docs/pdf/1998/sulfuric.pdf.

[EPA] US Environmental Protection Agency. 1998b. Locating and Estimating Air Emissions from Sources of Polycyclic Organic Matter. EPA-454/R-98-014. Available from: http://www.epa.gov/ttnchie1/le/pompta.pdf.

[EPA] US Environmental Protection Agency. 1999a. Emergency Planning and Community Right-to-Know Act, Section 313: Guidance for Reporting Hydrochloric Acid (acid aerosols including mists, vapors, gas, and other airborne forms of any particle size). EPA-745-B-99-014. December 1999. Available from: http://www.epa.gov/tri/guide_docs/pdf/1999/hclguidance.pdf

[EPA] US Environmental Protection Agency. 1999a. Compendium of Methods for the Determination of Inorganic Compounds in Ambient Air. EPA/625/R-96/010a. Available from: http://www.epa.gov/ttn/amtic/inorg.html.

[EPA] US Environmental Protection Agency. 1999c. Compendium of Methods for the Determination of Organic Compounds in Ambient Air. EPA/625/R-96/010b. Available from: http://www.epa.gov/ttn/amtic/airtox.html.

[EPA] US Environmental Protection Agency. 2000a. 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] US Environmental Protection Agency. 2000b. Emergency Planning and Community Right-to-Know Act – Section 313: Guidance for Reporting Toxic Chemicals within the Dioxin and Dioxin-like Compounds Category. EPA-745-B-00-021. Available from: http://www.epa.gov/tri/guide_docs/pdf/2000/TRIdioxinguidance.pdf

[EPA] US Environmental Protection Agency. 2001. Emergency Planning and Community Right-to-Know Act – Section 313: Guidance for Reporting Toxic Chemicals: Polycyclic Aromatic Compounds Category. EPA 260-B-01-03. Available from: http://www.epa.gov/tri/guide_docs/pdf/2001/pacs2001.pdf.

[EPA] US Environmental Protection Agency. 2005. Technical Memorandum from Eric Boswell (EPA, National Air and Radiation Environmental Laboratory) to Dennis Crumpler (EPA, Office of Air Quality Planning and Standards) regarding DRI Laboratory Audit. September 14, 2005. Available from: http://www.epa.gov/ttn/amtic/pmspec.html.

[EPA] US Environmental Protection Agency. 2007. Technical Memorandum from Eric Boswell (EPA, National Air and Radiation Environmental Laboratory) to Dennis Crumpler (EPA, Office of Air Quality Planning and Standards) regarding DRI Laboratory Audit. August 21, 2007. Available from: http://www.epa.gov/ttn/amtic/pmspec.html.

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

[EPA] US Environmental Protection Agency. 2010a. Emission data downloaded from the Toxics Release Inventory. Available from: http://www.epa.gov/triexplorer. Last accessed March 1, 2010.

[EPA] US Environmental Protection Agency. 2010b. 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] US Environmental Protection Agency. 2010c. Emission data from the 2005 National Emissions Inventory. Available from: http://www.epa.gov/ttn/chief/net/2005inventory.html. Last accessed March 1, 2010.

[EPA] US Environmental Protection Agency. 2010d. 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] US Environmental Protection Agency. 2010e. List of Designated Reference and Equivalent Methods. Available from: http://www.epa.gov/ttn/amtic/criteria.html.

[EPA] US Environmental Protection Agency. 2010e. Annual Criteria Pollutant Quality Indicator Summary Reports posted to EPA's Ambient Monitoring Technology Information Center website. Available from: http://www.epa.gov/ttn/amtic/qareport.html.

[ERG] Eastern Research Group, Inc. 2009. Midlothian 1st Quarter Laboratory Data Reports. Available from: http://www.tceq.state.tx.us/implementation/tox/research/midlothian.html.

Holcim. 2005. Letter from Holcim (Texas) LP to representatives of Blue Skies Alliance and Downwinders at Risk. Regarding: Environmental Project Update Meeting. November 10, 2005.

[NCDC] National Climatic Data Center. 2004. 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.

B Rumburg, R Alldredge, C Claiborn. 2001. Statistical distributions of particulate matter and the error associated with sampling frequency. Atmospheric Environment 35(16):2907-2920.

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

[TCEQ] Texas Commission on Environmental Quality. 2009b. Electronic database of ambient air monitoring and meteorological measurements. Data received June, 2009.

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

[TCEQ] Texas Commission on Environmental Quality. 2010c. Standard Operating Procedure (SOP): Modified U.S. Environmental Protection Agency (EPA) Method TO-15 Sample Analysis

for Organic Analysis Laboratory (OAL). Field Operations Support Division SOP #AMOR-006. April 22, 2010.

[TCEQ] Texas Commission on Environmental Quality. 2010d. Comparison of sampling results between TCEQ's Austin laboratory and Test America's laboratory for sampling conducted in the City of Fort Worth in February 2010. Available from: http://www.tceq.state.tx.us/assets/public/implementation/barnett_shale/Lab-Comparison-20100219.xls.

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

[TCEQ] Texas Commission on Environmental Quality. 2010f. Evaluation of the Midlothian, Texas Ambient Air Collection and Analytical Chemical Analysis Data. Available from: http://www.tceq.state.tx.us/implementation/tox/research/midlothian.html.

[TNRCC] Texas Natural Resources Conservation Commission. 1995. Critical Evaluation of the Potential Impact of Emissions from Midlothian Industries: A Summary Report. October 25, 1995.

Trinity Consultants. 2006-2010. Fourteen "Ambient Monitoring Data and Status Report" prepared between April 27, 2006, and February 22, 2010.

RJ Tropp, SD Kohl, JC Chow, JG Watson, JB Flanagan, RKM Jayanty, and C McDade. 2007. Developments in $PM_{2.5}$ Chemical Speciation. Extended Abstract #64 presented at the 2007 Air and Waste Management Association Symposium on Air Quality Methods and Technology. Cathedral Hill Hotel, San Francisco, CA. April 30-May 3, 2007.

[URS] URS Corporation. 2009a. Midlothian, Texas Ambient Air Collection and Chemical Analysis: Quality Assurance Project Plan. Revision number 3. Available from: http://www.tceq.state.tx.us/implementation/tox/research/midlothian.html.

[URS] URS Corporation. 2009b. Midlothian, Texas Ambient Air Collection and Chemical Analysis: Data Report for the First Sampling Round: December 6-10, 2008. Available from: http://www.tceq.state.tx.us/implementation/tox/research/midlothian.html.

[URS] URS Corporation. 2009c. Midlothian, Texas Ambient Air Collection and Chemical Analysis: Second Quarterly Report: For Samples Collected February 6 to March 2, 2009. Available from: http://www.tceq.state.tx.us/implementation/tox/research/midlothian.html.

[URS] URS Corporation. 2009d. Midlothian, Texas Ambient Air Collection and Chemical Analysis: Third Quarterly Report: For Samples Collected May 5-9, 2009. Available from: http://www.tceq.state.tx.us/implementation/tox/research/midlothian.html.

[URS] URS Corporation. 2009e. Midlothian, Texas Ambient Air Collection and Chemical Analysis: Final Report. Available from: http://www.tceq.state.tx.us/implementation/tox/research/midlothian.html.

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.

Tables and Figures

Figure 1. Facilities of Interest in Midlothian

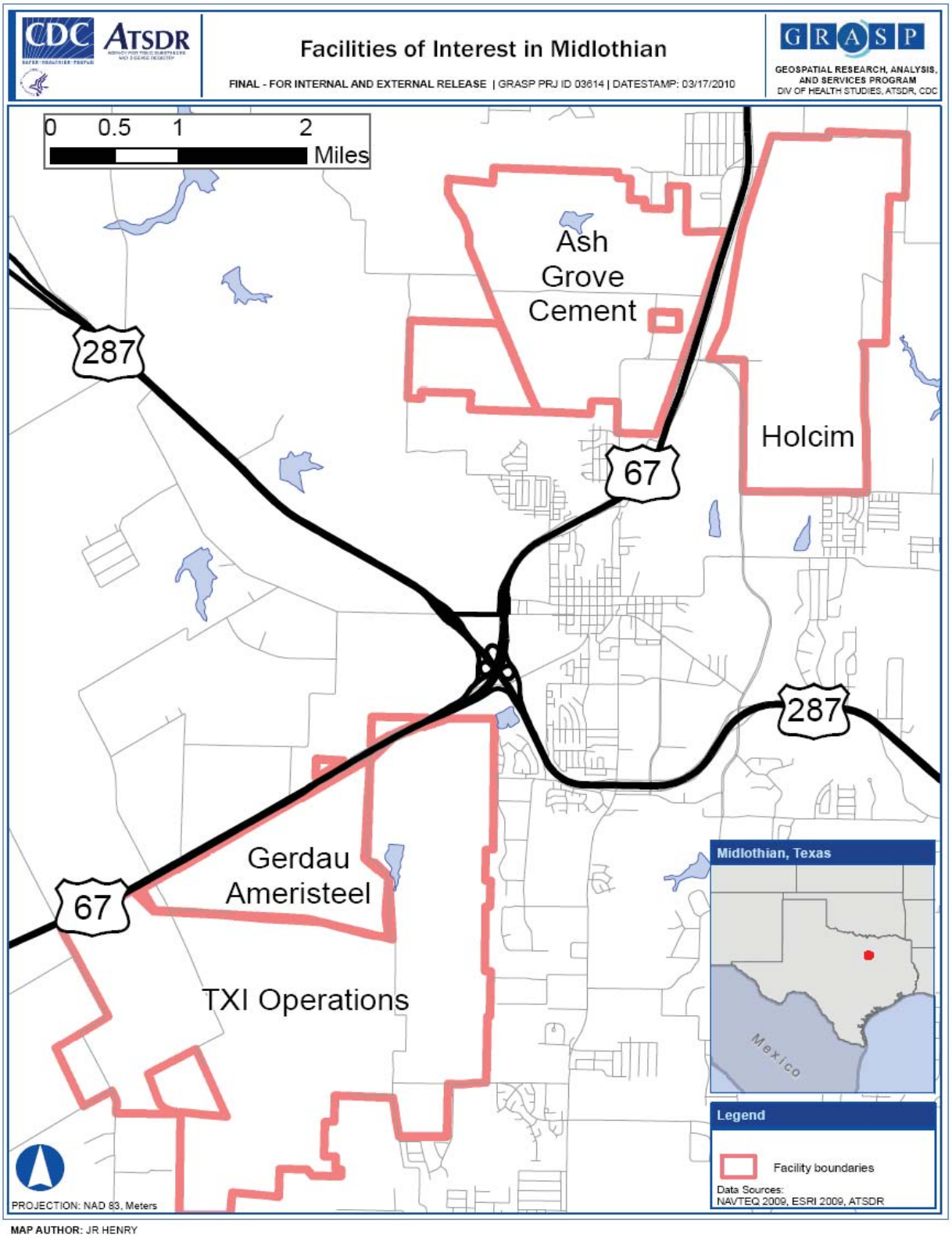
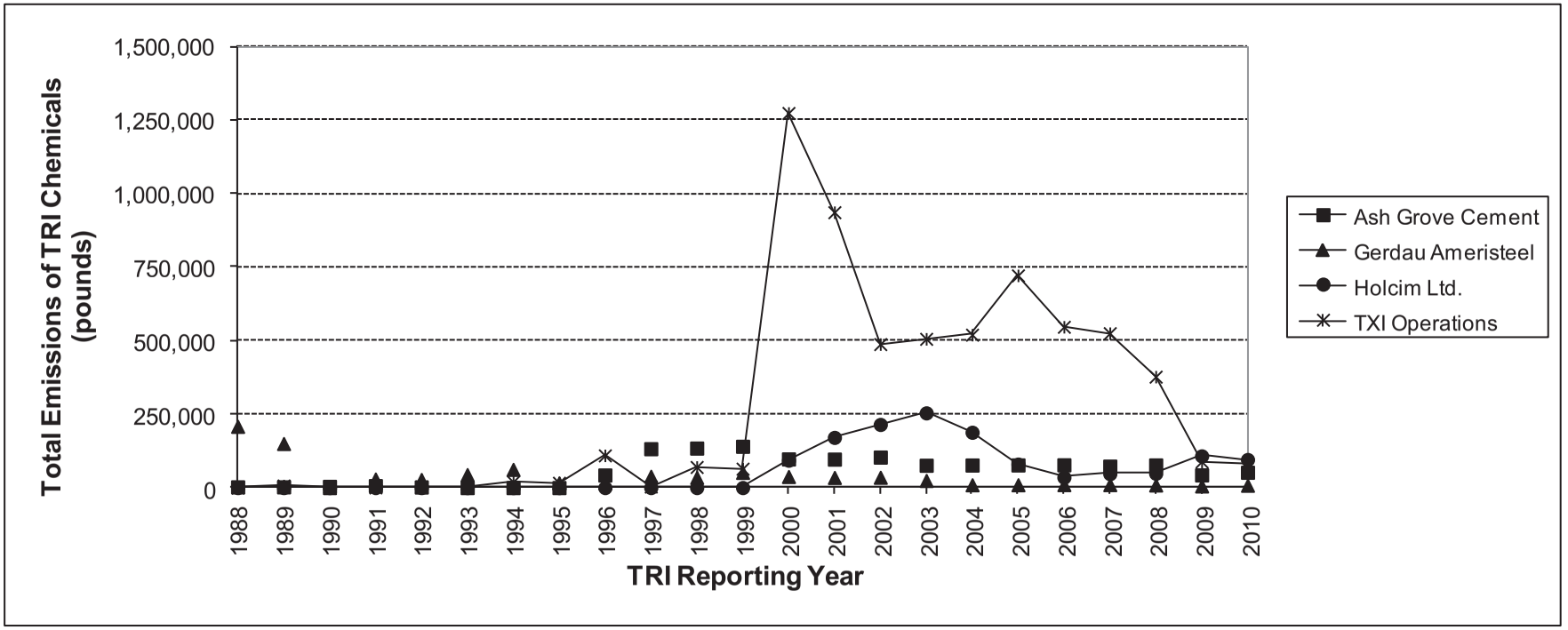


Figure 2. Total Air Emissions Reported by Midlothian Facilities to TRI, 1988–2010



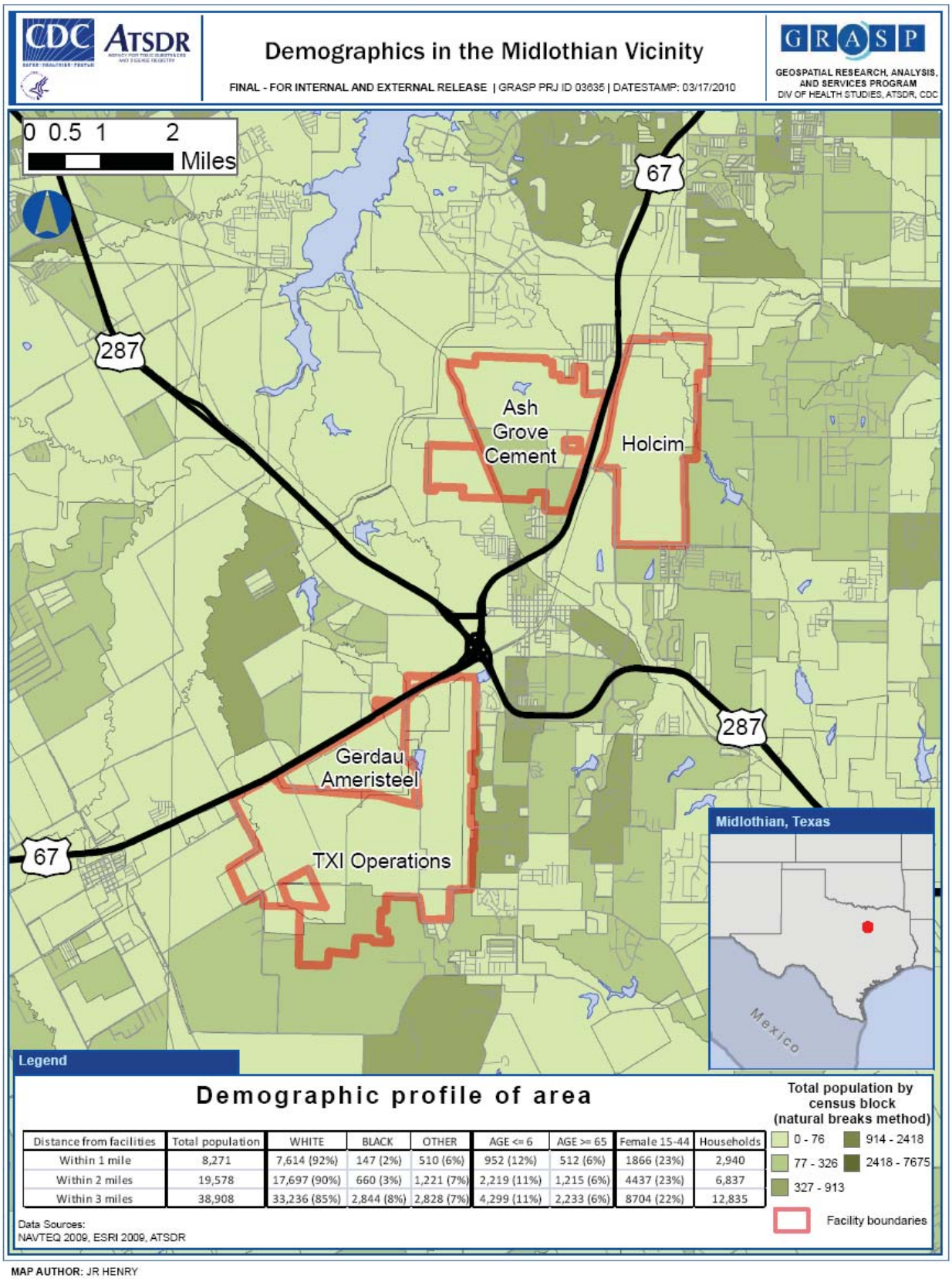
Data source: EPA 2010a

Notes: Figure presents total air emissions (stack and fugitive) from the four facilities of interest.

Long-term trends in emission data can reflect actual changes in facility emissions, as well as changes in the TRI reporting requirements. For instance, the reporting requirements for certain persistent bioaccumulative pollutants (e.g., mercury) and lead changed in 2000 and 2001, respectively, which resulted in some facilities reporting for certain pollutants they did not report for previously.

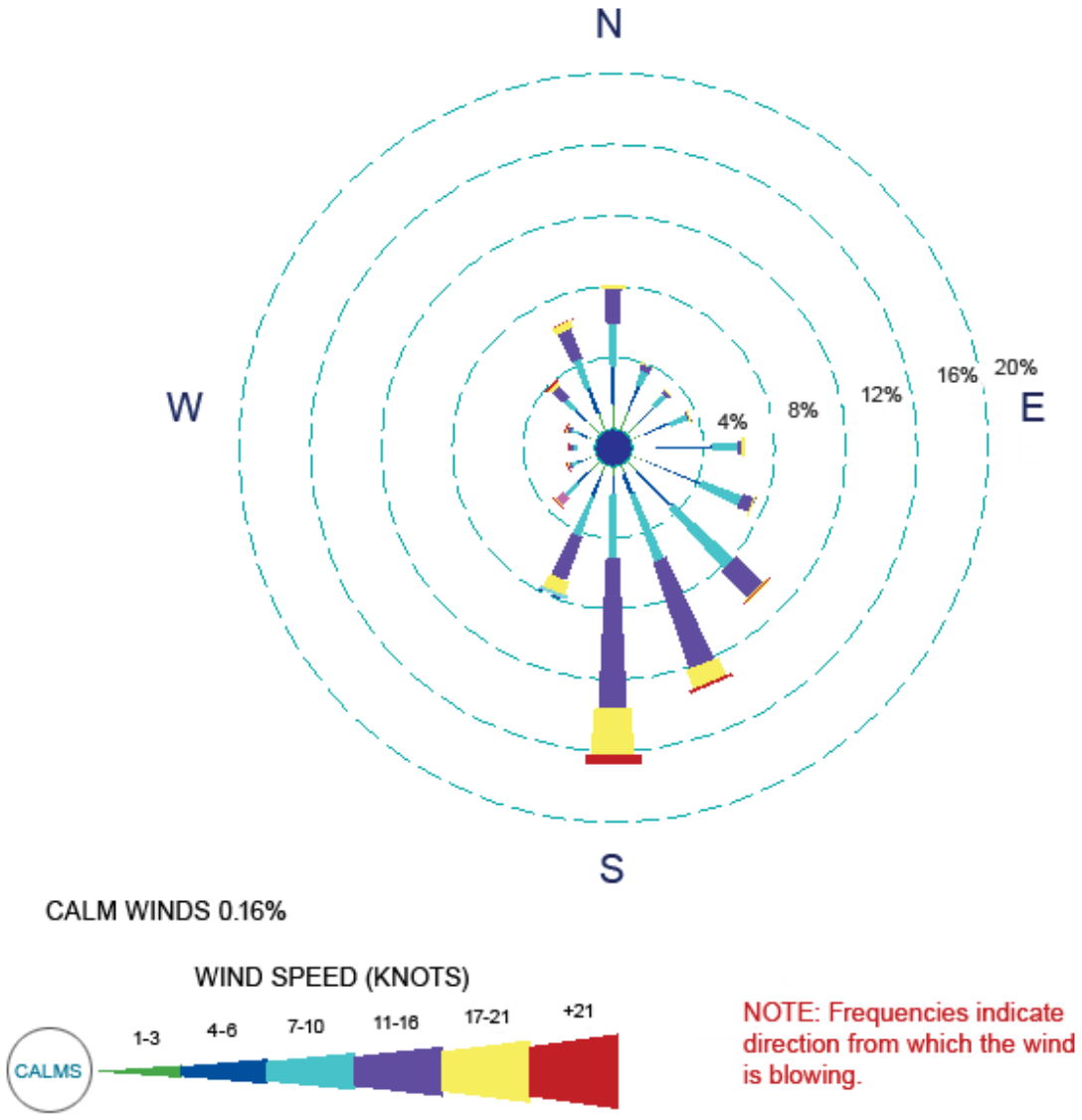
In some cases, facilities did not report any emissions to TRI during the time frame covered in this figure. This most likely resulted from either the facilities not meeting the chemical usage requirements necessary for triggering reporting or the facilities failing to report as required. It is beyond the scope of this Health Consultation to speculate on the exact reason why no TRI reports were submitted in certain years.

Figure 3. Demographics in the Midlothian Vicinity



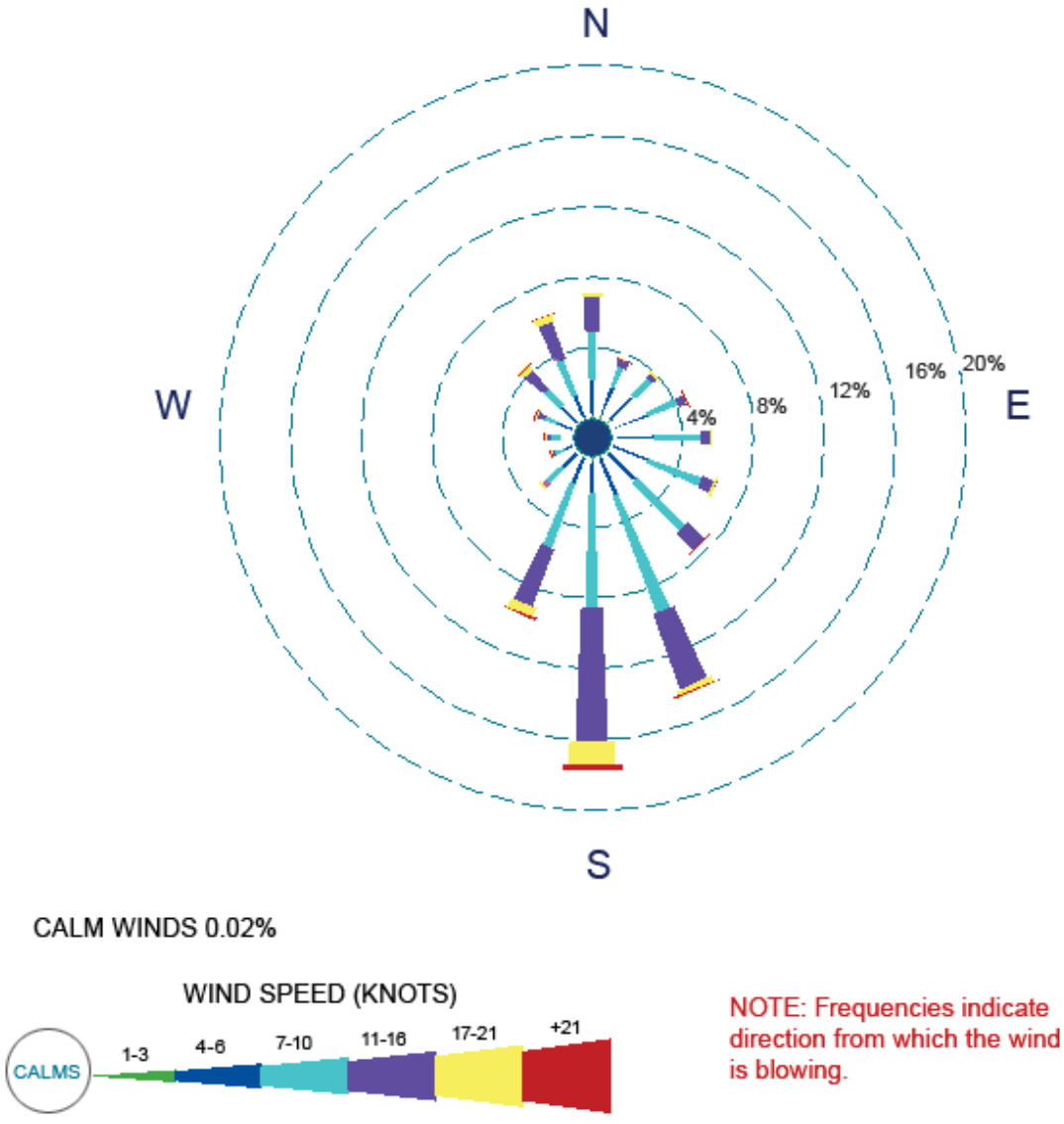
Distance from facilities	Total population	WHITE	BLACK	OTHER	AGE <= 6	AGE >= 65	Female 15-44	Households
Within 1 mile	8,271	7,614 (92%)	147 (2%)	510 (6%)	952 (12%)	512 (6%)	1866 (23%)	2,940
Within 2 miles	19,578	17,697 (90%)	660 (3%)	1,221 (7%)	2,219 (11%)	1,215 (6%)	4437 (23%)	6,837
Within 3 miles	38,908	33,236 (85%)	2,844 (8%)	2,828 (7%)	4,299 (11%)	2,233 (6%)	8704 (22%)	12,835

Figure 4. Wind Rose for the Old Fort Worth Road Monitoring Station, 2002–2006



Data source: TCEQ 2009b

Figure 5. Wind Rose for the Midlothian Tower Monitoring Station, 2002–2006



Data source: TCEQ 2009b

Figure 6. Monitoring Locations in Midlothian Area, January 1981 to Present

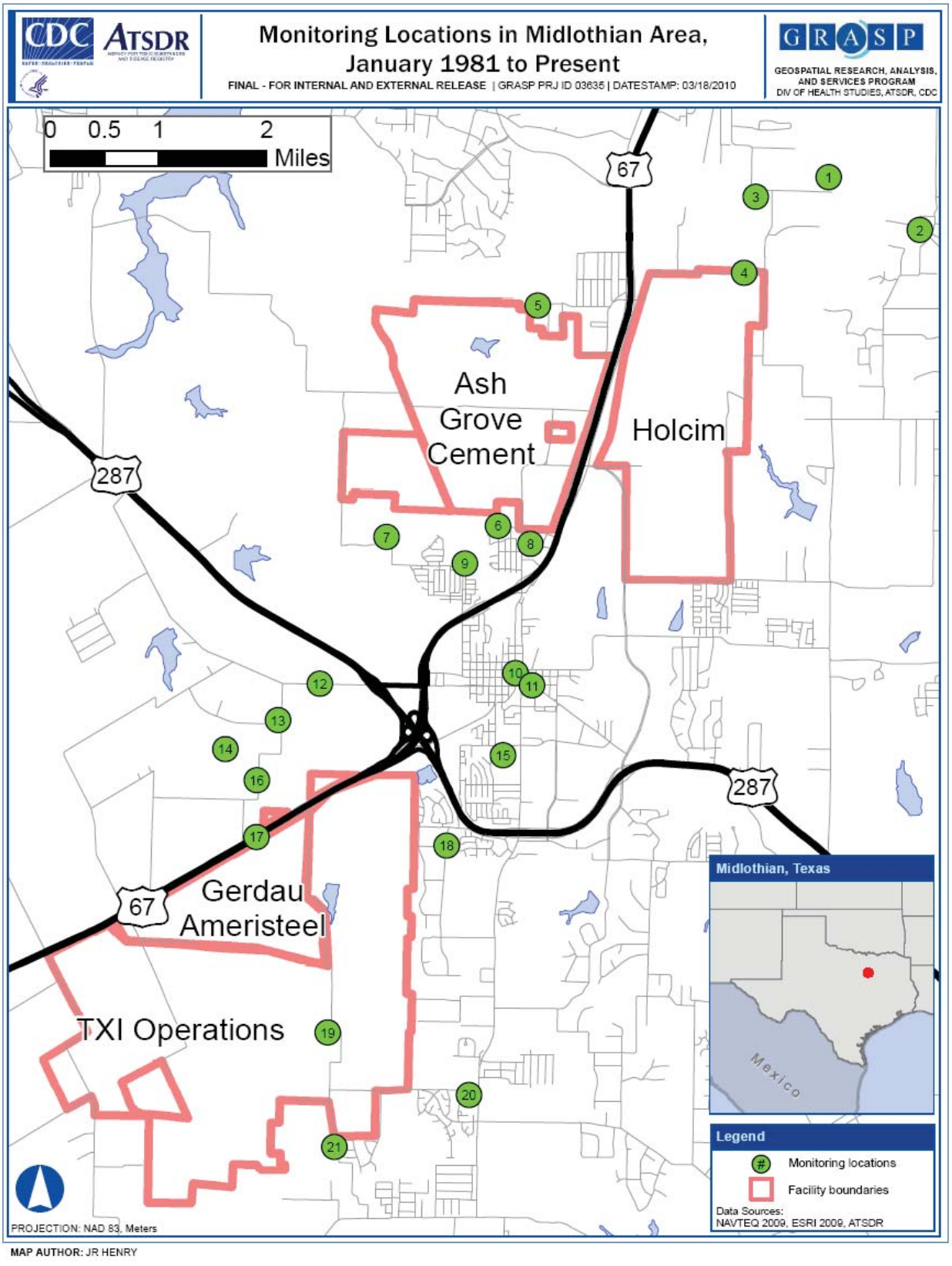
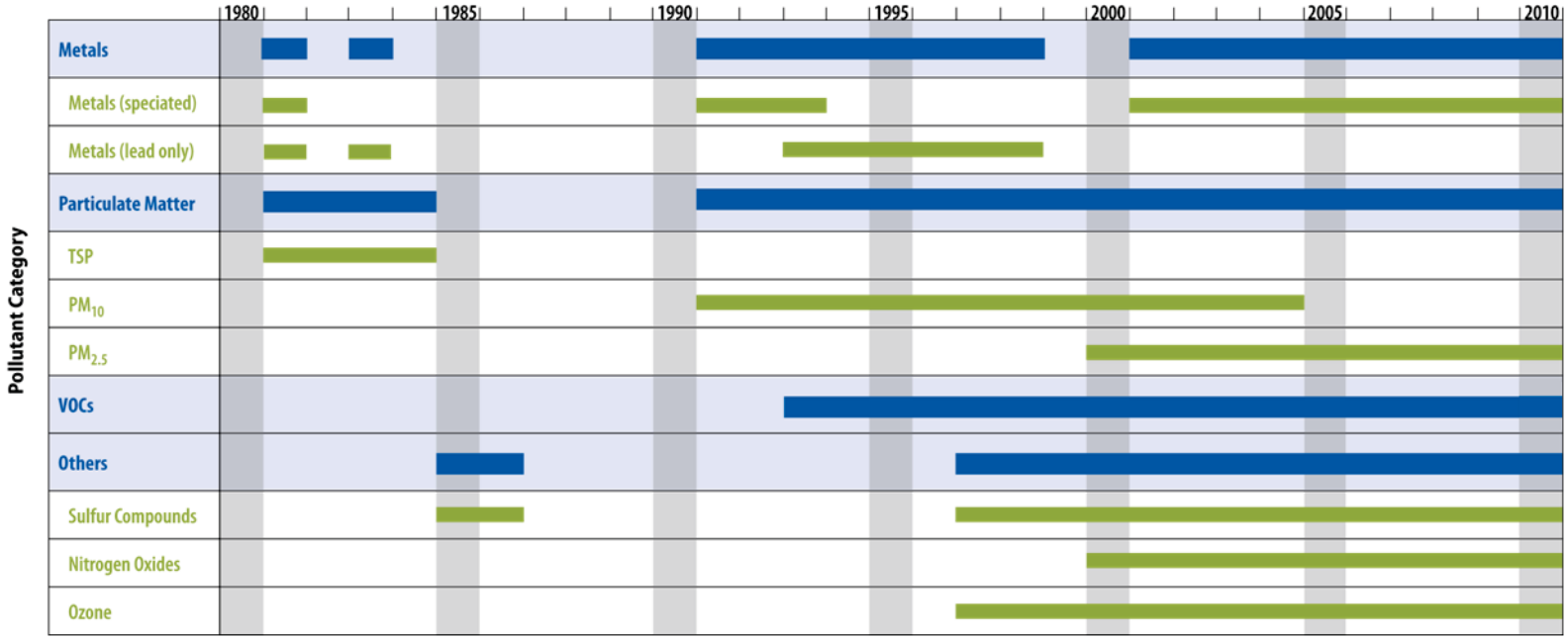


Figure 7. Timeline of Ambient Air Monitoring Activities by Pollutant Group, 1980–2010

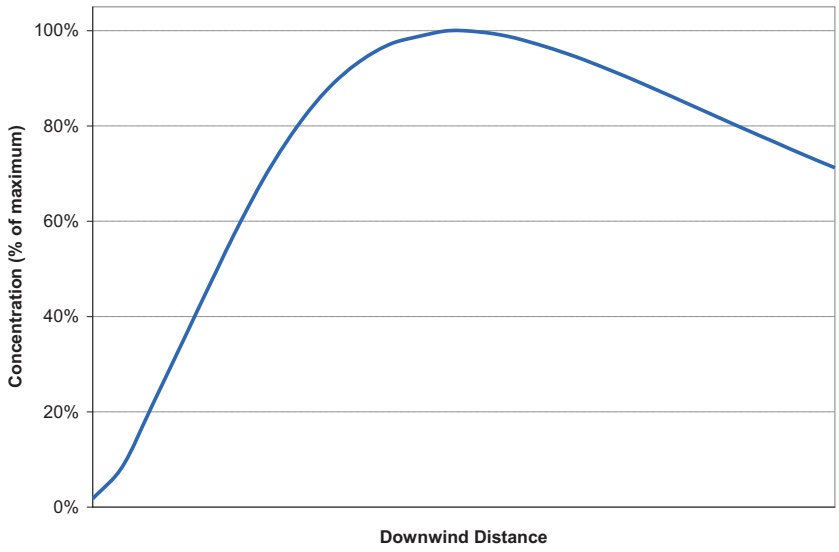


Notes: The timeline indicates the years in which ambient air monitoring occurred at any location in the Midlothian area. Section 4.2 of this Health Consultation provides more detailed information on the temporal coverage of the monitoring activities (e.g., the specific months when monitoring was conducted, the frequency with which samples were collected). Figures 9 through 12 of this Health Consultation show how the spatial coverage of monitoring stations varied by pollutant category and year.

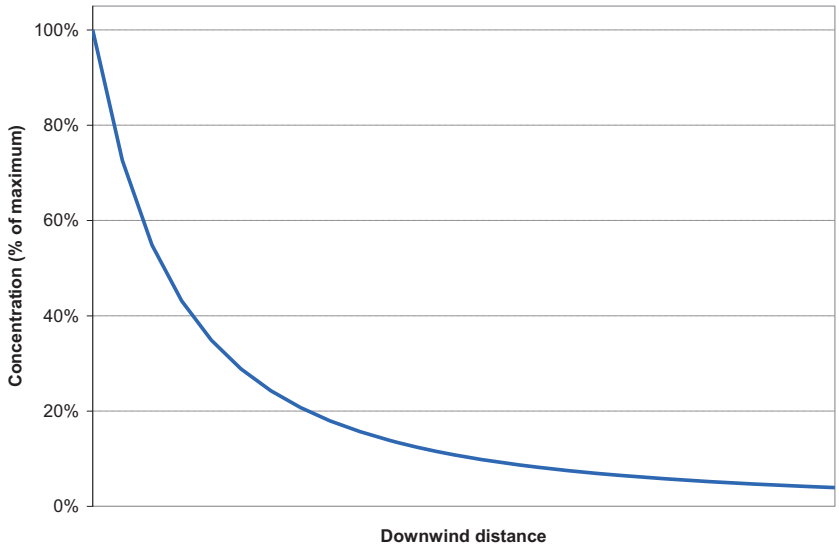
Although speciated metals monitoring was conducted in 1981 and from 1991 to 1993, ATSDR concluded that these data should not be used for public health assessment purposes, due to data quality concerns. Section 4.4 describes this issue in greater detail.

Figure 8. Air Concentrations versus Downwind Distance for Example Emission Sources

A] Ground-level ambient air concentrations as a function of downwind distance for a typical stack source

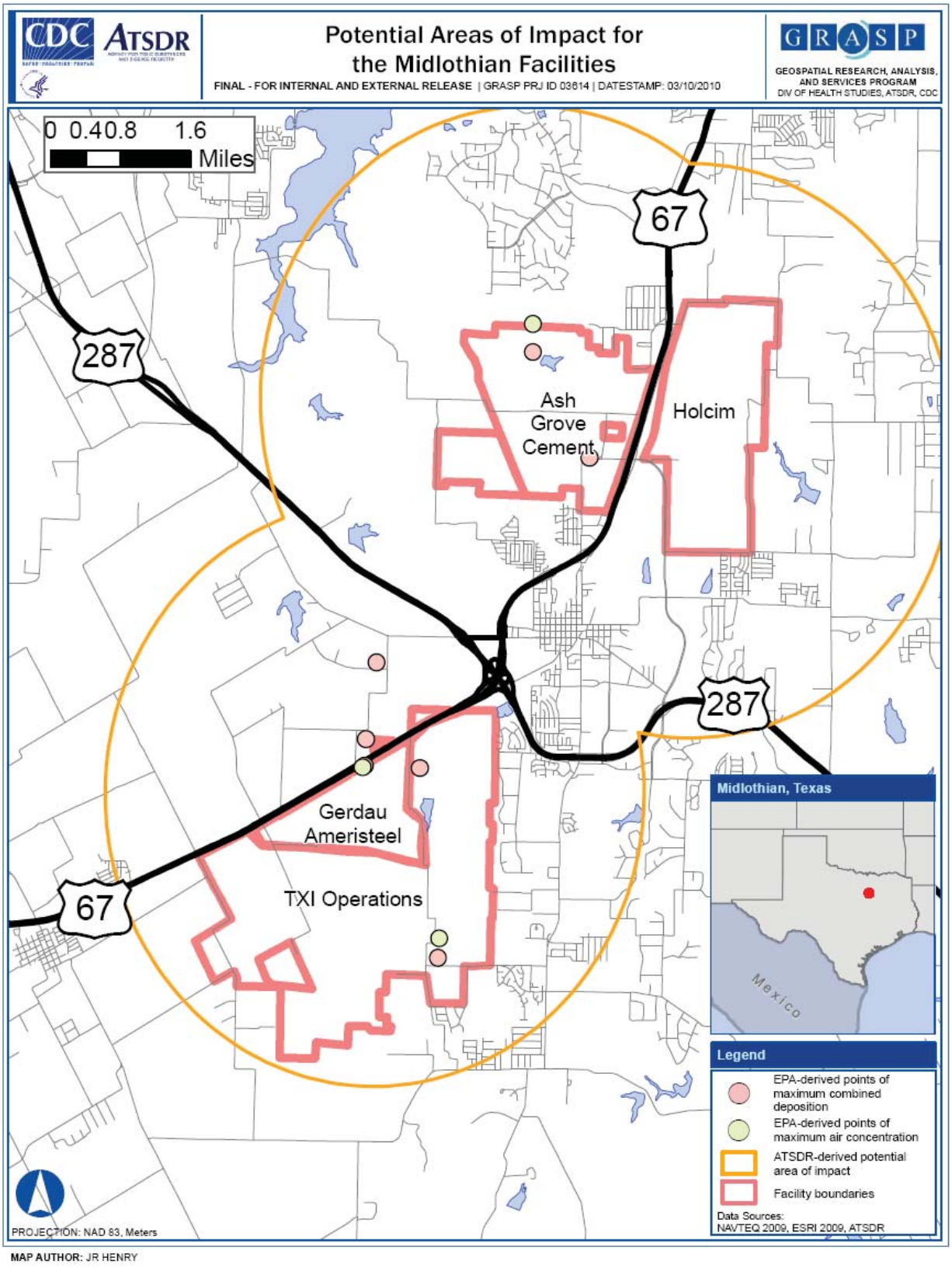


B] Ground-level ambient air concentrations as a function of downwind distance for a typical ground-level, passive release



Notes: Concentration profiles generated using SCREEN3 model and inputs for hypothetical scenarios.
For stack emissions, source parameters (e.g., stack heights, exit velocities) and meteorological conditions will determine the actual downwind distance to a peak concentration, the magnitude of the peak concentration, and the rate which concentrations decay further from the source.
For ground-level, passive releases, source parameters (e.g., dimensions of the source) and meteorological conditions will determine the magnitude of the ambient air concentrations and how quickly they decay with downwind distance.

Figure 9. Potential Areas of Impact for the Midlothian Facilities



Note: Please refer to Appendix C for how areas of impact were determined.

Figure 10. PM Monitoring Locations within Area of Interest

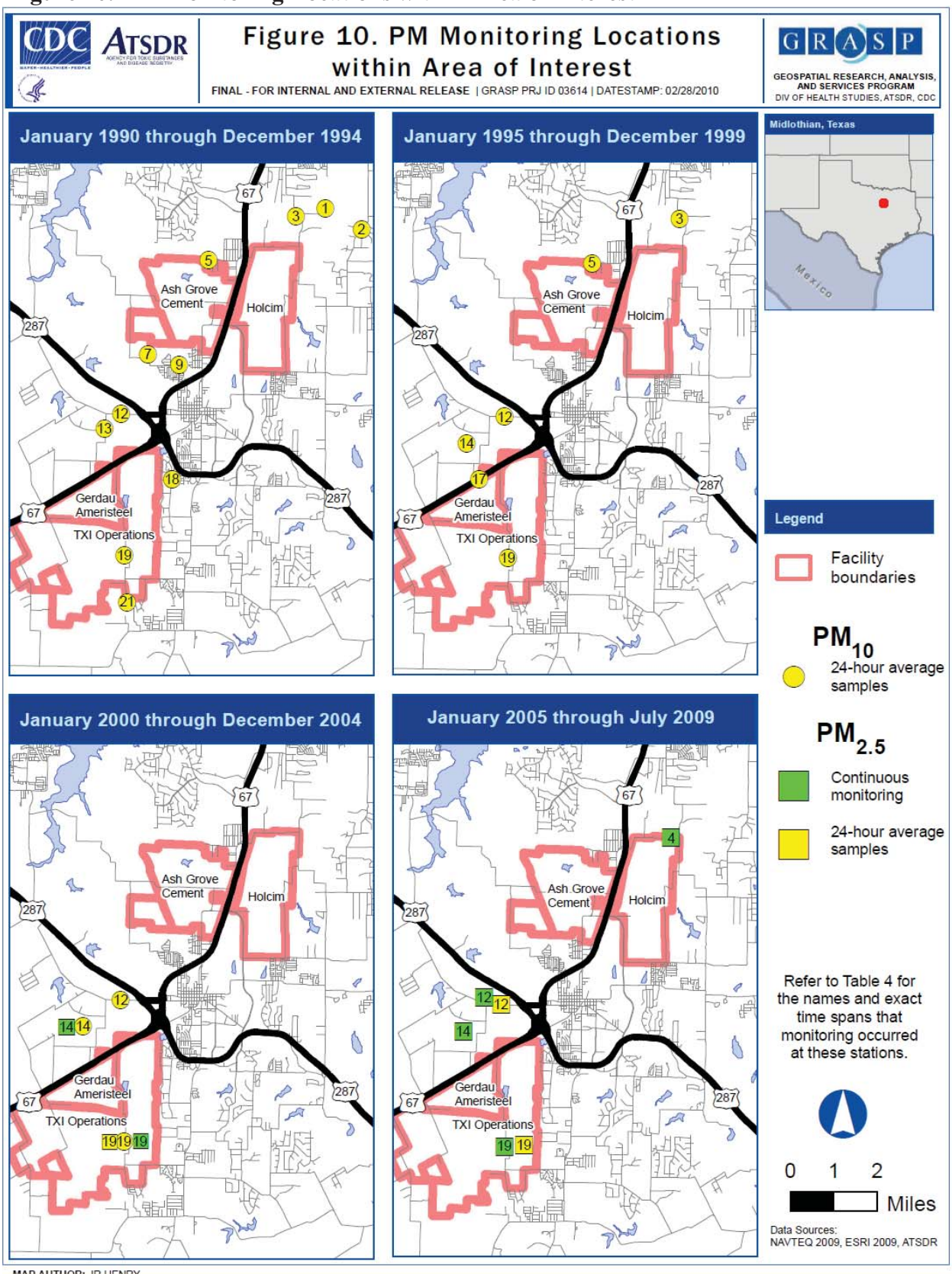


Figure 11. Inorganics (Metals) Monitoring Locations within Area of Interest

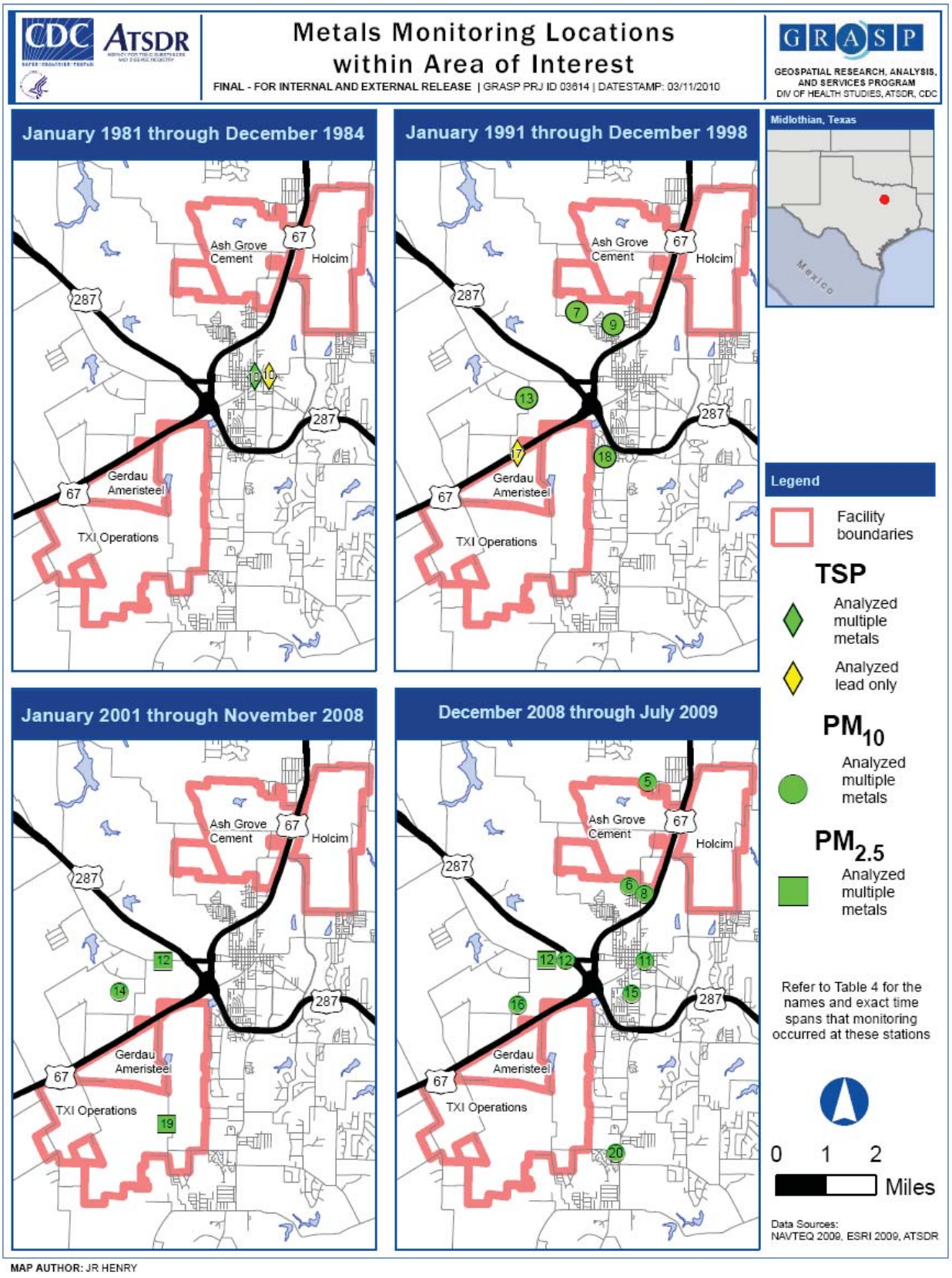


Figure 12. VOC Monitoring Locations within Area of Interest

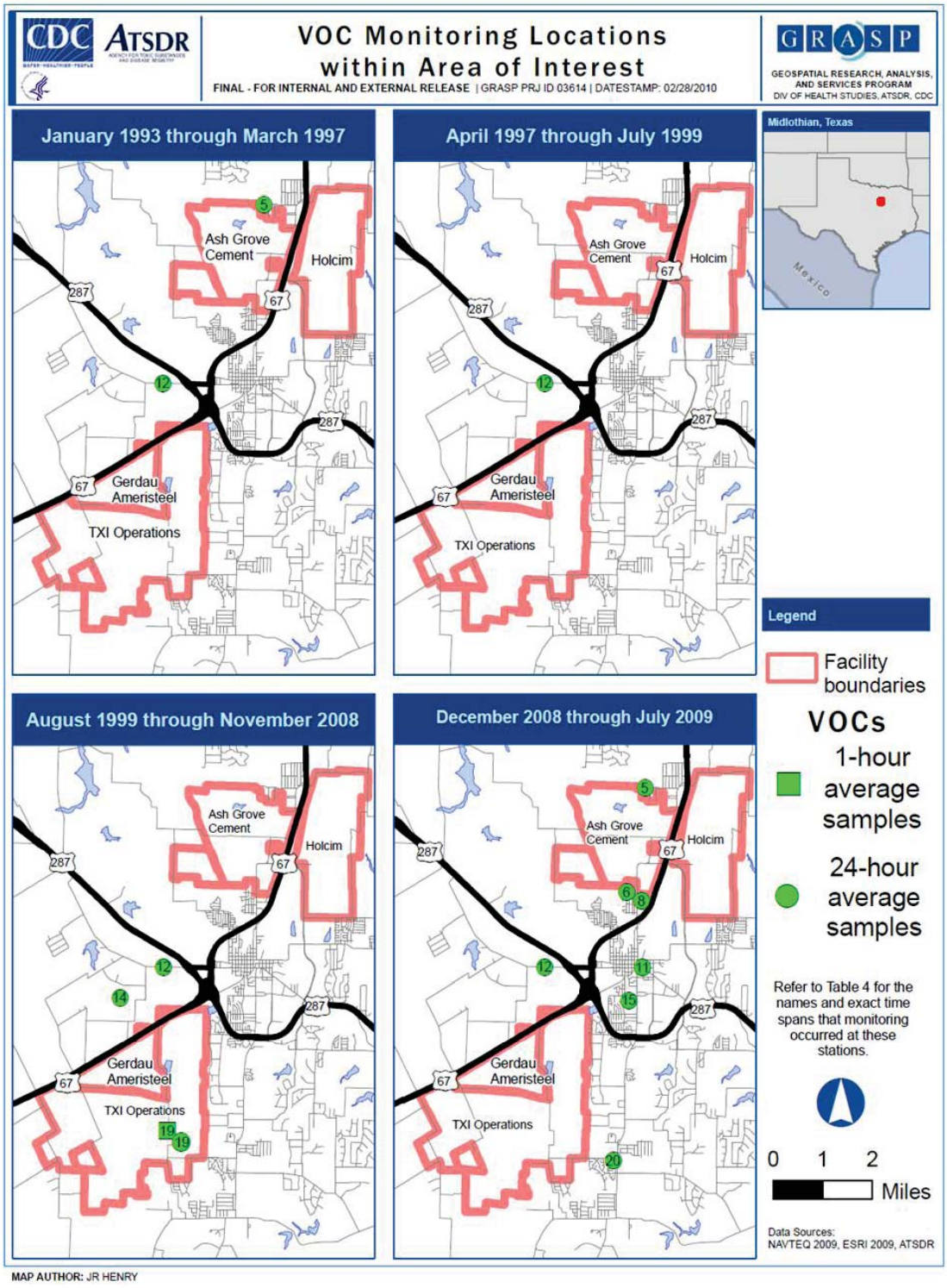


Figure 13. Sulfur Compound Monitoring Locations within Area of Interest, August 1985 through May 2009

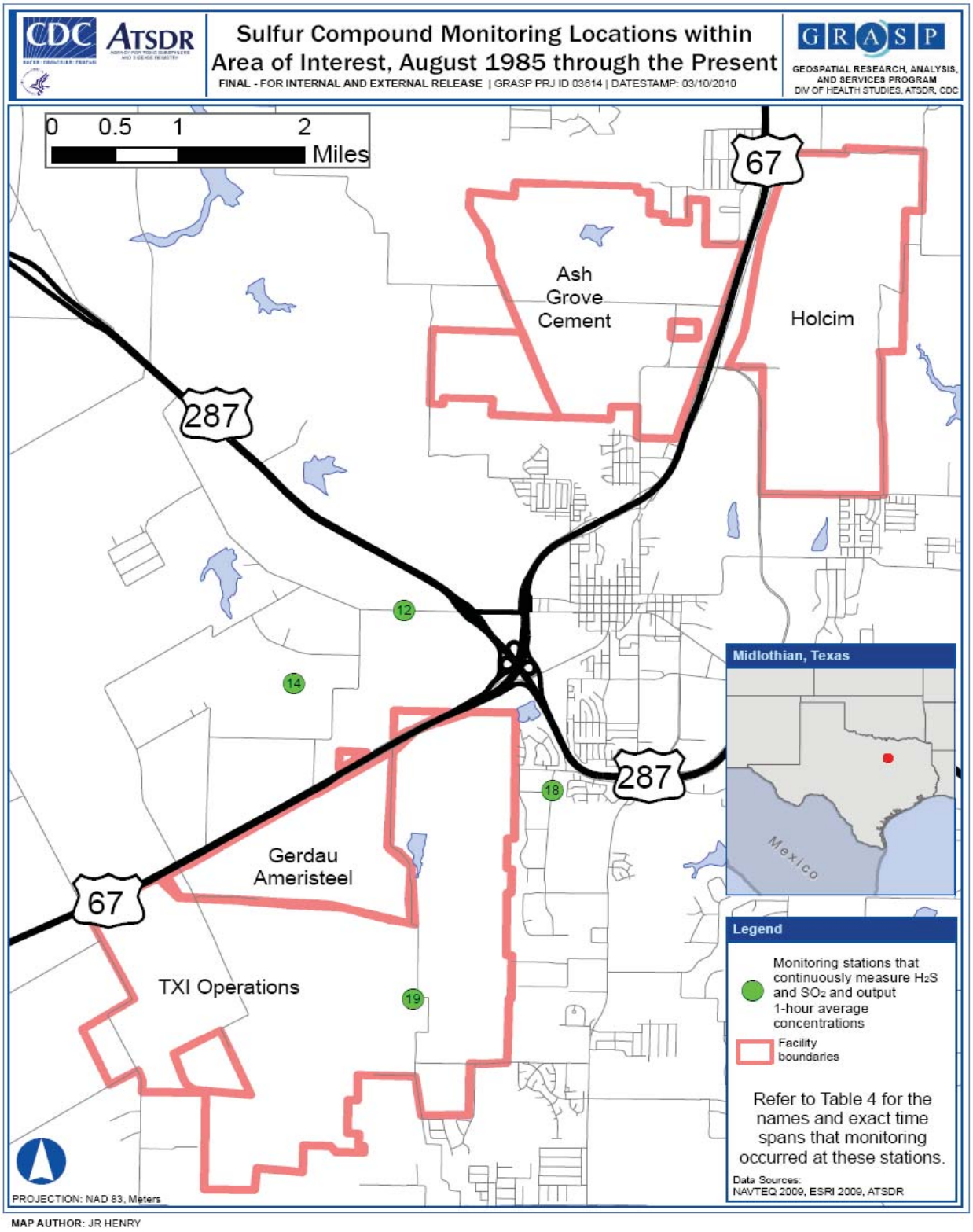


Table 1. Categories of Pollutants Emitted from Cement Kilns

Category	Pollutants within Category	Origin of Emissions
Particulate matter (PM)	$PM_{2.5}$, PM_{10}, TSP	Particles in the kiln exhaust that are not collected in pollution controls are emitted from the stacks as PM. This would include cement kiln dust. PM is also emitted from materials handling processes and many other supporting operations at ground-level.
Inorganics	Metals, elements, inorganic compounds	Most metals and elements emitted from cement kilns are found within the particles that are emitted as PM. The main exception is mercury, which is emitted as a gas from high temperature sources (i.e., the kilns). Some inorganic compounds (e.g., sulfates, hydrochloric acid, sulfuric acid) are also found in particles emitted from stacks, while other inorganic compounds (e.g., carbon monoxide, nitrogen oxides, sulfur dioxide, hydrogen sulfide) are released as gases.
Volatile organic compounds (VOCs)	Organic (or carbon-containing) compounds with high volatility	The high temperatures in cement kilns are expected to destroy most of the VOCs present, but some VOCs may still be found in stack emissions. These include constituents of the various raw materials and fuels and pollutants formed during the combustion of fuels.
Semi-volatile organic compounds (sVOCs)	Organic compounds with low volatility, which include dioxins, furans, and polycyclic aromatic compounds	Combustion of fuels, tires, and hazardous waste can create various products of incomplete combustion and other by-products, which include a wide range of sVOCs. At cement kilns, these would be expected to be found primarily in the stack emissions.

Table 2. Background Information on Midlothian Facilities

Parameter	Facility Name			
	Ash Grove Cement	**Gerdau Ameristeel**	**Holcim**	**TXI Operations**
Approximate years of operation	44	35	23	50
Number of furnaces or kilns	3	2	2	5
Energy sources allowed by the facility air permits	Coal, fuel oil, natural gas, petroleum coke, tires, wood chips	Electricity	Coal, natural gas, tire-derived fuel, alternative fuels	Coal, fuel oil, natural gas, petroleum coke, waste-derived fuel
Number of facility-specific complaints logged in TCEQ's database from 2002 through 2009	0	52	11	84
Number of air emission event reports filed with TCEQ from 2003 through 2011, by type of event:				
Emission event	26	2	8	8
Maintenance	61	0	4	1
Shutdown	8	0	1	0
Startup	18	0	1	0
Excess opacity	144	28	3	27

Data sources: Facility-specific complaint data: TCEQ 2010b
Emission event report data: TCEQ 2010a
Both types of data are reported exactly as queried from TCEQ's Web site.

Table 3. Criteria Pollutant Emission Data Reported to TCEQ's Point Source Emissions Inventory, 2000–2009

Pollutant	Facility	Emissions (tons) by Year									
		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Carbon monoxide	Ash Grove Cement	530	590	420	380	360	510	480	500	410	170
	Gerdau Ameristeel	1,700	1,600	1,600	1,600	1,600	1,600	1,700	1,700	1,500	910
	Holcim	4,400	5,400	5,100	5,100	6,100	3,500	4,200	3,400	5,400	2,500
	TXI Operations	820	720	760	690	610	780	1,000	770	650	290
Nitrogen oxides	Ash Grove Cement	2,900	2,900	2,600	2,600	2,300	2,200	2,200	1,800	1,400	1,270
	Gerdau Ameristeel	510	480	490	460	470	460	500	480	440	210
	Holcim	3,500	3,100	4,200	3,700	4,200	4,900	3,100	2,900	3,200	950
	TXI Operations	4,500	4,400	4,200	3,500	4,300	4,300	3,400	2,900	2,900	1,000
Lead	Ash Grove Cement	0.023	0.014	0.014	0.013	0.014	0.014	0.014	0.013	0.013	0.008
	Gerdau Ameristeel	2.1	1.9	2.0	1.3	0.52	0.50	0.55	0.54	0.48	.028
	Holcim	0.074	0.085	0.016	0.14	0.085	0.085	0.084	0.076	0.079	0.043
	TXI Operations	0.006	0.0038	0.002	0.002	0.0021	0.018	0.018	0.026	0.026	0.016
PM_{10}	Ash Grove Cement	500	450	450	270	270	280	290	280	270	170
	Gerdau Ameristeel	170	160	160	150	160	160	170	160	150	110
	Holcim	390	360	380	340	340	330	500	400	340	200
	TXI Operations	310	370	300	300	310	330	270	300	290	160
$PM_{2.5}$	Ash Grove Cement	260	96	350	230	240	240	250	240	230	140
	Gerdau Ameristeel	140	130	130	130	140	140	150	140	130	97
	Holcim	390	360	380	300	320	310	470	360	300	170
	TXI Operations	100	140	120	110	130	130	140	160	150	80
Sulfur dioxide	Ash Grove Cement	4,400	4,900	4,400	5,000	6,200	6,000	6,300	6,200	4,800	2,600
	Gerdau Ameristeel	130	120	120	120	130	120	130	130	110	74
	Holcim	4,500	2,400	3,200	2,500	2,700	2,700	3,300	2,500	2,700	1700
	TXI Operations	6,300	4,300	2,100	2,300	2,300	3,400	2,600	2,500	1,700	550
VOCs	Ash Grove Cement	13	15	15	15	23	22	23	21	22	13
	Gerdau Ameristeel	360	330	340	340	350	340	370	360	320	200
	Holcim	590	650	630	610	630	640	610	560	580	310
	TXI Operations	72	64	43	71	60	77	61	66	72	15

Data source: TCEQ 2009b
Note: Data rounded to two significant figures.

Table 4. Ambient Air Monitoring in the Midlothian Study Area

Location (Figure 6)	EPA Site Number	TCEQ Site Number	Station Name	Pollutants Measured	Sampling Duration	Time Frame
1	48-139-0011	N/A	Hidden Valley	PM_{10}	24-hour	9/92 - 10/93
2	48-139-0006	N/A	Gorman Road	PM_{10}	24-hour	3/92 - 4/93
3	48-139-0014	N/A	Box Crow	PM_{10}	24-hour	11/93 - 1/95
4	N/A	N/A	Holcim facility boundary	$PM_{2.5}$	Continuous	1/06 - present
5	48-139-0007	N/A	Tayman Drive Water Treatment Plant	PM_{10}	24-hour	3/92 - 12/96
				22 inorganics (PM_{10})	24-hour	12/08 - 7/09
				109 VOCs	24-hour	1/93 - 3/97
				60 VOCs	24-hour	12/08 - 8/09
6	N/A	N/A	Jaycee Park	22 inorganics (PM_{10})	24-hour	12/08 - 7/09
				60 VOCs	24-hour	12/08 - 7/09
7	48-139-0013	N/A	Auger Road Water Treatment	PM_{10}	24-hour	1/91 - 1/92
						1/93 - 11/94
				16 inorganics (PM_{10})	24-hour	1/91 - 12/91
						2/93 - 6/93
8	N/A	N/A	J.A. Vitovsky Elementary School	22 inorganics (PM_{10})	24-hour	5/09
				60 VOCs	24-hour	5/09
9	48-139-0004	N/A	Auger Road	PM_{10}	24-hour	1/91 - 1/93
				16 inorganics (PM_{10})	24-hour	1/91 - 10/92
10	48-139-0001	N/A	City Hall Roof	TSP	24-hour	5/81 - 12/84
				56 inorganics (TSP)	24-hour	5/81 - 12/81
				Lead	24-hour	5/81 - 12/81
						1/83 - 12/83
11	N/A	N/A	Triangle Park	22 inorganics (PM_{10})	24-hour	12/08
				60 VOCs	24-hour	12/08

Location (Figure 6)	EPA Site Number	TCEQ Site Number	Station Name	Pollutants Measured	Sampling Duration	Time Frame
12	48-139-0016	CAMS 52/137	Old Fort Worth (OFW) Road	PM_{10}	24-hour	11/94 - 6/04
				$PM_{2.5}$	24-hour	9/05 - present
					Continuous	4/06 - present
				88 inorganics ($PM_{2.5}$)	24-hour	9/05 - present
				22 inorganics (PM_{10})	24-hour	12/08 - 7/09
				88 VOCs	24-hour	3/97 - 10/04
						4/06 - present
				60 VOCs	24-hour	12/08 - 7/09
				Sulfur compounds	Continuous	8/97 - present
				Nitrogen oxides	Continuous	3/03 - 10/04
						1/05 - present
				Ozone	Continuous	4/06 - present
13	48-139-0005	N/A	Cement Valley Road	PM_{10}	24-hour	1/92 - 6/92
				16 inorganics (PM_{10})	24-hour	1/92 - 5/92
14	48-139-0017	CAMS 302	CAMS 302 - Wyatt Road	PM_{10}	24-hour	11/99 - 6/04
				$PM_{2.5}$	Continuous	8/00 - 3/06
				25 inorganics (PM_{10})	24-hour	1/01 - 6/04
				109 VOCs	24-hour	10/04 - 3/06
				Sulfur compounds	Continuous	10/04 - 3/06
				Nitrogen oxides	Continuous	10/04 - 3/06
15	N/A	N/A	Midlothian High School	22 inorganics (PM_{10})	24-hour	7/09
				60 VOCs	24-hour	7/09
16	N/A	N/A	Wyatt Road	22 inorganics (PM_{10})	24-hour	12/08 - 7/09
17	48-139-0012	N/A	Gerdau Ameristeel	PM_{10}	24-hour	1/96 - 12/98
				Lead	24-hour	1/93 - 8/98
18	48-139-0084	N/A	Cedar Drive	PM_{10}	24-hour	1/92 - 10/94
				16 inorganics (PM_{10})	24-hour	1/92 - 8/92
						2/93 - 6/93
				Sulfur compounds	Continuous	8/85 - 12/85
						3/86 - 7/86

Location (Figure 6)	EPA Site Number	TCEQ Site Number	Station Name	Pollutants Measured	Sampling Duration	Time Frame
19	48-139-0015	CAMS 94/158/160	Midlothian Tower	PM_{10}	24-hour	10/94 - 6/04
				$PM_{2.5}$	Continuous	2/00 - 12/06
				$PM_{2.5}$	24-hour	5/02 - 8/05
				70 inorganics ($PM_{2.5}$)	24-hour	5/02 - 8/05
				105 VOCs	1-hour	8/99 - 10/99
						5/00 - 10/00
						5/01 - 7/01
						5/02 - 10/02
						7/03 - 10/03
						6/04 - 9/04
						5/05 - 10/05
						5/06 - 7/06
				105 VOCs	24-hour	4/04 - 8/07
				Sulfur compounds	Continuous	8/97 - 8/07
				Nitrogen oxides	Continuous	10/00 - 8/07
				Ozone	Continuous	8/97 - 8/07
20	48-139-0008	N/A	Mountain Peak Elementary School	22 inorganics (PM_{10})	24-hour	2/09 - 3/09
				60 VOCs	24-hour	2/09 - 3/09
21	48-139-0008	N/A	Mountain Creek	PM_{10}	24-hour	3/92 - 4/93

Note: N/A = Not applicable. Some monitoring sites do not have EPA or TCEQ site identification numbers.
"Inorganics" refers to metals, other elements, and inorganic compounds detected in particulate filters that were analyzed for chemical composition.
This table was compiled in 2010. Therefore, "present" refers to monitors that were active at some point in 2010.

Table 5. Availability of Monitoring Data for Pollutants Listed on the Facilities' TRI Forms

A) Pollutants Included on TRI Forms for which Some Air Monitoring Data Are Available		
1,1,1-Trichloroethane	Carbon tetrachloride*	Mercury compounds
1,1,2-Trichloroethane*	Chlorine	Methyl ethyl ketone
1,2,4-Trimethylbenzene	Chlorobenzene	Methyl isobutyl ketone
1,3-Butadiene	Chloroethane*	Methyl methacrylate*
1,4-Dichlorobenzene*	Chloroform*	Methyl tert-butyl ether*
Acetonitrile*	Chloromethane*	n-Hexane
Acrylonitrile*	Chromium compounds	Nickel compounds
Aluminum oxide	Copper compounds	Propylene*
Ammonia	Cyclohexane	Styrene
Barium	Dichloromethane	Tetrachloroethylene*
Benzene	Ethyl acrylate	Toluene
Bromine	Ethylbenzene	Trichloroethylene*
Butyraldehyde*	Lead compounds	m-, o-, or p-Xylene
Cadmium compounds	Manganese compounds	Zinc compounds
Carbon disulfide*		

B) Pollutants Included on TRI Forms for which No Air Monitoring Data Are Available		
1,2,3-Trichloropropane*	di(2-Ethylhexyl)phthalate*	n-Butyl alcohol*
1,2,4-Trichlorobenzene*	Dicyclopentadiene*	n-Dioctyl phthalate*
1,2-Butylene oxide	Diepoxybutane	Nitrobenzene*
1,2-Dichlorobenzene*	Diethanolamine	N-Methyl-2-pyrrolidone*
1,3-Dichlorobenzene*	Dimethyl phthalate*	N-Nitrosodimethylamine*
1,4-Dioxane*	Dinitrobutyl phenol*	o-Cresol*
2,4-Dichlorophenol*	Dioxin and dioxin-like compounds	Osmium tetroxide
2,4-Dimethylphenol*	Diphenylamine*	p-Cresol*
2-Chloroacetophenone*	Epichlorohydrin*Ethylene glycol	Pentachlorophenol*
2-Ethoxyethanol*	Ethylene oxide*	Phenanthrene
2-Methoxyethanol*	Formaldehyde*	Phenol
2-Methylpyridine*	Freon 113*	Phthalic anhydride*
2-Nitropropane*	Glycol ethers*	Polychlorinated biphenyls
Acetaldehyde	Hydrochloric acid	Polycyclic aromatic compounds
Acetone	Isobutyraldehyde*	Propionaldehyde*
Acetophenone	Isopropyl alcohol*	Propylene oxide*
Acrylamide*	Maleic anhydride	Quintozene*
Allyl alcohol*	m-Cresol*	sec-Butyl alcohol*
Aniline*	Methanol	Sulfuric acid
Anthracene*	Methyl acrylate*	tert-Butyl alcohol
Biphenyl	N,N-Dimethylformamide*	Urethane*
Bis(tributyltin)oxide*	Naphthalene	Vinyl acetate*
Butyl acrylate*		
Cumene		
Cyanide compounds*		

Notes: The table shows any pollutant that is listed on any of the four industrial facilities' TRI forms at least once between 1988 and 2010, including pollutants that were listed with 0 pounds of air emissions.

Separate listings for a metal (e.g., "lead") and the corresponding metal compounds (e.g., "lead compounds") are grouped together in this table as the metal compound category. These listings were placed in the upper half of this table if ambient air monitoring for the parent metal has been conducted.

Asterisks (*) denote *VOCs* with total estimated emissions summed across all four facilities and all TRI reporting years less than 200 pounds. Section 4.2 of this Health Consultation reviews the significance of this evaluation. Asterisks were not applied to *sVOCs* (e.g., dioxins), regardless of their total emissions.

Table 6. Method Detection Limits for Selected Metals and Elements

Metal or Element	Lowest ATSDR or EPA Health-Based Comparison Value ($\mu g/m^3$)	Detection Limits ($\mu g/m^3$), by Study		
		2008-2009 Midlothian Ambient Air Collection and Analytical Chemical Analysis	2004-2009 Average Method Detection Limits for Routine Speciation Samples Collected by TCEQ	1991-1993 Method Detection Limits for Detailed Study of Midlothian Air Quality
Antimony	NA	0.000007	0.023	0.009
Arsenic	0.0002 (ATSDR)	0.000009	0.004	0.0009
Cadmium	0.0006 (ATSDR)	0.000029	0.008	0.006
Chromium	5 (ATSDR)	0.000165	0.002	0.0013
Lead	0.15 (EPA)	0.000056	0.008	0.0041
Manganese	0.05 (ATSDR)	0.000057	0.002	0.0031
Mercury	0.2 (ATSDR)	0.000017	0.013	0.0027
Nickel	0.09 (ATSDR)	0.000152	0.004	0.0009
Selenium	21 (EPA)	0.000013	0.004	0.0019
Vanadium	0.2 (ATSDR)	0.000014	0.003	0.0003

Notes: Data sources: ERG 2009; DRI 2010; TNRCC 1995.

The 2008-2009 method detection limits are based on analyses using ICP/MS; and the other two sets of method detection limits are based on analyses using XRF.

Method detection limits are available for numerous additional metals and elements. This table presents only those for metals and elements that were measured by all three monitoring programs.

The health-based comparison values were selected as follows: (1) If ATSDR has published a comparison value for a substance, the lowest value is shown in the table; and (2) if a substance has no ATSDR-derived values, EPA comparison values are shown. Note that some comparison values are derived for cancer health endpoints, and others for non-cancer. ATSDR's Health Consultations for future projects will more thoroughly document the approaches used to select health-based comparison values and the public health implications of exposures. This display is used to demonstrate that the monitoring methods employed are generally sensitive enough to measure ambient air concentrations at or near the method detection limits.

The health-based comparison value for chromium is based on trivalent chromium oxide. Section 4.3 of this Health Consultation presents information on the comparison value for hexavalent chromium, which has been measured separately. Neither ATSDR or EPA has published health-based comparison values for antimony.

Table 7. Method Detection Limits for Selected VOCs

Pollutant	Lowest ATSDR or EPA Health-Based Comparison Value (µg/m^3)	Detection Limits (ppb), by Study	
		2008-2009 Midlothian Ambient Air Collection and Analytical Chemical Analysis	Detection Limits Report by TCEQ's Analytical Laboratory for VOC Sampling
Benzene	0.04	0.010	0.27
1,3-Butadiene	0.02	0.005	0.27
Carbon tetrachloride	0.01	0.004	0.27
Chloroform	0.009	0.007	0.21
1,2-Dibromoethane	0.0002	0.007	0.20
1,2-Dichloroethane	0.01	0.009	0.27
Methylene chloride	0.6	0.018	0.14
1,1,2,2-Tetrachloroethane	0.003	0.009	0.20
1,1,2-Trichloroethane	0.01	0.008	0.21
1,2,4-Trimethylbenzene	1.5	0.016	0.27
1,3,5-Trimethylbenzene	NA	0.016	0.25
Vinyl chloride	0.04	0.005	0.17
m,p-Xylene	20	0.019	0.27

Notes: Data sources: ERG 2009; TCEQ 2010c.
All detection limits are based on analyses of canister samples by GC/MS.
Method detection limits are available for numerous additional VOCs. This table presents only those for the "target compound" VOCs identified in the 2008-2009 study [URS 2009].
The health-based comparison values were selected as follows: (1) If ATSDR has published a comparison value for the substance, the lowest value is shown in the table; and (2) if a substance has no ATSDR-derived values, EPA comparison values are shown. Note that some comparison values are derived for cancer health endpoints, and others for non-cancer. ATSDR's Health Consultations for future projects will more thoroughly document the approaches used to select health-based comparison values and the public health implications of exposures. This display is used to demonstrate that the monitoring methods employed are generally sensitive enough to measure ambient air concentrations at or near the method detection limits.
Neither ATSDR or EPA have published health-based comparison values for 1,3,5-trimethylbenzene.

Table 8. Inter-Method Comparisons for TCEQ's $PM_{2.5}$ Monitoring

Parameter	Midlothian Tower Monitoring Station	Old Fort Worth Road Monitoring Station
Time frame of co-located $PM_{2.5}$ measurements using two different methods	May 2002 – August 2005	April 2006 – December 2008
Number of days for which both monitoring methods generated valid results	192	163
Average concentration for these days as measured by the continuous $PM_{2.5}$ monitor	10.1 $\mu g/m^3$	9.4 $\mu g/m^3$
Average concentration for these days as measured by the federal reference method $PM_{2.5}$ monitor that collects 24-hour average samples	11.5 $\mu g/m^3$	11.8 $\mu g/m^3$
Percent difference between the two monitoring methodologies	13%	23%
Correlation between the continuous and 24-hour $PM_{2.5}$ data sets	$R^2 = 0.87$	$R^2 = 0.88$

Notes: ATSDR calculated all data in this table from the validated $PM_{2.5}$ monitoring database provided by TCEQ. Percent difference was calculated by dividing the difference between the two concentrations by the average of the two concentrations.

Table 9. $PM_{2.5}$, Hydrogen Sulfide (H_2S), and Sulfur Dioxide (SO_2) Air Pollution Levels: Days When 1-in-6 Day Samples Are Collected Versus All Other Days

Parameter	Summary of Continuous Ambient Air Monitoring Data	
	Days when 1-in-6 Day Ambient Air PM Samples Were Collected	**Days when 1-in-6 Day Ambient Air PM Samples *Were Not* Collected**
Ambient air monitoring data for the Midlothian Tower Monitoring Station		
Time frame considered	May 2002 – August 2005	
Number of days of valid data	194	1,004
Average $PM_{2.5}$ concentration ($\mu g/m^3$)	9.4	8.9
Average H_2S concentration (ppbv)	0.40	0.39
Average SO_2 concentration (ppbv)	1.09	1.06
Ambient air monitoring data for the Old Fort Worth Road Monitoring Station		
Time frame considered	April 2006 – December 2008	
Number of days of valid data	159	799
Average $PM_{2.5}$ concentration ($\mu g/m^3$)	10.2	10.1
Average H_2S concentration (ppbv)	0.39	0.35
Average SO_2 concentration (ppbv)	1.75	1.62

Notes: The table summarizes all valid $PM_{2.5}$ measurements from the Midlothian Tower and Old Fort Worth Road monitoring stations during the time when side-by-side measurements were collected with the continuous monitor and the 1-in-6 day sampler.

For both monitoring stations, the concentration differences shown in this table are not statistically significant, as determined by a large sample test of a hypothesis, which considers whether the difference between arithmetic means for two unmatched distributions is statistically significant.

Table 10. Continuous Emission Monitoring Data: Days When 1-in-6 Day Samples Are Collected Versus All Other Days

Parameter	Days when 1-in-6 Day Ambient Air PM Samples Were Collected at Offsite Monitors	Days when 1-in-6 Day Ambient Air PM Samples *Were Not* Collected at Offsite Monitors
Summary of TXI Operations' Continuous Emission Monitoring Data		
Time frame considered	September 2005 – December 2008	
Number of days of valid data	202	1,011
Average CO emission rate (pounds/day)	4,700	4,610
Average NO_x emission rate (pounds/day)	18,200	17,900
Average SO_2 emission rate (pounds/day)	13,400	13,300
Average THC emission rate (pounds/day)	335	327
Summary of Ash Grove Cement's Continuous Emission Monitoring Data		
Time frame considered	May 2002 – December 2008	
Number of days of valid data	398	2,026
Average CO emission rate (pounds/day)	2,410	2,400
Average NO_x emission rate (pounds/day)	11,700	11,700
Average SO_2 emission rate (pounds/day)	30,500	30,600
Summary of Holcim's Continuous Emission Monitoring Data		
Time frame considered	May 2002 – December 2008	
Number of days of valid data	399	2,038
Average CO emission rate (pounds/day)	23,300	23,800
Average NO_x emission rate (pounds/day)	19,900	18,900
Average SO_x emission rate (pounds/day)	13,800	13,700

Notes: CO = carbon monoxide; NO_x = nitrogen oxides; SO_2 = sulfur dioxide; THC = total hydrocarbons

Table is based on all valid continuous emission monitoring data for the time frame when 1-in-6 day PM samples were collected at the Midlothian Tower and Old Fort Worth Road monitoring stations.

The emission rates shown are the sum of emissions from the five kiln stacks for which at least some continuous emission monitoring is required.

Data are not presented for Gerdau Ameristeel because the facility's permit does not require continuous emission monitoring for individual pollutants.

For all pollutants shown in the table, the differences between emission rates measured on days when 1-in-6 day samples were collected and emission rates on all other days are not statistically significant. Statistical significance was assessed using a large sample test of a hypothesis, which considers whether the difference between arithmetic means for two unmatched distributions is statistically significant.

Table 11. Effectiveness of 1-in-6 Day Sampling for Evaluating Long-Term and Short-Term Exposures

Parameter	Old Fort Worth Road Station		Midlothian Tower Station		Holcim Station	
	Statistics Considering Every 6th Day of Data	Statistics Considering Entire Data Set	Statistics Considering Every 6th Day of Data	Statistics Considering Entire Data Set	Statistics Considering Every 6th Day of Data	Statistics Considering Entire Data Set
Time frame considered	April 2006 – May 2009		February 2000 – December 2006		January 2006 – June 2009	
Number of days with valid data	191	1,141	418	2,505	207	1,241
Average $PM_{2.5}$ concentration ($\mu g/m^3$)	9.4 – 10.0	9.7	8.7 – 9.1	8.9	10.7 – 11.3	11.1
90th percentile of $PM_{2.5}$ concentrations ($\mu g/m^3$)	15.8 – 16.7	16.3	14.9 – 16.1	15.4	17.7 – 18.6	18.2
Highest 24-hour average $PM_{2.5}$ concentration ($\mu g/m^3$)	29.0 – 50.6	50.6	27.7 – 49.6	49.6	27.1 – 42.2	42.2

Notes: 1. Data source: All validated continuous $PM_{2.5}$ monitoring data provided by TCEQ and UTA.
2. Data are summarized for the three monitoring stations equipped with continuous $PM_{2.5}$ monitoring devices. The entire period of record of valid results was considered for this analysis. For each data set, a range of values is shown for "statistics considering every 6th day of data." Use of range was necessary because statistics were first computed by assigning the first day of record as the first every 6th day sampling event; statistics were then recalculated by assigning the second day of record as the first every 6th day sampling event; and so on. The range shown in this table is the span of possible values for the six different scenarios considered.
3. This table was generated to address community concerns about the ability of 1-in-6th day sampling to adequately characterize exposures. For chronic exposures, our assessment indicates that 1-in-6th day sampling is appropriate. However, the highest concentrations may not be captured by this approach.
4. The purpose of this table is to evaluate the representativeness of 1-in-6th day sampling. It should not be used to assess attainment of the NAAQS.

Table 12. Comparison of Air Pollution Measurements at Old Fort Worth Road (OFW) and Wyatt Road (Wyatt)

Parameter	Nitrogen Oxides Data		PM_{10} Data		Sulfur Dioxide Data	
Start of concurrent measurements	January 27, 2005		January 1, 2000		January 27, 2005	
End of concurrent measurements	March 29, 2006		June 26, 2004		March 29, 2006	
Days with concurrent data	417		252		425	
	OFW Data	**Wyatt Data**	**OFW Data**	**Wyatt Data**	**OFW Data**	**Wyatt Data**
Average concentration	15.2	11.1	25.6	25.9	2.40	0.85
90^{th} percentile concentration	33.1	21.7	40.9	40.9	5.65	1.72
95^{th} percentile concentration	47.7	33.4	44.5	45.5	12.85	3.31
Maximum concentration	245.5	170.1	78	73	153.6	180.0
Date of maximum concentration	January 25, 2006	January 25, 2006	May 9, 2003	July 26, 2003	January 11, 2006	August 2, 2005

Notes: Data source: validated monitoring data collected at TCEQ's OFW and Wyatt Road monitoring stations.
The number of days with concurrent data were calculated after excluding dates for which no valid results were collected.
For nitrogen oxides and sulfur dioxide, the underlying data set is continuous 1-hour average measurements, and all concentrations in the table are reported in units of ppb; for PM_{10}, the underlying data set is 24-hour measurements collected every six days, and all concentrations in the table are reported in units of micrograms per cubic meter.

Table 13. Utility of Particulate Matter Monitoring Data for Health Assessment Purposes

Time Frame	Findings
Prior to 1981	**No PM monitoring data are available.** ATSDR will either (1) consider this time frame a data gap and make no health conclusions regarding PM levels or (2) make inferences about this time frame based on surrogate information and thoroughly document all assumptions in this analysis.
1981 – 1984	**Limited PM monitoring data are available.** PM monitoring is limited to TSP measurements at a single location (Midlothian City Hall). Though these data were collected with well-established methods and appear to be of a known and high quality, the data very likely do not characterize ambient air concentrations of PM immediately downwind of the industrial facilities due to the location where this monitor was placed. ATSDR will evaluate these data as rough indicators of exposure in this specific part of the Midlothian area, but they will not be assumed to reflect air pollution levels at other locations.
1985 – 1990	**No PM monitoring data are available.** ATSDR will either (1) consider this time frame a data gap and make no health conclusions regarding PM levels or (2) make inferences about this time frame based on surrogate information and thoroughly document all assumptions in this analysis.
1991 – 2009	**Locations nearest Gerdau Ameristeel and TXI Operations.** Some form of PM monitoring has occurred almost continually, both at locations upwind and downwind from the two facilities, and during times when TXI Operations was and was not burning hazardous waste. This monitoring was conducted using rigorous methods known to be capable of generating measurements of a known and high quality. These monitors were placed at or near locations believed to have the greatest air quality impacts, based on EPA's previous modeling study (see Figure 10). Thus, ATSDR concludes that monitoring data from these stations are reasonably representative of the outdoor air concentrations of PM in the offsite areas most heavily impacted by the two facilities' emissions.
	Locations nearest Ash Grove Cement and Holcim. PM monitoring using the same or similar methods has also occurred downwind of Ash Grove Cement and Holcim, but only for a few years between 1991 and 2009, and not when Ash Grove Cement was burning hazardous waste. ATSDR will use these data to evaluate the health implications of exposure. This evaluation will specifically acknowledge that no monitoring data were collected downwind of Ash Grove Cement in 1991 and from 1997 to 2007; and no monitoring data were collected downwind from Holcim from 1996 to 2005. ATSDR will research other indicators of facility emissions (e.g., continuous emission monitoring data, types and quantities of fuels burned, production levels) to determine if defensible conclusions regarding PM concentrations can be reached for these locations during times when ambient air monitors were not operating.
	Other considerations. When interpreting the PM monitoring data, ATSDR will also consider two findings discussed earlier in this Health Consultation. First, though widely used in field applications, the continuous $PM_{2.5}$ monitoring devices used in Midlothian understated air concentrations by as much as 23 percent (see Section 4.4). Second, collection of 24-hour average samples every sixth day has proven to be highly reliable at quantifying annual average concentrations and 90^{th} percentile concentrations. However, this sampling schedule likely does not capture the highest pollution levels that occurred, and ATSDR's review of other Midlothian data suggests that the maximum PM concentration from a 1-in-6 day data set might understate the actual highest 24-hour average PM concentration by as much as 44% (see Section 4.6).

Table 14. Utility of Inorganics Monitoring Data for Health Assessment Purposes

Time Frame	Findings
All time frames	**General considerations.** Some monitoring data are available for every inorganic included in the facilities' emission reports. However, no monitoring has been conducted for vapor-phase mercury (see Section 4.2), hydrochloric acid, and sulfuric acid, and data for nitrates should not be used for health assessment purposes (see Section 4.3). ATSDR will consider other sources of information when evaluating these pollutants. Most metals sampling was conducted on a 1-in-6 day schedule, which provides a reasonable account of annual average levels but likely understates the highest 24-hour levels (see Section 4.6).
Prior to Jan. 2001	**Some data on inorganics, but these will be used qualitatively (for screening and trend analysis only) and not for health assessment purposes.**[12] Limited ambient air monitoring occurred during this time frame for inorganics. This monitoring used methods commonly used at the time, but these methods were later found to potentially underestimate ambient air concentrations (see Section 4.3). ATSDR will use the metals and element measurements with caution from this time frame in future public health assessment activity. When evaluating metals and elements other than lead, ATSDR will either: (1) consider this time frame a data gap and make no health conclusions or (2) make inferences about this time frame based on surrogate information and thoroughly document all assumptions in this analysis.
Jan. 2001 – Aug. 2005	**Monitoring data are available for metals and elements at two locations.** Air monitoring for metal and elements during this time occurred at the Midlothian Tower and Wyatt Road sites, which bracket the Gerdau Ameristeel and TXI Operations facilities. ATSDR will use these measurements in future health assessment analyses, because they are valid and of a known and high quality. However, winds do not blow frequently from north to south and the Midlothian Tower station is typically upwind from the facilities of interest. ATSDR will interpret these data accordingly, and spatial variations in PM data will be used to assess the extent to which Midlothian Tower data might understate the highest site-related air quality impacts that actually occurred in the Midlothian area.
Sept. 2005 – Dec. 2008	**Monitoring for metals and elements downwind from two facilities.** Ambient air monitoring for metal and elements during this time occurred only at the Old Fort Worth Road site, due north of Gerdau Ameristeel and TXI Operations. Because these measurements are valid and of a known and high quality, ATSDR will use them in future health assessment analyses. Monitoring occurred at a location near where EPA predicted maximum deposition of certain pollutants released by Gerdau Ameristeel and TXI Operations. ATSDR therefore views these measurements as reasonable indicators of the highest offsite concentrations downwind from these two facilities. In its future evaluations, ATSDR will use PM measurements from closer monitoring stations (e.g., Wyatt Road) and an analysis of metals data from the 2008-2009 study to comment further on the representativeness of the metals data from Old Fort Worth Road.
Dec. 2008 – Dec. 2009	**Extensive monitoring for metals and elements.** During this time frame, metals (including hexavalent chromium) and elements were monitored at eight locations throughout the Midlothian area. Monitors were placed at or near residential locations believed to have the greatest air quality impacts. ATSDR found the data to be of a known and high quality and will use them for health assessment purposes, considering the fact that these data were collected during a time when certain facility operations differed from past operations (e.g., TXI Operations was not burning hazardous waste during this study).

[12] As an exception, ATSDR's future Health Consultations will use monitoring data for lead collected during this time frame, because these measurements were made with an EPA Federal Reference Method and are considered to be of a known and high quality. Federal Reference Methods do not apply to the other metals and elements.

Table 15. Utility of Volatile Organic Compounds Monitoring Data for Health Assessment Purposes

Time Frame	Findings
All time frames	**General considerations.** Monitoring data are available for nearly every VOC that the facilities emitted in greatest quantities (e.g., toluene, benzene, and xylenes). The facilities have emitted numerous other VOCs that have never been monitored, but many of these were emitted in relatively small quantities (see Section 4.2). For these other VOCs, ATSDR will either: (1) consider them a data gap and make no health conclusions or (2) make inferences about these VOCs based on surrogate information and thoroughly document all assumptions in this analysis. Most VOC sampling was conducted on a 1-in-6 day schedule, which provides a reasonable account of annual average levels but likely understates the highest 24-hour levels (see Section 4.6). ATSDR's future Health Consultation will include a more in-depth review of continuous emission monitoring data to evaluate this issue further.
Prior to Jan. 1993	**No VOC monitoring conducted.** ATSDR will either (1) consider this time frame a data gap and make no health conclusions regarding VOC levels or (2) make inferences about this time frame based on surrogate information and thoroughly document all assumptions in this analysis.
Jan. 1993 – Mar. 1997	**VOC monitoring at one station (Tayman Drive Water Treatment Plant).** VOC monitoring occurred on the northern boundary of Ash Grove Cement, between the facility and the nearest residential neighborhood. The data were collected with appropriate methods and are of a known and high quality. ATSDR will use the measurements to assess exposures for this time frame, which includes years when Ash Grove Cement used tires as fuel but does not include years when the facility burned hazardous waste. Data interpretations will apply to areas downwind from Ash Grove Cement.
Apr. 1997 – Sep. 2004	**VOC monitoring at two stations (south of Midlothian).** VOC monitoring occurred at the Old Fort Worth Road and Midlothian Tower sites, which bracket Gerdau Ameristeel and TXI Operations. Because these measurements are valid and of a known and high quality, ATSDR will use them in future health assessment analyses. Monitoring occurred at a location near where EPA predicted maximum deposition of certain pollutants released by Gerdau Ameristeel and TXI Operations. An important issue is whether VOC measurements at Old Fort Worth Road are reasonable indicators of highest offsite concentrations near these two facilities. However, data analyzed in this document (see Table 12) suggest that, for several pollutants, air concentrations at Old Fort Worth Road were likely comparable to or greater than those that occurred at Wyatt Road.
Oct. 2004 – Dec. 2008	**VOC monitoring at three stations south of Midlothian.** During some part of this time frame, VOC monitoring occurred at two locations downwind from Gerdau Ameristeel and TXI Operations and at one location typically upwind from the facilities. All three of these monitors were placed at or near locations where EPA previously predicted that facility air quality impacts and deposition rates would be greatest. ATSDR has found these measurements to be of a known and high quality and will use them for health assessment purposes. No VOC monitoring occurred in the vicinity of Ash Grove Cement or Holcim during this time frame.
Dec. 2008 – Dec. 2009	**VOC monitoring at seven stations.** During this time frame, VOCs were monitored at seven locations throughout the Midlothian area. Monitors were placed at or near residential locations believed to have the greatest air quality impacts. ATSDR found the data to be of a known and high quality and will use them for health assessment purposes, considering the fact that these data were collected during a time when certain facility operations differed from past operations (e.g., TXI Operations was not burning hazardous waste during this study).

Table 16. Utility of Sulfur Compound Monitoring Data for Health Assessment Purposes

Time Frame	Findings
All time frames	**General considerations.** For time frames when monitoring occurred, sulfur dioxide monitoring was conducted with acceptable methods and data were judged to be of a known and high quality, but hydrogen sulfide monitoring prior to 2000 did not achieve detection limits necessary for assessing long-term exposures. Therefore, ATSDR will consider most of the validated measurements for health assessment purposes. All monitoring for sulfur compounds was continuous and focused on areas surrounding Gerdau Ameristeel and TXI Operations. ATSDR will evaluate facility-specific annual emission estimates and continuous emission monitoring data to determine if conclusions can be reached for the areas surrounding Ash Grove Cement and Holcim.
Prior to Aug. 1985	**No monitoring conducted.** ATSDR will either (1) consider this time frame a data gap and make no health conclusions regarding sulfur compound levels or (2) make inferences about this time frame based on surrogate information and thoroughly document all assumptions in this analysis.
Aug. 1985 – July 1986	**Monitoring at one station (Cedar Drive in Midlothian).** H_2S and SO_2 monitoring occurred at this one location, almost directly east of the main production operations at Gerdau Ameristeel and TXI Operations. Because winds in the area rarely blow from west to east, this station likely did not capture the greatest site-related air quality impacts and the data will not be assumed to be representative of other locations.
Aug. 1986 – Mar. 1997	**No monitoring conducted.** ATSDR will either (1) consider this time frame a data gap and make no health conclusions regarding sulfur compound levels or (2) make inferences about this time frame based on surrogate information and thoroughly document all assumptions in this analysis.
Apr. 1997 – Sep. 2004	**Monitoring at two stations (Old Fort Worth Road and Midlothian Tower).** Continuous monitoring of H_2S and SO_2 occurred throughout this time frame at Old Fort Worth Road. At Midlothian Tower, monitoring for SO_2 and H_2S started in April 1997 and April 2001, respectively. The two stations are in the primary upwind and downwind directions from the facilities, at or near locations where EPA's previous modeling analysis predicted the highest air quality impacts. An important issue is whether measurements at Old Fort Worth Road are reasonable indicators of highest offsite concentrations near these two facilities. ATSDR will address this issue in a future Health Consultation by evaluating differences in simultaneous measurements (2004-2006) of sulfur compounds at Old Fort Worth Road and at Wyatt Road.
Oct. 2004 – Mar. 2006	**Monitoring at three stations.** During this time frame, sulfur compound monitoring occurred at two locations downwind from Gerdau Ameristeel and TXI Operations and at one location typically upwind from the facilities. All three monitors were placed at or near locations where EPA previously predicted that facility air quality impacts and deposition rates would be greatest. ATSDR will use these data for health assessment purposes.
Apr. 2006 – Aug. 2007	**Monitoring at two stations (Old Fort Worth Road and Midlothian Tower).** H_2S and SO_2 data are available for this entire time frame for both stations. Refer to the 1995-2004 time frame for additional information on how ATSDR will evaluate these data.
Sep. 2007 – Dec. 2009	**Monitoring at one station (Old Fort Worth Road).** In recent years, sulfur compound monitoring has occurred only at the Old Fort Worth Road site, north of Gerdau Ameristeel and TXI Operations. As noted above, an important issue is whether measurements at Old Fort Worth Road are reasonable indicators of highest offsite concentrations near these two facilities. ATSDR will address this issue in a future Health Consultation by evaluating differences in simultaneous measurements (2004-2006) of sulfur compounds at Old Fort Worth Road and at Wyatt Road.

Appendix A. Glossary of Terms

The Agency for Toxic Substances and Disease Registry (ATSDR) is a federal public health agency in Atlanta, Georgia, with 10 regional offices in the United States. 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 from toxic substances. ATSDR is not a regulatory agency, unlike the U.S. Environmental Protection Agency (EPA), which is the federal agency that develops and enforces laws to protect the environment and human health. This glossary defines words used by ATSDR in communications with the public. It is not a complete dictionary of environmental health terms. For additional questions or comments, call ATSDR's toll-free telephone number, 1-888-42-ATSDR (1-888-422-8737).

Ambient
Surrounding (for example, ambient air).

Cement kiln
A high-temperature industrial process in which limestone and other raw materials are combined to form clinker, which is later used to make cement.

Cement kiln dust
A fine dust that is carried by the exhaust air from cement kilns, most of which is collected at cement manufacturing facilities by air pollution control equipment.

Concentration
The amount of a substance present in a certain amount of soil, water, air, food, blood, hair, urine, breath, or any other media.

Continuous emission monitoring
The continuous measurement of the amount of pollutants leaving a source (typically, a stack) over time.

Criteria pollutant
Six common air pollutants—carbon monoxide, lead, nitrogen dioxide, ozone, particulate matter, and sulfur dioxide—for which EPA has developed National Ambient Air Quality Standards.

Deposition
The settling of air pollutants to the Earth's surface, both in wet form (e.g., pollutants brought to the ground in rainfall) or dry form (e.g., pollutants reaching the ground when it is not raining or snowing).

Detection limit
The lowest concentration of a chemical that can reliably be distinguished from a zero concentration.

Dioxins and furans
A large family of pollutants that have a similar chemical structure. Certain pollutants within this family have been shown to be highly toxic.

Emissions
Pollutants released into the air from smokestacks, vents, and other industrial processes. Emissions can also occur from motor vehicles, household activities, and natural sources.

Emission inventory
A listing, by source, of the amount of air pollutants released into the air within a given area. Examples include EPA's Toxics Release Inventory, EPA's National Emissions Inventory, and TCEQ's Point Source Emissions Inventory. These inventories differ in terms of scope and pollutants addressed.

Exposure
Contact with a substance by swallowing, breathing, or touching the skin or eyes. Exposure may be short-term (acute exposure), of intermediate duration, or long-term (chronic exposure).

Inorganic pollutant (metal, element, inorganic compound)
Chemical substances of a mineral nature that are not typically made up of linked carbon atoms. Most inorganic pollutants considered in this Health Consultation are found in airborne particles.

Particulate matter
Small solid particles and aerosols found in air, including dust, smoke, mist, and fumes. Different subsets of particulate matter are defined based on the size of the particles.

Pollutant
Generally, any substance introduced into the environment that adversely affects the usefulness of a resource or the health of humans, animals, or ecosystems. Pollutants can come from many types of sources: industry, motor vehicles, agricultural, and nature.

Semi-volatile organic compound
Organic compounds that evaporate slowly at room temperature. These pollutants can be found in the air as gases and bound to particulate matter.

Steel mill
An industrial facility that manufactures steel.

Valid data
Environmental measurements generated by instruments or reported by laboratories that have met certain quality assurance and quality control criterion. Rejected data are not considered valid.

Volatile organic compound (VOC)
Any organic compound that evaporates readily at room temperature. VOCs tend to be found in air as gases. When in the air, these pollutants participate in the chemical reactions that form ozone.

Appendix B. Tabulation of Emission Events and Complaints

TCEQ regulations require industrial facilities to disclose information associated with certain scheduled activities that lead to excess emissions (e.g., process maintenance, planned shutdowns) as well as unscheduled emission events (e.g., following process upsets or accidental releases). Whether reporting is required depends on several factors, such as the nature and the amount of pollutants emitted. Industrial facilities report emission event data to TCEQ, and the agency compiles these data into a publicly accessible online database.

TCEQ maintains a separate online database tracking complaints that citizens file to the agency regarding environmental conditions at industrial facilities.

Table B-1 documents the entire history of emission events and complaints that ATSDR accessed from TCEQ's online databases. ATSDR will consider the dates and descriptions of these events and complaints when preparing its future Health Consultations.

Table B-1. Emission Events and Complaints for the Midlothian Facilities, in Reverse Chronological Order (2002-2010)

Date	Facility	Type of Event
6/15/2010	Ash Grove Cement	Maintenance
5/10/2010	Ash Grove Cement	Excess Opacity
5/5/2010	TXI Operations	Excess Opacity
4/20/2010	Ash Grove Cement	Maintenance
4/4/2010	Ash Grove Cement	Maintenance
4/3/2010	Ash Grove Cement	Air Startup
2/20/2010	Holcim	Air Shutdown
2/1/2010	Ash Grove Cement	Emissions Event
1/21/2010	Ash Grove Cement	Emissions Event
1/11/2010	Ash Grove Cement	Maintenance
1/7/2010	Ash Grove Cement	Maintenance
11/12/2009	Holcim	Complaint (Odor)
11/4/2009	Ash Grove Cement	Maintenance
10/22/2009	Chaparral Steel	Complaint (Smoke)
10/20/2009	Chaparral Steel	Complaint (Odor)
10/20/2009	TXI Operations	Complaint (Other)
9/5/2009	Ash Grove Cement	Maintenance
9/5/2009	Ash Grove Cement	Maintenance
6/29/2009	Ash Grove Cement	Maintenance
6/28/2009	Ash Grove Cement	Excess Opacity
5/14/2009	Ash Grove Cement	Maintenance
3/18/2009	Ash Grove Cement	Excess Opacity
3/10/2009	Ash Grove Cement	Excess Opacity
3/2/2009	Ash Grove Cement	Maintenance
3/1/2009	Ash Grove Cement	Maintenance
2/17/2009	Holcim	Excess Opacity
2/8/2009	Ash Grove Cement	Maintenance
2/3/2009	Holcim	Excess Opacity
12/2/2008	Ash Grove Cement	Maintenance
11/23/2008	Ash Grove Cement	Maintenance
11/12/2008	Ash Grove Cement	Maintenance
10/28/2008	Ash Grove Cement	Excess Opacity
10/21/2008	TXI Operations	Complaint (Odor)
10/15/2008	Ash Grove Cement	Excess Opacity
9/24/2008	Holcim	Maintenance
9/19/2008	Ash Grove Cement	Excess Opacity
9/13/2008	Ash Grove Cement	Excess Opacity
9/8/2008	Ash Grove Cement	Emissions Event
8/6/2008	TXI Operations	Complaint (Other)
7/29/2008	Chaparral Steel	Complaint (Odor)
7/24/2008	TXI Operations	Complaint (Odor)
7/22/2008	Chaparral Steel	Excess Opacity
7/1/2008	Ash Grove Cement	Excess Opacity
6/26/2008	TXI Operations	Complaint (Odor)
6/18/2008	TXI Operations	Complaint (Odor)
6/11/2008	Chaparral Steel	Complaint (Industrial)
6/10/2008	Chaparral Steel	Complaint (Dust)
5/26/2008	Chaparral Steel	Complaint (Smoke)
4/29/2008	Holcim	Excess Opacity
4/7/2008	TXI Operations	Emissions Event
4/4/2008	Ash Grove Cement	Emissions Event
4/4/2008	Ash Grove Cement	Maintenance
3/19/2008	Chaparral Steel	Complaint (Industrial)
3/17/2008	TXI Operations	Complaint (Odor)
3/11/2008	Ash Grove Cement	Excess Opacity
3/9/2008	Ash Grove Cement	Excess Opacity
3/7/2008	Ash Grove Cement	Maintenance
3/3/2008	TXI Operations	Excess Opacity
2/26/2008	Ash Grove Cement	Excess Opacity
2/26/2008	Ash Grove Cement	Maintenance
2/11/2008	Holcim	Maintenance
2/11/2008	Chaparral Steel	Complaint (Smoke)
2/7/2008	Ash Grove Cement	Maintenance
2/5/2008	TXI Operations	Emissions Event
2/3/2008	TXI Operations	Excess Opacity
1/17/2008	Ash Grove Cement	Excess Opacity
1/17/2008	Ash Grove Cement	Excess Opacity
1/13/2008	Holcim	Maintenance
1/8/2008	Ash Grove Cement	Excess Opacity
1/4/2008	Ash Grove Cement	Maintenance

Date	Facility	Type of Event
12/17/2007	TXI Operations	Excess Opacity
12/11/2007	TXI Operations	Excess Opacity
12/9/2007	Ash Grove Cement	Excess Opacity
12/3/2007	Ash Grove Cement	Excess Opacity
12/2/2007	Ash Grove Cement	Maintenance
10/26/2007	TXI Operations	Excess Opacity
10/16/2007	TXI Operations	Complaint (Other)
9/26/2007	Holcim	Emissions Event
9/26/2007	Ash Grove Cement	Excess Opacity
9/24/2007	Holcim	Emissions Event
9/20/2007	TXI Operations	Excess Opacity
9/19/2007	Ash Grove Cement	Excess Opacity
9/10/2007	Holcim	Complaint (Odor)
9/5/2007	Ash Grove Cement	Emissions Event
8/8/2007	Holcim	Emissions Event
7/31/2007	Ash Grove Cement	Excess Opacity
7/24/2007	Ash Grove Cement	Air Startup
7/18/2007	Ash Grove Cement	Air Startup
7/11/2007	Ash Grove Cement	Air Shutdown
7/10/2007	Chaparral Steel	Complaint (Odor)
6/28/2007	Ash Grove Cement	Air Shutdown
6/26/2007	Ash Grove Cement	Air Shutdown
6/8/2007	Ash Grove Cement	Excess Opacity
5/13/2007	Ash Grove Cement	Excess Opacity
5/11/2007	TXI Operations	Complaint (Odor)
5/5/2007	Ash Grove Cement	Emissions Event
4/30/2007	Chaparral Steel	Complaint (Smoke)
4/4/2007	Ash Grove Cement	Emissions Event
4/3/2007	Chaparral Steel	Complaint (Odor)
4/3/2007	TXI Operations	Complaint (Odor)
3/28/2007	Chaparral Steel	Complaint (Odor)
3/21/2007	Ash Grove Cement	Emissions Event
3/21/2007	Chaparral Steel	Complaint (Odor)
3/7/2007	Ash Grove Cement	Excess Opacity
2/24/2007	Ash Grove Cement	Excess Opacity
2/23/2007	Chaparral Steel	Complaint (Odor)

Date	Facility	Type of Event
2/23/2007	TXI Operations	Complaint (Odor)
2/12/2007	TXI Operations	Complaint (Odor)
2/3/2007	Ash Grove Cement	Maintenance
2/1/2007	TXI Operations	Complaint (Odor)
1/7/2007	Ash Grove Cement	Excess Opacity
1/1/2007	TXI Operations	Complaint (Stormwater)
12/29/2006	Ash Grove Cement	Excess Opacity
12/20/2006	Ash Grove Cement	Excess Opacity
12/17/2006	Ash Grove Cement	Emissions Event
12/4/2006	Ash Grove Cement	Maintenance
12/3/2006	Ash Grove Cement	Maintenance
11/30/2006	Ash Grove Cement	Excess Opacity
11/15/2006	Ash Grove Cement	Emissions Event
11/15/2006	Ash Grove Cement	Emissions Event
11/15/2006	Ash Grove Cement	Emissions Event
10/31/2006	TXI Operations	Complaint (Odor)
10/30/2006	TXI Operations	Complaint (Odor)
10/24/2006	Ash Grove Cement	Excess Opacity
10/10/2006	Holcim	Air Startup
10/5/2006	Holcim	Emissions Event
10/3/2006	Ash Grove Cement	Excess Opacity
10/3/2006	Ash Grove Cement	Excess Opacity
9/23/2006	Ash Grove Cement	Excess Opacity
9/20/2006	TXI Operations	Complaint (Dust)
9/5/2006	Ash Grove Cement	Excess Opacity
9/5/2006	TXI Operations	Excess Opacity
8/3/2006	TXI Operations	Emissions Event
8/1/2006	TXI Operations	Complaint (Smoke)
7/27/2006	TXI Operations	Excess Opacity
7/26/2006	TXI Operations	Excess Opacity
7/26/2006	TXI Operations	Excess Opacity
7/5/2006	TXI Operations	Excess Opacity
6/22/2006	Ash Grove Cement	Excess Opacity
6/15/2006	Ash Grove Cement	Excess Opacity
6/7/2006	Chaparral Steel	Complaint (Odor)
6/4/2006	Ash Grove Cement	Excess Opacity

Date	Facility	Type of Event
6/4/2006	Ash Grove Cement	Excess Opacity
6/4/2006	Ash Grove Cement	Excess Opacity
6/3/2006	Ash Grove Cement	Excess Opacity
6/3/2006	TXI Operations	Excess Opacity
6/2/2006	TXI Operations	Excess Opacity
6/2/2006	TXI Operations	Excess Opacity
6/1/2006	TXI Operations	Excess Opacity
5/30/2006	TXI Operations	Complaint (Dust)
5/29/2006	Ash Grove Cement	Excess Opacity
5/29/2006	Ash Grove Cement	Excess Opacity
5/29/2006	Ash Grove Cement	Excess Opacity
5/23/2006	Chaparral Steel	Complaint (Odor)
5/13/2006	Ash Grove Cement	Excess Opacity
5/3/2006	Ash Grove Cement	Excess Opacity
5/3/2006	Ash Grove Cement	Excess Opacity
5/3/2006	Ash Grove Cement	Excess Opacity
5/2/2006	TXI Operations	Excess Opacity
4/28/2006	Ash Grove Cement	Excess Opacity
4/27/2006	Chaparral Steel	Emissions Event
4/17/2006	Ash Grove Cement	Excess Opacity
4/17/2006	Ash Grove Cement	Excess Opacity
4/17/2006	Ash Grove Cement	Excess Opacity
4/11/2006	TXI Operations	Complaint (Odor)
4/10/2006	Chaparral Steel	Complaint (Odor)
4/10/2006	Holcim	Complaint (Odor)
4/7/2006	TXI Operations	Complaint (Dust)
3/30/2006	TXI Operations	Complaint (Odor)
3/25/2006	Ash Grove Cement	Excess Opacity
3/25/2006	Ash Grove Cement	Excess Opacity
3/24/2006	Ash Grove Cement	Excess Opacity
3/13/2006	Ash Grove Cement	Excess Opacity
3/10/2006	Ash Grove Cement	Excess Opacity
3/7/2006	Chaparral Steel	Complaint (Odor)
3/7/2006	TXI Operations	Complaint (Odor)
3/7/2006	TXI Operations	Complaint (Odor)
3/6/2006	Chaparral Steel	Excess Opacity
3/6/2006	Chaparral Steel	Complaint (Smoke)
3/6/2006	Holcim	Complaint (Smoke)
3/6/2006	TXI Operations	Complaint (Smoke)
2/28/2006	TXI Operations	Excess Opacity
2/18/2006	Ash Grove Cement	Excess Opacity
2/16/2006	Ash Grove Cement	Excess Opacity
2/8/2006	Ash Grove Cement	Excess Opacity
2/7/2006	TXI Operations	Complaint (Dust)
2/7/2006	Chaparral Steel	Complaint (Industrial)
2/6/2006	Ash Grove Cement	Maintenance
2/3/2006	Ash Grove Cement	Maintenance
2/1/2006	TXI Operations	Complaint (Odor)
1/29/2006	Ash Grove Cement	Excess Opacity
1/23/2006	TXI Operations	Complaint (Smoke)
1/17/2006	TXI Operations	Complaint (Smoke)
1/9/2006	Ash Grove Cement	Maintenance
1/9/2006	Ash Grove Cement	Maintenance
1/9/2006	Ash Grove Cement	Maintenance
12/30/2005	Chaparral Steel	Complaint (Odor)
12/30/2005	TXI Operations	Complaint (Odor)
12/27/2005	Chaparral Steel	Complaint (Dust)
12/27/2005	Ash Grove Cement	Excess Opacity
12/27/2005	Chaparral Steel	Complaint (Odor)
12/27/2005	TXI Operations	Complaint (Odor)
12/4/2005	Ash Grove Cement	Maintenance
12/1/2005	TXI Operations	Complaint (Odor)
11/30/2005	Chaparral Steel	Excess Opacity
11/30/2005	Chaparral Steel	Excess Opacity
11/30/2005	Chaparral Steel	Excess Opacity
11/29/2005	Chaparral Steel	Complaint (Odor)
11/28/2005	Chaparral Steel	Excess Opacity
11/14/2005	Ash Grove Cement	Excess Opacity
10/25/2005	TXI Operations	Complaint (Dust)
10/25/2005	Holcim	Complaint (Odor)
10/19/2005	Ash Grove Cement	Excess Opacity
10/19/2005	Ash Grove Cement	Excess Opacity

Date	Facility	Type of Event
10/6/2005	TXI Operations	Complaint (Odor)
10/4/2005	Ash Grove Cement	Excess Opacity
9/21/2005	Ash Grove Cement	Excess Opacity
9/21/2005	TXI Operations	Excess Opacity
9/16/2005	Ash Grove Cement	Excess Opacity
8/16/2005	Ash Grove Cement	Emissions Event
8/5/2005	Ash Grove Cement	Excess Opacity
8/5/2005	Ash Grove Cement	Excess Opacity
8/5/2005	Ash Grove Cement	Excess Opacity
8/1/2005	TXI Operations	Complaint (Dust)
7/21/2005	TXI Operations	Complaint (Odor)
7/18/2005	Holcim	Emissions Event
7/1/2005	Ash Grove Cement	Excess Opacity
7/1/2005	Ash Grove Cement	Excess Opacity
6/21/2005	Chaparral Steel	Excess Opacity
6/13/2005	Chaparral Steel	Complaint (Odor)
6/13/2005	Holcim	Complaint (Smoke)
5/23/2005	Chaparral Steel	Complaint (Odor)
5/19/2005	Holcim	Complaint (Dust)
4/22/2005	TXI Operations	Emissions Event
4/18/2005	Ash Grove Cement	Excess Opacity
3/28/2005	TXI Operations	Complaint (Other)
3/21/2005	TXI Operations	Complaint (Odor)
3/18/2005	Chaparral Steel	Excess Opacity
3/1/2005	TXI Operations	Complaint (Odor)
2/16/2005	Ash Grove Cement	Emissions Event
2/16/2005	Ash Grove Cement	Excess Opacity
2/7/2005	Ash Grove Cement	Excess Opacity
2/6/2005	Ash Grove Cement	Maintenance
2/4/2005	Ash Grove Cement	Excess Opacity
2/3/2005	TXI Operations	Complaint (Other)
1/31/2005	Ash Grove Cement	Excess Opacity
1/28/2005	Ash Grove Cement	Excess Opacity
1/14/2005	Ash Grove Cement	Excess Opacity
1/13/2005	Ash Grove Cement	Excess Opacity
1/6/2005	TXI Operations	Complaint (Dust)

Date	Facility	Type of Event
1/2/2005	Ash Grove Cement	Maintenance
12/26/2004	Chaparral Steel	Excess Opacity
12/8/2004	Chaparral Steel	Complaint (Odor)
12/8/2004	TXI Operations	Complaint (Odor)
11/29/2004	Holcim	Complaint (Odor)
11/28/2004	Ash Grove Cement	Maintenance
10/22/2004	Ash Grove Cement	Maintenance
10/19/2004	Ash Grove Cement	Excess Opacity
10/13/2004	Chaparral Steel	Excess Opacity
9/28/2004	TXI Operations	Complaint (Odor)
9/18/2004	Ash Grove Cement	Excess Opacity
9/16/2004	Chaparral Steel	Complaint (Dust)
9/8/2004	TXI Operations	Complaint (Odor)
9/8/2004	TXI Operations	Complaint (Smoke)
9/8/2004	TXI Operations	Complaint (Smoke)
8/25/2004	TXI Operations	Complaint (Dust)
8/12/2004	Ash Grove Cement	Excess Opacity
8/12/2004	Ash Grove Cement	Excess Opacity
8/12/2004	Ash Grove Cement	Excess Opacity
8/5/2004	Ash Grove Cement	Excess Opacity
7/29/2004	Ash Grove Cement	Emissions Event
7/29/2004	Ash Grove Cement	Excess Opacity
7/29/2004	Ash Grove Cement	Excess Opacity
7/18/2004	Ash Grove Cement	Emissions Event
7/13/2004	Ash Grove Cement	Excess Opacity
6/10/2004	TXI Operations	Complaint (Smoke)
6/7/2004	Ash Grove Cement	Maintenance
6/4/2004	Ash Grove Cement	Maintenance
5/27/2004	Ash Grove Cement	Emissions Event
5/27/2004	Ash Grove Cement	Emissions Event
5/27/2004	Ash Grove Cement	Excess Opacity
5/5/2004	TXI Operations	Complaint (Odor)
4/15/2004	Ash Grove Cement	Excess Opacity
4/7/2004	Chaparral Steel	Complaint (Smoke)
4/6/2004	Ash Grove Cement	Excess Opacity
4/6/2004	Ash Grove Cement	Excess Opacity

Date	Facility	Type of Event
4/6/2004	Ash Grove Cement	Excess Opacity
4/2/2004	Ash Grove Cement	Excess Opacity
3/22/2004	Ash Grove Cement	Excess Opacity
3/16/2004	Chaparral Steel	Complaint (Odor)
3/11/2004	Chaparral Steel	Complaint (Odor)
3/9/2004	Ash Grove Cement	Excess Opacity
3/9/2004	Ash Grove Cement	Excess Opacity
3/1/2004	Ash Grove Cement	Excess Opacity
3/1/2004	Ash Grove Cement	Excess Opacity
2/20/2004	Ash Grove Cement	Excess Opacity
2/14/2004	Ash Grove Cement	Excess Opacity
2/8/2004	Holcim	Maintenance
2/1/2004	Ash Grove Cement	Maintenance
1/30/2004	Chaparral Steel	Excess Opacity
1/29/2004	Chaparral Steel	Excess Opacity
1/15/2004	Ash Grove Cement	Excess Opacity
1/14/2004	TXI Operations	Complaint (Odor)
1/14/2004	Chaparral Steel	Complaint (Smoke)
1/4/2004	Ash Grove Cement	Maintenance
1/4/2004	Ash Grove Cement	Maintenance
12/24/2003	TXI Operations	Maintenance
12/17/2003	Ash Grove Cement	Excess Opacity
12/17/2003	Ash Grove Cement	Excess Opacity
12/17/2003	Ash Grove Cement	Excess Opacity
12/14/2003	TXI Operations	Emissions Event
12/13/2003	Chaparral Steel	Excess Opacity
12/1/2003	Ash Grove Cement	Air Shutdown
12/1/2003	Chaparral Steel	Excess Opacity
11/25/2003	TXI Operations	Complaint (Odor)
11/22/2003	Chaparral Steel	Excess Opacity
11/12/2003	TXI Operations	Excess Opacity
11/9/2003	Ash Grove Cement	Excess Opacity
10/22/2003	Holcim	Complaint (Dust)
10/16/2003	Chaparral Steel	Excess Opacity
10/15/2003	Holcim	Emissions Event
10/8/2003	Chaparral Steel	Excess Opacity

Date	Facility	Type of Event
10/6/2003	Ash Grove Cement	Excess Opacity
10/6/2003	Ash Grove Cement	Excess Opacity
10/6/2003	Ash Grove Cement	Excess Opacity
9/26/2003	Ash Grove Cement	Excess Opacity
9/22/2003	Chaparral Steel	Excess Opacity
9/18/2003	TXI Operations	Complaint (Odor)
9/18/2003	Chaparral Steel	Complaint (Smoke)
9/15/2003	Chaparral Steel	Excess Opacity
8/15/2003	Ash Grove Cement	Excess Opacity
8/15/2003	Chaparral Steel	Excess Opacity
8/6/2003	Ash Grove Cement	Excess Opacity
8/6/2003	Ash Grove Cement	Excess Opacity
8/4/2003	Ash Grove Cement	Excess Opacity
8/3/2003	Ash Grove Cement	Excess Opacity
7/22/2003	Chaparral Steel	Complaint (Odor)
7/22/2003	TXI Operations	Complaint (Odor)
7/22/2003	Chaparral Steel	Complaint (Smoke)
6/25/2003	Holcim	Complaint (Dust)
6/24/2003	Chaparral Steel	Complaint (Dust)
6/24/2003	Chaparral Steel	Complaint (Odor)
6/23/2003	TXI Operations	Complaint (Odor)
6/17/2003	Holcim	Emissions Event
6/17/2003	Holcim	Emissions Event
6/5/2003	Ash Grove Cement	Excess Opacity
5/24/2003	Chaparral Steel	Excess Opacity
5/17/2003	Chaparral Steel	Excess Opacity
5/13/2003	TXI Operations	Complaint (Odor)
5/12/2003	Chaparral Steel	Complaint (Odor)
5/10/2003	Ash Grove Cement	Excess Opacity
5/10/2003	Ash Grove Cement	Excess Opacity
5/2/2003	Ash Grove Cement	Excess Opacity
5/1/2003	Chaparral Steel	Complaint (Smoke)
4/27/2003	Chaparral Steel	Emissions Event
4/24/2003	TXI Operations	Excess Opacity
4/24/2003	TXI Operations	Excess Opacity
4/24/2003	TXI Operations	Excess Opacity

Date	Facility	Type of Event
4/20/2003	Ash Grove Cement	Excess Opacity
4/18/2003	Ash Grove Cement	Excess Opacity
4/17/2003	Ash Grove Cement	Excess Opacity
4/17/2003	TXI Operations	Complaint (Smoke)
4/15/2003	Ash Grove Cement	Excess Opacity
4/15/2003	Chaparral Steel	Excess Opacity
4/12/2003	Ash Grove Cement	Excess Opacity
4/12/2003	Chaparral Steel	Excess Opacity
4/8/2003	Ash Grove Cement	Maintenance
4/1/2003	TXI Operations	Complaint (Odor)
4/1/2003	TXI Operations	Complaint (Other)
3/27/2003	Ash Grove Cement	Excess Opacity
3/22/2003	Ash Grove Cement	Excess Opacity
3/22/2003	Ash Grove Cement	Excess Opacity
3/22/2003	Ash Grove Cement	Excess Opacity
3/22/2003	Chaparral Steel	Excess Opacity
3/18/2003	TXI Operations	Complaint (Odor)
3/11/2003	TXI Operations	Complaint (Odor)
3/8/2003	Ash Grove Cement	Excess Opacity
3/8/2003	Ash Grove Cement	Excess Opacity
3/8/2003	Ash Grove Cement	Excess Opacity
3/6/2003	TXI Operations	Emissions Event
3/3/2003	Chaparral Steel	Excess Opacity
3/1/2003	Ash Grove Cement	Excess Opacity
3/1/2003	Ash Grove Cement	Excess Opacity
3/1/2003	Ash Grove Cement	Excess Opacity
2/28/2003	Ash Grove Cement	Excess Opacity
2/28/2003	Ash Grove Cement	Excess Opacity
2/28/2003	Chaparral Steel	Excess Opacity
2/27/2003	Chaparral Steel	Excess Opacity
2/14/2003	TXI Operations	Emissions Event
2/13/2003	TXI Operations	Complaint (Odor)
2/5/2003	TXI Operations	Complaint (Odor)
1/31/2003	TXI Operations	Emissions Event
1/29/2003	TXI Operations	Complaint (Odor)
1/29/2003	Chaparral Steel	Complaint (Smoke)

Date	Facility	Type of Event
1/21/2003	Holcim	Complaint (Odor)
1/21/2003	TXI Operations	Complaint (Odor)
12/12/2002	TXI Operations	Complaint (Odor)
12/12/2002	TXI Operations	Complaint (Odor)
12/12/2002	TXI Operations	Complaint (Odor)
12/12/2002	TXI Operations	Complaint (Odor)
12/12/2002	TXI Operations	Complaint (Odor)
12/12/2002	TXI Operations	Complaint (Odor)
12/12/2002	TXI Operations	Complaint (Odor)
12/12/2002	TXI Operations	Complaint (Odor)
12/12/2002	TXI Operations	Complaint (Odor)
12/4/2002	Chaparral Steel	Complaint (Odor)
11/21/2002	Chaparral Steel	Complaint (Dust)
11/21/2002	Chaparral Steel	Complaint (Smoke)
11/18/2002	TXI Operations	Complaint (Odor)
11/18/2002	TXI Operations	Complaint (Odor)
11/18/2002	TXI Operations	Complaint (Odor)
11/4/2002	Chaparral Steel	Complaint (Odor)
10/30/2002	TXI Operations	Complaint (Odor)
10/30/2002	TXI Operations	Complaint (Odor)
10/30/2002	TXI Operations	Complaint (Odor)
10/30/2002	TXI Operations	Complaint (Smoke)
10/29/2002	Chaparral Steel	Complaint (Smoke)
10/25/2002	Chaparral Steel	Complaint (Smoke)
10/25/2002	Chaparral Steel	Complaint (Smoke)
10/25/2002	Chaparral Steel	Complaint (Smoke)
10/2/2002	TXI Operations	Complaint (Odor)
10/2/2002	TXI Operations	Complaint (Odor)
7/24/2002	TXI Operations	Complaint (Odor)
7/18/2002	Chaparral Steel	Complaint (Dust)
7/18/2002	Chaparral Steel	Complaint (Smoke)
7/12/2002	Chaparral Steel	Complaint (Smoke)

Appendix C. ATSDR Modeling to Identify Potential Areas of Impact

As part of this assessment, ATSDR delineated a potential area of impact, which was defined as the geographic area surrounding the Midlothian facilities where the agency was reasonably confident that the greatest air quality impacts occurred, whether over the short term or the long term. This analysis considered only where facility-related *air pollution levels* would be expected to be the greatest, which may differ from areas of maximum impact to other media.

The potential area of impact (see Figure 9) was prepared as a preliminary step in ATSDR's health assessment process and is not intended to convey health conclusions. The area merely indicates locations where the greatest facility-related air quality impacts are expected to occur, and future Health Consultations will comment on the significance of these impacts. Moreover, the area should not be interpreted as suggesting that facility emissions do not transport beyond the area of impact. Models predict that pollutants emitted by the facilities can remain airborne for long distances, but their concentrations become immeasurably small beyond a certain distance from the facilities. Thus, pollutants released by the facilities likely are found in locations beyond the area of impact, even though the highest levels of facility-related air pollution are expected to occur in the areas shown in Figure 9.

ATSDR considered three factors when developing the area of impact:

Background information on the facilities and atmospheric dispersion. The facilities of concern at Midlothian—three cement kilns and a steel mill—are large facilities, each having dozens of emission sources documented in TCEQ's air emission inventory. The sources include both fugitive sources, which have no appreciable exit velocity and therefore tend to have their maximum offsite ground-level impacts at the facility boundary, and stack sources, which are released through confined streams (e.g., vents, stacks) and may have maximum ground-level impacts at locations further from the facility depending on various factors. ATSDR's delineation of the potential area of impact focused on stack emission sources, because their air quality impacts occur further downwind than those from fugitive sources. Accordingly, the remainder of Section C.1 focuses on stack emission sources.

Several factors determine how a given stack air emission source affects offsite air quality. Most atmospheric dispersion models consider four general categories of factors that affect dispersion:

- Meteorological conditions (e.g., wind speed, wind direction, atmospheric stability, temperature, and mixing height) all affect how pollutants move through the air. Representative data for most of these parameters are available from multiple meteorological stations operating in the Midlothian area.

- Characteristics of the emission sources also affect dispersion. For example, the height, diameter, exit velocity, and exit temperature all affect how pollutants disperse from stacks. These source characteristics are also well documented for the Midlothian facilities.

- Emission rates, or the amount of pollutants released over a given time frame, are also very important factors in atmospheric dispersion. While emission rate data are available for stack and fugitive emissions from all four facilities, most of these data (particularly for fugitive sources) are estimates based on engineering calculations and are of unknown quality. Further, the emission rates can vary considerably with time.

- Other factors, such as local terrain features and the proximity of emission sources to buildings and other obstructions, also affect atmospheric dispersion. These factors are also relatively well characterized for these facilities.

For a given stack, all four of the above factors affect the *magnitude and location* of the point of maximum offsite air quality impacts; however, only three factors (meteorology, source parameters, and other factors) affect the *downwind distance* of maximum impact. Thus, the approximate *downwind distance* of maximum offsite impact can be estimated for every individual emission source, without being affected by uncertainties in the underlying emission rates. ATSDR considered this background information when deciding how to delineate the potential area of impact.

Review of EPA's Modeling. In January, 1996, EPA published a multi-pathway risk assessment evaluating air emissions from the four main facilities in Midlothian. An air dispersion model (Industrial Source Complex Short Term, or ISCST) was used to estimate off-site ambient air concentrations and deposition rates of selected pollutants. The model considered both stack emissions and fugitive emissions, with emission rates based on either stack testing data or engineering calculations. The risk assessment focused on multiple pollutants, including metals, dioxin and dioxin-like compounds, and polycyclic aromatic hydrocarbons.

Dispersion modeling results were communicated in text, tables, and figures. Figure 9 presents some of the findings from EPA's modeling. Specifically, points on the map indicate (1) locations where *deposition rates* were predicted to be highest for selected groups of pollutants and (2) locations where *ambient air concentrations* were predicted to be highest for the same groups of pollutants. All of these points fell either within facility boundaries or within ½-mile of the facility boundaries. Moreover, the points of maximum impact (whether for deposition or ambient air concentration) were located either directly south or north of the main facility emission points, which is consistent with prevailing wind directions in Midlothian.

The key inference to draw from EPA's analysis is that the estimated points of maximum impact, whether for deposition or air concentration, *when averaged over the long term*, are all in very close proximity to the facilities and typically found due north or south from the emission points. However, two limitations should be noted regarding this past modeling effort:

- By design, EPA's model evaluated air quality impacts over the long term. The locations with the greatest air quality impacts over the short term may be substantially different (e.g., further downwind, in different compass directions) than what EPA found, depending on the meteorological conditions at the time of a release event.

- EPA's analyses are based on data that were available 15 years ago, and many notable changes have occurred since then. For instance, many operational changes have occurred at the facilities of interest: since 1995, new kilns were added at some facilities, while others began burning different fuels. Therefore, the modeling results from 1995 may not adequately represent current conditions.

ATSDR's modeling analysis. To delineate the potential area of impact, ATSDR used a screening dispersion model (SCREEN3) to predict the offsite distance within which the agency is reasonably confident that maximum site-related air pollution levels impacts occur, whether over the short term or the long term. To complete this assessment, ATSDR accessed information on all emission sources from the four industrial facilities, as reported to TCEQ's Point Source Emission Inventory. For each facility, the agency then identified the emission source expected to have the furthest air quality impacts. This is typically the tallest stack with the highest release temperature and exit velocity. In cases where it was not immediately clear from the source parameters which stack would have the furthest impacts, the screening model was used to identify the stack whose plume would reach ground-level at the furthest distance from the stack base. This evaluation identified the following stacks for modeling:

- For Ash Grove Cement, modeling was conducted for "Kiln #1 Vent." Stack parameters for this source are: stack height = 45.7 meters; exit velocity = 10.3 meters/second; stack diameter = 3.2 meters; and temperature = 449.8 Kelvin.

- For Gerdau Ameristeel, modeling was conducted for "Baghouse B Vent." Stack parameters for this source are: stack height = 45.7 meters; exit velocity = 20.2 meters/second; stack diameter = 4.9 meters; and temperature = 338.7 Kelvin.

- For Holcim, modeling was conducted for "Kiln #2." Stack parameters for this source are: stack height = 94.5 meters; exit velocity = 16.0 meters/second; stack diameter = 4.2 meters; and temperature = 390.9 Kelvin.

- For TXI Operations, modeling was conducted for "Cement Kiln Stack." Stack parameters for this source are: stack height = 94.5 meters; exit velocity = 15.2 meters/second; stack diameter = 5.5 meters; and temperature = 394.3 Kelvin.

After identifying the stacks expected to have the furthest air quality impacts, ATSDR then ran SCREEN3 to assess how concentrations likely vary with distance from the facilities. The model was run using the "full meteorology" mode. In this mode, the model estimates 1-hour average concentrations at each downwind distance for more than 50 different combinations of meteorological parameters. Emission rates of 1 gram per second were used, because the goal of this modeling was to determine the point of maximum ground-level impacts—which is independent of the magnitude of the emission rate. The model outputs indicate, among other things, the distance from the stack base expected to have the highest air pollution levels out of all meteorological conditions considered.

For all four stacks considered, the point with the maximum ground-level impact was predicted to occur within 1,100 meters (or 3,600 feet) from the stack base. While the model suggested that

facility-related air pollution levels at further distances would likely be lower than this worst-case scenario, ATSDR considered an additional margin to be reasonably confident that the area of impact truly contains the locations with the highest facility-related air pollution levels. Specifically, as a precautionary step to ensure that ATSDR did not underestimate the potential area of impact, the agency decided to set the boundaries for this area using the downwind distance where the estimated ground-level concentration from the stacks with the furthest reaching plumes were 75 percent below the estimated maximum concentration. (Note: This decay factor was selected based primarily on professional judgment, as no guidance exists for this type of assessment.) The downwind distance where concentrations fell at least 2.5 times below the maximum concentrations was found to be at least 5,900 meters (or 3.7 miles) from the base of the stacks modeled. ATSDR then used this downwind distance to construct the potential area of impact shown in Figure 9.

In summary, the potential area of impact represents ATSDR's judgment as to the locations where the agency is reasonably confident that the greatest facility-related air pollution levels are observed. The potential area of impact should not imply that facility emissions do not travel longer distances. Rather, the potential area of impact simply denotes the region within which ATSDR believes the highest facility-related air pollution levels occur and, under most scenarios, levels at further distances will be lower. These findings are consistent with the EPA modeling analyses, which found that long-term air quality impacts would likely occur within the potential area of impact. For short-term events, it is possible that plumes from the tallest stacks may reach ground level at further downwind distances, but this would be expected to occur only during meteorological conditions not commonly observed (e.g., calm winds and highly stable atmospheres). Moreover, in these cases, the plumes will have dispersed considerably before ever reaching ground level.

Table C-1. Input Parameters for Modeling of Potential Areas of Impact

Parameter	Facility-Specific Information			
	Ash Grove Cement	Gerdau Ameristeel	Holcim	TXI Operations
Stack height (meters)	45.7	45.7	94.5	94.5
Stack diameter (meters)	3.2	4.9	4.2	5.5
Exit velocity (meters/second)	10.3	20.2	16.0	15.2
Exit temperature (deg Kelvin)	449.8	339	390.9	394.3

Notes: 1. The stack parameters listed in the table are for the individual stacks that (1) vent emissions from kilns and furnaces and (2) are believed to contribute to the furthest distance offsite air quality impacts. These are generally the tallest stacks that vent emissions from the kilns and furnaces.
2. Stack parameters listed here were derived from the TCEQ Emission Inventory Questionnaires