Health Consultation

Review and Analysis of Volatile Organic Compounds (VOCs) and
Metal Exposures from Air Emissions in Media Other than Air

as part of the

MIDLOTHIAN AREA AIR QUALITY PETITION RESPONSE

MIDLOTHIAN, ELLIS COUNTY, TEXAS

JANUARY 18, 2017

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 health consultation is one of a series of six health consultations being prepared by ATSDR for this site. The completion of all six health consultations 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

For more information about ATSDR's work in Midlothian visit
http://www.atsdr.cdc.gov/sites/midlothian/ or call 1-800-CDC-INFO.

HEALTH CONSULTATION

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Prepared By:

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

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Abbreviations

ATSDR	Agency for Toxic Substances and Disease Registry
BDL	below detection limit
CKD	cement kiln dust
CREG	cancer risk evaluation guide
CV	comparison value
EAF	electric arc furnace
EMEG	environmental media evaluation guide
EPA	(U.S.) Environmental Protection Agency
°F	degrees Fahrenheit
MDL	method detection limit
mrem	millirem
MRL	minimal risk level
MTL	maximum tolerable level
NA	not available
N/A	not analyzed
NAAQS	National Ambient Air Quality Standards
NRC	(National Academies) National Research Council (U.S.)
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PM	particulate matter
ppb	parts per billion
ppm	parts per million
RMEG	reference dose media evaluation guide
RSL	(EPA) regional screening level
SVOC	semi-volatile organic compound
TACB	Texas Air Control Board
TCEQ	Texas Commission on Environmental Quality
TDH	Texas Department of Health
TDSHS	Texas Department of State Health Services
TNRCC	Texas Natural Resources Conservation Commission
TRI	Toxics Release Inventory
VOC	volatile organic compound

Summary

INTRODUCTION/ OVERVIEW

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 related to air quality in Midlothian, Texas based on a petition request by several community members. The community is located in an area that includes three large cement manufacturers and a steel mill. ATSDR is preparing a series of public health consultation documents, in accordance with the Public Health Response Plan prepared with community input. This health consultation is one of a series of six health consultations being prepared by ATSDR for the Midlothian site. Air sampling data, health outcome data, and animal health issues are addressed in the other health consultations. This health consultation examines available sampling data on volatile organic compounds and metals that deposited from air emissions onto other media, including soil, surface water, sediment, and groundwater, and vegetation.

METHODS/ APPROACH

In this health consultation, ATSDR reviewed a range of data including information provided by individuals in the community, the cement and steel mill facilities, newspaper stories, and environmental and public health agencies. The documentation reviewed covered a timespan from about 1985 to 2012, with most of the information coming from the 1990s. ATSDR screened all data obtained into three categories: (1) background information used to understand community issues in relation to the other media health consultation, (2) data from monitoring and/or measurements that are limited in quality, but are potentially suitable to address some of the scientific aspects of the consultation, and (3) data suitable to address scientific aspects of this consultation.

Of the environmental media examined for this health consultation, data on soil sampling proved to have the most sufficient quality and quantity. Data and modelling results from other media are discussed. Since this health consultation evaluated impacts from air deposition and the previous documents on air emissions did not demonstrate the potential for much impact from deposition, ATSDR believes that the available sampling was sufficient to address community concerns.

CONCLUSION

ATSDR reached one main conclusion in this health consultation: People in the vicinities of the four facilities of interest since the early to mid-1990s have not been adversely affected by exposure to soil, sediment, surface water, or groundwater, or through indirect exposure pathways (including ingestion of beef and fish) from air contaminant

	deposition of metals or volatile organic chemicals from the four facilities of interest. Contact with deposited cement kiln dust may cause brief irritant health effects.
BASIS FOR DECISION By Media	**Soil** • Between 1991 and 1995, TNRCC collected 175 area-wide soil samples at 80 locations, and 22 additional soil samples collected near the Gerdau facility. Concentrations of pollutants measured in these samples do not appear to be related to facility emissions deposition patterns, and appear to fall within background ranges of these pollutants. There was a lot of variability in the concentrations of metals in these soil samples. • ATSDR reviewed the TNRCC surface soil results and compared them to 2015 health based comparison values. In the area wide study, there were some isolated samples that exceeded the comparison values for iron, lead, or manganese. In the Gerdau focused study, there were two samples that exceeded comparison values for cadmium and lead that were immediately south of the facility but collected from an area not accessible to the public. Arsenic exceeded the comparison value at seven off-site locations, but did not exceed this value at on-site locations. The highest concentration of arsenic, which was about double the comparison value, was collected several miles away in a cotton field. It appears that some arsenic may be related to historical agricultural pesticide application. • ATSDR reviewed surface soil sampling data collected in 2003 on property just south of the Gerdau Ameristeel facility with limited public access and compared the pollutant concentrations to 2015 health based comparison values. Only two of 44 soil samples had metal (manganese) concentrations that exceeded its health based comparison value. If access remains restricted, ATSDR believes these concentrations are unlikely to pose a health risk to the public. • A 2005 TCEQ report detailing the results of five surface soil samples collected approximately one-half mile north of the TXI cement kiln and the Gerdau Ameristeel facilities found no metals in soil that exceeded health based comparison values. Therefore ATSDR concludes these concentrations are unlikely to pose a health risk to the public. **Sediment, Surface Water, and Groundwater Samples** • ATSDR evaluated sampling data from1994 (surface water) and 2003 (sediment, surface water, and groundwater) from around the Gerdau Ameristeel facility and compared them with 2015 health based comparison values. ATSDR found that concentrations of metals in these media did not exceed health based comparison values and therefore were not a public health concern.

Vegetation

- Vegetation, including hay bales and forage were sampled in 1994 and 2003-04 around the Gerdau Ameristeel facility. Concentrations of aluminum, cadmium, and iron in some of the samples were above the livestock maximum tolerable level for intake in feed, especially vegetation sampled in 1994. Given the varied mix of vegetation and hay that an animal might consume, that it was unknown whether the cattle was butchered and sold locally, and that a person's diet would not be exclusively meat products from cattle grazing in this field, ATSDR did not consider the vegetation results as a public health concern. This determination was further supported by air contaminant deposition modeling results reviewed by ATSDR.
- ATSDR reviewed the 2004 metal analyses and risk analysis of wheat head samples taken from a field south of the Gerdau facility. No metal exceeded the EPA's oral reference dose, and TNRCC concluded that the wheat was acceptable for human consumption. ATSDR agreed with the assumptions and conclusions.

Cement Kiln Dust

- Tapelift sample results, particulate modeling in previous health consultations, and reports from residents support airborne deposition of alkaline cement kiln dust in residential areas. Direct contact with this dust would be expected to cause temporary irritation to skin, eyes, and mucous membranes.

NEXT STEPS	As recommended in the Midlothian health consultations that addressed air issues, ATSDR recommends that community focused air investigations continue.
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, please 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.

Purpose of this Document
This Health Consultation documents ATSDR's findings from the project: Review and Analysis of Volatile Organic Compounds and Metal Exposures from Air Emissions in Media Other than Air (for example, soil, sediment, dust, water, and vegetation samples). The findings from ATSDR's previous Health Consultations for Midlothian, TX are incorporated into this evaluation, as appropriate.

When reading this document, it is important to note that ATSDR's role in evaluating environmental media in Midlothian as a public health agency is different than agencies charged with addressing environmental issues. ATSDR evaluations focus on the public health implications of the levels of pollutants identified in various areas of interest, such as the Midlothian area. These evaluations are not meant to address facility compliance, or lack thereof, with state and federal standards and guidance values. State and federal environmental enforcement agencies are responsible for evaluating facility adherence to existing rules and regulations.

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.

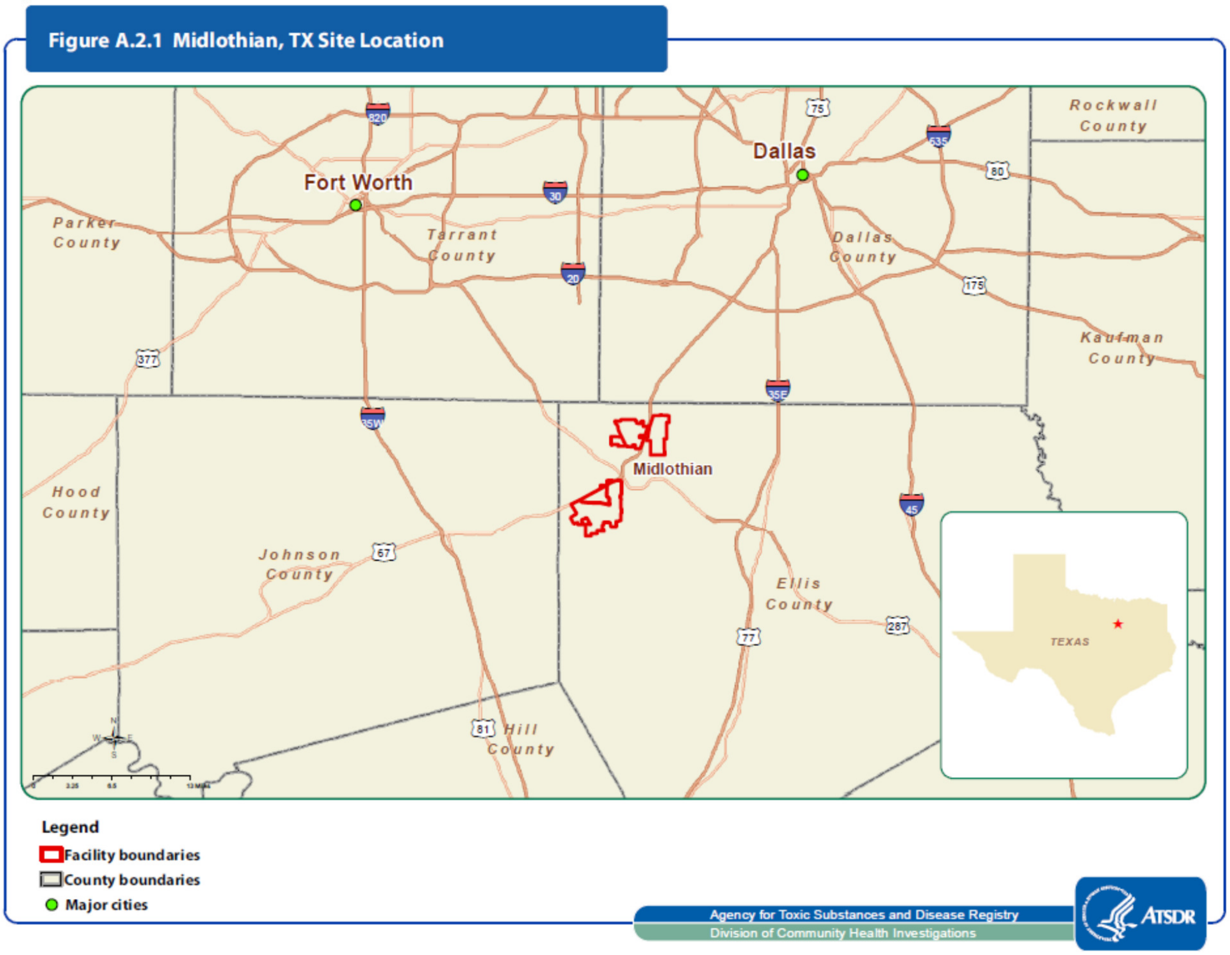
During the process of evaluating these comments, the ATSDR and National Center for Environmental Health Director requested that the ATSDR and TDSHS team take a more comprehensive look at the site. Specifically, this new evaluation would review the initial petitioner's concerns which questioned whether 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 2012a], ATSDR is completing the Midlothian reevaluation through a series of projects and associated reports.

The purpose of this health consultation is to identify and evaluate available data and airborne contaminant deposition modeling results to assess the potential concentrations and health impacts that may result from the deposition of air pollutants emitted from nearby industrial facilities onto the ground, surface waters, sediments, groundwater, and vegetation (for example, animal fodder, wheat, hay, and home-grown vegetables). Findings from the other five health consultations that ATSDR has prepared for this site are referenced in this document, as appropriate. The reader can refer to these other documents for more information on the evaluations of air emissions, human health outcomes, and animal health concerns.

2.0 Background

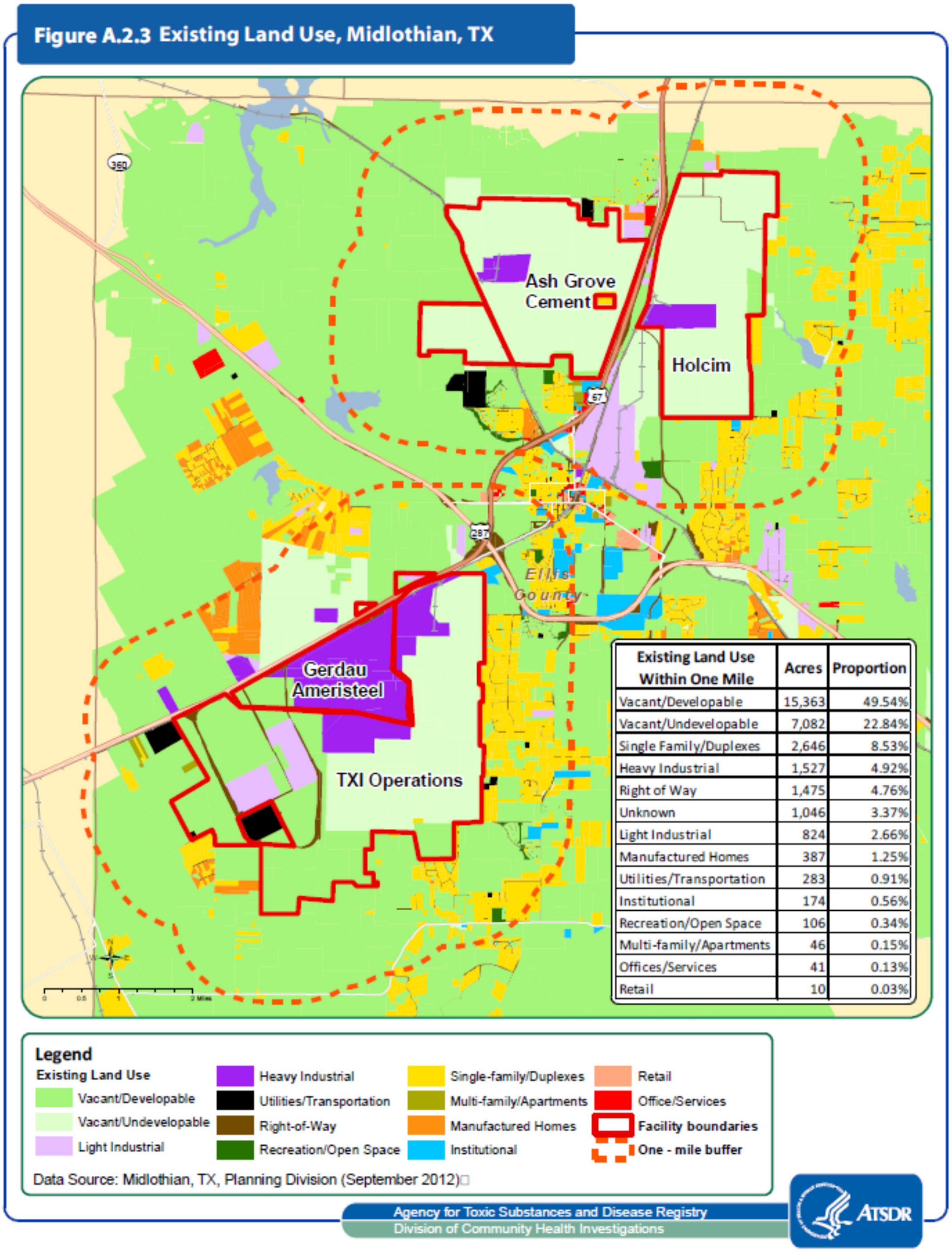
Midlothian is located in Ellis County, Texas, approximately 30 miles south of the Dallas-Fort Worth metropolitan area (Figure 2-1). This section provides background information on the industries that are the subject of this study in Midlothian, focusing on three cement plants (Ash Grove Cement, Holcim, and TXI Operations[1]) and a steel mill (Gerdau Ameristeel) currently operating in the community. Within one mile of these facilities, land use in 2012 was predominantly vacant (either developable on non-developable) (Figure 2-2).

Figure 2-1: Locations of the Four Facilities of Interest (Source: [ATSDR 2016b])



[1] Texas Industries, Inc. (TXI) merged with Martin Marietta Materials, Inc. in January 2014. This document refers to this facility as TXI.

Figure 2-2: Existing Land Use (2012), Midlothian, TX (Source: Midlothian, TX, Planning Commission; [ATSDR 2016b])



Existing Land Use Within One Mile	Acres	Proportion
Vacant/Developable	15,363	49.54%
Vacant/Undevelopable	7,082	22.84%
Single Family/Duplexes	2,646	8.53%
Heavy Industrial	1,527	4.92%
Right of Way	1,475	4.76%
Unknown	1,046	3.37%
Light Industrial	824	2.66%
Manufactured Homes	387	1.25%
Utilities/Transportation	283	0.91%
Institutional	174	0.56%
Recreation/Open Space	106	0.34%
Multi-family/Apartments	46	0.15%
Offices/Services	41	0.13%
Retail	10	0.03%

This background information builds on information provided in three of the ATSDR health consultations for Midlothian that address air quality [ATSDR 2015b, 2016a,d], and adds a focus on potential impacts to other media. Although this report focuses on pollutants found in media other than air (for example, soils, surface water, and ground water), it is important to acknowledge that air emissions comprise the primary pathway by which contaminants from the four facilities of interest may reach these other media. That is, pollutants in air emissions from these facilities have the potential to settle out of the air and become deposited in other media such as water and soil, where they may come in direct contact with humans or become part of the local food chain.

2.1 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 processes and operations commonly found at cement kilns (Section 2.1.1) and steel mills (2.1.2). This material is in part provided from the ATSDR Health Consultation *Assessing the Adequacy of the Ambient Air Monitoring Database for Evaluating Community Health Concerns* [ATSDR 2015b]. Sections 2.1.1 and 2.1.2 also provide a general overview of operations and waste management practices common at these types of industrial operations.

2.1.1 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.

Many by-products are also formed and exit the kiln in air exhaust. The primary by-product is cement kiln dust (CKD) 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. These air emissions are often referred to as fugitive emissions and, as compared to stack emissions, deposit close to where they become airborne.

Table 2-1 presents a summary of typical management units at cement facilities and the by-products and wastes associated with environmental media such as air, land, surface water, and groundwater (See Sections 2.2.1 to 2.1.3 and 4.7.1 for specific information on the cement kilns in Midlothian). While this health consultation focusses on air emissions, ATSDR recognizes that these other waste streams may also contribute to the sampling results we reviewed on soil, sediment, groundwater, surface water, and media other than air. Management of these by-products and wastes is regulated by a variety of environmental regulations implemented by the U.S. Environmental Protection Agency (EPA) and the Texas Commission on Environmental Quality (TCEQ). Table 2-1 provides general industry information; facility-specific information is presented in Section 2.2.

Table 2-1: Typical Management Units and By-Products/ Wastes Associated with Air, Land, Surface Water, and Groundwater at Cement Kilns*

Onsite Management Units†	Description of By-Products and Wastes
	AIR
Cement Kiln Stacks and Fugitive Emissions‡	**Inorganics**: Metals and elements emitted from cement kiln stacks and from fugitive emissions enter the ambient air mainly as particulate matter (PM). The main exception is mercury metal, which is emitted as a gas. Some inorganic compounds (such as sulfates, hydrochloric acid, and sulfuric acid) are also found in particles emitted from stacks, while other inorganic compounds (such as carbon monoxide, nitrogen oxides, sulfur dioxide, and hydrogen sulfide) are released as gases.
	Volatile/Semi-Volatile Organic Compounds (VOCs/SVOCs): 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. 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, such as dioxins, furans, and polycyclic aromatic compounds. At cement kilns, these would be expected to be found primarily in the stack emissions.
	LAND
Container/Drum Storage Areas	Container/drum storage areas are used to store raw materials and manage waste materials before treatment and disposal, or recycling, respectively. Separate storage areas are designated for hazardous and nonhazardous wastes because of the more stringent regulations for managing hazardous wastes. Stored wastes in these areas may include chemicals from onsite laboratories, tank bottoms, spent solvents from parts cleaning, spent oils and lubricants, spent batteries, waste oils, plant/office refuse, and construction debris.
Landfills	Non-hazardous waste landfills are used to dispose of cement kiln dust (CKD); however, CKD can also be used for agricultural soil enhancement, base stabilization for pavements, wastewater treatment, waste remediation, low-strength backfill and municipal landfill cover [Adaska 2008] §. Landfills are also used to dispose of plant/office refuse, sludge from water treatment operations, spent refractory brick from relining of kilns, and other construction debris.
Storage Tanks	Storage tanks may be used to store high-volume nonhazardous wastes before onsite treatment or shipment offsite for treatment/disposal. Such wastes may include oily water from fuel tank cleaning and other plant maintenance operations. Storage tanks are also used to store and blend different types of fuels before burning them in the kilns. In addition, tanks may be used to store CKD before it is recharged into kilns or disposed in onsite landfills.
Sumps	Sumps generally are used to intercept leachates from landfills, surface impoundments, and waste piles to prevent contamination of groundwater and surface waters. In addition, sumps may be used for secondary containment purposes around product and waste storage tanks. Sludge and wastewaters collected in sumps may be stored in container/drum storage areas or in tanks before onsite or offsite treatment and disposal or recycling.

Onsite Management Units†	Description of By-Products and Wastes
Surface Impoundments	Surface impoundments may be used for many of the same purposes as landfills. In addition, these units may serve as storm water retention ponds to settle suspended solids before discharging facility water into nearby surface waters.
Waste Piles	Waste piles may be used to store scrap metals before recycling. Waste piles also may be used to store CKD before reuse (recharge) as a feed material in the kilns, reuse offsite for agricultural (as soil amendments), or disposal on site or off site.
	SURFACE WATER
Wastewater and Storm Water Discharges	Wastewater and storm water discharges may involve permits for releases to nearby surface waters from onsite water treatment operations involving wash water, process wastewater, cooling system cleaning wastes, storm water runoff from plant areas and coal piles, and domestic wastewaters subject to effluent limitations.
	GROUNDWATER
Solid Waste Storage and Disposal Units	Any or all of the onsite management units listed above may cause groundwater contamination if management units or materials are improperly managed. Hazardous waste landfills are required to monitor groundwater and to take corrective actions in the event that groundwater is found to be contaminated. Because CKD is regulated as a nonhazardous waste, TCEQ generally does not require groundwater monitoring at all landfills used to dispose of CKD; however, any given landfill may be required to monitor groundwater depending on the results of applying TCEQ's landfill classification rules.

* The information in this table was obtained from a similar table in ATSDR 2015b, from EPA industry documentation, and from on-line registration and permit information identified for the three cement kiln facilities in Midlothian, TX [EPA 1993; TCEQ 2014a].

† Offsite management units are similar to onsite units; however, hazardous wastes that are sent to offsite facilities are more likely to require special treatment before final disposal. Some facilities use both onsite and offsite units depending on site-specific cost factors.

‡ Fugitive emissions at cement kilns generally contain the same types of contaminants as stack emissions; however, they originate from process feed, product and waste storage piles, and piping and valves on fuel storage tanks and other operations.

§ CKD most likely comprises the largest volume waste stream generated at cement kiln facilities. CKD is collected by a variety of air pollution control devices at cement kilns, including electrostatic precipitators, baghouses, cyclones, gravity separators, and granular bed filters. It is alkaline in nature, and is mainly comprised of thermally unchanged raw materials, dehydrated clay, calcium compounds, ash from fuel, and minerals.

2.1.2 Steel Mills

Most steel in the United States is manufactured in either basic oxygen furnaces or in electric arc furnaces (EAF) [EPA 2000b]. 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 its final form. The steel then usually undergoes additional finishing processes (e.g., rolling, beam straightening) to make the final product. Slag is a solid by-product from the melting process. Steel mills employ various strategies for managing slag, including disposal and beneficial reuse.

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. Table 2-2 presents a summary of typical management units at secondary steel mill facilities and the by-products and wastes associated with air, land, surface water, and groundwater (See Sections 2.2.4 and 4.7.2 for specific information on the Gerdau facility). Management of these raw materials and by-products (wastes) is regulated by a variety of environmental regulations implemented by EPA and TCEQ.

Table 2-2: Typical Management Units and By-Products/ Wastes Associated with Air, Land, Surface Water, and Groundwater at Electric Arc Furnace Steel Mills*

Onsite Management Units†	Description of By-Products and Wastes
	AIR
Electric Arc Furnace Stacks and Fugitive Emissions‡	Metals and elements emitted from electric arc furnace stacks enter the air mainly as particulate matter (PM). The main exception is mercury metal, which is emitted as a gas. Pollutants emitted by electric arc furnace stacks include metals and organic compounds. Some facilities primarily emit lead and manganese with smaller amounts of cadmium, chromium, and nickel. Other facilities may also emit significant levels of chromium and nickel. These emissions also may be contaminated with other contaminants (for example, radionuclides) depending on the type of materials used to feed the electric arc furnace. The high temperatures in electric arc furnaces are expected to destroy most of the volatile organic compounds (VOCs) present, but some VOCs may still be found in stack emissions. Organic emissions from electric arc furnaces may include acetophenone, benzene, cumene, dibenzofurans, dioxins, formaldehyde, methanol, naphthalene, phenol, pyrene, toluene, triethylamine, and xylene.
	LAND
Container/ Drum Storage Areas	Container/drum storage areas are used to store raw materials and to collect and manage wastes and other materials before further treatment and disposal, or recycling. Separate storage areas are designated for raw materials and for hazardous and nonhazardous wastes because of more stringent and costly regulations for managing hazardous wastes. Stored wastes in these areas may include chemicals from onsite laboratories, tank bottoms, spent solvents from parts cleaning, spent oils and lubricants, spent batteries, waste oils, plant/office refuse, and construction debris.
Landfills	Separate types of landfill units are designated for hazardous and nonhazardous wastes, and there are subcategories of landfill unit types within both of waste categories. Nonhazardous landfills may contain non-metallic residue from onsite automobile shredder operations, slag from the arc furnace, plant/office refuse, sludge from water treatment operations, spent refractory brick, and other construction debris. Hazardous waste landfills may be present at electric arc furnace facilities that generate large quantities of emission control dusts from bag houses and sludge from other air pollution control equipment. These dusts may be contaminated with a range of constituents depending on the type of materials used to feed the electric arc furnace. These dusts and sludge are federally listed hazardous wastes (waste code K061). However, most of the hazardous waste types generated at electric arc furnace facilities are most likely shipped to an offsite treatment/disposal site, and are stored in drums (see container/drum storage areas) before shipment off site.
Storage Tanks	Storage tanks may be used to store high-volume nonhazardous wastes before onsite treatment or shipment offsite for treatment/disposal. Such wastes may include oils and sludge generated by automobile shredder operations, and oily water from fuel tank cleaning and other plant maintenance operations. Storage tanks are also used to store and blend different types of fuels before they are burned in the furnaces.

Onsite Management Units†	Description of By-Products and Wastes
Sumps	Sumps generally are used to intercept leachates from landfills, surface impoundments, and waste piles to prevent contamination of groundwater and surface waters. In addition, sumps may be used for secondary containment purposes around product and waste storage tanks. Sludge and wastewaters collected in sumps may be stored in container/drum storage areas or tanks before onsite or offsite treatment and disposal.
Surface Impoundments	Surface impoundments may be used for many of the same purposes as landfills. In addition, these units may serve as storm water retention ponds for settling of suspended solids before discharge into nearby surface waters.
Waste Piles	Waste piles may be used to store scrap metals before recycling (melting in the furnace) and non-metallic automobile shredder waste before it is landfilled.
	SURFACE WATER
Wastewater and Storm Water Discharges	Wastewater treatment plants may be used to treat wastes from tank cleaning operations, public lavatories, runoff from storm water collection sumps, leachate sumps, and other watery wastes that may be generated at a typical industrial facility. Treated water is generally discharged to nearby surface waters. These discharges generally are regulated under permits to prevent contamination of surface waters.
	GROUNDWATER
Solid Waste Storage and Disposal Units	Any or all of the onsite management units listed above may cause groundwater contamination if units, raw materials, or wastes, are improperly managed; however, hazardous waste landfills pose the greatest potential threat. Therefore, hazardous waste landfills are required to monitor groundwater and to take corrective actions in the event that groundwater is found to be contaminated.

* The information in this table was obtained from a similar table in ATSDR 2015b and from online registration and permit information listed for an electric arc furnace facility in in Midlothian, TX [TCEQ 2014b].

† Offsite management units are similar to onsite units; however, hazardous wastes that are sent to offsite facilities are more likely to require special treatment before final disposal. Some facilities use both onsite and offsite units depending on site-specific cost factors.

‡ Fugitive emissions at electric arc furnace facilities generally contain the same types of contaminants as stack emissions; however, they originate from process feed, product and waste storage piles, and from piping and valves on fuel storage tanks and other operations.

2.2 Facility Descriptions

This section summarizes the industrial processes and releases to air, surface water, and land for the four facilities of interest to provide context for this document's public health evaluation. Operations at these facilities have changed over the years. Some changes have increased air emissions (for example, increased production levels, use of different fuels in the kilns) while others have decreased air emissions (for example, installation of pollution control devices or upgrades to these systems). The four facilities have emitted several pollutants at rates that have consistently ranked among the highest of the industrial facilities in Ellis County that submit data to TCEQ's Point Source Emissions Inventory [TCEQ 2011]. To control air emissions, the facilities operate under regulatory requirements (including air permits) that are implemented by EPA Region 6 and TCEQ.

In addition to air emissions, the four facilities of interest also store raw materials used in their production processes and manage wastes that are generated from their operations. If these materials and wastes are not properly managed, they have the potential to enter surface waters due to storm water runoff during rain events and/or through direct discharges associated with waste water treatment operations. In addition, these pollutants could enter groundwater through infiltration and/or directly through collapses of overlying soils in areas with limestone deposits.

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

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

To prevent releases associated with these raw materials and wastes, the facilities operate under solid waste, clean water, and other regulations implemented by EPA Region 6 and TCEQ. This health consultation focuses on pollutants in other media associated with deposition from air emissions from the facilities of interest.

As part of preparation for the series of health consultation reports for Midlothian, ATSDR accessed and reviewed additional information on each facility's history and TCEQ's records documenting the history of air permits and compliance status.[2] For this other media health consultation, ATSDR also accessed and reviewed an online listing of each facility's environmental permits and registrations (specifically, those that apply to the management of solid waste and any discharges to surface waters) [TCEQ 2014a, 2014b]. The material in this section is provided in part from the ATSDR Health Consultation *Assessing the Adequacy of the Ambient Air Monitoring Database for Evaluating Community Health Concerns* [ATSDR 2015b].

2.2.1 Ash Grove Cement

Ash Grove[3] Texas L.P. is a business entity that operates a Portland cement manufacturing facility located on the northwest side of Midlothian, referred to in this document as "Ash Grove Cement" or "Ash Grove." The facility was formerly named North Texas Cement Company and Gifford Hill Cement Company. The facility was constructed in 1965, began operating in 1966, and has historically operated three rotary kilns to manufacture cement. The old rotary kilns began operating in 1966, 1969, and 1972 [TNRCC 1995a]. In 2013, the facility began a $150 million upgrade to decommission the older kilns and construct one modern kiln to reduce emissions of nitrogen oxides and sulfur dioxide [Ash Grove 2013].

Cement is manufactured at the Ash Grove facility by feeding limestone, shale, and other raw materials into the rotary kilns, which operate at temperatures reaching 4,000°F. Various fuels have been used to fire the kilns at the facility, including: natural gas, fuel oil, coal, coke, wood chips, waste-derived fuel, hazardous waste, and whole tires. Ash Grove burned hazardous waste as fuel between 1986 and 1991. As of 2012, the facility employs a combination of coal, petroleum coke, and tires to fire its kilns; typically, natural gas has been used only for startup of the kilns but its usage has expanded in recent years.

[2] An expanded explanation of the history and estimated air emissions (short and long term) is available in the ATSDR Health Consultation *Assessing the Adequacy of the Ambient Air Monitoring Database for Evaluating Community Health Concerns* [ATSDR 2015b].

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

Ash Grove's production processes use raw materials and generate by-products and wastes that have the potential to impact soil, surface water, and groundwater in the Midlothian community. These include airborne emissions from stacks, process equipment, and waste management areas that can be transported to area soils; migration of contaminants from material processes and waste operation areas to groundwater; and runoff from these process and waste operations to surface water and sediments. The facility is required to manage raw materials, emissions, discharges, and waste in accordance with laws and permits designed to avoid impacts to other media.

Releases also can occur from the facility's quarry activities, physical processing of raw materials (for example, crushing, grinding, and milling), materials handling operations, stockpiles, and other storage areas. Many of these other operational sources are also equipped with air pollution and other waste management 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 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. Production rates also can impact emission levels. The three ATSDR health consultations for Midlothian [ATSDR 2015b, 2016a,d] provide Toxic Release Inventory (TRI) data pertaining to air releases from the Ash Grove facility.

2.2.2 Holcim

Holcim Texas Limited Partnership (referred to in this document as "Holcim") is a Portland cement manufacturing facility located on the northeast side of Midlothian that opened in 1987. The facility began its operations as Holnam Texas LP, which was also formerly known as Box Crow Cement Company. Holcim operates two dry kilns that began operations in 1987 and 2000, respectively. An onsite quarry provides limestone and other raw materials used to feed the rotary kilns, which operate at temperatures reaching 3,000^{o}F. Raw materials are crushed and milled onsite before being fed to pre-heaters that precede the kilns. Since 1987, Holcim has used multiple fuels to fire its kilns. The facility originally was permitted to use coal and natural gas, but has also been permitted to fire its kilns with tire chips, oil, non-hazardous liquids, non-hazardous solids, and petroleum coke.

Holcim's cement manufacturing operations emit air pollutants from multiple sources, and various measures are in place to reduce facility emissions. Both kilns operate with air pollution controls. Process gases from the kilns eventually vent to the atmosphere through 250-foot and 273-foot tall stacks. 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 particulate matter from process exhaust streams Three ATSDR health consultations for Midlothian [ATSDR 2015b, 2016a,d] provide TRI data pertaining to air releases from the Holcim facility.

2.2.3 TXI

TXI Operations, Inc. (referred to in this document at "TXI" and since January 2014 merged with Martin Marietta Materials, Inc.), is the largest of the three Portland cement manufacturing facilities in Midlothian. TXI is located southwest of the city center, adjacent to Gerdau Ameristeel. TXI opened in 1960 and for many years operated five cement kilns that came online in 1960, 1964, 1967, 1972, and 2002, respectively. Four of these were "wet kilns" and the newest is a “dry kiln.” TXI has permanently shut down its wet kilns and the authority to operate these kilns has been removed from its permit. An onsite quarry provides the limestone and shale used to manufacture cement. Other raw materials are delivered by truck.

TXI has used multiple fuels to fire its kilns, which reach temperatures of 2,800°F. The kilns were originally fired with natural gas. From the mid-1970s through the late 1980s, the facility was authorized to fire kilns using coal, fuel oil, petroleum coke, hazardous waste, and waste-derived fuel. However, the only currently operating kiln (the dry kiln, mentioned above) is authorized to fire natural gas and coal as fuel. Though TXI was permitted to burn hazardous waste since 1987, the facility has not used this fuel continuously over the years and does not burn it now; records indicate that the facility burned hazardous waste between 1991 and 2007.

TXI includes a range of air emission sources that are typically found at cement manufacturing facilities. In addition to air 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 particulate emissions. Air emissions are reviewed in three ATSDR health consultations for Midlothian [ATSDR 2015b, 2016a,d].

2.2.4 Gerdau Ameristeel

Gerdau Ameristeel − sometimes referred to as Chaparral Steel (its former name) − operates a secondary steel mill located on the southwest side of Midlothian and adjacent to the TXI cement plant. The facility began operating in 1975 [TNRCC 1995a] and uses two EAFs 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 EAFs melt scrap steel. Casting operations then form the molten material into structural steel beams, reinforcing bars, and other shapes and forms.

Gerdau Ameristeel’s production processes have multiple air emission sources. Exhaust from the two EAFs passes through baghouses to remove pollutants before being vented to the atmosphere through three stacks ranging from 80 to 150 feet high. Emissions also occur from the facility’s automobile shredding operation, melt shop, and scrap and slag handling operations. Many of these operations are also equipped with air pollution controls. As pollution controls have been installed and upgraded at the facility, air emissions have decreased significantly over time. TRI data pertaining to air releases from the Gerdau facility can be found in other ATSDR health consultations for Midlothian [ATSDR 2015b, 2016a,d].

2.3 Air Emissions

Since this health consultation focuses on possible deposition to media other than air from air emissions from the four facilities of concern, this section summarizes some of the conclusions and findings from previous Health Consultations that have addressed air quality issues in the Midlothian area.

In the first Health Consultation, *Addressing the Adequacy of the Ambient Air Monitoring Database for Evaluating Community Health Concerns* [ATSDR 2015b], ATSDR performed a screening modeling analysis to assess the furthest reaches of maximum ground-level impacts from the Midlothian facilities. This analysis established the potential area of impact which could be reasonably expected to have the highest ambient air concentrations due to facility emissions (Figure 2-3). This area represented the locations where ATSDR believed that the highest ground-level impacts at any given time may be expected to occur, and this area remained the focus of the evaluation of monitoring locations and sampling data for the other health consultations, including this one. Also as shown in the figure, EPA's modelling of the points of maximum air deposition and air concentrations from all four facilities combined [EPA 1996] were included in these boundaries. 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.

As part of the evaluation on air emissions, ATSDR reviewed meteorological conditions in the Midlothian area, because those factors will influence air deposition from sources to downwind locations. A wind rose is used to display the wind speeds and directions reported at a meteorological station for a given time period. The wind rose in figure 2-4 from three meteorological stations in Midlothian show that the prevailing winds are from the southeast, south, and southwest. The modeled potential area of impact also shows the south to north influence from the four facilities (Figure 2-3). Wind speeds were highest in March and April and lowest in August and September [ATSDR 2015b].

The Health Consultation, *Assessing the Public Health Implications of the Criteria (NAAQS) Air Pollutants and Hydrogen Sulfide* [ATSDR 2016a] evaluated the six criteria air pollutants (sulfur dioxide, nitrogen dioxide, ozone, carbon dioxide, particulates, and lead) and hydrogen sulfide in the Midlothian area. Based on sampling data, ATSDR determined that breathing air contaminated with fine particulate matter ($PM_{2.5}$) for a year or more was not a health concern. However, there have been some infrequent shorter term levels of $PM_{2.5}$ measured in Midlothian between 2001 and 2011 that could have potentially been harmful to sensitive individuals. ATSDR also concluded that during the period 1993 to 1998, in a localized area north of the Gerdau Ameristeel fence line, airborne lead exposures could have posed a risk to the health of children who resided or frequently played in this area. It was unknown if children resided in that area. Since 1998, lead air levels in this area have decreased.

In the Health Consultation, *Review and Analysis of VOCs and Metal Exposures in Air* [ATSDR 2016d], ATSDR evaluated cancer and non-cancer risks from both measured and modeled ambient concentrations of volatile organic compounds and metals. Over 1,600 VOC samples measured at 12 monitoring locations and over 1,100 metal samples found in either total suspended particulates or fine particulate matter (PM_{10} or $PM_{2.5}$) measured at 17 monitoring stations in the Midlothian area were evaluated. Because of their volatility in air, no or minimal deposition impacts would be expected from the VOCs. No metals found in particulate sampling exceeded the health based comparison values for chronic inhalation exposure. Further, cancer risks were not found to be elevated for metal and VOC exposure during the sampling periods evaluated (1991-2011).

Figure 2-3: Potential Area of Impact for the Midlothian Facilities. [ATSDR 2015b]

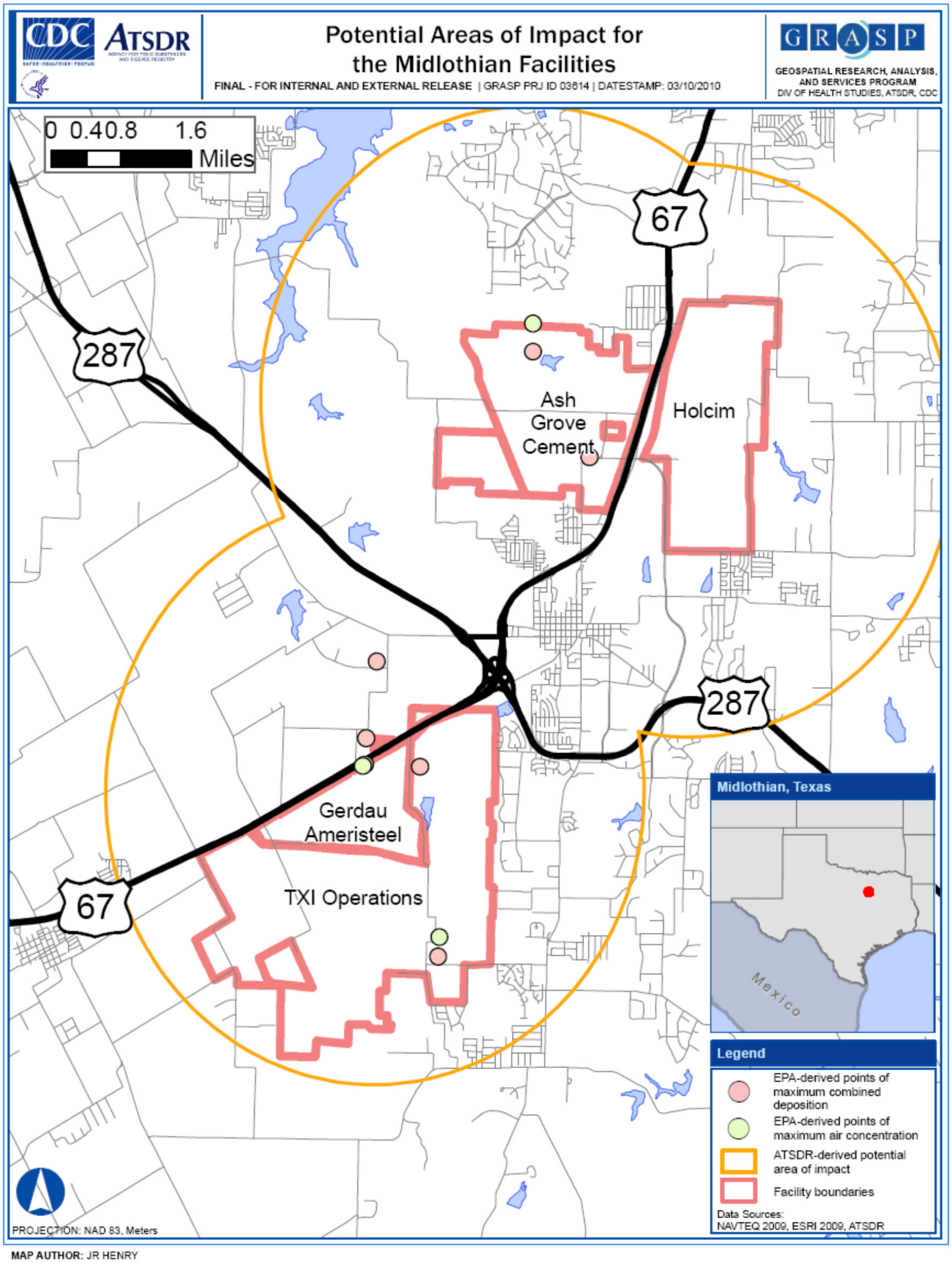
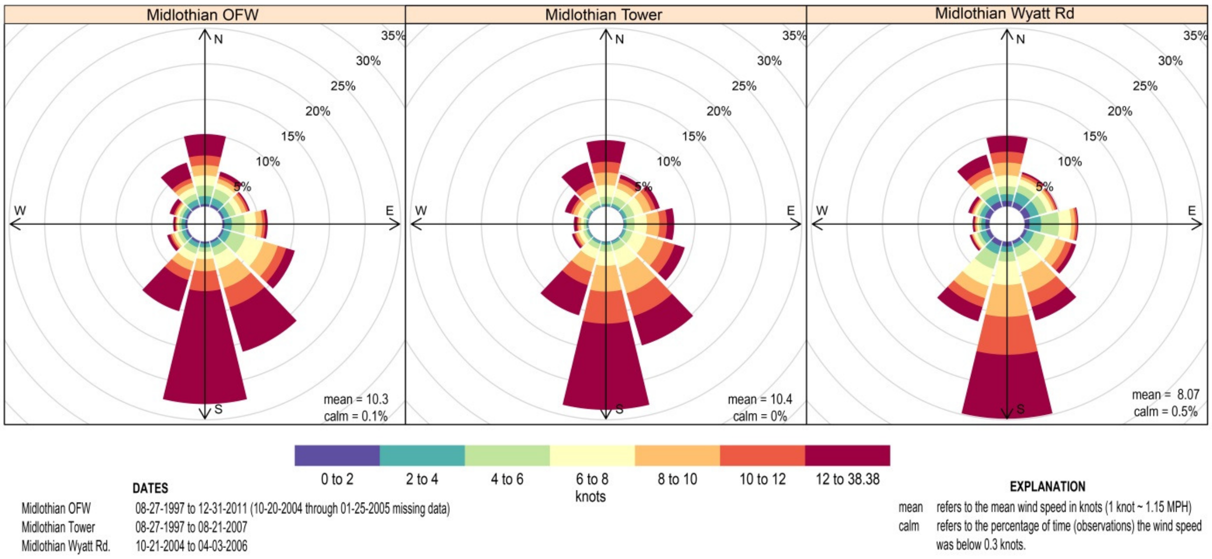


Figure 2-4: Wind Roses Depicting Prevailing Wind Patterns in Midlothian* (2001-2011) [ATSDR 2016d]



* Midlothian meteorological stations: Old Fort Worth Road (OFW) (north of the border of Gerdau Ameristeel and TXI), Midlothian Tower (on TXI's property), and Wyatt Road (north of Gerdau Ameristeel).

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). Information prepared for the ATSDR Health Consultation, *Review and Analysis of VOCs and Metal Exposures in Air* [ATSDR 2016d], is included in this section for reference.

An estimated 38,908 people live within 3 miles of any of the facilities of interest, 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 (as shown in Figure B.2.5 in Appendix B of *Evaluation of Health Outcome Data* [ATSDR 2016c]). Some residents live on property adjacent to one of the facilities or immediately across the highway from TXI and Gerdau Ameristeel. Approximately 7.9 percent of the population of Midlothian are children under the age of 5; 22 percent are women of childbearing age; and 7.6 percent are older than 65 [Census 2010].

2.5 Community Concerns

Since 2005, ATSDR and TDSHS have been documenting community concerns regarding the Midlothian facilities. The agencies have learned of these concerns through various means, including the petition submitted by the community, 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. Concerns were summarized from written and oral communication with residents and consolidated in ATSDR's Public Health Response Plan [ATSDR 2012a].

This health consultation considers potential impacts and exposure concerns in environmental media other than air, but related to organics and metals emissions in air (for example, through deposition to soil and water). Public concerns and topics that relate to this other media evaluation include: pathway evaluation and chemical evaluation (for media other than air), persistence of emissions and the effects of continuous low levels of emissions (on media other than air), and the potential health impact on area residents, especially sensitive populations (pregnant women, infants, children, the elderly, the immune-suppressed).

These concerns are addressed in the Public Health Implications section of this document. Available data was used to evaluate potential exposure pathways of concern and determine potential impacts to human health. While some data related to animals is evaluated, this topic is more fully addressed in the ATSDR Health Consultation, *Evaluation of Reported Health Issues in Animals in the Midlothian Area* [ATSDR 2016b].

3.0 Methods

This section presents the methods used for this health consultation. When performing public health assessments, ATSDR uses an exposure pathway analysis and media-specific health based comparison values to determine if a public health hazard exists at a site as the foundation of the evaluation [ATSDR 2005]. Environmental sampling data, modeling, and health outcome data provide information to support conclusions about public health hazards at a site. Pollutants in the environment might harm health, but only if people have sufficient contact or exposure to those pollutants.

This section describes the exposure pathway evaluation for this site for media other than air (Section 3.1) and describes methods used in evaluating data gathered for this site. Specifically, the following subsections describe (1) the methods used to collect data and information (Section 3.2), (2) the screening of data that were identified (Section 3.3), (3) ATSDR's evaluation of the completeness and quality of the data that were identified (Section 3.4) and ATSDR's health based comparison value screening analysis for pollutants of concern (Section 3.5).

3.1 Exposure Pathway Analysis

An exposure pathway is the link between environmental releases and local populations; a person must be exposed to chemical contaminants in the environment before an adverse health effect is possible. An exposure pathway consists of five parts that must be present to be considered a completed exposure pathway. If one or more of the parts are unknown, it may be considered a potentially completed exposure pathway. The five parts of the exposure pathway are:

- Contaminant source or release (in this case, primarily air deposition);
- Environmental fate and transport—the method that allows the chemicals to move from the source and contact the population (soil, dust, surface water, groundwater, vegetation);
- Exposure point or area—the location(s) where people might come into contact with a contaminated medium;
- Route of exposure—the route through which the chemical enters the body (drinking, eating, breathing, touching);
- Potentially exposed populations.

For this health consultation, while air emissions from the four major facilities were the contaminant source, the deposition of those air emissions on soil, surface water, and vegetation or as dust was evaluated. Once in soil, uptake by vegetation or potential transfer to groundwater was also considered. Individuals could be exposed by direct contact with these environmental media or by incidental ingestion from hand to mouth behavior and drinking groundwater from on-site wells. Vegetation grown on-site was consumed by cattle, so was not considered as a direct exposure pathway. As described in section 2.3, locations within the modeled potential area of impact were more likely to have the highest ground-level impacts at any given time. This area includes the central part of the city of Midlothian, as well as surrounding subdivisions, farmland, and ranchland.

A summary of potential and completed exposure pathways for this health consultation which addresses deposition to media other than air for past, present or future exposures in the Midlothian area is presented below (Table 3-1). As shown in Figure 2-3, existing land use surrounding and off-site of the facilities is predominantly not occupied by residents, but may be used for farming, grazing, or left vacant. For many years, until the early 2000s, on-site land south of the Gerdau Ameristeel facility was used by a local rancher for cattle. Other than knowing that cattle used the land, ATSDR is not aware of specific practices by the rancher or other residents that would increase their exposure to these media. Thus, because of the potentially exposed populations, the exposure pathways are considered potential pathways. While this health consultation focuses on the off-site exposures to residents, environmental sampling available for all media other than air for both on-site and off-site exposures are presented.

Exposure pathways not included in the evaluation for this health consultation are pathways related to the inhalation route of exposure and pathways in which the exposed population is domestic animals. These pathways, for example, the inhalation of dust, are discussed in other health consultations prepared for the Midlothian area [ATSDR 2015b, 2016a,d]. The exposure pathways for domestic animals are discussed in the ATSDR Health Consultation, *Evaluation of Reported Health Issues in Animals in the Midlothian Area* [ATSDR 2016b].

Table 3-1 Potential and completed exposure pathways for Midlothian area residents.

Environmental medium	Exposure Route	Exposure Point	Potentially exposed population	Time Frame	Exposure Pathway Status
Soil	Direct contact, Incidental ingestion	On-site	Rancher	Past	Complete
		Off-site	Residents	Past/Present/Future	Complete
Sediment	Direct contact, Incidental ingestion	On-site	Rancher	Past	Potential
Surface water	Direct contact, Incidental ingestion	On-site	Rancher	Past	Potential
Groundwater	Direct contact, Ingestion	On-site	Rancher/ worker	Past/Present/Future	Complete
Dust*	Direct contact, Incidental ingestion	Off-site	Residents	Past/Present/Future	Complete

*Inhalation of dust is discussed in other Midlothian Health Consultations [ATSDR 2016a,d]

3.2 Data and Information Collection

ATSDR received and collected a range of documentation regarding facilities and potential concerns related to industrial operations and potential chemicals in the environment in the Midlothian area. The information was obtained from sources such as: individuals, facilities, the press, and environmental and public health agencies.

These data included, but were not limited to, sampling data and laboratory analyses by the Texas Air Control Board[4] (TACB) and the TCEQ (formerly, the Texas Natural Resources Conservation Commission (TNRCC)) for a variety of environmental media; correspondence between private citizens, state and federal agencies; newspaper articles; on-line data resources from TCEQ; and reports compiled and prepared by other environmental and health agencies. The documentation reviewed covers a timespan from about 1985 to 2012, with most of the information being from the early- to mid-1990s and was focused primarily on releases to air from facilities of interest in the Midlothian area.

3.3 Screening of Data and Information Identified for this Health Consultation

While all of the available data were used to help review citizen concerns, understand the geographic layout of the area, review operational information for the facilities, evaluate potential exposure pathways to consider, and/or provide general background on the area, only some of the records provided quantitative and well-documented information that was suitable to evaluate potential impacts to human health from air emissions to other media. ATSDR screened the available data using the process shown in Figure 3-1. Using this process, ATSDR divided the available data into three categories: (1) background information used to understand community issues in relation to the other media health consultation, discussed in Section 3.3.1; (2) data from monitoring and/or measurements that are limited quality, but are potentially suitable to address some of the scientific aspects of the consultation, discussed in Section 3.3.2; and (3) data suitable to address scientific aspects of this consultation, described in Section 3.3.3, evaluated in Section 3.4, and presented in Section 4.

3.3.1 Background Information Identified for this Health Consultation

As shown in Figure 3-1, air data available for the Midlothian area was mainly included as background data for this health consultation. Air data are more thoroughly evaluated in three other health consultations prepared for Midlothian, Texas [ATSDR 2015b, 2016a,d]. Although those data are not directly relevant to this other media health consultation, they provided useful background information on the environmental setting, industry history, wind direction, and contaminants of concern.

A large volume of information in the files reviewed for the Midlothian health consultation was compiled by citizens or in response to citizen complaints. ATSDR reviewed this information and found that while it was informative for background purposes, it did not provide quantitative data to support the public health evaluation goals of this health consultation. Much of this background data was qualitative or anecdotal in nature, and some was related to topics addressed in other health consultations. This background data included lists of acute and chronic human health effects reported by Midlothian residents which are addressed primarily in the ATSDR Health Consultation, *Evaluation of Health Outcome Data* [ATSDR 2016c] and also included in discussions on public health implications in the health consultations that evaluate air emissions [ATSDR 2016a,d]. Animal health issues reported in the Midlothian area were evaluated in the ATSDR health consultation, *Evaluation of Reported Health Issues in Animals in the Midlothian*

[4] On September 1, 1993, the Texas Air Control Board (TACB) and Texas Water Commission were consolidated to form the Texas Natural Resources Conservation Commission (TNRCC). On September 1, 2002, the name of TNRCC was formerly changed to Texas Commission on Environmental Quality (TCEQ).

Area [ATSDR 2016b]. Therefore, these data were also used mainly as background information for this health consultation.

The first box in Figure 3-1 shows examples of the types of data and information that were retained as background information, and Table 3-2 summarizes the categories and numbers of records that were retained as background information. Table 3-2 also summarizes the types and numbers of records described in Section 3.3.2 that contain sampling data with potential to address scientific aspects of this health consultation.

ATSDR's review of background information provided a baseline understanding of community concerns, potential receptors, the geographic layout of the area, past studies, and environmental media uses that are relevant to this health consultation. ATSDR notes that some of the media types also are addressed in the air, health outcome, and animal-focused health consultations prepared in this Midlothian series.

Figure 3-1: Decision Tree for Screening Data for the ATSDR Other Media Health Consultation for Midlothian, TX

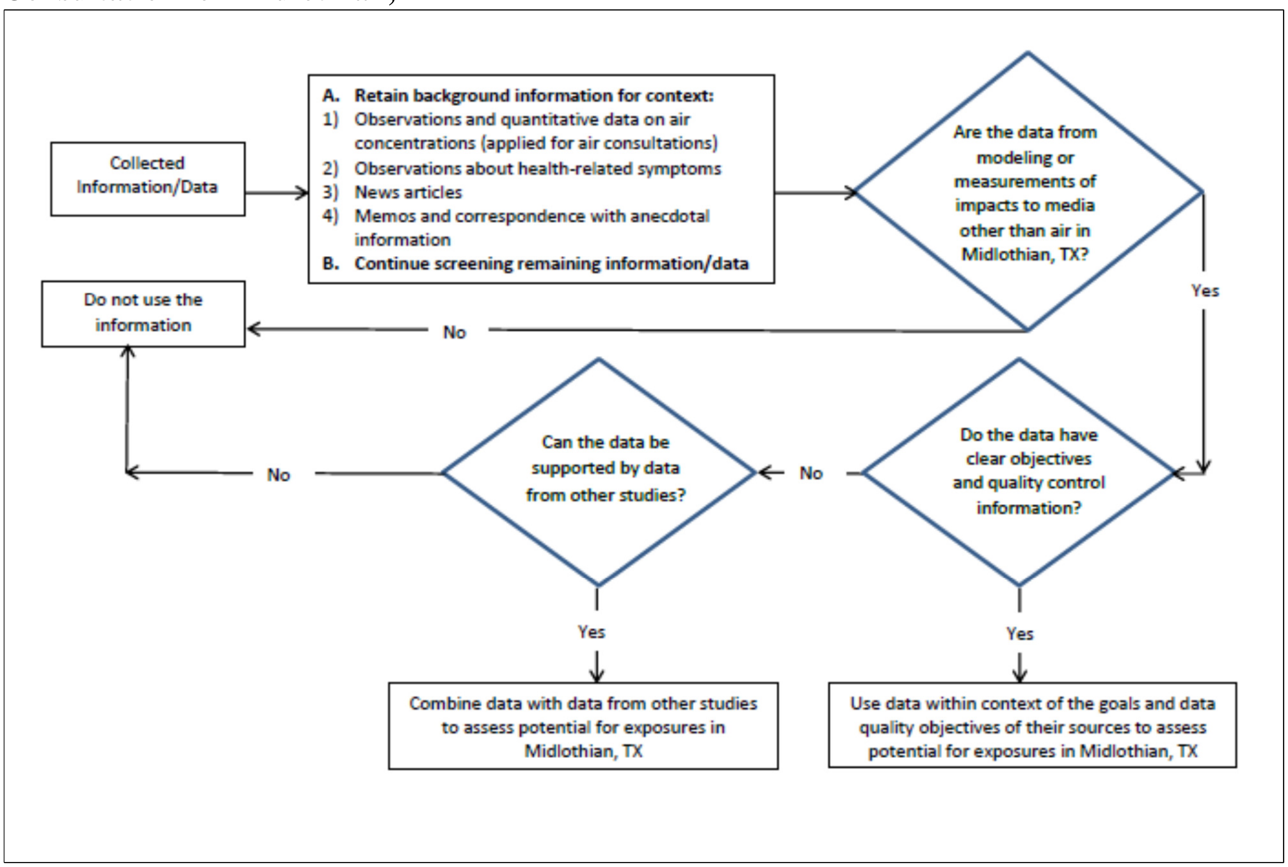


Table 3-2: Summary of Records Used as Background Information and Sampling Data of Limited Quality but with Potential to Address Scientific Aspects of this Health Consultation

Document Type	Background Information	Number of Records
Citizen Documentation	Citizen complaints, observations, correspondance, petitions, etc.	22
Newspaper Articles/Press Releases	Articles from a variety of media sources.	9
Community-based Organization Documentation	Work plans, mailing lists, meeting notes, letters to state agencies	5
State and Federal Agency Documentation	Memos, reports, permitting information, general correspondence from state agencies such as Texas Air Control Board, Texas Department of Health, Texas Commission on Environmental Quality (formerly Texas Natural Resources Conservation Commission), U.S. EPA, U.S. Nuclear Regulatory Commission, etc.	22
Media Type	**Sampling Data with Potential Value**	**Number of Records**
Air	Ambient and indoor air, air emissions	37
Animal Hair	Dog, cow, and horse hair	1
Dust	Cement kiln dust (CKD), clinker, indoor and outdoor dust, filters, lint, and fly ash	17
Human Hair	Human scalp hair	2
Soil	Soil	10
Paving Materials	Rock, sand, asphalt, and road materials	4
Slag	Slag	2
Vegetation	Wheat, oats, grass, and hay	2
Fish Tissue	Fish tissue	1
Miscellaneous	White powder, waste-derived fuel distillate, fuel oil, and rainwater	3
Multi-Media	Air, dust, human hair, Slag, Paving Materials, Vegetation, Soil, Surface Water, Foundation Materials, etc.	10

3.3.2 Evaluation of Potentially Usable Data

As shown in Figure 3-1, once the background data were retained, ATSDR reviewed all the remaining records and extracted those with potential to address the scientific aspects of this health consultation. As part of this screening step, shown in top right of Figure 3-1, ATSDR rejected some records and reviewed the quality of the data and information in the remaining records. This step is shown in the lower right of the figure. The sampling information and results that were determined to be of good quality are discussed in Section 3.3.3, and this section discusses the sampling information and results that were determined to be limited in quality for one or more of the following reasons:

- Not representative of the media from which they were collected,
- Unknown or uncertain collection procedures,
- Unknown or unacceptable quality control techniques,
- Lack of media specific health comparison values (example, hair samples), and
- Unknown/uncertain sample holding times.

The types of media described by these types of data included dust, slag, road materials, fish tissue, and hair. The numbers of records that contained these types of data are presented in Table 3-2, and are discussed below.

3.3.2.1 Dust

ATSDR reviewed many types of dust samples collected in the community, including cement kiln dust, dust collected from cars, dust collected from air conditioners with tape, etc. Most of these dust samples did not meet quality control standards for inclusion in this health consultation. ATSDR determined that only one round of cement kiln dusts and no samples of electric arc furnace dusts that met quality standards. The reasons for this are discussed below.

Cement Kiln Dusts

During the cement manufacturing process, many by-products are formed in the high-temperature kilns, including the generation of fine-grained particles that are referred to as cement kiln dust (CKD). These particles are carried in the cement kiln exhaust gas. Most of the CKD generated in cement kilns is captured in air pollution control devices (e.g., electrostatic precipitators, baghouses), but some is emitted to the air through the kiln stacks. CKD includes particles of many different sizes, and the particle size distribution depends on the specific production processes and air pollution controls at a given cement manufacturing facility. Some CKD will have particles small enough that they can blow from open surfaces into the air and be inhaled (i.e., are respirable). Any CKD that the Midlothian facilities release in the respirable size fraction should be reflected in the ambient air monitoring data collected from offsite locations. The ambient air monitoring data on particulates is discussed in the Health Consultation on *Assessing the Public Health Implications of the Criteria (NAAQS) Air Pollutants and Hydrogen Sulfide* [ATSDR 2016a].

CKD is a highly alkaline material. The primary constituent is calcium oxide, which can account for almost half of CKD by weight; with lesser quantities of silicon dioxide, sulfur trioxide, aluminum oxide, and potassium oxide [EPA 1993; KDOT 2004]. The limited available data on cement kiln dust in Midlothian is from six samples collected over two days in 1992 at three area cement kilns (two samples were collected from Ash Grove, one from Holcim, and three from TXI). The results of these samples are not representative of the ranges of dusts that these facilities may generate over any period of time; however, ATSDR used these results to determine whether they fit within the ranges of cement kiln dusts described in the EPA Report to Congress on Cement Kiln Dusts [EPA 1993], a report that concluded that

> "*…cancer risks for individuals living around cement plants under average conditions of transport and exposure (defined as central tendency estimates) were low (below 1 × 10-4). In addition, noncancer effects were below the threshold effects level, indicating a negligible likelihood of noncancer impact. This analysis also quantified the high end of the distribution of risks around these same cement plants. While the risks were somewhat higher, they are generally considered within an acceptable risk range*."

The results of comparisons between the levels of metals measured in cement kiln dusts from Midlothian facilities and facilities from the EPA Report to Congress [EPA 1993] are presented in Table 3-3. The highest and average concentration of metals from the Midlothian cement facilities were lower than those reported in EPA Report to Congress.

Table 3-3: Comparison of Metal Concentrations in Cement Kiln Dust at Midlothian Facilities with Nationwide Facilities in the EPA Report to Congress [EPA 1993].

Constituent	Midlothian Facilities*†		EPA Report to Congress†	
	Highest Concentration (ppm)	Average Concentration (ppm)	Range of Concentrations (ppm) from EPA study‡	Highest Average Concentration (ppm) from 5 studies¶
Arsenic	13.4	10.4	2.1 - 20.3	34.3
Barium	295	135.3	11 - 779	185.8
Cadmium	7.5	3.83	0.89 - 80.7	20
Chromium (total)	50.5	29.75	11.5 - 81.7	41.6
Lead	257	75.8	5.1 - 1,490	434.5
Mercury	0.09	<0.02	0.005 – 14.4	17.3
Selenium	13	6.2	2.5 - 109	18.3
Silver	BDL	BDL	1.1 – 22.6	10.3

ppm: parts per million; NA: not analyzed; BDL: below detection limit.
* From a total of six samples (two samples were collected from Ash Grove, one from Holcim, and three from TXI)
† No comparison criteria are provided because none apply. The levels shown here would be expected to undergo dilution in air, soil, and water prior to exposure to most receptors.
‡ EPA study results of generated CKD from 15 facilities [EPA 1993].
¶ EPA reported the highest average concentrations of trace metals observed in the five studies of CKD [EPA 1993].

In addition to metals, the EPA Report to Congress on CKD also evaluated man-made and naturally occurring radionuclides. EPA noted that of 17 radionuclides detected in CKD, none were elevated above normal background levels. Their evaluation included the Midlothian TXI CKD samples. An ATSDR health physicist reviewed the TXI CKD data and concurred that the naturally occurring radionuclide activity detected was consistent with background and that manmade radionuclide activity, including plutonium, had no verifiable detectable activity.

In 11 of the 15 facilities, which did not include Midlothian TXI samples, EPA also evaluated other groups of chemicals and found that:

- dioxins and furans were consistently detected in CKD but posed low risks from exposure to CKD;
- polychlorinated biphenyls (PCBs) do not appear to be present in CKD;
- volatile organic compound detected in CKD samples were artifacts of analytical procedures;
- semi-volatile organic compounds were not detected in CKD samples; and
- pesticides were infrequently detected in CKD [EPA 1993].

As stated previously, CKD is highly alkaline, in reference to typical pH levels of CKD, the EPA Report to Congress noted that CKD pH levels (a number expressing the acidity or basicity of a chemical) ranged from 11 to 13 (very basic), and the highest pH levels could result in human tissue burns and corrosion in pipes.

Six tapelift samples (one in 1985, one in 1991, and four in 1992) analyzed by microscopy to determine particle type by TACB in response to citizen requests were reviewed that mentioned rust, molding sand, and/or cement dust as being particles found on the tapelift. The cement dust contribution of five of the samples ranged from 2 to 15% [TACB 1985, 1992b,c]; cement dust was the most prevalent particle type reported in one of the tapelift samples [TACB 1991a]. Analysis of a white particulate sample collected from a juniper tree near the Box Crow (now Holcim) cement plant was determined to be limestone [TACB 1991b].

Cement kiln dust will be further evaluated in the Public Health Implications Section.

Electric Arc Furnace Dusts

Information on EAF dust is presented in an EPA report entitled “Midlothian Cumulative Risk Assessment” [EPA 1996]. This report used emission data from responses to an EPA information collection request from 77 steel facilities across the United States. Results from this collection request initially were used to support EPA air regulations; however, they were also used to estimate emissions from the Gerdau facility in the Midlothian cumulative risk assessment. For the cumulative risk assessment in Midlothian, EPA used the results to compile a profile of metals concentrations in EAF and then compared the EAF profile to sampling results provided by the Gerdau facility in a letter to EPA dated December 20, 1995.

With the exception of antimony, EPA found the two sets of concentrations to be reasonably similar. For example, the emissions profile assumes that EAF dust contains 0.33 percent (3,300 parts per million (ppm)) of total chromium. Actual data from Gerdau indicated that their EAF dust contains 0.20 to 0.27% chromium (2,000 to 2,700 ppm). Approximately 2% of the total chromium is in the hexavalent form. The emissions profile assumes that EAF dust contains 0.0033 percent (33 ppm) arsenic. Actual data from Gerdau indicates that their EAF dust contains 0.0040 to 0.0054 percent (40 to 54 ppm) arsenic. The emissions profile assumes cadmium to comprise 0.054 percent (540 ppm) of EAF dust. Gerdau reports cadmium concentrations ranging from 0.05 to 0.09 percent (500 to 900 ppm) in their EAF baghouse dust.

In the 1996 report, using default values for antimony, EPA identified antimony as the only contaminant that was theoretically above threshold levels. Gerdau (then Chaparral Steel) was implicated as the primary source of antimony. Subsequently, Gerdau provided measured antimony concentrations in EAF dust to EPA. Measured antimony concentrations ranged from 50.5 to 81.9 ppm in EAF dusts at the Gerdau facility and the re-calculated risk showed no cancer risks or potential for non-cancer health effects above the regulatory levels of concern [EPA 1997]. Although these data are important for understanding the composition of the EAF dust, they can’t be used directly to evaluate community exposures. These data were helpful in modeling impacts of Gerdau to the surrounding community and evaluating the risk of adverse health effects from exposure.

Electric arc furnace (EAF) dusts are regulated as a listed hazardous waste (waste code K061) under the Resource Conservation and Recovery Act (RCRA) because they generally contain toxic levels of cadmium, hexavalent chromium, and lead. Their status as a hazardous waste compels stringent requirements for their storage, treatment and disposal, which generally preclude releases into the environment, thus greatly reducing potential exposures to human and ecological receptors. Because the levels of many metals in EAF dusts are elevated in general relative to soils and other natural media, releases of such dusts are often detected due to spikes in the concentrations of several metals simultaneously in a given media sample.

Other Dust Samples

Community residents have submitted samples to state agencies (mainly the TACB) and received results from a variety of dust samples collected by tapelifts from surfaces such as television sets, satellite dishes, picture glasses, interior walls, and furniture. There did not appear to be any standardized sampling procedures used for these collections. Most of these samples were analyzed using microscopy to determine particle type and found to be consistent with household dust; all of them were inconclusive with respect to assessing risks. Because these samples were not analyzed for metals, it would not be possible to evaluate if they contained metals in concentrations that could pose risks to humans.

3.3.2.2 Slag/Road Materials

Other data reviewed in this health consultation included the use of slag from the Gerdau facility as road building materials. These uses were not identified as a major focus of this health consultation because slag used for road building would not be expected to be ingested or inhaled consistently by the community and the source of this media was not air emissions. However, it should be noted that community residents raised concerns in the early 1990s that if the metals in the road building materials could be mobilized by rainwater or wind action, that significant exposures would have the potential to occur. Therefore, the TACB received and analyzed samples of slag and road materials and collected air samples at roadway sites where these materials had been used [TACB 1992a]. One of the purposes of these samples was to determine if significant levels of hexavalent chromium could mobilize from road building materials to the air or water.

In reference to air, the TACB concluded that all sample results were below detection limits for hexavalent and total chromium, and that adverse health effects to sensitive receptors in the general population were not expected to result from exposure to concentrations of hexavalent chromium and total chromium below these detection limits. In reference to the road building materials and slag, the TACB concluded that although the concentrations of metals in the slag are high enough that they could increase the risk of adverse health effects, an increased risk to the public is unlikely because the slag is in the form of a hard gravel [TACB 1992a]. In addition, the estimated ranges of hexavalent chromium in these samples did not exceed 1.6 ppm, which is below ATSDR's children's chronic health based comparison value for soil (the environmental media evaluation guide (EMEG) of 45 ppm).

TNRCC provided similar results on slag in a 1995 study [TNRCC 1995a]. To address community concerns that area roads might pose a health risk, TNRCC analyzed slag samples from area roads for 13 metals: aluminum, antimony, arsenic, beryllium, cadmium, chromium, iron, lead, manganese, mercury, nickel, selenium, and strontium. All were below their health based screening levels. TNRCC reanalyzed the chromium to determine the amount of hexavalent chromium in their samples. Total chromium concentrations ranged from 3,700 to 6,400 ppm, while hexavalent chromium concentrations in slag samples ranged from 1 to 13 ppm. The hexavalent chromium was well below their screening level of 300 ppm. TNRCC concluded that health effects from metals in slag were not expected to cause adverse health effects.

3.2.2.3 Fish Tissue

Other data considered limited in quality included data for fish tissue samples collected and analyzed by the Texas Department of Health (TDH), now TDSHS, in 1994 [TDH 1994]. While the purpose of this the sampling effort was not clearly described in the source document available for review, it is believed that the data were used to determine the need for fish consumption advisories. Sixteen fish tissue samples were collected from Joe Pool Reservoir (located in Tarrant, Ellis, and Dallas counties) and analyzed for PCBs, metals, pesticides, and semi-volatile organic compounds (SVOCs).

This report indicated that six contaminants were detected above their laboratory detection limits, including copper (0.22 - 0.80 ppm), mercury (0.115 - 0.388 ppm), zinc (4.46 - 14.35 ppm), and the pesticides aldrin (4.0 parts per billion (ppb)), dichlorodiphenyldichloroethylene (DDE) (5.22 ppb), and heptachlor (5.06 ppb) [TDH 1994]. However, ATSDR reviewed the TDSHS web site regarding fish consumption advisories and found that TDSHS currently has no fish consumption advisories or possession bans for Joe Pool Reservoir based on August 1994 sampling (http://www.dshs.state.tx.us/seafood/no-advisories.aspx). According to the TDSHS web site, this indicates that a water body was tested for environmental chemical contaminants in fish tissue and eating fish from this water body poses no apparent public health hazard. Given air modeling of the potential area of impact for air emissions [ATSDR 2015b], which overlays the reservoir in only a small southernmost area, and that the air modeling and air sampling results for metals in particulates did not indicate levels of inhalation health concern in this area [ATSDR 2016d], any contribution to these pollutant concentrations in fish that would be related to facility operations are expected to be low.

3.3.2.4 Hair

Metal analysis results for hair samples were provided to ATSDR by residents for analyses performed primarily between 1988 and 1997, with a few additional hair samples collected in 2004. Results were provided for hair samples taken from 81 children (aged 17 or younger), 66 adults (aged 18 or over), and 31 Midlothian area residents of unknown age. ATSDR could not evaluate these results. No sample collection or laboratory procedures were provided, and the length of the hair sample, the proximity to the scalp, and the use of hair treatments or shampoos were unknown. These considerations prevented us from evaluating the results of the hair analyses.

ATSDR finds only a limited usefulness of human hair analyses for evaluating potential environmental exposures. Many scientific issues need to be resolved before they can be used confidently to assess exposure [ATSDR 2001]. In addition to the lack of standardized methods, interpretation of human hair analyses is limited by the lack of reference ranges to frame results, difficulty in distinguishing internal and external contamination, lack of correlation between levels in hair and blood or other target tissues, and lack of epidemiologic data linking hair levels with adverse health effects.

3.3.3 Data Presented in this Health Consultation

ATSDR used the screening process in Figure 3-1 to identify data/information sources available and considered to be applicable to this health consultation, which focusses on sampling and modeling data that address the effects of depositions of contaminants from air emissions on media other than air. ATSDR identified information available in the following primary sources discussed in this report:

- Media sampling data and modeling results presented in a report dated 1995, prepared by the TNRCC (now the TCEQ) [TNRCC 1995a] ("1995 Report")
- Modeling results presented in reports prepared by the U.S. EPA [EPA 1996 ("1996 Report"), 1997, 2000a]
- Other Media-specific data collected and compiled in Other Reports by various sources before and after the time of the above-referenced reports, often in response to specific concerns identified by area residents [TACB 1991c, 1993; TNRCC 1994a,b, 1995b,c; ERM 2004; TECQ 2005].
- Facility-specific information available in TCEQ registration and permit records accessible online [TCEQ 2014a,b]

Collectively, the sources listed above provide multimedia health modeling findings and analytical data for soil, vegetation, surface water, sediments, and well water. ATSDR used this information in combination with available exposure pathway information to explore the potential for human health impacts associated with the deposition of pollutants from air emissions to other media from the four target facilities.

3.4 Evaluation of the Completeness and Quality of the Available Usable Data

ATSDR evaluated the completeness and quality of the data/information sources described above in Section 3.3.2 by comparing them to the types, quantities, and quality of data that ATSDR would need to fulfill the main purpose of this other media health consultation (evaluate potential health risks posed by other media through deposition of facility air emissions). These comparisons included four basic types of data, including data on:

- Primary sources of contamination
- Release and transport mechanisms
- Exposure points
- Receptors

Table 3-4 shows that of the data and information reviewed by ATSDR on the primary onsite sources, most of the information was on air emissions. Air modelling and sampling results are evaluated in the health consultations that address air quality [ATSDR 2015b, 2016a,d]. Less information was available on concentrations of metals and other contaminants in the byproducts and wastes, such as CKD and EAF dusts, that could be potential sources of exposure in the Midlothian community. Because of limitations on these data, they were discussed in Section 3.3.2. While CKD, EAF dust and other facility by-products and wastes have the potential to come in direct contact with community members if improperly managed, the potential for such contact is greatly diminished if these facilities control fugitive dusts that otherwise may be blown into neighboring properties and manage waste on- and off-site in accordance with waste management regulations. Also, the primary public concern being addressed in this health consultation is the potential for deposition of pollutants in air emissions to other media, rather than concerns associated with on- or off-site waste management practices.

Table 3-4 also shows that the data and information available to ATSDR contained measured and modeled information regarding how metals and other contaminants may be transported from air to other media and toward potential exposure points. Although the transport mechanisms for soil to air and other media were not available, this was not the focus of this health consultation. Additionally, modeling results and analytical results from samples collected within the soil, water, wheat, and other media (representing the exposure points) mitigate the lack of data on contaminant transport mechanisms.

The media representing exposure points were modeled and sampled more than the media representing other types of data shown in Table 3-4; however, there are gaps in the quantity and representativeness of data for the exposure points. The largest data gaps in sampling data for the points of exposure are related to surface waters, groundwater, vegetation, and crops. The only measurements of these media documented in the files and considered usable for Section 4.0 address sampling of the area surrounding the Gerdau Ameristeel property.

Table 3-4: Types of Data Available in the Documents Used for this Health Consultation

Contaminant Concentration Data by Subject Area	Data Types		
	TNRCC 1995a Report	**EPA 1996 Report**	**Other Reports***
Primary Sources (Onsite)			
Air emissions	Measured and modeled†‡	Modeled‡	Not applicable‡
Solid wastes	Limited data on slag	Unavailable	Unavailable
Wastewaters	Unavailable	Unavailable	Unavailable
Storm water	Unavailable	Unavailable	Unavailable
Groundwater	Unavailable	Unavailable	Unavailable
Release/Transport Mechanisms			
Air to soil, surface water and crops	Modeled and measured‡	Modeled‡	Unavailable
Onsite soils to air, surface water, and groundwater	Unavailable	Unavailable	Unavailable
Solid waste to air, surface waters and groundwater	Unavailable	Unavailable	Unavailable
Exposure Points			
Air	Not applicable‡	Not applicable‡	Not applicable‡
Crops	Measured and modeled	Modeled	Some measured
Homegrown Vegetables	Modeled	Modeled	Unavailable
Surface water	Modeled	Modeled	Some measured
Solid wastes	Unavailable	Unavailable	Unavailable
Soil	Measured and modeled	Modeled	Measured
Groundwater	Measured	Unavailable	Some measured
Receptors Scenarios			
Residential Child/Adult	Modeled	Modeled	Not addressed
Beef Farmer	Modeled	Modeled	Not addressed
Dairy Farmer	Modeled	Modeled	Not addressed
Fisher	Modeled	Modeled	Not addressed
Cattle	Measured	Modeled	Not addressed

* Other reports include TACB 1991c,1993; TNRCC 1994a,b, 1995b,c; ERM 2004; TECQ 2005].

†Unless otherwise indicated in these notes, modeled means estimated using air dispersion modeling based on emission data from each facility or based on general emission factors and the assumption that the concentration of contaminants in the emissions are similar to the concentrations of contaminants typically found in the residue from air pollution control devices at steel mills across the United States. Details on the emission factors and assumptions were not available to ATSDR.

‡Concentrations of contaminants in air are not included in the scope of this health consultation of other media. Information and evaluation of air modeling and air sampling can be found in the health consultations that address this media [ATSDR 2015b, 2016a,d].

Table 3-4 also shows that the information available to ATSDR included modeling that considered the exposures points that would be expected to be a concern based on potential releases from the four facilities of interest. That is, the EPA report addresses the range of receptors that is reasonable, including potential exposures to residents who were assumed to consume homegrown produce, ingest soils, inhale the air, and ingest surface water for modeling purposes [EPA 1996,1997]. This report also considers exposures to subsistence beef farmers who consume beef from their cattle, subsistence dairy farmers who consume milk from their cows, and subsistence fishers who consume fish from nearby surface waters.

Table 3-5 summarizes the completeness and quality of each specific type of data that was reviewed pertaining to the four basic types of data needed for this other media health consultation. Based on ATSDR's review, the quality of the data appear to be sufficient to reach preliminary conclusions about the potential effects of these four facilities on other media that could impact the public health of the Midlothian community.

Table 3-5: Purpose, Completeness, and Quality of Data Used in this Health Consultation

Type of Data	Purpose	Completeness	Data Quality
Input data for modeling in the TNRCC report [1995a]	Support Cumulative Risk Modeling	Not addressed. No listing of data is included in the document, data can be obtained from individual reports.	No discussion of data quality is provided in the document. Information can be obtained from individual sampling reports.
Input data for modeling in U.S. EPA report [1996]	Support Cumulative Risk Modeling	ATSDR addressed adequacy of database and monitoring in other health consultation [ATSDR 2015b].	ATSDR addressed adequacy of database and monitoring in other health consultation [ATSDR 2015b].
Area-wide soil sampling data reported in the 1995 TNRCC report. (80 sampling locations for metals and 60 locations for PCDD/PCDF).	Support community-wide assessment of potential health concerns.	Summary data were available, data quality information can be obtained from individual sampling reports.	Good descriptions of sampling and analytical methods, chain of custody, and quality assurance/quality control testing were provided for available data, but no formal data validation documentation was available in the materials reviewed.
Focused sampling data on and adjacent to the Gerdau Ameristeel property reported in the 1995 TNRCC report (22 locations for metals in soils).	Support focused assessment of the potential health impacts from the Gerdau Ameristeel property, where data from area-wide sampling showed higher concentrations of lead and arsenic.	Data were complete for the purposes of this study.	Good descriptions of sampling and analytical methods, chain of custody, and quality assurance/quality control testing were provided, but no formal data validation available.

Type of Data	Purpose	Completeness	Data Quality
Soil sampling in the 2003/2004 ERM-Southwest report (44 locations for metals in soils).	Support a second assessment of the Gerdau Ameristeel property.	Data were complete for the purposes of this study.	Chain of custody, sampling and analytical procedures appear to be acceptable. Some data quality information available. No formal validation documentation is included in the material reviewed.

3.5 Screening for Pollutants of Potential Concern

The documents identified in the screening process described in Figure 3-1 as providing good quality data and applicable for this health consultation (section 3.2.2) are presented in section 4.0 by media type. As an initial screen, the data were compared to media-specific health based screening levels to determine if any chemicals were present at levels of potential concern to public health. If a chemical was found to have a concentration above the screening level, additional evaluation was made that included exposure duration and frequency to the media.

In this document, ATSDR refers to these screening levels as comparison values or "CVs". The media-specific comparison values are derived using ATSDR's minimal risk levels (MRLs). An MRL is an estimate of the daily human exposure to a hazardous substance that is likely to be without appreciable risk of adverse, non-cancer health effects over a specified duration of exposure [ATSDR 2005]. The derived comparison value uses exposure assumptions on ingestion and inhalation rates, exposure duration, and body weight. Comparison values are set well below the levels that are known or suspected to cause an adverse health effect. These values were established as screening values for the most sensitive human population. In this health consultation, when both child and adult comparison values were available, the comparison value for children was used. If ATSDR had not established a comparison value for a particular chemical in a specific media, EPA regional screening levels (RSLs) were used if available. The comparison values used in this document address exposures from ingesting chemicals from soil or water [ATSDR 2015a]. To evaluate sediment, soil comparison values were used. Comparison values include:

- ***ATSDR Environmental Media Evaluation Guides (EMEGs)*** are estimated contaminant concentrations that are not expected to result in adverse noncarcinogenic health effects. They are based on MRLs for chronic, intermediate, and acute exposures (those occurring longer than 365 days, from between 14-365 days, and 14 days of exposure or less, respectively).
- ***ATSDR Reference Dose Media Evaluation Guides (RMEGs)*** represent the concentration in water or soil at which daily human exposure is unlikely to result in adverse noncarcinogenic effects. They are based on EPA's oral reference doses and are used for chronic (greater than a year) exposures.
- ***EPA Regional Screening Levels (RSLs***) are risk-based numbers that are available for multiple exposure pathways and for chemicals with both carcinogenic and noncarcinogenic effects. The RSLs used in this analysis correspond to either a one additional person with cancer per million exposed people (10^{-6}) for carcinogens or a Hazard Quotient (HQ) (the ratio of the concentration of the chemical to the level at which no adverse health effects are expected) of 1 for non-carcinogens [EPA 2015].

While the above comparison values are based on noncancer health effects, ATSDR has established Cancer Risk Evaluation Guides (CREGs) for some chemicals that are known or probable human carcinogens. The CREGs are estimated contaminant concentrations that would be expected to cause no more than one excess cancer in a million (10^{-6}) persons exposed during their lifetime (78 years). CREGs are calculated from EPA's cancer slope factors for oral exposures. Where applicable, cancer risks are discussed for exposures to chemicals over an extended period, but are not taken into account for incidental, infrequent exposures especially in industrial, non-residential settings. CREGs were also not applied for soil arsenic, since normal, background concentrations exceed the CREG.

The comparison values described above were developed for adults and children, and not for animals. For sample analyses on vegetation, the National Academies National Research Council's (NRC) Committee on Minerals and Toxic Substances in Diets and Water for Animals, maximum tolerable level (MTL) was used [NRC 1980, 2005] for health-based screening values for animals. The MTL of a mineral is defined as "the dietary level that, when fed for a defined period of time, will not impair animal health and performance." The toxicity threshold is dependent on the animal species and tolerance usually increases with age. The 2005 MTL is based solely on animal health and productivity and does not take into consideration the possible human toxicity from consuming food products of animal tissues where minerals might have accumulated. The 1980 MTL does take into consideration human toxicity and the dietary level for animals should not produce unsafe residues in human food derived from the animal.

4.0 Media-Specific Data and Findings

ATSDR used the review process explained in Section 3 to identify the following primary data/information sources used in this section to document media-specific data and findings. These included the following primary sources discussed in this report:

- Media sampling data on soil and vegetation and modeling results presented in a report dated 1995, prepared by the TNRCC (now the TCEQ) [TNRCC 1995a] ("TNRCC Report")
- Modeling results presented in reports prepared by the U.S. EPA [EPA 1996 ("1996 Report"), 1997, and 2000a]
- Data collected and compiled in reports by government agencies during or after 1990, often in response to specific concerns identified by area residents [TACB 1991c, 1993; TNRCC 1994a,b, 1995b,c; TECQ 2005]
- Media sampling data for soil, vegetation, surface water, sediment, and groundwater in a report by a private source [ERM 2004] and
- Facility-specific information available in the TCEQ registration and permit records accessible online [TCEQ 2014a,b].

Sections 4.1 through 4.7 summarize the data and results from these sources as they apply to multimedia modeling (Section 4.1), media-specific analytical data for soil, vegetation, surface water, sediments, and well water (Sections 4.2 through 4.6, respectively), and TCEQ registration and permit records accessible online (Section 4.7).

4.1 Multimedia Modeling Studies

As noted in Section 3, two agencies conducted multimedia modeling related to other media and the facilities of interest. These efforts were undertaken to evaluate potential health impacts from industrial facilities in Midlothian. These two efforts are documented in a report prepared by the TNRCC (now the TCEQ) [TNRCC 1995a] and in a report prepared by EPA Region 6 [EPA 1996]. Sections 4.1.1 and 4.1.2 summarize the findings of these reports.

4.1.1 TNRCC Modeling Results

The TNRCC report presents the results of a multi-media, multi-pathway risk screening assessment using dispersion and deposition modeling that was based on estimated air emissions from two of the facilities of interest (Ash Grove and TXI). The modeling was conducted because both of these facilities had burned (and were burning at the time of the modeling activities), hazardous wastes as fuel in their kilns. The chemicals of concern used in the risk screening assessment included, arsenic, beryllium, benzo(a)pyrene toxicity equivalency quotients (TEQs), bis(2-ethylhexyl)phthalate, cadmium, 1,3-dinitrobenzene. 2,4-dinitrotoluene, 2.6- dinitrotoluene, di-n-octyl phthalate, hexachlorobenzene, lead, mercury, nickel, nitrobenzene, PCBs, pentachloronitrobenzene, pentachlorophenol, and 2,3,7,8-tetrachlorodibenzo-p-dioxin TEQs. TNRCC conducted this risk screening assessment using EPA guidance [EPA 1994] to estimate human health risks from these two facilities to the following pathways and receptors:

- Soil and home-grown vegetable ingestion by adult and child residents
- Soil, milk, home-grown vegetable, and beef ingestion by subsistence farmers, and
- Soil, home-grown vegetable, and fish ingestion by subsistence fishers

The TNRCC report states that the modeling effort also followed the EPA guidance to select chemicals of concern and identify representative concentrations of these chemicals as inputs to the model. In addition, the report notes that a number of methods and site-specific professional judgments were made to fine tune the model input data and assumptions; however, the report does not describe how such judgments were applied to the risk screening process. The model used input data and the assumptions made by the modelers to estimate the concentrations of each chemical of concern that would be deposited in soil, taken up by homegrown vegetables, taken up by forage and feed vegetation for cattle and dairy cows, and bio-accumulated in fresh water environments for uptake by fish. The model then used a number of default assumptions to estimate the exposure levels and calculate risks posed by each chemical of concern to residents, subsistence farmers (dairy and beef), and subsistence fishers [TNRCC 1995a].

TNRCC concluded that the modeling results indicated that risks to all receptors were low and did not warrant further action. This conclusion was reached with consideration of results from direct sampling and analysis of soil, which were also presented in this report. Soil sampling findings associated with this 1995 report are presented in Section 4.2. TNRCC's conclusion also indicates no adverse effects from exposures to air; however, direct air pathways are considered in more detail by other ATSDR health consultations prepared for this site [ATSDR 2016a,d].

4.1.2 U.S. EPA Modeling Results

The 1996 EPA report entitled "Midlothian Cumulative Risk Assessment" [EPA 1996] represents another application of the same EPA guidance that was used by TNRCC (see Section 4.1.1) to assess risks from hazardous waste combustion facilities [EPA 1994]. However, the EPA effort incorporates risk modeling for all four of the facilities of interest (rather than just the two cement facilities addressed by TNRCC), and the report provides greater details regarding the data used as primary input data and modeling variables. The constituents of concern used in the model included dioxin and dioxin-like compounds, furans, polycyclic aromatic hydrocarbons (PAHs), PCBs, nitroaromatics, phthalates, other chlorinated organics, antimony, arsenic, barium, beryllium, cadmium, hexavalent chromium, lead, mercury, silver, and thallium.

EPA estimated air emissions from the three cement manufacturing facilities based on stack test data collected during trial burns or compliance tests. Gerdau Ameristeel facility air emissions were estimated based on theoretical emission factors[5] and the concentrations of contaminants typically found in the residue from air pollution control devices at steel mills across the United States. Using the emissions data (cement facilities) and steel industry emission estimates, EPA applied dispersion modeling techniques to map areas in Midlothian with maximum expected air concentrations and associated deposition levels to other media from the four facilities. These points appear as circles in Figure 2.3.

EPA also modeled exposures of contaminants from the facilities to human receptors via inhalation, incidental ingestion of soil, ingestion of drinking water, ingestion of beef and milk, and the ingestion of fish. Potential human receptors were assumed to be located in areas that reasonably approximated actual area land use patterns. The receptors used for this assessment included a child resident, an adult resident, a subsistence fisher, and a subsistence farmer. All of

[5] Theoretical emission factors are based on a number of assumptions regarding the waste feed composition, temperature of gasses in the stack, type of air pollution control devices, and the height of the stack.

these receptors were assumed to be present at a location between Ash Grove and Holcim and at a location south of TXI; all except the subsistence fisher were assumed to be present at a location immediately north of Gerdau; and only a subsistence fisher was assumed to be present at a small pond location about one mile northwest of Gerdau. Thus, there were a total of 12 receptor-location exposure scenarios evaluated that were all within close proximity to the areas having the highest estimated deposition rates from the emissions of the four target facilities. In addition, the emissions from these facilities were assumed to occur over a thirty-year period, and the receptors were assumed to be lifetime members of the community.

The conclusions were that there were no cancer risks or the potential for non-cancer health effects above regulatory levels of concern even though the modeling of antimony made non-cancer risk slightly exceed threshold values, and that the risk was predominately from Chaparral Steel (now Gerdau Ameristeel) Company [EPA 1996]. The report was revised in 1997 to reflect additional and more detailed emission rate data from Chaparral Steel for antimony, and the language regarding the slightly elevated non-cancer risk was deleted. The conclusion in the revised summary was that there were no adverse effects from exposures to air. Antimony was not identified as a contaminant of concern in ATSDR health consultations on air pollutants that were prepared for the site [ATSDR 2016a,d].

In the health consultation that addressed the adequacy of air monitoring [ATSDR 2015b], ATSDR reviewed the EPA modeling and provided its own dispersion modeling analysis to determine a potential area of impact (Figure 2-3). The findings on air deposition were consistent between the EPA and ATSDR modeling analyses. EPA's points of maximum combined air deposition from all four facilities and maximum air concentrations were all within ATSDR's modelled potential area of impact. ATSDR believes that any long-term air quality impacts would likely occur within the potential area of impact.

4.2 Soil Results

Based on the review process described in Section 3 of this health consultation, 13 documents addressed complaints, investigations, and/or data regarding soil. Quantitative soil sampling results available to ATSDR to identify potential health impacts from the deposition of air emissions by industrial facilities in Midlothian were found in a report prepared by the TNRCC (now the TCEQ) [TNRCC 1995a], a report prepared by ERM-Southwest [2004], and a report prepared by TCEQ [2005]. The TNRCC Report including summary data from sampling in 1991 [TACB 1991c], 1992 [TACB 1993], 1994 [TNRCC 1995b] and 1995 [TNRCC 1995c]; soil sample results from a focused study near Gerdau (Chaparral Steel); summary local background soil results; and dioxin and furan soil sampling analysis results. Soil sampling information and findings in these reports are presented in the following subsections.

As part of the evaluation of these soil sampling results, ATSDR compared the results to 2015 health based comparison values for soil [ATSDR 2015a; EPA 2015] (Table 4-1). ATSDR also looked at background soil concentrations of the metals analyzed in the extended area, Texas, and the western United States (Table 4-1). Soil is a heterogeneous mixture and concentrations of metals can vary widely between soil types. Metal concentrations are dependent upon the rock material from which the soil is formed and human activities such as agricultural practices (example, use of arsenical pesticides) [TNRCC 1995a].

Table 4-1: Background* Soil Metal Concentrations and 2015 Comparison Values†

Contaminant	Western U.S. 1984 Observed Range (ppm)	10 miles West- 1992/94 (ppm)	10 miles East- 1992/94 (ppm)	Local Area Maximum Background 1995 (ppm)	Texas specific 2004 (ppm)	2015 Comparison Values† in ppm (source)
Aluminum	5,000**->100,000**	16,000	12,000	24,000	30,000	50,000 (EMEGc)
Antimony	<1-2.6	<MDL	<MDL	<MDL	1	20 (RMEGc)
Arsenic	<0.10-**97**	6	8	7	5.9	15 (EMEGc)‡
Beryllium	<1-15	0.78	0.4	0.88	1.5	100 (EMEGc)
Cadmium	N/A	<MDL	0.5	0.5	N/A	5 (EMEGc)
Chromium (total)	3-2,000	120	47	200	30	75,000 (RMEGc)
Copper	2-300	N/A	N/A	11	15	500 (IEMEGc)
Iron	1,000->**100,000**	29,000	16,000	31,000	15,000	55,000 (RSL)
Lead	<10**-700**	8	10	23	15	400 (RSL)¶
Manganese	**30-5,000**	310	950	1,500	300	2,500 (RMEGc)
Mercury	<0.1-4.6	<MDL	<MDL	<MDL	0.04	9.4 (RSL)
Molybdenum	<3-7	N/A	N/A	14	N/A	250 (RMEGc)
Nickel	<5-700	100	30	250	10	1,000 (RMEGc)
Selenium	<0.1-4.3	<MDL	<MDL	<MDL	0.3	250 (EMEGc)
Strontium	10-3,000	N/A	N/A	320	100	30,000 (RMEGc)
Thallium	2.4-31	N/A	N/A	<MDL	9.3	0.78 (RSL)
Titanium	500-20,000	N/A	N/A	180	2,000	NA
Zinc	10-2,100	N/A	N/A	56	30	15,000 (EMEGc)

N/A – metal not analyzed or data not provided; Method detection limits (MDLs) were available for [TACB 1991c, 1993; TNRCC 1995b] but not for [TNRCC 1995a].

* Source documents for background data: western U.S. [Shacklette 1984]; maximum 10 miles east/west of Box Crow (Holcim) [TACB 1991c, 1993; TNRCC 1995b]; maximum background 8 samples [TNRCC 1995a]; and Texas specific [ERM 2004]

† ATSDR 2015 Comparison Values [ATSDR 2015a]. EMEGc indicates the comparison value source as the ATSDR chronic Evaluation Media Evaluation Guide (Child); IEMEGc indicates ATSDR Intermediate Evaluation Media Evaluation Guide (Child); RMEGc indicates ATSDR chronic Reference Dose Media Evaluation Guide (Child); RSL indicates U.S. EPA Regional Screening Level [EPA 2015]; and NA indicates no comparison value was available. The revised November 2016 CVs were reviewed and the updates do not impact the screening and overall health conclusions for this assessment.

‡ ATSDR cancer risk evaluation guide (CREG) for arsenic of 0.47 ppm is less than background soil concentrations, so was not used for soil sampling results.

¶ No ATSDR health-based CV exists for screening lead surface soil levels because there is no clear threshold for some of the more sensitive health effects associated with lead exposures. 400 ppm represents the EPA and TCEQ soil screening levels used in their reports.

BOLD numbers indicate concentrations that exceed 2015 comparison values.

4.2.1 Soil Results from the TNRCC Report

The 1995 TNRCC report describes the results of an area wide soil sampling study of the four target facilities, and a focused soil sampling effort that was conducted around the borders of the Gerdau facility that was initiated at the request of a local farmer. The area wide study involves analytical data from soil sampling in areas expected to receive high rates of deposition from the emissions of the four facilities of interest and in areas selected to represent background concentration levels. Shallow surface soil samples were collected at 0.25 to 0.5-inch depths around the four facilities of interest at their property lines and approximately five miles beyond their property lines. Background samples were collected approximately 10 miles east and west of the four facilities. Sampling took place in the spring of 1991, 1992, 1994, and 1995.

4.2.1.1 Area Wide Study

Soil samples were analyzed for metals, polychlorinated dibenzo-p-dioxins (PCDDs), and polychlorinated dibenzofurans (PCDFs). Figure 4-1 provides a map of the locations of most of the eighty surface soil sampling locations (representing 175 samples) where soil was collected and analyzed for metals; it also shows the location of the four facilities. Another 60 surface soil sampling locations (representing 60 samples), collected in the same vicinity as shown on Figure 4-1, were analyzed for dioxins and furans. The soil samples for metals and dioxins/furans analysis were collected along, within, and near the property boundaries to the north, south, east, and west of each facility. These sample locations are consistent with the prevailing wind directions in the Midlothian area, which are toward the north, northwest, and south, respectively, in terms of relative directional frequencies [ATSDR 2016d]. Additional samples were collected at further distances, up to 5 miles to the north, south, east and west of each facility. It should be noted that the 1995 TNRCC report only sumarizes the ranges of contaminant concentration data associated with the samples collected at the 80 locations where samples were collected for metals analysis; therefore, this report does not provide the analytical results for each individual sampling location. However, ATSDR was able to identify additional details on some of the soil sample data from a series of reports that were prepared over the four years when TNRCC was collecting its data [TACB 1991c, 1993; TNRCC 1995b,c]. Individual data for all of the 60 dioxin/furan soil samples collected from 60 additional soil sampling locations were available in the 1995 TNRCC report.

Table 4-2 summarizes the maximum concentrations detected in soils associated with the TNRCC study, the comparison values TNRCC applied, and updated comparison health values for each contaminant (where applicable). The 2015 comparison values were either the same or lower than the comparison values used in the TNRCC report. This table shows that the TNRCC report found that of the 18 metals analyzed, only arsenic, iron, lead, and manganese exceeded the 2015 comparison values. To evaluate these results, ATSDR reviewed source soil reports used for the summary report and found location data and other details on 145 of the 175 samples [TACB 1991c, 1993; TNRCC 1995b,c].

Arsenic concentrations exceeded the TNRCC comparison value of 20 ppm in 6 samples representing three locations. Using the source reports to evaluate the 2015 comparison value for arsenic of 15 ppm, 17 samples representing 7 locations were identified. The highest of these concentrations (32 ppm) occurred at location 2 shown on Figure 4-1, which is approximately five miles from any of the target facilities in a cotton field, and more importantly five miles from the modeled potential area of impact for the highest expected metals deposition in the Midlothian area (Figure 2-3). The next highest arsenic concentration is 23 ppm, which was from the area of highest deposition just north of the Gerdau facility.

No ATSDR health-based comparison value exists for screening lead surface soil levels because there is no clear threshold for some of the more sensitive health effects associated with lead exposures. One sample did exceed the EPA RSL for lead of 400 ppm. The sample location was described as being below the AT&T tower and surrounded on all sides by TXI property [TNRCC 1995a]. Thus this property is not accessible to the public, especially children. The second highest concentration of lead was 120 ppm; this sampling location was 5 miles east of Holcim and not considered related to the site. [TNRCC 1995c]. Of note, pharmacokinetic modelling of site specific air and soil lead concentrations estimated that children do not have an elevated risk of having a blood lead level above 5 micrograms lead per deciliter blood, the current reference value [ATSDR 2016a].

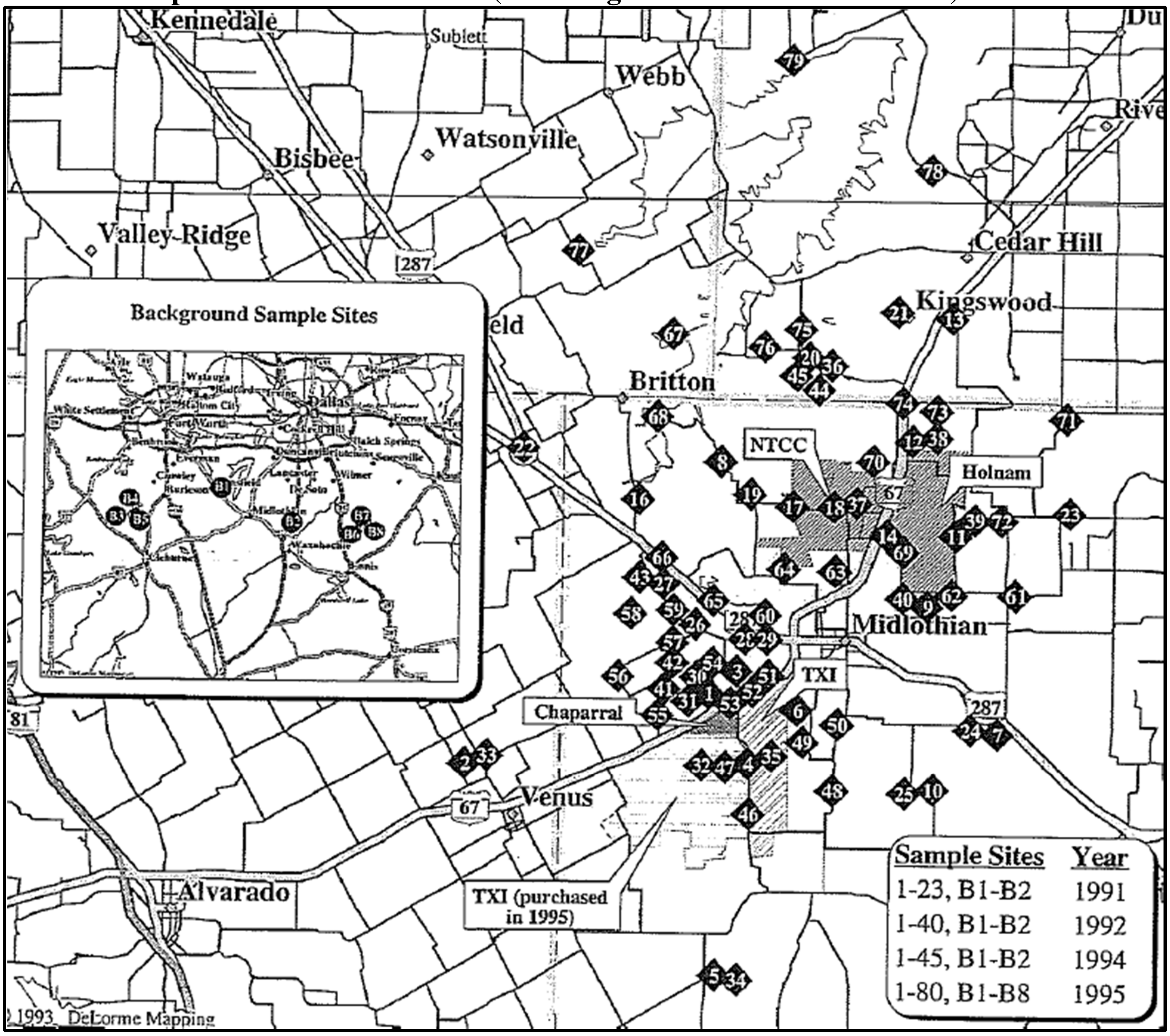
Iron and manganese concentrations exceeded their updated comparison values (see shaded numbers in Table 4-2). Thirty samples, including the sample with the iron concentration of 67,000 ppm and the manganese concentration of 4,700, were not accounted for in the four source reports. The data from these four reports showed that none of the 145 samples exceeded the comparison value for iron, and only 1 out of 145 samples exceeded the 2015 comparison value of 2,500 ppm for manganese. That sample contained 3,900 ppm of manganese and it was collected two miles north of the Ash Grove Cement facility [TNRCC 1995c]. Earlier manganese results from this same location showed concentrations of 450 ppm [TACB 1993] and 970 ppm [TNRCC 1995b].

For the TNRCC soil sampling analyses, total chromium but not hexavalent chromium was analyzed. While none of the soil samples exceeded the comparison value for total chromium, if all the chromium was in the hexavalent form, about one quarter of the chromium concentrations in the four source reports exceeded the hexavalent chromium comparison value of 45 ppm. The estimated hexavalent chromium percentages in emissions from cement production and specialty steel production are about 0.2 and 2.2 percent, respectively [ATSDR 2012c]. Applying the larger of these percentages (2.2) to the maximum total chromium result (540 ppm) in Table 4.2 would result in a hexavalent chromium concentration of 12 ppm, which is well below the comparison value of 45 ppm.

Concentrations of PCDDs and PCDFs were summed and converted to a toxicity equivalent quotient (TEQ) relative to concentrations of tetrachlorodibenzo-p-dioxin. The TEQ concentration in the Midlothian soils ranged from 0.3 to 17.9 parts per trillion. All samples were below the 2015 comparison value.

Arsenic in soil will be further evaluated in the Public Health Implications Section.

Figure 4-1: Map of the Midlothian Area Showing 80 Sampling Locations Representing 175 Samples Collected for Metals (From Figure 2.10 in TNRCC 1995a)



Note: NTCC denotes North Texas Cement Company, now known as Ash Grove Cement; Holnam now Holcim; Chaparral now Gerdau Ameristeel.

Table 4-2: TNRCC Results for Metals and Dioxins/Furans in Soils Compared to 1995 and 2015 Comparison Values (Updated from Table B.1 in TNRCC 1995a)

Contaminant	MDL* (ppm)	Number of Samples	Maximum Concentration (ppm)	1995 TNRCC CV (ppm)	Number of Samples Exceeding 1995 CV	2015 CV † in ppm, (source)
Aluminum	2	152	46,000	NA	0	50,000 (EMEGc)
Antimony	3	175	<3	20	0	20 (RMEGc)
Arsenic	3	140	32	20	6	15 (EMEGc)‡
Beryllium	0.2	175	1.7	300	0	100 (EMEGc)
Cadmium	0.5	175	2	40	0	5 (EMEGc)
Chromium (total)	0.3	175	540	50,000	0	75,000 (RMEGc)
Chromium VI¶	0.3	175	12	300	5	45 (EMEGc)
Copper	0.2	54	110	1,000	0	500 (IEMEGc)
Iron	1	175	67,000	NA	0	55,000 (RSL)
Lead	2	175	490	400	1	400 (RSL)**
Manganese	0.3	175	4,700	5,000	0	2,500 (RMEGc)
Mercury	2	175	4	15	0	9.4 (RSL)
Molybdenum	2	54	36	300	0	250 (RMEGc)
Nickel	0.5	175	250	1,000	0	1,000 (RMEGc)
Selenium	3	175	<3	300	0	250 (EMEGc)
Strontium	0.02	54	620	NA	0	30,000 (RMEGc)
Thallium	3	54	<MDL	4	0	0.78 (RSL)
Titanium	0.1	54	430	NA	0	NA
Zinc	2	54	1,000	15,000	0	15,000 (EMEGc)
PCDD/PCDF§	NA	54	0.0000179	0.001	0	0.00005 (EMEGc)

* Method detection limits (MDLs) were not provided in the source document; however, they were available from TACB 1991c, 1993; TNRCC 1995b,c.

† ATSDR 2015 Comparison Values [ATSDR 2015a]. EMEGc indicates the comparison value source as the ATSDR chronic Evaluation Media Evaluation Guide (Child); IEMEGc indicates ATSDR Intermediate Evaluation Media Evaluation Guide (Child); RMEGc indicates ATSDR chronic Reference Dose Media Evaluation Guide (Child); RSL indicates U.S. EPA Regional Screening Level [EPA 2015]; and NA indicates no comparison value was available The revised November 2016 CVs were reviewed and the updates do not impact the screening and overall health conclusions for this assessment.

‡ ATSDR cancer risk evaluation guide (CREG) for arsenic of 0.47 ppm is less than background soil concentrations, so was not used for soil sampling results.

¶ Assuming 2.2% of the total chromium is in the hexavalent form, maximum concentration of hexavalent chromium is 12 ppm, see text for additional details.

§ Concentrations of polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzo-p-furans (PCDFs) were summed and converted to a toxicity equivalent quotient (TEQ) relative to concentrations of tetrachlorodibenzo-p-dioxin.

**No ATSDR health-based CV exists for screening lead surface soil levels because there is no clear threshold for some of the more sensitive health effects associated with lead exposures. 400 ppm represents the EPA and TCEQ soil screening levels used in their reports.

Shaded numbers indicate maximum concentrations that exceed the 1995 and/or 2015 comparison values.

4.2.1.2 Gerdau Focused Study

In addition to the area wide data above, the TNRCC report provided summary data on metals in soil from a study that focused on areas immediately outside the borders of the Gerdau Ameristeel (formerly known as, Chaparral Steel) property that was conducted in 1994. This study involved the collection of 22 soil samples; six immediately north of the facility and 16 immediately south of the facility on what is now TXI property (Figure 4-2).

The results from the study are presented in Table 4-3. Cadmium exceeded the 2015 comparison value of 5 ppm, at two locations with a maximum concentration of 52 ppm. These samples were collected at locations 2 and 8 (Figure 4-3), which are immediately south of the Gerdau Ameristeel facility and not accessible to the public, especially children. At these same two sample locations lead concentrations exceeded the EPA RSL of 400 ppm (1,500 and 2,200 ppm, respectively). The 2015 comparison value for manganese (2,500 ppm) was exceeded for at least one location. Insufficient information was provided in the report to determine how many of the 22 samples were above 2,500 ppm since none exceeded the TNRCC comparison value of 5,000 ppm. The range of manganese concentrations reported were from 590 to 4,200 ppm.

Figure 4-2: Map of the Gerdau Ameristeel (Chaparral) Facility Showing 22 Sampling Sites (From Figure 2.13 in TNRCC 1995a)

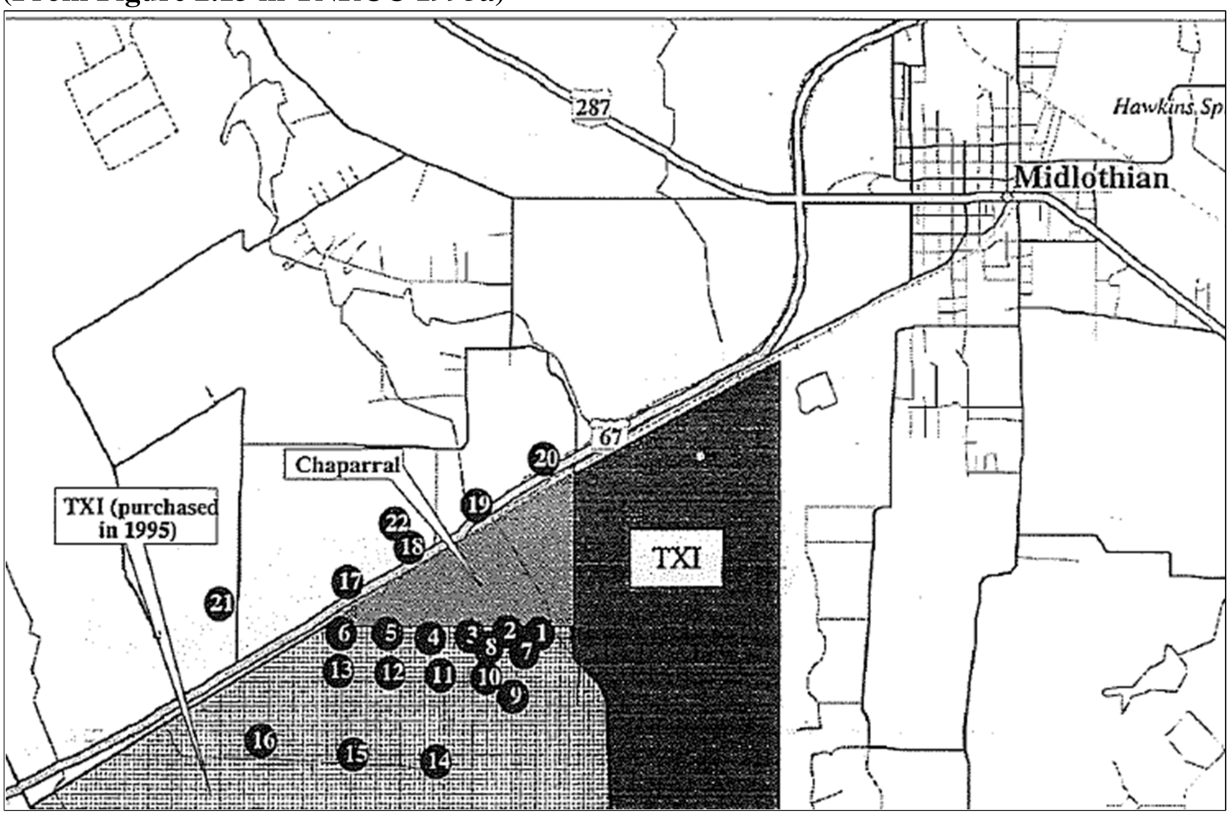


Table 4-3. TNRCC Results for Metals in Soils on the Gerdau Ameristeel Property Compared to 1995 and 2015 Comparison Values (Updated from Table B.3 in TNRCC, 1995)

Contaminant	MDL* (ppm)	Number of Samples†	Maximum Concentration (ppm)	1995 TNRCC CV (ppm)	2015 CV‡ in ppm (source)	Number of Samples Exceeding the 2015 CV
Aluminum	2	22	38,000	NA	50,000 (EMEGc)	0
Antimony	3	22	4.3	20	20 (RMEGc)	0
Arsenic	3	22	<MDL	20	15 (EMEGc)¶	0
Beryllium	0.2	22	1.6	300	100 (EMEGc)	0
Cadmium	0.5	22	52	40	5 (EMEGc)	2
Chromium (total)	0.3	22	278	50,000	75,000 (RMEGc)	0
Copper	0.2	22	190	1,000	500 (IEMEGc)	0
Iron	1	22	52,000	NA	55,000 (RSL)	0
Lead	2	22	2,200	400	400 (RSL)§	2
Manganese	0.3	22	4,200	5,000	2,500 (RMEGc)	U
Mercury	2	22	<MDL	15	9.4 (RSL)	0
Molybdenum	2	22	6.2	300	250 (RMEGc)	0
Nickel	0.5	22	51	1,000	1,000 (RMEGc)	0
Selenium	3	22	<MDL	300	250 (EMEGc)	0
Strontium	0.02	22	360	NA	30,000 (RMEGc)	0
Thallium	3	22	<MDL	4	0.78 (RSL)	0
Titanium	0.1	22	180	NA	NA	0
Zinc	2	22	10,000	15,000	15,000 (EMEGc)	0

* Method detection limits (MDLs) were not provided in the source document; however, they were available from TACB 1991c, 1993; TNRCC 1995b,c.

† Single samples were collected from 20 sampling locations; multiple samples were collected and averaged from two additional locations.

‡ ATSDR 2015 Comparison Values [ATSDR 2015a]. EMEGc indicates ATSDR chronic Evaluation Media Evaluation Guide (Child); IEMEGc indicates ATSDR Intermediate Evaluation Media Evaluation Guide (Child); RMEG(c) indicates ATSDR Chronic Reference Dose Media Evaluation Guide (Child); RSL indicates U.S. EPA Regional Screening Level [EPA 2015]; and NA indicates no comparison value was available. The revised November 2016 CVs were reviewed and the updates do not impact the screening and overall health conclusions for this assessment.

¶ ATSDR cancer risk evaluation guide (CREG) for arsenic of 0.47 ppm is less than background soil concentrations, so was not used for soil sampling results.

§ No ATSDR health-based CV exists for screening lead surface soil levels because there is no clear threshold for some of the more sensitive health effects associated with lead exposures. 400 ppm represents the EPA and TCEQ soil screening levels used in their reports.

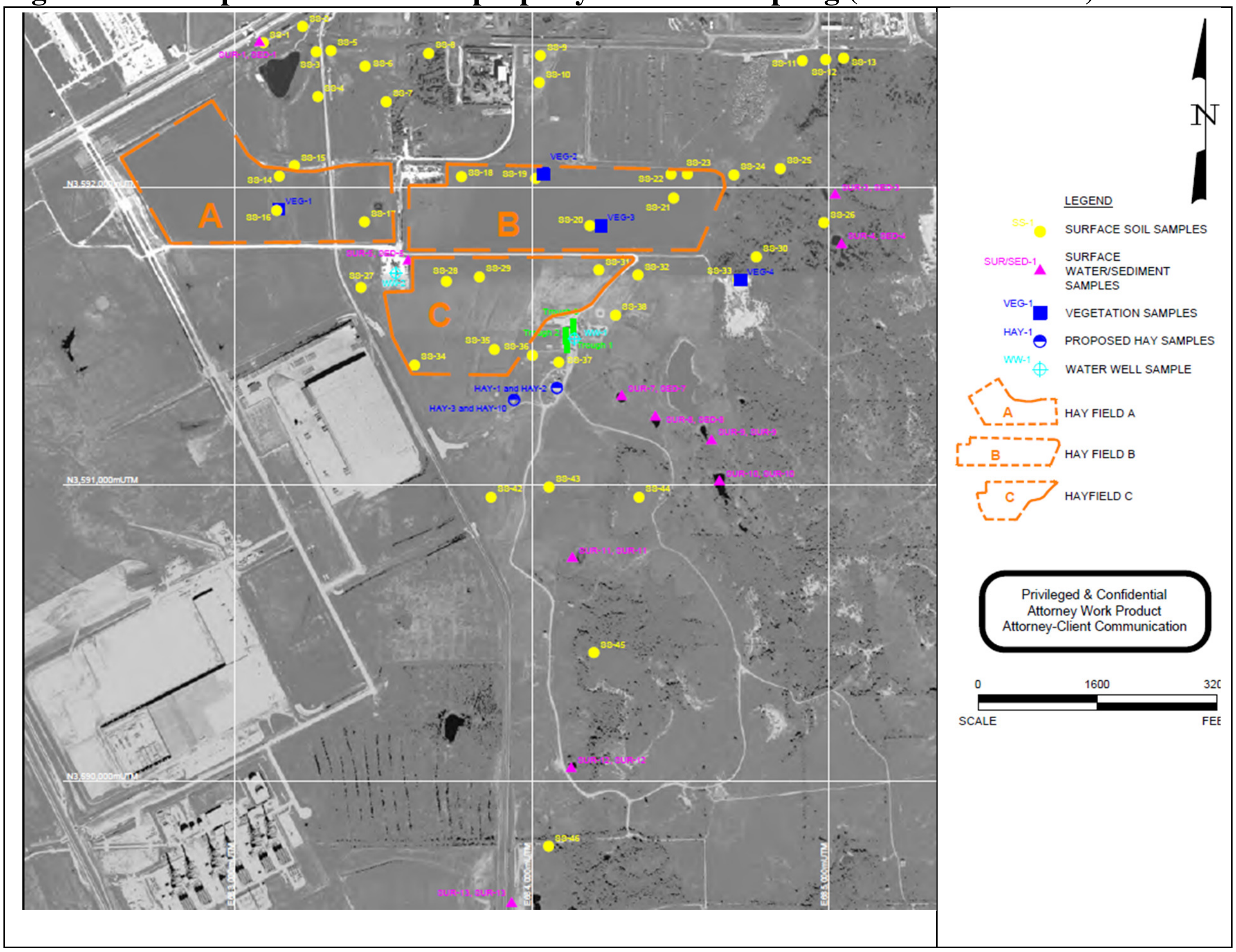
U—unknown, individual sampling results were not provided for manganese.

Shaded numbers indicate maximum concentrations that exceed the 1995 and/or 2015 comparison values.

4.2.2 Soil Results from the ERM-Southwest Report

The ERM-Southwest Report presents metals concentration data generated from 44 surface soil samples collected in December 2003 across one-square-foot areas at 0- to 2-inch depths south of the Gerdau Ameristeel property line on property owned by TXI [ERM 2004]. The purpose of this investigation was to assess surface soil concentrations in the undisturbed areas south of the Gerdau Ameristeel property line. Therefore, the soil sample locations were near those reported in the focused investigation of the Gerdau Ameristeel facility (presented in the TNRCC study described in section 4.2.1) and included the 18 metals evaluated in that study plus cobalt. Only one metal (manganese) in two of the 44 soil samples exceeded its 2015 comparison value (2,500 ppm). The samples were located at SS-9 (6,100 ppm) and SS-10 (2,720 ppm) (Figure 4-3). In addition, this report provided results for seven different PCB Aroclors analyzed in 5 of the soil samples. For all samples, PCBs were not detected at their sample quantitation limits.

Figure 4-3: Sample Locations TXI property 2003-04 Sampling (From ERM 2004)



4.2.3 Soil Results from TECQ Private Property Report

TCEQ conducted surface soil sampling (depth not otherwise specified) at a private property located approximately one-half mile north of the TXI cement kiln and the Gerdau Ameristeel facilities. Four samples were collected on May 20, 2005 and one sample was collected on May 26, 2005. The four samples collected on May 20th were analyzed for eleven metals, SVOCs, PAHs, pesticides/herbicides, and dioxins/furans. The sample collected on May 26th was analyzed for all of the previously stated constituents, with the exception that in lieu of the metals beryllium, antimony, and nickel, the levels of copper, zinc, and molybdenum were measured. Analytical data for metals are presented in Table 4-4. SVOCs, PAHs, pesticides/herbicides, and dioxins/furans were below ATSDR comparison values and with few exceptions, below detection levels. Visual inspection by the sampling team indicated no noticeable evidence of contamination on or around the property and sample locations were selected to avoid areas of runoff [TCEQ 2005].

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Table 4-4. Private Property Metal Soil Data [TCEQ 2005] with 2015 Comparison Values

Contaminant	2015 CV* (ppm)	Sample Concentrations (ppm)						
		1	2	3	4	5	Max	Average
Antimony	20 (RMEGc)	6.9	6.2	6.5	7.2	N/A	7.2	6.7
Arsenic	15 (EMEGc)†	11	11	10	8.5	7	11	9.5
Barium	10,000 (EMEGc)	200	160	170	160	110	200	160
Beryllium	100 (EMEGc)	<2.8	<2.8	<2.8	<3	N/A	BDL	BDL
Cadmium	5 (EMEGc)	<2.8	<2.8	<2.8	<3	<2.8	<3	BDL
Chromium (total)	75,000 (RMEGc)	44	41	41	48	38	48	42.4
Chromium‡ (hexavalent)	45 (EMEGc)	1	1	1	1	1	1	1
Copper	500 (IEMEGc)	N/A	N/A	N/A	N/A	11	11	11
Lead¶	400 (RSL)	17	15	15	22	12	22	16.2
Mercury	9.4 (RSL)	<0.22	<0.22	<0.22	<0.24	<0.22	BDL	BDL
Molybdenum	250 (RMEGc)	N/A	N/A	N/A	N/A	<5.5	BDL	BDL
Nickel	1,000 (RMEGc)	26	22	23	24	N/A	26	23.75
Selenium	250 (EMEGc)	<14	<14	<14	<15	<14	BDL	BDL
Silver	250 (RMEGc)	<2.8	<2.8	<2.8	<3	<2.8	BDL	BDL
Zinc	15,000 (EMEGc)	N/A	N/A	N/A	N/A	80	80	80

* ATSDR Comparison Values [ATSDR 2015a]. EMEGc indicates ATSDR chronic Evaluation Media Evaluation Guide (Child); IEMEGc indicates ATSDR Intermediate Evaluation Media Evaluation Guide (Child); RMEG(c) indicates ATSDR Chronic Reference Dose Media Evaluation Guide (Child); RSL indicates U.S. EPA Regional Screening Level [EPA 2015]; NA indicates no comparison value was available; N/A indicates not analyzed, and BDL indicates below detection limits.

† ATSDR cancer risk evaluation guide (CREG) for arsenic of 0.47 ppm is less than background soil concentrations, so was not used for soil sampling results. The revised November 2016 CVs were reviewed and the updates do not impact the screening and overall health conclusions for this assessment.

‡ Assuming 2.2% of the total chromium is in the hexavalent form, maximum concentration of hexavalent chromium is 1 ppm, see text for additional details.

¶ No ATSDR health-based CV exists for screening lead surface soil levels because there is no clear threshold for some of the more sensitive health effects associated with lead exposures. 400 ppm represents the EPA and TCEQ soil screening levels used in their reports.

None of the analyzed constituents were above the health-based screening comparison values. For these TCEQ soil sampling analyses, total chromium but not hexavalent chromium was analyzed. In one of five samples, the total chromium concentration of 48 ppm was detected in a soil sample collected from a vegetated area adjacent to the north fence line of the property. However, as discussed previously, the comparison value of 45 ppm is for hexavalent chromium which comprises a very small fraction of total chromium in soil [ATSDR 2012c] Using an estimate that 2.2% of the total chromium was in the hexavalent form, the hexavalent chromium in these samples would be about 1 ppm, which is well below the comparison value. All samples were far below the comparison value of 75,000 ppm for trivalent chromium.

ATSDR also compared the metals concentrations from the residential property to acute and intermediate EMEGs that represent exposure levels in preschool children who exhibit soil pica behavior, which involves eating large amounts of soil while playing. These “pica child” comparison values are lower than the comparison values shown on Table 4-4. One or more samples contained concentrations of arsenic and/or hexavalent chromium that exceeded current ATSDR pica child ingestion comparison values, both of which are 10 ppm (acute and intermediate exposures, respectively). Of the five samples collected, two exceed the comparison value for arsenic. As described above, the total chromium is expected to be primarily in the form of trivalent chromium, with about 1 ppm as hexavalent chromium. Trivalent chromium does not have a pica comparison value, and none of the five samples would exceed the pica comparison value for hexavalent chromium.
Soil arsenic results will be further evaluated in the Public Health Implications Section.

4.3 Sediment Results

Based on the review process described in Section 3 of this health consultation, the only sediment sampling results available to ATSDR to identify potential health impacts from deposition of air emissions by industrial facilities in Midlothian were found in a report prepared by ERM-Southwest [2004]. Eleven surface sediment samples were collected south of the Gerdau Ameristeel property line on property owned by TXI which was not publicly accessible (Figure 4-3). Sediment samples were collected in December 2003 and were co-located with surface water samples (Section 4.4). The results of these sediment samples are presented below in Table 4-5.

Table 4-5: Concentrations of Metals in Sediments near Gerdau Ameristeel [ERM 2004]

Chemical	Soil Comparison Value*(ppm)	Maximum (ppm)
Aluminum	50,000 (EMEGc)	14,700
Antimony	20 (RMEGc)	<3.0
Arsenic	15 (EMEGc)	13.6
Beryllium	100 (EMEGc)	1.10
Cadmium	5 (EMEGc)	1.39
Chromium	75,000 (RMEGc)	69.4
Cobalt	500 (IEMEGc)	12.9
Copper	500 (IEMEGc)	45.4
Iron	55,000 (RSL)	23,400
Lead	400 (RSL)†	47.1
Manganese	2,500 (RMEGc)	1,810
Mercury	9.4 (RSL)	0.087
Molybdenum	250 (RMEGc)	12.9
Nickel	1,000 (RMEGc)	34.3
Selenium	250 (EMEGc)	11.1
Strontium	30,000 (RMEGc)	947
Thallium	0.78 (RSL)	1.50

Chemical	Soil Comparison Value*(ppm)	Maximum (ppm)
Titanium	NA	284
Zinc	15,000 (EMEGc)	294

* All comparison values in the table are for soil and have been applied to sediment. ATSDR Comparison Values [ATSDR 2015a]. EMEGc indicates ATSDR chronic Evaluation Media Evaluation Guide (Child); IEMEGc indicates ATSDR Intermediate Evaluation Media Evaluation Guide (Child); RMEGc indicates ATSDR Chronic Reference Dose Media Evaluation Guide (Child); RSL indicates U.S. EPA Regional Screening Level (soil) [EPA 2015]; and NA indicates no comparison value available. The revised November 2016 CVs were reviewed and the updates do not impact the screening and overall health conclusions for this assessment.

† No ATSDR health-based CV exists for screening lead surface soil levels or sediment because there is no clear threshold for some of the more sensitive health effects associated with lead exposures. 400 ppm represents the EPA and TCEQ soil screening levels used in their reports.

Shaded numbers indicate concentrations that exceed the comparison values.

This table shows that thallium was the only metal in the sediment samples that exceeded the soil comparison value of 0.78 ppm. The exceedance occurred in two of the eleven sediment samples that were analyzed for thallium and the maximum concentration was less than two times the comparison value. In addition, this comparison value is from EPA's regional screening level for soil and assumed to be protective over a lifetime exposure; exposure at the sediment sampling location, which is on industrial land, would be infrequent, at best. Thus, the thallium in the sediment sample was not considered a public health concern and the ***sediment results will not be further evaluated in the Public Health Implications Section.***

4.4 Surface Water Results

Based on the review process described in Section 3 of this health consultation, the surface water sampling results available to identify potential health impacts from depositions of air emissions by industrial facilities in Midlothian were found in reports prepared by TNRCC [TNRCC 1994a,b] and ERM-Southwest [2004]. Both sampling plans were centered near the Gerdau Ameristeel facility.

TNRCC collected five surface water samples in May 1994: one from a manmade holding tank, two from standing pools immediately south of the facility fence line, one from a backed up creek between the hay and wheat fields, and one from a creek southwest of the facility. In December 2003, ERM collected 11 surface water samples from ponds and an intermittent stream south of the Gerdau Ameristeel facility on property owned by TXI (Figure 4-3). The samples were co-collected with the sediment samples described above. The purpose of both investigations was to sample portions of the property being rented by a rancher, and it was anticipated that cattle might be exposed to water in these seasonal creeks and ditches.

The results of these surface water samples are presented below in Table 4-6. In addition, the ERM report provided results for seven different PCB Aroclors analyzed in 6 of the surface water samples. For all six samples, PCBs were not detected at their sample quantitation limits [ERM 2004].

Table 4-6: Concentrations of Metals in Surface Water near Gerdau Ameristeel [TNRCC 1994a and ERM 2004]

Chemical	2015 Drinking Water Comparison Value* (ppm)	May 1994 Maximum (ppm)	December 2003 Maximum (ppm)
Aluminum	10 (EMEGc)	0.90	1.05
Antimony	0.004 (RMEGc)	<MDL†	0.00285
Arsenic	0.003 (EMEGc)	<MDL	0.00275
Beryllium	0.02 (EMEGc)	<MDL	<0.00030
Cadmium	0.001 (EMEGc)	<MDL	0.00037
Chromium (total)‡	0.1 (MCL)	0.008	0.0358
Chromium (hexavalent)§	0.009 (EMEGc)	0.008	0.0358
Cobalt	0.1 (IEMEGc)	N/A	0.000762
Copper	0.1 (IEMEGc)	0.015	0.0115
Iron	14 (RSL)	1.4	1.20
Lead	0.015 (RSL)	<MDL	0.00653
Manganese	0.5 (RMEGc)	0.61	0.0706
Mercury	0.00063 (RSL)	<MDL	<0.000042
Molybdenum	0.05 (RMEGc)	0.68	0.325
Nickel	0.2 (RMEGc)	0.007	0.00748
Selenium	0.05 (EMEGc)	<MDL	0.00453
Strontium	6 (RMEGc)	1.6	4.92
Thallium	0.002 (RSL)	<MDL	<0.00040
Titanium	NA	0.011	0.0124
Zinc	3 (EMEGc)	0.046	0.0458

* ATSDR Comparison Values [ATSDR 2015a]. CREG indicates Cancer Risk Evaluation Guide level; EMEGc indicates ATSDR Evaluation Media Evaluation Guide (Child); IEMEGc indicates ATSDR Intermediate Evaluation Media Evaluation Guide (Child); RMEGc indicates ATSDR Chronic Reference Dose Media Evaluation Guide (Child); RSL indicates U.S. EPA Regional Screening Level (tap water) [EPA 2015]; NA indicates no comparison value available; and N/A indicates not analyzed. The revised November 2016 CVs were reviewed and the updates do not impact the screening and overall health conclusions for this assessment.

† Method detection limits (MDLs) provided in the source documents [TNRCC 1994a; ERM 2004].

‡ No EPA RSL for total chromium was available, MCL indicates maximum contaminant level, as defined by U.S. EPA under the Safe Water Drinking Act.

§ Based on the very conservative assumption that all of the measured total chromium was in the form of hexavalent chromium.

Shaded numbers indicate concentrations that exceed the comparison values.

Molybdenum exceeded the chronic comparison value in two of the five samples collected in 1994 and in one of the eleven samples collected in 2005. One sample out of the 16 water samples exceeded the chronic RMEG for manganese. While chromium concentrations exceeded the hexavalent chromium comparison values, in natural systems, almost all chromium would be in the trivalent form; and no samples exceeded that comparison value. Additionally, the surface waters sampled are not a source of drinking water for the community and only infrequent and incidental ingestion, if any, would be expected from these difficult to access surface waters. The primary source of drinking water for the City of Midlothian is Joe Pool Lake. Thus, the on-site surface water was not considered a public health concern and ***surface water results will not be further evaluated in the Public Health Implications Section.***

4.5 Groundwater Results

Ellis County is located in the Trinity River drainage basin; the largest cities in the county, including Midlothian, rely primarily on surface water [TWDB 2009]. Prior to shifting to surface water (Joe Pool Lake) for drinking water, Midlothian pumped almost all of its water supply from wells in the Hosston Formation at a depth of about 2,300 feet. The Woodbine formation, which is also located in the western part of the county, is not as deep (less than 400 feet) and was used for small to moderate supplies for domestic and livestock wells. A couple of private wells are found on TXI property and pump from both the Hosston and Woodbine formations. Most of the groundwater in Ellis County is high in sodium, bicarbonate, fluoride, and dissolved solids [TWDB 1967].

Based on the review process described in Section 3 of this health consultation, the only groundwater sampling results available to ATSDR to identify potential health impacts from depositions of air emissions by industrial facilities in Midlothian were found in a report prepared by ERM-Southwest [2004]. The report presents metals concentration data generated from two groundwater well samples collected south of the Gerdau Ameristeel property line on property owned by TXI. One sample was from three cattle watering troughs located at ranch headquarters, and the other was from a tap located at the TXI batch plant. It was not clear if people would have access to this water for drinking or washing.

Both samples were analyzed for the 19 metals included in Table 4-6. None of the analytes exceeded non-cancer health based comparison values in water listed in Table 4-6. The ranch headquarters water well was also analyzed for chemicals in the EPA primary and secondary drinking water standards, PCBs, and pesticides and herbicides. With the exception of a total dissolved solids (inorganic salts with some organic matter) result of 576 ppm, which exceeded the secondary, non-enforceable, drinking water standard of 500 ppm, all constituents were below the EPA primary and secondary drinking water standards. All PCBs, organics, SVOCs, VOCs, pesticides, and herbicides were not detected at their sample quantitation limits. ***Thus, groundwater results will not be further evaluated in the Public Health Implications Section.***

4.6 Vegetation Results (Hay Bales, Forage, and Wheat Heads)

Of the records reviewed, four addressed investigations and/or data regarding vegetation. Some of these records contain anecdotal information and/or reflected that concentrations of potential contaminants were below levels of concern. The only vegetation quantitative sampling results available to ATSDR to identify potential health impacts to domestic animals from depositions of air emissions by industrial facilities in Midlothian were found in a report prepared by the TNRCC (now the TCEQ) [TNRCC 1994a,b,1995a] and a report prepared by ERM-Southwest [2004]. The information provided in these reports is presented in the following subsections.

4.6.1 Vegetation Results from the TNRCC Report

TNRCC collected surface samples from two hay bales (Locations 8 and 16, Figure 4-2) stored on the field south of the Gerdau Ameristeel facility in February 1994 and collected eight additional samples from location 8 in April 1994 (four surface and four at 3 to 6 inch depth). In May 1994, twelve miscellaneous forage samples were collected from locations 1-6, 8, and 16-20 (Figure 4-2). Also in May 1994, TNRCC collected ten wheat head samples: seven south of the hay fields (locations 9-15), two north of the facility (21 and 22), and one located one mile northeast of the facility (Figure 4-2).

Table 4-7 shows the maximum concentrations of metals identified in the vegetation samples and the Maximum Tolerable Levels[6] (MTL) from the summary table in a National Academies National Research Council (NRC) publication [NRC 1980] that presents recommendations for MTLs of dietary minerals in feed materials for cattle following chronic exposure (10 days or more). The values from this publication were used as screening values by TNRCC in 1995; updated MTL values from 2005 [NRC 2005] are also provided. The MTL values in the NRC summary table are broadly applicable to all domestic animals. MTLs are not human health based comparison values, however, the 1980 MTLs incorporate the idea of residual metals in human food derived from the animal (for example, milk or meat). The 2005 MTLs look at possible impairment of animal health and performance and do not include human considerations.

Table 4-7. Concentrations of Metals Detected in Vegetation in the Vicinity of the Gerdau Ameristeel Facility in 1994 by TNRCC [adapted from TNRCC 1994b]

Contaminant	Maximum Detected Concentration (ppm)*				1980 MTL†	2005 MTL‡
	Hay Bales		Forage	Wheat Heads		
	0-3 inch	3-6 inch				
Aluminum	1,200	685	580	72	1,000	1,000
Antimony	<MDL	<MDL	<MDL	<2	NA	NA
Arsenic	<MDL	<MDL	<MDL	<2	NA	30
Beryllium	<MDL	<MDL	<MDL	<0.01	NA	NA
Cadmium	1.3	0.6	1.4	<0.1	0.5	10
Chromium (Total)	44	21	17	6	1,000	3,000
Copper	N/A	N/A	14	5.2	100	40
Iron	4,300	1,400	2,500	350	1,000	500
Lead	20	6.5	10	<1	30	100
Manganese	400	160	190	67	1,000	2,000
Mercury	<MDL	<MDL	<MDL	<0.5	NA	NA
Molybdenum	N/A	N/A	5.5	1.4	10	5
Nickel	12	6.6	5.2	14	50	100
Selenium	<MDL	<MDL	<MDL	<2	NA	5
Strontium	52	31	120	18	2,000	2,000
Thallium	<MDL	<MDL	<MDL	<2	NA	NA
Titanium	43	13	21	3.1	NA	NA
Zinc	N/A	N/A	130	38	500	500

* All concentrations reported as parts per million (ppm) on a dry weight basis.
† The TNRCC 1995a Report compared these samples to Maximum Tolerable Levels in cattle feed as reported by the National Research Council [NRC 1980].
‡ ATSDR compared results to updated Maximum Tolerable Levels in cattle feed as reported by the NRC [2005].
NA = No comparison value provided in TNRCC 1995a Report; N/A: Not analyzed
Shaded numbers indicate maximum concentrations that exceed the 1980 and/or 2005 MTL.

[6] The National Academies National Research Council (NRC) Subcommittee on Mineral Toxicity defines Maximum Tolerable Level (MTL) as "that dietary level that, when fed for a limited period, will not impair animal performance and should not produce unsafe residues in human food derived from the animal" [NRC 1980]. However, in 2005 NRC updated the definition as the dietary level that, when fed for a defined period of time, will not impair animal health or performance" [NRC 2005].

Hay bale sampling at 0-3 inches consistently showed higher concentrations of metals than what was found at 3-6 inches. Possible explanations included wind-blown deposition of soil or air deposition on the hay bale surface. The five hay bale samples that were collected from bales stored at location 8 also showed a range of concentrations of metals for either depth [TNRCC 1994a,b]. Forage samples also showed a wide range of metal concentrations, and generally had lower concentrations of a given metal as compared to concentrations in hay bales. Given that this was vegetation and hay was not an exclusive diet that an animal might consume, ATSDR felt that the one hay bale sample that exceeded the MTL for aluminum and the one forage sample that exceeded the MTL for molybdenum would have implications for public health.

Cadmium was above the 1980 MTL in two forage samples, four of the five 0-3 inch hay bale, and one of four 3-6 inch hay bale samples. All of these samples were taken at either location 8 or location 2 (one of the forage samples). These were also the two locations where soil samples exceeded the comparison value (see section 4.2.1.2). Iron exceeded the MTL in three of 12 forage samples and 9 of ten hay bale samples. Based on the cadmium and iron results, TNRCC advised the rancher not to have cattle feed exclusively on vegetation from the fields immediately south of the facility [TNRCC 1994b].

It is unknown whether cattle was butchered and sold locally. Cadmium is not a required nutrient and average intake from dietary sources is about 28 micrograms per day in an 80 kilogram adult male; intake is higher in smokers, since tobacco accumulates cadmium [ATSDR 2012b]. Since cadmium concentrations varied in forage and within the hay bales, ATSDR considers it unlikely that dietary intake of cadmium from the cattle would have been a health concern. Iron is a required nutrient, with the recommended daily intake of 8 to 18 mg and an upper tolerable limit of intake of 45 mg/day for adults [IOM 2001]. Assuming a varied diet that did not exclusively consist of meat from cattle grazing on this property, it is unlikely that the iron concentrations in this vegetation would be a health concern.

No wheat head samples exceeded the MTL for the metals analyzed. TNRCC calculated daily exposure levels and determined that none would exceed EPA's oral reference dose for each metal. TNRCC, in consultation with TDH Division of Food and Drug, found that the wheat was acceptable for human consumption [TNRCC 1994a,b]. ATSDR reviewed the TNRCC analysis and agreed with the assumptions and conclusions.

4.6.2 Vegetation Results from the ERM-Southwest Report

The ERM-Southwest Report presents metals concentration data generated from 18 vegetation samples (8 forage and 10 hay bale) collected south of the Gerdau Ameristeel property line on property owned by TXI (Figure 4-3). The purpose of this investigation was to assess portions of the property being rented by a rancher, because agricultural practices had not ceased at the property as had been expected by TNRCC in 1995 [TNRCC 1995b].

None of the hay bale samples collected in December 2003 exceeded the 1980 or 2005 MTLs. Four forage samples collected in December 2003 included roots, stems, and leaves, and contained soil particles. Results from this sampling were not considered, since they do not represent vegetation alone. Laboratory analyses confirmed the contribution from soil particles. Two of four forage samples (stems and leaves) collected in February 2004 exceeded the MTL for aluminum and iron. As discussed above, given the varied mix of vegetation and hay that an animal might consume and that a person's diet would not be exclusively meat products from cattle grazing in this field, ATSDR did not consider the vegetation as a public health concern. ***Thus, vegetation will not be further evaluated in the Public Health Implications Section.***

4.7 Online Permit and Registration Records

As described in Section 3, ATSDR reviewed online permit and registration records to identify any activities at the facilities of interest that may increase or decrease the likelihood of any significant health effects in the Midlothian community. These records were available from the TCEQ Central Registry website for regulated entity information [TCEQ 2014a,b]. The following text provides the results of these reviews for the cement kiln facilities and the Gerdau Ameristeel facility.

4.7.1 Cement Kiln Facilities

Permit and registration records indicate that the raw materials, waste types, and waste management units at the three cement kilns appear to be typical of those found at cement kilns across the country. None of these facilities has management units for onsite disposal of hazardous waste; however, all of them have landfills used to dispose of CKD and other non-hazardous industrial wastes. In addition, all of these kilns have: (1) surface impoundments (mostly for managing storm water), (2) tanks for storing fuels and other materials, and (3) separate container/drum storage areas for storage of hazardous and non-hazardous wastes (such as onsite laboratory wastes) before offsite transport and disposal. The wastes and/or materials in these units have the potential to contaminate soil, groundwater, and surface waters in the event of unexpected and uncontrolled releases; however, regulations are in place to reduce the probabilities and extent of such potential events. Many of these regulations require monitoring of wastes, wastewaters, and storm water at industrial facilities; however, the files reviewed for this other media health consultation did not include any facility monitoring requirements or results or compliance records for other media for the three cement facilities.

4.7.2 Gerdau Ameristeel Facility

Permit and registration records indicate that the types of raw material, waste, and waste management units at the Gerdau Ameristeel facility appear to be typical of those across this industry. This facility generates significant volumes of a federally listed (40 CFR 261.32) hazardous waste that is common to the industry and is known as "emission control dust/sludge from the primary production of steel in electric arc furnaces" (waste code K061). This K061 waste is federally listed because it typically contains elevated concentrations of lead and hexavalent chromium.

Records for the Gerdau Ameristeel facility also indicate that some of the K061 waste generated in the past at this facility had been contaminated with cesium-137, which is a radionuclide. The permit and registration records do not provide details on the quantities of waste contaminated by cesium-137, how it was managed, or the time period over which it was generated. Based on this information from the website, ATSDR obtained additional records documenting an incident that occurred on September 16, 1993, in which five rail cars of EAF dust from the Gerdau Ameristeel facility, destined for a recycling facility in Mexico, triggered a radiation detector [Chaparral Steel 1993]. Subsequent investigation by the TDH Bureau of Radiation Control traced the source of the cesium-137 to one of Gerdau Ameristeel's (formerly, Chaparral Steel) furnaces and the air collection system leading to one of the facility's baghouses that serve as air pollution control devices [TDH 1993]. Files available for review indicate that the radionuclide was probably contained in a soil density or moisture gauge that had been mixed in with the scrap metal accepted by the facility and the source activity was estimated to be approximately 89 millicuries [Chaparral Steel 1993; TDH 1993]. Available files also indicate that all of the cesium-137 impacted waste at the facility and in the rail cars was identified and properly managed shortly after it was discovered [TDH 1993]. However, it should be noted that because this waste was found in emission control dusts, it is likely that at least some cesium-137 was emitted by stacks into the air.

Records reviewed for this health consultation do not indicate that soil or air sampling for cesium-137 was conducted in association with the cesium-137 incident. However, at the time, TDH used a plume modeling program, HOTSPOT, to generate the greatest downwind dispersal from a 1,000 millicurie cesium-137 source. Modeling calculations indicated less than 2 millirem (mrem) total dose to people one mile downwind in the centerline of any radioactive plume, which was well within regulatory limits that would require protective actions [TDSHS 2014]. The modeling scenario was repeated using the most recent version of HOTSPOT; projected doses did not exceed 2 mrem at about 0.13 miles, which is within the site boundary [TDSHS 2014]. No health issues would be expected that would be directly tied to this cesium-137 release. ATSDR calculated similar doses based on this scenario and concurred with the TDH conclusion [ATSDR 2014].

The Gerdau Ameristeel facility disposes of K061 waste in three onsite hazardous waste landfills. These landfills are required to meet state regulations promulgated in response to federal requirements for state programs developed by U.S. EPA under the Resource Conservation and Recovery Act (RCRA). In addition, this facility has other waste and process material management units and generates wastes that are similar to those described for the industry in Section 2.12. For example, this facility has: (1) surface impoundments (mostly for managing storm water), (2) tanks for storing fuels and other materials, and (3) separate container/drum storage areas for storage of hazardous and non-hazardous wastes (such as, onsite laboratory wastes), before offsite transport and disposal. As is true for the three cement facilities, the wastes and/or materials managed in any of these units at the Gerdau Ameristeel facility have the potential to contaminate soil, groundwater and surface waters in the events of unexpected and uncontrolled releases; however, state regulations are designed to provide management and administrative requirements that reduce the probability and extent of such events. The files reviewed for this health consultation did not include any facility monitoring requirements or results or compliance records for other media like groundwater.

5.0 Public Health Implications

This section looks at whether there were completed exposure pathways (Section 5.1) and which pollutants identified in pathways selected for further evaluation were of potential public health concern (Section 5.2).

5.1 Completed Exposure Pathways

In Section 3.1, potential exposure pathways for Midlothian residents were described related to soil, sediment, surface water, groundwater, and dust. Exposure pathways not included in this evaluation were pathways related to the inhalation route of exposure and pathways in which the exposed population was domestic animals; these pathways are discussed in other health consultations prepared for this site [ATSDR 2015b, 2016a,b,c,d].

While the ingestion of meat products from animals that grazed on-site vegetation was evaluated, the potential for human health effects from the ingestion pathway was expected to be very low. While it was unknown whether cattle were butchered and sold locally, these meat products would contribute only partially to a person's diet. This determination was further supported by modeling results (Section 4-1).

After reviewing the available data, three pathways in Table 3-1 were removed from further evaluation based on their on-site exposure point and/or sampling results: sediment (ingestion/direct contact), surface water (ingestion), and groundwater (ingestion). Without an exposure point, as would be the case for some publicly inaccessible sites, there would be no completed pathway. As further explained in section 5.2, evaluations on these pathways also took into account the dose an individual may receive, in part based on access to the site. Sampling results were either below the health based comparison value and/or the comparison value pertained to life-long exposures, which was not the case. So these pathways were not considered to be a public health concern.

Completed exposure pathways identified in this health consultation that needed further evaluation were direct contact or incidental ingestion of contaminants in on-site or off-site soils and dusts. Based on screening using health based comparison values, concentrations of soil arsenic needed to be further evaluated because of incidental soil ingestion. In view of cement kiln dust chemical properties and reported and modeled deposition of dust particulates, direct contact with cement kiln dust was considered a completed exposure pathway. These completed pathways and the chemicals of potential concern identified in these pathways are further examined in the next section.

5.2 Potential Pollutants of Concern

Contact with a chemical contaminant in and by itself does not necessarily result in adverse health effects. A chemical's ability to affect a person's health is affected by a number of other factors, including:

- How much of the chemical a person comes into contact with (the dose);
- How long a person is exposed to the chemical (duration of exposure);
- How often a person is exposed to the chemical (acute versus chronic);
- The chemical's toxicity and how it impacts the body.

Other factors include a person's history of past exposure to chemicals, current health status, age and sex, or genetic predisposition.

After determining the existence or potential for a completed exposure pathway, evaluation is made by comparing the dose an individual may receive to a health screening value. For evaluating exposures to the public, as explained in Section 3.5, ATSDR has derived media-specific comparison values from minimal risk levels (MRLs) and EPA reference doses (RfDs). MRLs, RfDs and the media specific comparison values are screening levels – no appreciable risk is associated when sampling concentrations are below the comparison value. The comparison values are designed to be protective of the most sensitive populations, including children and pregnant women. In our evaluations, when a comparison value was available for a child's exposure, that value was used instead for the adult comparison value. These media-specific comparison values were used to identify pollutants that may potentially be of health concern and that required more in-depth evaluation.

As described in the data evaluation of soil samples (Section 4.2), of the over 200 soil samples taken, there were only a few samples where some metals exceeded comparison values. Often, these were isolated occurrences. Variability in these soil samples also reflected variability in background soil levels. Furthermore, elevated soil concentrations were inconsistent with soil contamination from air deposition patterns described in the Midlothian health consultation that addressed air issues [ATSDR 2015b, 2016a,d]. The highest concentrations of most metals were found on non-residential properties, and generally not likely to be accessed frequently by area residents. This was the case for the surface soil levels for lead, where the highest concentrations were on-site and not publicly accessible and pharmacokinetic modelling of site specific air and residential soil lead concentrations estimated that children do not have an elevated risk of having a blood lead level above 5 micrograms lead per deciliter blood, the current reference value [ATSDR 2016a].

Arsenic

Arsenic was identified as a potential chemical of concern based on area-wide surface soil sampling and private property surface soil sampling. On-site arsenic concentrations from the focused Gerdau study did not exceed the soil arsenic comparison value.

The predominant potential exposure route for arsenic is through ingestion, primarily from food and drinking water. Acute effects to high oral doses of arsenic can cause gastrointestinal upset, including nausea, vomiting, and diarrhea. Long term effects from chronically ingesting lower doses can result in skin effects such as increased pigmentation and thickening of the skin and numbness in the hands and feet [ATSDR 2007].

Arsenic is a naturally occurring metal that is found in soil and many types of rock. In the past, arsenic has been used as a wood preservative and in weed control. Arsenic is released to the atmosphere by industrial facilities that process mineral ores and by facilities that burn coal and other fuels containing trace amounts of arsenic. The Midlothian facilities have never reported arsenic emissions to TRI. Both the measured and modeled arsenic concentrations in particulates collected at the monitoring stations around Midlothian exceeded health based comparison values for long-term cancer risk, but not for non-cancer acute or chronic inhalation exposure [ATSDR

2016d]. It is not unusual for arsenic and other ubiquitous pollutants to exceed a one in a million increased cancer risk, and arsenic air concentrations in the Midlothian community are similar to those across the United States [ATSDR 2016d].

Off-site surface soil sampling results for arsenic varied and were not consistent with air deposition patterns. The majority of the samples did not exceed the soil comparison value. The arsenic soil comparison value assumed a child was exposed daily for a year or more. Given the sampling locations, this scenario was unlikely. The highest concentration of arsenic was measured in soil collected from a cotton field. It is reasonable to assume that some soil arsenic may be associated with agricultural practices, since arsenical pesticides have a long history of use in many different crops.

An evaluation of the private property soil results revealed that several, but not the average, sample concentrations exceeded the soil pica child comparison value for a child who exhibited soil pica behavior. The comparison value assumes 100% of the arsenic is absorbed, which is more likely when ingesting drinking water containing arsenic, while only 3 to 50% of the arsenic is absorbed from soil [ATSDR 2007]. Children did not live at this property and soil arsenic concentrations were consistent with background concentrations in the area.
Thus, the soil pathway, although complete, would not be expected to result in adverse health effects from exposure to arsenic or other metals.

Cement Kiln Dust

While there was limited environmental data to evaluate cement kiln dust, citizen complaints, particulate modeling, and tapelift samples that contained cement dust or limestone provide support for airborne deposition of CKD. ATSDR's health consultaton on NAAQS stated that it would not be inconsistent with the operations at the three cement plants operating in Midlothian that some releases of cement kiln dust could occur [ATSDR 2016a]. Reports from residents indicate that in the past, dust was an intermittent problem. In this evaluation, we were unable to quantify exposure.

CKD is highly alkaline with a pH range of 11 to 13. Because of the alkaline nature of the dust, one would expect some irritation of exposed skin, eyes, and mucous membranes from direct contact on these body surfaces. One would expect these health effects to be temporary, and rinsing the irritated area with water would alleviate these issues.
Thus, the direct contact with dust exposure pathway is considered complete and may result in some intermittent, but temporary health effects.

6.0 Summary of Conclusions and Recommendations on Health Risks

The information and data presented in this health consultation indicate that the people in the vicinities of the four facilities of interest since the early to mid-1990s have not been adversely affected by air pollutant emissions impacting soil, sediment, surface water, groundwater, or vegetation. Direct contact with cement kiln dust may cause brief eye, nose, throat, or skin irritation.

Over the past ten years, all four of the facilities have improved their equipment and operations in response to major air regulations promulgated by EPA and the State of Texas (See Section 2). While environmental data were primarily available from the mid-1990s or early 2000s, ATSDR believes that this conclusion can be extended to future exposure periods, since the sampling data evaluated covered a period of higher air emissions.

Recommendations

Since it is air pollution deposition to soil, water, and other environmental media that is the focus of this health consultation, as recommended in the Midlothian health consultations that addressed air issues [ATSDR 2016a,d], ATSDR recommends that community focused air investigations continue.

7.0 Public Health Actions Planned

General:

ATSDR will meet with residents to present the findings in this Health Consultation and of all future Health Consultations and to answer questions from residents. Completed: May 2016.

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Appendix – ATSDR Response to Public and Peer Review Comments

Review and Analysis of Volatile Organic Compounds (VOCs) and Metal Exposures from Air Emissions in Media Other than Air as Part of the Midlothian Area Air Quality Petition Response Midlothian, Ellis County, Texas
HEALTH CONSULTATION
MAY 2016

PUBLIC COMMENT VERSION
ATSDR released this health consultation as a public comment version on May 12, 2016. ATSDR held a public availability session in Midlothian, Texas on May 23, 2016 to answer any questions concerning this health consultation. No comments were received at the meeting, during the 30 day public comment period that ended on June 9, 2016, or since the submission of the final version of the document.

In late June 2016, the public comment version on this health consultation was provided to three peer reviewers selected by ATSDR's Office of Science. The responses to the peer reviewers' comments and our responses to these comments follow.

GUIDE TO REVIEWERS:

The objective of peer review conducted by the Office of Science is to ensure the highest quality of science for NCEH/ATSDR studies and results of research; therefore, your comments should be provided with this goal in mind. Unlike other peer review processes in which you may have participated, the questions to be addressed for NCEH/ATSDR are broadly based so that each reviewer may have a wide latitude in providing his/her comments. Any remarks you wish to make that have not been specifically covered by the General Questions Section may be included under question # 2 in the Additional Questions Section. Please note that your unaltered comments will be sent to the investigator for a response. You should receive a copy of the response to the peer review comments when they are available.

This health consultation, which examines environmental sampling data from the Midlothian area for media other than air, is one of a series of six health consultations being prepared by ATSDR for this site. For information on other health consultations, please visit http://www.atsdr.cdc.gov/sites/midlothian/health_consultations.html.

Reviewer #1

General Questions:

1. Does the health consultation adequately describe the nature and extent of contamination?

Reviewer Answer: No, the investigation relies on non-reproducible science and cannot be considered truly reliable.

ATSDR Response: An ATSDR health consultation is not an investigation or other research endeavor. In this health consultation, as with other ATSDR public health assessments, we used available sampling data (in this case from the U.S. EPA, Texas environmental agencies, and other parties) to determine if there were completed exposure pathways and chemicals of concern based on our health based screening levels [ATSDR 2005]. The data reviewed were collected by standard data collection procedures. ATSDR was not involved with the environmental sampling design and we did not collect our own samples. This is one of six health consultations prepared for this site. The first health consultation for this site addressed the adequacy of the air emissions data and

found the data to be reliable and to have met standard air quality data objectives [ATSDR 2015b]. Other health consultations in this series addressed the air data [ATSDR 2016a,d], while this health consultation addressed impacts to other environmental media from air deposition. In Section 3.4, we evaluate the completeness and quality of the environmental data used in this report. ATSDR stands by this health consultation and the health consultation process.

2. **Does the public health assessment adequately describe the existence of potential pathways of human exposure?**

Reviewer Answer: Yes, although I believe the effects of a) fugitive dust on lungs and b) fish consumption (for mercury) need to be given more serious weight as potential pathways – the Hg levels for fish do exceed EPA guidelines and this is not discussed. Cement dust contains high levels of some heavy metals including mercury. The cumulative risk from low dose chronic exposure to metal mixtures is crucial in this issue and has been completely overlooked by the authors– who instead have made the fatal flaw of relying on small sample sizes and data sets that are non-reproducible.

ATSDR Response: This health consultation is one of six health consultations prepared for the Midlothian Area Air Quality petition response. The health consultation that evaluated sampling data on NAAQS criteria pollutants and hydrogen sulfide [ATSDR 2016a] evaluated particulate inhalation exposure for particles less than PM_{10}. Dust particles of larger sizes would not settle in the lungs, but would be filtered out in the upper airways.

Fish tissue was evaluated in section 3.2.2.3. Given there are no fish consumption advisories or possession bans for Joe Pool Reservoir, that the modelled potential area of air emission impact only overlaid a small southernmost portion of the reservoir, and that air sampling results for metals and particulates did not indicate levels of inhalation health concern in this area, ATSDR concluded that contributions to pollutant concentrations in fish that were related to the facility operations would be low.

ATSDR evaluated the cement kiln dust data available for this site. As shown in table 3-3, mercury concentrations from Midlothian facilities were much lower than the mercury concentrations reported in other studies. Based on the alkalinity of cement kiln dust and information demonstrating potential exposure, ATSDR determined that cement kiln dust could be a temporary direct contact irritant to community members exposed to cement kiln dust deposition.

The health consultation that evaluated inhalation exposure to volatile organic compounds and metals [2016d] found that no metals found in particulate sampling exceeded the health based comparison values for chronic inhalation exposure. Deposition of these particulates and contribution of metals to other media would also be low and not pose a chronic health concern.

3. **Are all relevant environmental, toxicological, and radiological data (i.e., hazard identification, exposure assessment) being appropriately used?**

Reviewer Answer: No, the report does not provide evidence that the data they are relying on is actually reproducible science and hence credible. The report fails to even mention uncertainty in these data sets.

ATSDR Response: As explained in our response to comment #1, an ATSDR consultation is not a research investigation and evaluates available environmental sampling data for Midlothian. For some media, for example, soil, multiple data sets were available and the sampling results were fairly consistent. In Section 3.4, we evaluate the completeness and quality of the data used in this report and discuss any limitations found. As explained in Section 3.3, the available environmental data was

screened into three categories based on data quality and uncertainty in the data sets. Most of our evaluation involved the environmental data with the highest quality. However, we did include discussions on less robust available data (for example cement kiln dust) because of community concerns. ATSDR feels that we have adequately explained the data limitations.

4. **Does the public health assessment accurately and clearly communicate the health threat posed by the site?**

Reviewer Answer: No.

ATSDR Response: The comment is noted. This health consultation is one in a series of six health consultations prepared for the site. This health consultation evaluates media other than air which may have been impacted by air emissions from the facilities of concern. Based on environmental sampling data, for the most part, the air deposition has not impacted these other media and does not pose a health concern. ATSDR recognizes that the air inhalation pathway is the exposure pathway of most community concern. The evaluation of air sampling data and the inhalation exposure pathway can be found in two other health consultations in this series [ATSDR 2016a,d].

5. **Are the conclusions and recommendations appropriate in view of the site's condition as described in the public health assessment?**

Reviewer Answer: No, the report fails to truly consider sensitive individuals and relies on non-reproducible science and very small sample sizes and very limited data sets.

ATSDR Response: For the sampling data evaluated in section 4.0, ATSDR used its media specific health-based comparison values to screen for chemicals of concern. As explained in section 3.5 and 5.2, these comparison values are set well below levels that are known or suspected to cause and adverse health effect and they were established for the most sensitive human population. As described in response to comments 1 and 3, this health consultation included evaluation of available data sets and ATSDR did not collect any samples. A health consultation does not answer a research question. The limitations of the data sets and the method ATSDR used to screen the available data by quality are described in sections 3.3 and 3.4 and further illustrated in table 3-5.

6. **Are there any other comments about the health consultation that you would like to make?**

Reviewer Answer: The objectives and hypotheses of the study are not very clear. The report does not represent reproducible science. The report is very weak with regard to source apportionment of the pollutants – which is a key issue. No statistical power analyses were conducted and the experimental design is extremely weak. No quality control or quality assurance information is presented. Tables and figures need better headings and legends so that the "what, where and when" of each table/figure is included and hence "stand-alone" in nature.

ATSDR Response: The purpose and statement of issue for this health consultation is described in section 1. This health consultation is not a research study, so there are no hypothesis and no statistical evaluation of the available sampling data. Data quality was evaluated and discussed in sections 3.3 and 3.4. All figures and many of the tables were taken from original sources and not created for this health consultation. ATSDR has reviewed the figure and table headings and has added additional information to the title or as a footnote to make the tables stand alone.

Additional Questions:

1. **Are there any comments on ATSDR's peer review process?**

Reviewer Answer: No.

2. Are there any other comments?
Reviewer Answer: No.

<u>Reviewer #2</u>

<u>General Questions:</u>
1. Does the health consultation adequately describe the nature and extent of contamination?

Reviewer Answer: Overall, the document provides good verbal summaries of the various documents addressing sampling data of various media. The nature and origin of the contamination are adequately described. The extent of contamination, based on the available data, is described in narrative form only. It would be very beneficial to include more figures regarding the distribution of sample points exceeding comparison values, so the reader gets a better overview of the extent of existing contamination. This document will not be easy to read for a lay person, and any visual help possible should be provided to help with the understanding of the situation. Some of the existing figures need clarification. Some more explanation re the ATSDR potential area of impact (Fig. 2-3) would be helpful (is there a buffer zone, if so, how wide?) – and subsequently including this impact boundary in figures depicting the discussed sample locations exceeding comparison values would be good. More specific comments are below.

ATSDR Response: Thank-you for your comments. Since this health consultation included figures from source documents, existing figures were not modified to include the modelled potential area of impact described in the first health consultation for this site [ATSDR 2015b]. In lieu of modifying the figures, more description has been added to the text and figures to clarify sampling points that exceeded any comparison values. ATSDR understands that the document is fairly technical, and a companion consumer summary is available for the public for this health consultation. Specific responses to the itemized comments for question 1 are provided below in bold italicized text.

Figure 2-3: Potential Area of Impact: this figure would benefit from further description in the narrative: what exactly is meant by "combined deposition"? What are "maximum air concentrations"? – one would assume air emission concentrations, but it should be spelled out. ***Text added to explain that combined deposition refers to EPA [1996] air modelling four the combined emissions from all four facilities.***

Page 20, first para: "The types of media described by these types of data included dust, slag, road materials, fish tissue, and hair. The numbers of records that contained these types of data are presented in Table 3-2…" Fish tissue is not mentioned in Table 3-2 ***Fish tissue records have been added to Table 3-2.***

Page 22, Electric Arc Furnace Dusts section, 2nd para, sentence 8: antimony concentrations from the emissions profile are not mentioned for comparison. Doing so would be helpful. ***Antimony concentrations from Gerdau EAF dust samples are now included.***

Page 22, Electric Arc Furnace Dusts section, 2nd and 3rd para: hexavalent chromium and not total chromium appears to be a more hazardous contaminant in EAF dust. No mention of hexavalent chromium concentrations is made when discussing the emissions profile of EAF dust. 3rd para: what is the context of the last sentence here? Is there a connection to be made with the Midlothian facilities? If so, it should be made. If not, this sentence appears irrelevant. ***The percentage of total chromium in the hexavalent form has been added to the discussion. The final sentence is relevant to sampling results, i.e. none of the sampling points had metal concentrations that suggested an EAF source.***

Page 23, section 3.3.2.2, 2nd para, first sentence: "…to result from exposure to concentrations of chromium and total chromium below these detection limits." Replace "chromium" with "hexavalent chromium". ***Done.***

Page 31, last para, last sentence: "…which found that long-term air quality impacts would likely occur within the potential area of impact." This area of impact needs to be referenced to a figure. Figure 4-1 or Fig 2-3? See following comment. ***Reference to Figure 2-3 added.***

Fig 4-1, page 32: The legend needs to include the meaning of the flesh-colored and hashed areas. In addition, it should be noted that Holnam is the former name for the Holcim facility or, the most recent name of the facility should be used. There needs to be consistency re the facility names throughout the doc. Explain the term "combined deposition" in the text – it will be very confusing to a lay reader without explanation. Suggest to make the Location of Receptors a different color to facilitate "readability" of the figure. What is "CS"? - not mentioned in legend. It may be a bit confusing to a reader to have both, Figure 2-3 and Fig 4-1 in the doc without further explanation. One is an ATSDR model, the other an EPA model. Is one using different data sets than the other? Some discussion would be helpful. ***ATSDR agrees that Figure 4-1 was confusing and contained information already available on Figure 2-3. Text was added to describe receptor locations and the reader was referred to Figure 2-3 (see above).***

Fig 4-2, page 36: what does "NTCC" stand for? Is that another name for one of the facilities? Explain. ***NTCC stands for North Texas Cement Company, now Ash Grove Cement. A footnote has been added.***

Page 41, section 4.2.3: Table 4-4 presents analytical results for metals only as does the associated text. Results for pesticides, PAHs, SVOCs, and dioxins/furans are not reported. ***All results for pesticides, PAHs, SVOCs, and dioxin/furans were below detection limits and/or ATSDR comparison values. Text has been added to the health consultation.***

Soil sample results: It would be very helpful to have a summary of the soil sampling locations exceeding comparison values displayed in a figure. It is impossible to relate the sampling results in the various tables to locations. ***When available, text is provided that denotes which sampling locations exceeded the comparison values. Since for several metals, the ATSDR comparison value was more conservative than the TCEQ screening level, only approximate on-site or off-site locations are known because the source documents do not address those locations. The figures included provide location numbers when known.***

A map identifying sampling locations for groundwater, surface water, sediment and vegetation samples would be helpful as well. As there appear not that many locations for these types of samples, it may be feasible to combine the general locations map with identifying the locations with exceeding comparison values. ***While we agree this would be helpful, if no figure was provided in the source report, a description of the sampling locations is included. Sampling locations for these other media from the ERM 2004 report are provided in Figure 4-3.***

Page 42, first para (section 4.2.3), 3rd sentence: "One or more samples contained concentrations of arsenic and/or hexavalent chromium that exceeded current ATSDR pica child ingestion comparison values, both of which are 10 ppm (acute and intermediate exposures, respectively)." This sentence in the context of the following sentences in this para does not make sense. Should this be "chromium" instead of "hexavalent Chromium"? It would be good to know how many samples exceeded comparison values for hexavalent chromium (or chromium?). The # of As samples is provided. ***Replaced "no samples" with "none of the five samples" to make this clearer.***

2. **Does the public health assessment adequately describe the existence of potential pathways of human exposure?**

Reviewer Answer: There are data gaps in samples for exposure points (acknowledged in the document) for surface and ground water, vegetation and crops. Nevertheless, sediment, surface and ground water pathways were removed from further evaluation. It seems all could have been potential pathways in the past (the lack of data does not prove otherwise) and at least ground water could still be a potential pathway in the future, depending on further analyses, hydrogeology, and shifts in future land use. Table 3-1 mentions exposure time frames, but no discussion re ground water follows anywhere in the narrative. The document states that "the quality of the data appear to be sufficient to reach preliminary conclusions about the potential effects of these four facilities on other media that could impact the public health of the Midlothian community." (page 27; without the underlining). Only soil data seem to be of sufficient quality and quantity. This is a weakness and limitations should be made clear in the beginning (summary) of the document. In addition, it would be beneficial to note if the input data for modeling were adequate or not. Allusions are made to this issue (Table 3-5; page 30, 2nd para), but without reading the actual reports referenced, a reader has no idea. ***Text has been added to the Methods/Approach section of the summary to explain the limitations. Text has also been added that highlights the ATSDR review of EPA's multi-pathway risk assessment and modelling of air emissions from the four facilities that is provided in a previous health consultation for the site [ATSDR 2015b].***

Page 16, Table 3-1: Table header: "potential and completed exposure pathways.." –are the pathways potential pathways, completed pathways or potentially completed pathways? This is confusing and individual pathways should clearly be designated. A clear table depicting potential and completed pathways based on available data would be beneficial. ***Table revised and explanatory text added.***

Page 16, Table 3-1: in the column "potential exposed population", ranchers are mentioned as potentially affected by on and off-site exposure in the past and present. Nowhere in the preceding text is it mentioned that there are active ranches on-site or off-site. Figure 2-2 "Existing Land Use" does not mention ranching. Not until page 43 is it mentioned that parts of the TXI property was rented by a rancher in the past. Is ranching a current land use anywhere on and/or off-site? This should be clarified prior to page 16, i.e. table 3-1. ***Text added to Section 3.1 exposure pathway analysis discussion.***

Page 17, first para: "…, (2) data from monitoring and/or measurements that are limited quality, but are potentially suitable to address some of the scientific aspects of the consultation, discussed in Section 3.3.2, and (3) data suitable to address scientific aspects of this consultation, discussed in Section 3.3.3." According this this sentence one would expect to find a discussion of "good" data in section 3.3.3 That, however, is not the case, as that particular section only lists the source publications of the data. It seems, the bulk of the data (potentially suitable data!) are discussed in section 3.3.2. What standards are being applied to assess the suitability of the data? Either some rewording of sentence quoted above needs to take place, or qualifying statements/clarifications as to the reliability of the data need to be made in all sections where media data are discussed. ***Text revised to include the sections where suitable data is described, evaluated, and provided.***

Table 3-4, page 26: "1995 report", "1996 report" – reports by what agency? This information should be in a foot note or identified in the column header. ***References added.***

ATSDR Response: Specific responses to the itemized comments on question 2 are provided above in bold italicized text.

3. **Are all relevant environmental, toxicological, and radiological data (i.e., hazard identification, exposure assessment) being appropriately used?**

Reviewer Answer: Yes.

ATSDR Response: Comment noted.

4. **Does the public health assessment accurately and clearly communicate the health threat posed by the site?**

Reviewer Answer: Yes and no. The document is based on historic and partially insufficient data. As noted above, lack of data should not be used to preclude exposure pathways. While exposure points to surface water, ground water and crops may be unlikely, the available data are scarce and highly geographically localized and do not support, in my mind, the general exclusion of related potential pathways. Ground water, for example, may reside in an aquifer for very long periods of time, depending on the geology/hydrogeology, before it may become a point of exposure. Fracture flow may occur, causing the ground water to go off-site. Not knowing the underlying geology/hydrogeology of this site, the reader will not know if this is a possibility here or not. It would be good to include a section on site geology/hydrogeology. A list of limitations and uncertainties should be included in the document.

The document will be very hard to read for a layperson not familiar with the technical concepts and the science in general. Examples are section 3.4 and this sentence: "The RSLs used in this analysis correspond to either a one excess risk of cancer per million exposed people (10-6) for carcinogens or a Hazard Quotient (HQ) of 1 for non-carcinogens [EPA 2015]. " – explain the concept of HZs, and reword the sentence to make it clearer for a layperson, something like: "…correspond to either a one in a million extra risk of cancer per million…". It should be explained how the health based comparison values for soil were derived – for this type of document, a reference alone is not sufficient. A glossary of terms and more figures summarizing sampling results would be helpful. Exposure pathway analysis needs to be explained better and in more depth: what are receptors, what is a source, what is exposure, will people respond differently to exposure based on age, genetic make-up, age, health status, what is a completed pathway, a potential pathway, an eliminated pathway, ingestion, inhalation, dermal, what drives an adverse health effect, etc, etc. A summary (narrative or table) of identified potential, completed, and eliminated pathways for the site, including explanations as to why potential, completed or eliminated, should be added. Some sentences appear to be convoluted and could be more clearly stated. In general, more figures clearly depicting sampling results and extent of contamination would be helpful. A figure depicting prevalent wind directions throughout the seasons would be good to include as well. It may be beneficial to have this document edited by someone who can make it more "understandable" for a layperson.

ATSDR Response: Based on your comment, a description of the groundwater resources in Ellis County has been added. There are several places where limitation of data sources are discussed, including section 3.4. Additional text was added as appropriate in other sections discussing environmental sampling data.

ATSDR is aware that some of the material discussed in the health consultation is technical. As a companion to the health consultation, a consumer summary is available. We have gone through your comments in the second paragraph and have added descriptions as needed to make certain concepts clearer, including additional explanation of risks and exposure pathways. We have added a wind rose (Figure 2-4) to the background section on air emissions.

5. **Are the conclusions and recommendations appropriate in view of the site's condition as described in the public health assessment?**

Reviewer Answer: Yes, definitely for soils. The fact that significant data gaps exist for surface water, ground water and crops should be more of a factor in the conclusions and recommendations for the site – see above.

ATSDR Response: Text has been added to the summary and in several sections to explain the limitations.

6. Are there any other comments about the health consultation that you would like to make?

Reviewer Answer: In its current form, the document does not appear very suitable to communicate information to a layperson.

ATSDR Response: Comment is noted. ATSDR is aware that in parts, the document is technical. To account for this, the executive summary is provided at the front of the document and a stand-alone consumer summary of the document was made available to the public.

Additional Questions:

1. Are there any comments on ATSDR's peer review process?

Reviewer Answer: No.

2. Are there any other comments?

Reviewer Answer: Several typos, missing words, missing concentration designations (ppm, ppb), more clarity, grammar. The document would benefit from being read by an editor. Here is what I caught:

Page vii, second bullet: "Only two of 44 soil samples had a metal (manganese) that exceeded its health based comparison value." Insert 'concentration" after metal.

Page 3, last para: "This background information builds on information provided in three of the ATSDR health consultations for Midlothian that address air quality [ATSDR 2015b,e, 2016], and adding a focus on potential impacts to other media." Replace "adding" with "add".

Page 12, last para, second sentence: "Over 1,600 VOC samples measured at 12 monitoring locations and over 1,100 metal samples found in either total suspended particulates or fine particulate matter (PM10 or PM2.5) at 17 monitoring stations in the Midlothian area were evaluated. The last part of the sentence does not make sense.

Page 22, Electric Arc Furnace Dust section, first para: "For the cumulative risk assessment in Midlothian, EPA used the results to compile a profile of metals concentrations in EAF and then compared the EAF profile to some actual sampling results provided by the Gerdau facility in a letter to EPA dated December 20, 1995." Specify "some actual sampling results".

Page 23, section 3.3.2.2, 3rd para: "To address community concerns that area road might pose a health risk,…" - "road" should be plural.

Page 25, section 3.4, 2nd para, 4th sentence: "Because of limitations on these data, these were discussed in Section 3.3.2." Should be "…of these data…". Replace "these" with "they".

Page 25, section 3.4, 3rd para: "While the transport mechanisms for soil to air and other media were not available, air transport to other media was the focus of this health consultation." This sentence does not make sense as is. Do you mean "because the transport mechanisms…"?

Page 25, section 3.4, 3rd para: "Additionally, modeling results and analytical results from samples collected within the soil, water, wheat, and other media (representing the exposure points) mitigates the lack of data on contaminant transport mechanisms." This would only be true, if the input data used for modeling are of sufficient quality and quantity (see question 2). Replace "mitigates" with mitigate".

Page 26, first para: "The only measurements of these media documented in the files and considered usable for Section 4.0 address sampling on the area surrounding the Gerdau Ameristeel property." Replace "…on the area…" with "…of the area…".

Page 28, section 3.4, 2nd para: "If ATSDR had not established a comparison value for a particular chemical in a specific media, than EPA regional screening levels…". Replace "than with "then" or delete.

Page 31, last para: "The findings on air deposition were consistent between the EPA and ATSDR modeling analyses, which found that long-term air quality impacts would likely occur within the potential area of impact." It would be very helpful to add reference to a figure depicting the potential area of impact.

Page 34, section 4.2.1.1, first sentence: "Soil samples were analyzed for metals, dioxins (PCDDs), and furans (PCDFs)." Spell out acronyms.

Page 32, section 4.2.1.1, 2nd sentence: "Figure 4-2 provides a map of the locations of most of the eighty surface soil sampling locations (representing 175 samples) where soil was collected and analyzed for metals; it also shows the location of the four facilities." The figure shoes a facility name not previously mentioned – NTCC.

Table 4-2, column header: "Number Exceeding 1995 CV" replace with "Number of samples exceeding…".

Page 38, section 4.2.1.2., 2nd para: "Insufficient information was provided in the report to determine how many of the 22 samples were above 2,500 since none exceeded the…" Insert 'ppm" after 2,500.

Page 40, 2nd sentence: "The samples were located at SS-9 and SS-10 (Figure 4-4), and had concentrations of 6,100 and 2,720, respectively." Insert concentration measures after the numbers.

Figure 4-2: Where is the Gerdau facility in relation to the sample points? It would be good to point this out in the figure.

Page 41, last para, first sentence: "None of the analyzed constituents was below the health-based screening comparison values." This should read "…were above the health-based screening values." Replace "was with "were" in the original sentence.

Page 42, first para, third sentence: "None of the analyzed constituents was below the health-based screening comparison values." It would be good to be more specific here and report the actual # of samples. The information for As is provided in the next sentence but the info re chromium is not provided.

Page 43, section 4.4., 2nd para, first sentence: "TNRCC collected five surface water samples in May 1994: one from a manmade holding tank, two from standing pools immediately south of the facility fenceline, one from…" Fence line is two words.

Page 46, para below table, last sentence: "Given that this was vegetation and hay was not an exclusive diet that an animal might consume, ATSDR did not consider the one hay bale sample that exceeded the MTL for aluminum and the one forage sample that exceeded the MTL for molybdenum would not have many implications for public health." Convoluted sentence and grammatically incorrect.

ATSDR Response: The reviewer's careful reading of the document is appreciated. Edits were made to correct these mistakes.

Reviewer #3

General Questions:

1. Does the health consultation adequately describe the nature and extent of contamination?

Reviewer Answer: The nature and extent of contamination of air, soil, vegetables, sediments, surface and groundwater in the Midlothian area (Ellis county, Texas), are adequately described in the public health assessment document. This environmental contamination has been associated with the establishment and operation of four industrial facilities in Midlothian, including three cement plants (Ash Grove Cement, Holcim, and TXI Operations) and a steel mill (Gerdau Ameristeel).

The major contaminants of concern at this site are the myriad of heavy metals and elements, as well as inorganic compounds (sulfates, hydrochloric acid, and sulfuric acid) emitted from cement kiln stacks and from fugitive emissions that enter the ambient air mainly as particulate matter (PM). Inorganic compounds such as carbon monoxide, nitrogen oxides, sulfur dioxide, and hydrogen sulfide, and mercury are released as gases, and some. are also found in particles emitted from stacks. It is also reported that volatile and semivolatile organic compounds such as dioxins, furans, and polycyclic aromatic compounds may be released from stack emissions although the high temperatures in cement kilns are expected to destroy most of the VOCs present.

In addition to the air, other environmental media or compartments are subject to contamination. Industrial operations and management units such as container/drum storage areas, landfills, storage tanks, sumps, surface impoundments, and waste piles are likely to release both hazardous and non-hazardous waste to the land/soil. Surface water contamination by hazardous chemicals may result from wastewater and storm water discharges, while groundwater contamination is likely to result from solid waste storage and disposal units.

ATSDR Response: Comment noted.

2. **Does the public health assessment adequately describe the existence of potential pathways of human exposure?**

Reviewer Answer: The potential pathways of human exposure to contaminants from soil, surface water, and ground water, are adequately described in the health assessment document. Media-specific pathways of exposure were analyzed and data were compared to chemical-specific environmental criteria to determine if a public health hazard exists. It is indicated that human exposure to soil, surface water and ground water may have occurred through on-site and/or off-site direct contact or incidental ingestion.

It is reported that the inhalation route of exposure and pathways involving exposure of domestic animals were provided in other published ATSDR health assessment documents, and hence were not discussed in the present document. Therefore, the exposure assessment has been focused on the examination of potential human contacts with volatile organic compounds and metals that deposited from air emissions onto other environmental media, including soil, surface water, sediment, and groundwater, and vegetation.

ATSDR Response: Comment noted.

3. **Are all relevant environmental, toxicological, and radiological data (i.e., hazard identification, exposure assessment) being appropriately used?**

Reviewer Answer: The relevant environmental, toxicological and radiological data were used appropriately to assess the potential health risk associated with exposure to various environmental contaminants. The health assessment has considered all relevant data on the environmental concentrations of heavy metals and volatile and semi-volatile organic compounds published in various reliable/peer-reviewed publications. These important data were then compared with those reported on similar industrial operations.

Data on heavy metals, VOCs, and radionuclide concentrations in environmental media such as air (ambient and indoor air, air emissions), animal hair (dog, cow, and horse hair), Dust Cement kiln dust (clinker, indoor and outdoor dust, filters, lint, and fly ash), human hair (human scalp hair), soil (soil paving materials, rock, sand, asphalt, and road materials), slag, vegetation (wheat, oats, grass, and hay), and miscellaneous (white powder, waste-derived fuel distillate, fuel oil, and rainwater), and/or multi-Media (air, dust, human hair, slag, paving materials, vegetation, soil, surface water, foundation materials, etc.), were analyzed and compared to media-specific health based screening levels to determine if any chemicals were present at levels of potential concern to public health.

ATSDR Response: Comment noted.

4. **Does the public health assessment accurately and clearly communicate the health threat posed by the site?**

Reviewer Answer: The potential health risks/threats posed by the Midlothian site are accurately and clearly communicated in the public health assessment document. The concentrations of specific contaminants in various environmental matrices were listed and those that exceeded the regulatory/screening levels were clearly highlighted. Also, clear and concise statements were made on the potential for each specific contaminant of concern to cause a systemic/non carcinogenic and/or carcinogenic effect.

ATSDR Response: Comment noted.

5. **Are the conclusions and recommendations appropriate in view of the site's condition as described in the public health assessment?**

Reviewer Answer: The conclusions and recommendations presented in the public health assessment document are appropriate. The main conclusions that the Midlothian populations residing in the vicinities of the four major industrial operations are not likely to suffer major adverse health effects associated with the release of inorganic and organic contaminants from air emissions impacting soil, sediment, surface water, groundwater, or vegetation, and that a direct contact with cement kiln dust may cause brief eye, nose, throat, or skin irritation, were highly supported by the thorough analysis and critical evaluation of relevant scientific data.

Also, ATSDR's recommendation for the continuation of air pollution monitoring in Midlothian is strongly justified by the fact that air emissions constitute the major sources of industrial release of contaminants in the affected areas.

ATSDR Response: Comment noted.

6. Are there any other comments about the health consultation that you would like to make?
Reviewer Answer: With a special emphasis on soil, surface water, groundwater, vegetation, and sediment contamination, this public health assessment document on the "Review and Analysis of Volatile Organic Compounds (VOCs) and Metal Exposures from Air Emissions in Media Other than Air" presents a very comprehensive review of the health risk assessment and management of environmental contamination in Midlothian area, Texas. It fully complements other previously published ATSDR's health assessment documents on this contamination. It thoroughly describes the nature and extent of contamination by metals and VOCs released from air emissions by four industrial facilities operating in the Midlothian area, identifies the exposure pathways, reviews and analyzes relevant environmental and toxicological data, discusses the potential for systemic and carcinogenic effects, and accurately communicates the potential health risks associated with human exposure.

ATSDR Response: Comment noted.

Additional Questions:

1. Are there any comments on ATSDR's peer review process?
Reviewer Answer: ATSDR's peer-review approach is very appropriate. The dual involvement of both the public and the scientific community, is commendable.

ATSDR Response: Comment noted.

2. Are there any other comments?
Reviewer Answer: I have no additional comments.