ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Public Health Assessment for

AMBIENT AIR QUALITY IN CLAREMONT,
SULLIVAN COUNTY, NEW HAMPSHIRE
MARCH 2, 2009

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
Agency for Toxic Substances and Disease Registry

Comment Period Ends:

MAY 8, 2009

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

This Public Health Assessment-Public Comment Release was prepared by ATSDR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) section 104 (i)(6) (42 U.S.C. 9604 (i)(6), and in accordance with our implementing regulations (42 C.F.R. Part 90). In preparing this document, ATSDR has collected relevant health data, environmental data, and community health concerns from the Environmental Protection Agency (EPA), state and local health and environmental agencies, the community, and potentially responsible parties, where appropriate. This document represents the agency's best efforts, based on currently available information, to fulfill the statutory criteria set out in CERCLA section 104 (i)(6) within a limited time frame. To the extent possible, it presents an assessment of potential risks to human health. Actions authorized by CERCLA section 104 (i)(11), or otherwise authorized by CERCLA, may be undertaken to prevent or mitigate human exposure or risks to human health. In addition, ATSDR will utilize this document to determine if follow-up health actions are appropriate at this time.

This document has previously been provided to EPA and the affected state in an initial release, as required by CERCLA section 104 (i) (6) (H) for their information and review. Where necessary, it has been revised in response to comments or additional relevant information provided by them to ATSDR. This revised document has now been released for a 30-day public comment period. Subsequent to the public comment period, ATSDR will address all public comments and revise or append the document as appropriate. The public health assessment will then be reissued. This will conclude the public health assessment process for this site, unless additional information is obtained by ATSDR which, in the agency's opinion, indicates a need to revise or append the conclusions previously issued.

Please address comments regarding this report to:

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PUBLIC HEALTH ASSESSMENT

AMBIENT AIR QUALITY IN CLAREMONT, SULLIVAN COUNTY, NEW HAMPSHIRE

Prepared by:

New Hampshire Department of Environmental Services
Environmental Health Program
Under a Cooperative Agreement with the
U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

This information is distributed by the Agency for Toxic Substances and Disease Registry for public comment under applicable information quality guidelines. It does not represent and should not be construed to represent final agency conclusions or recommendations.

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LIST OF ABBREVIATIONS

AQAD	Air Quality Action Day
AQI	Air Quality Index
ARD	NH Department of Environmental Services, Air Resources Division
As_2O_3	Arsenic trioxide
ATSDR	US Agency for Toxic Substances and Disease Registry
CDC	US Centers for Disease Control and Prevention
CEMS	Continuous emission monitoring system
CI	Confidence interval
CO	Carbon monoxide
CREG	Cancer Risk Evaluation Guide
CSF	Cancer Slope Factor
CV	Comparison Value
DES	NH Department of Environmental Services
NHDHHS	New Hampshire Department of Health and Human Services
ED	Emergency department
EHP	NH Department of Environmental Services, Environmental Health Program
EPA	US Environmental Protection Agency
HAP	Hazardous Air Pollutant
Hg	Mercury
HSDM	Health Statistics and Data Management
LOAEL	Lowest Observable Adverse Effect Level
MRL	Minimum Risk Level
MW	Megawatts
NAAQS	National Ambient Air Quality Standards
NESCAUM	Northeast States for Coordinated Air Use Management
NHSCR	New Hampshire State Cancer Registry
NO_2	Nitrogen dioxide
NOAEL	No Observable Adverse Effect Level
NWS	National Weather Service
O_3	Ozone
PHA	Public Health Assessment
$PM_{2.5}$	Particulate matter 2.5 microns in diameter or smaller
PM_{10}	Particulate matter between 2.5 and 10 microns in diameter
ppb	Parts per billion
ppm	Parts per million
PSNH	Public Service of New Hampshire
RADS	Reactive airway dysfunction syndrome
RfC	Reference Concentration
RfD	Reference Dose
SCR	Selective Catalytic Reduction
SIR	Standardized Incidence Ratio
SO_2	Sulfur dioxide
TSP	Total suspended particulate matter
USDHHS	US Department of Health and Human Services
VOC	Volatile Organic Compounds

PUBLIC HEALTH ASSESSMENT
AMBIENT AIR QUALITY IN CLAREMONT, SULLIVAN COUNTY, NEW HAMPSHIRE

1.0 SUMMARY

The US Agency for Toxic Substances and Disease Registry (ATSDR) is a non-regulatory federal agency mandated by Congress to assess human health effects from exposure to hazardous substances at Superfund and other sites. To fulfill its mandate, ATSDR enters formal partnerships with state agencies throughout the nation to carry out site-related research on environmental exposures and public health. For 17 years, ATSDR and New Hampshire's Environmental Health Program (EHP) have maintained a cooperative agreement to conduct this research in the state. EHP is a non-regulatory program within the New Hampshire Department of Environmental Services (DES). It functions independently of regulatory programs within DES to assess the human health implications of hazardous chemical releases, and to make recommendations to protect the public health.

During public hearings related to air permits for a local stationary source, some residents of Claremont, New Hampshire expressed concerns about air pollution emissions from the Wheelabrator, Claremont waste-to-energy facility. As a result, DES requested EHP to examine air quality and certain health effects that might be associated with air emissions from nearby point sources including the Wheelabrator, Claremont facility.

The overall conclusion of this report is that ambient air in the Claremont area does not present a health hazard to the general population. During the study periods, the ambient air monitors in the Claremont area confirmed compliance with all National Ambient Air Quality Standards, including those for the four criteria pollutants examined in this report: sulfur dioxide (SO_2), fine particulate matter ($PM_{2.5}$), ozone (O_3), and nitrogen dioxide (NO_2). Based on monitored levels, there are infrequent days when air pollution levels (i.e., O_3 and $PM_{2.5}$) in the Claremont area may result in adverse health effects among people with certain heart or lung diseases during outdoor exertion. Atmospheric analyses have determined that O_3 air pollution events originate from regional and distant stationary and mobile sources and are transported long distances, primarily by winds that originate from a southerly direction in summer months. Claremont specifically experiences elevated O_3 levels most often when winds blowing from the south bring air pollution originating from the New York City metropolitan region into the area. $PM_{2.5}$ events usually share the same origin and transport characteristics as ozone events. The ozone and $PM_{2.5}$ levels measured at other state locations are generally similar or higher than in Claremont. The Claremont location also experiences fewer air quality action day events than other monitored locations.

Based on review of the monitoring data, sulfur dioxide (SO_2) levels in the Claremont area do not represent a public health hazard. Monitored ambient air SO_2 levels were below EPA health-based limits and thresholds associated with adverse health effects.

Ozone and fine particulate matter ($PM_{2.5}$) do not represent a public health hazard to residents of the Claremont area. According to EPA's Air Quality Index (AQI) categories, ozone levels in the

Claremont area during the nine-year study period were rated "good" almost 96% of the time, "moderate" 4% of the time, and "unhealthy for sensitive groups" 5 times (<1%). For "moderate" ozone days, EPA provides the following cautionary statement: "*People who are unusually sensitive to ozone should consider reducing prolonged or heavy exertion outdoors*." During events categorized as "unhealthy for sensitive groups", the cautionary statement, available at: http://airnow.gov/index.cfm?action=aqibroch.aqi#aqipar is, "*Active children and adults, and people with lung disease, such as asthma, should reduce prolonged or heavy exertion outdoors*." Elevated ozone events occur primarily during the summer when the prevailing winds are out of the south or southwest. Ozone events are regional, as confirmed by the high correlation in their day-to-day ambient air monitored levels across the state, and often across the New England Region.

For $PM_{2.5}$ in the Claremont area, AQI levels were "good" more than 84% of the time, "moderate" 14.7%, "unhealthy for sensitive groups" twice, and "unhealthy" once. EPA's cautionary statement for "moderate" $PM_{2.5}$ days is, "*Unusually sensitive people should consider reducing prolonged or heavy exertion.*" For days categorized as "unhealthy for sensitive groups", EPA advises: "*People with heart or lung disease, older adults, and children should reduce prolonged or heavy exertion.*" When $PM_{2.5}$ reaches "unhealthy" levels, EPA advises: "*People with heart or lung disease, older adults, and children should avoid prolonged or heavy exertion. Everyone else should reduce prolonged or heavy exertion.*" These and other $PM_{2.5}$ events are regional (i.e., not a localized), as indicated by the high correlation of ambient air monitored levels in Claremont with those at Manchester and Portsmouth.

Nitrogen dioxide levels do not pose a human health hazard. This conclusion was based on DES analysis of data (including the use of modeled concentrations.) Predicted cumulative "worst-case" exposure levels were all below applicable health-based thresholds associated with adverse health outcomes.

DES reviewed the Claremont area ambient air monitoring data for 28 regulated toxic air pollutants, and concludes that the levels do not pose a human health hazard to any sensitive population. Based on the analyses of the data, Claremont regulated toxic air pollutant levels are expected to have no effect on rates of non-cancer diseases and their effect on cancer rates is negligible. Regulated toxic air pollutant levels at the South Street monitoring station were also consistent with those from other air monitors across the state regardless of season, wind direction, and other factors.

Levels of mercury in the ambient air are difficult to monitor. The results of air dispersion modeling analyses of mercury emissions from local sources conducted by DES, concludes that concentrations of mercury in the air pose no human health hazard through inhalation. Mercury from local, regional, and distant industrial sources is transported in the ambient air and deposited in water bodies, converted to methyl mercury through natural processes, and is ingested by fish where it bioaccumulates in the fish tissue. Consumption of fish, with high levels of mercury, in large quantities may pose a health hazard, especially to children and pregnant women. EHP launched an initiative in spring 2008 to obtain fish samples in the greater Claremont area and analyze them for mercury. The results of this forthcoming study will be published in a separate health consultation and disseminated to the public.

Ambient air dispersions modeling analyses conducted by DES of dioxin/furan (CDD/CDF) emissions concludes that localized ambient air concentrations pose no human health hazard through inhalation. Predicted "worst-case" exposure levels were also below all applicable health-based thresholds.

Based on the conclusions of this report, EHP has developed the following recommendations that will be implemented by DES:

- Continue routine inspections and monitoring of all regulated facilities in the Claremont area to assess compliance with applicable ambient air quality regulatory requirements.

- Continue to issue DES Air Quality Action Day (AQAD) notifications encouraging residents, especially children, the elderly, and those with asthma or other respiratory conditions to avoid prolonged outdoor activity and take precautions to protect their health. On AQADs, residents are also encouraged to conserve energy and electricity, and to minimize driving. NH Air Quality information is available at: www.airquality.nh.gov

- Continue to encourage residents and schools interested in obtaining daily regional air quality information to register to receive alerts via EnviroFlash from EPA's AIR NOW website: http://airnow.gov/. EnviroFlash is a system that sends e-mails about your daily air quality forecast. The message is the same air quality information that the local radio or television stations provide, plus suggested safety measures when levels are unhealthy. (source:http://www.enviroflash.info/)

- Continue DES efforts to advise residents to limit their exposure to environmental mercury by following the recommendations of the NH Statewide Fish Consumption Advisory. The Advisory recommendations are included in the Fact Sheet " NH Fish Consumption Guidelines" on the DES website: http://des.nh.gov/factsheets/ehp/ard-ehp-25.htm

2.0 PURPOSE AND HEALTH ISSUES

The US Agency for Toxic Substances and Disease Registry (ATSDR) is a non-regulatory federal agency mandated by Congress to assess human health effects from exposure to hazardous substances at Superfund and other sites. To fulfill its mandate, ATSDR enters formal partnerships with state agencies throughout the nation to carry out site-related research on environmental exposures and public health. For 17 years, ATSDR and New Hampshire's Environmental Health Program (EHP) have maintained a cooperative agreement to conduct this research in the state. EHP is a non-regulatory program within the New Hampshire Department of Environmental Services (DES). ATSDR functions independently of the US Environmental Protection Agency and regulatory programs within DES to assess the human health implications of hazardous chemical releases, and to make recommendations to protect the public health.

In 2006, a petition from medical professionals in Claremont, NH was delivered to NH Governor John Lynch regarding the Wheelabrator Waste-to-Energy Incinerator. The Governor's Office subsequently requested that appropriate NH State agencies review cancer incidence data in the

Claremont area. In response, EHP prepared a health consultation for ATSDR based on cancer data from 1987-2001 (1). To expand the original health consultation, EHP has prepared the current public health assessment (PHA). This PHA presents an evaluation of data related to Claremont area air quality.

The Wheelabrator Claremont waste-to-energy facility was specifically mentioned in the 2006 petition and is considered a primary source of air pollution in PHA. EHP however, also considered other nearby facilities (in New Hampshire and eastern Vermont) that emit air pollutants that are measured by the DES air monitoring station in Claremont. These air pollutants include: sulfur dioxide (SO_2), fine particulate matter ($PM_{2.5}$), and several air toxic metals, volatile organic compounds (VOCs), and aldehydes. This PHA also examines ozone (O_3), an air pollutant that is primarily transported to NH from regional and distant sources, nitrogen dioxide (NO_2), as well as mercury and dioxins/furans (CDDs/CDFs), which are emitted by The Wheelabrator Claremont waste-to-energy facility, but not monitored by DES. DES measures mercury and dioxins/furans directly from the source through periodic stack tests.

This PHA presents an evaluation of air quality conditions over the past 10 years and related potential public health implications in the Claremont area. Secondary exposures such as ingestion of pollutants that bioaccumulate in the food chain (e.g., mercury) are also briefly discussed. This scientific evaluation employs health-based benchmarks developed by ATSDR, the US Environmental Protection Agency (EPA), the World Health Organization (WHO) and the Northeast States for Coordinated Air Use Management (NESCAUM). Regulatory air quality standards such as the EPA's National Ambient Air Quality Standards (NAAQS) and Air Quality Index (AQI), as well as the European Union, Canada, and the States of California and Connecticut were also utilized. The use of regulatory standards in this document is for health-related comparative purposes only.

3.0 BACKGROUND

3.1 Facility Descriptions

EHP identified 32 facilities located within a 15-mile radius of the DES ambient air monitoring station in downtown Claremont that were known by state environmental regulatory agencies in New Hampshire and Vermont to emit regulated air pollutants between 1994 and 2005. These facilities, ranked by total emissions, are described below.

Wheelabrator-Claremont Company (Wheelabrator) operates a resource recovery (waste-to-energy) facility at 145 Grissom Lane in Claremont, NH. The site is located approximately 3 miles to the southwest of downtown Claremont. Wheelabrator burns municipal solid waste (MSW) generated by twenty-nine communities in Vermont and New Hampshire. Two 100 tons/day mass-burn, waterwall boiler units combust MSW at temperatures exceeding 2500 degrees Fahrenheit to produce steam. The steam drives a turbine generator to create electricity for sale to the local utility. At full capacity, the facility can generate 6 megawatts of electrical energy (2).

MSW is brought to the facility and unloaded from incoming trucks onto the receiving room floor. The MSW is then pushed and loaded on to hoppers and transported inside to the facility's

boilers. Air to feed the combustion process is drawn from the refuse receiving building, creating a negative pressure that prevents odors and dust from escaping outdoors. The flue gas runs through pollution control equipment that controls acid gases, particulate matter, oxides of nitrogen (NOx), mercury and other pollutants. According to the 2005 Toxics Emissions Inventory, Wheelabrator emits pollutants including air toxic metals, hydrogen chloride, dioxins and furans. Each boiler stack is equipped with a continuous emission monitoring system and a continuous opacity monitoring system. The quenched bottom ash is transported via a drag conveyor to an ash handling room. The ash is loaded into containers and stored under cover until it is transported for disposal in a landfill. Wheelabrator is considered a major source of air emissions in accordance with the CAA and has a Title V Operating Permit (2).

APC Paper Company, Inc. (APC Paper) is located at 130 Sullivan St., in Claremont, New Hampshire. The site is located approximately 1 mile west of City Hall in Claremont. APC produces various grades of all-natural papers derived from recycled paper (old corrugated containers and newsprint). This recyclable paper feedstock is re-pulped and processed onsite using refiners, screens, and cleaners. A paper machine then forms and dries the material into finished “bag grade” paper products (3).

Steam for the pulping, papermaking, and building heat is provided by two Riley Stoker boilers. The #6 fuel oil boilers emit criteria pollutants including particulate matter, SO_2 and NO_x and air toxics. The paper machine also emits VOCs. The boilers and paper machine operate without any pollution control equipment. APC Paper is considered a “major source” of air emissions in accordance with the federal Clean Air Act, and therefore requires a Title V Operating Permit (3).

Sturm, Ruger & Company, Inc. (Sturm Ruger) operates a firearms manufacturing facility on 411 Sunapee Street in Newport, New Hampshire. Sturm Ruger manufactures a variety of investment castings for the firearm industry and other industrial clients. Manufacturing operations include, but are not limited to: wax pattern making, wax pattern cleaning, mold forming, dewaxing, steel melting and pouring, casting cleaning, mold recycling, shell removal, cutting, grinding, tempering, heat treating, wood gunstock coating, and assembly. Sturm Ruger operates several small boilers and three emergency generators to produce building heat and support the manufacturing operations. The Sturm Ruger facility originally was considered a major source of air emissions in accordance with the Clean Air Act and held a Title V Operating Permit. However, Sturm Ruger has since chosen to limit their facility-wide potential emissions through enforceable permit conditions and became minor source. Sturm Ruger operates several bag houses to minimize the emissions of PM and a packed bed scrubber to control emissions of regulated toxic air pollutants (RTAPs) (4).

Ruger Titanium (Ruger) operates a titanium investment casting operation in buildings 5, 6 and 11 of the Dorr Business Center located at 529 Sunapee Street, Newport, NH. The Dorr Business Center consists of 11 connected buildings that formerly housed Dorr Woolen (a textile manufacturing and finishing facility). Dorr Woolen shut down in November 2003, but continued to operate their four Dillon boilers during the heating season. In 2004, these boilers were converted from burning #6, to #2 fuel oil. The fuel change resulted in emissions below the permitting threshold. Ruger’s additional firing ovens and cutting, blasting and grinding operations utilize afterburner and dust collector pollution control devices to minimize the emissions of toxic air pollutants (5).

Ascutney Mountain Resort is a ski and recreational resort located on Hotel Road in Brownsville, Vermont. Ascutney Mountain Resort operates three diesel air compressors and several propane-fired heating units. These devices emit criteria pollutants including nitrogen dioxide, sulfur dioxide, PM, and carbon monoxide as well as VOCs (6).

Churchill Coatings Corporation (Churchill Coatings) owns and operates a clapboard painting facility located at the Precision Drive Industrial Park in North Springfield, Vermont. Churchill Coatings was formerly known as Prestained Lumber Products, Inc., prior to its change in ownership. Churchill Coatings' two roll-coating machines apply primer and/or paint to clapboards and wood trim products used predominantly in residential building construction. Churchill Coatings' coating operation is the sole regulated source of air contaminant emissions (VOCs). Several small, residential-sized fuel oil and propane furnaces are also used to provide space heat during winter (7).

Kiosko, Inc. currently operates a woodworking facility that manufactures kiosk components located at 36 Precision Drive in North Springfield, Vermont (formerly Great Brook Furniture). Kiosko moved from their 10 Precision Drive address to this new location in 2006. While occupying the old location, Kiosko operated a #2 fuel oil/wood waste Hurst boiler, and a spray booth. Wood dust was controlled with a fabric filter dust collector and spray booth emissions were limited with paper filters. The former processes emitted criteria pollutants including nitrogen dioxide, sulfur dioxide, PM, and carbon monoxide as well as VOCs. Manufacturing activities at the new location, however, no longer require an air pollution permit because the facility no longer operates a boiler, and has updated its fabric filters, and has limited use of its spray booth (8,9).

Homestead Industries, Inc. (Homestead), located on Sullivan Street in Claremont, NH, was a wool/fabric manufacturing company that went out of business in 1998. Homestead had a permit to operate a boiler that has since been removed from the facility at the closing auction. According to 2001 DES inspection records, Stan & Sons New and Used Fixtures d/b/a Homestead, which refurbishes refrigeration equipment from grocery stores and restaurants, was operating at the site. At the time of inspection, Homestead was not required to obtain an air permit from DES since the boiler had been removed from the site. (10).

Fellows Corporation (Fellows) manufactured gear-shaping and measuring machines, cutting tools, comparators at its Precision Drive facility in North Springfield, Vermont until 2002. The processes conducted at the facility included general metal working and milling, welding, salt bath heat treating, and parts coating. In addition, two Cleaver Brooks #6 fuel oil-fired boilers provided building heat which resulted in criteria air pollutant emissions. Hazardous Air Pollutants (HAPs), as defined in the federal Clean Air Act, were emitted from the coating and heat treating processes. Fellows operated a water-type particulate control system to treat VOCs from coating as well as dust collectors/electrostatic precipitators to control metal dusts. A March 2005 air inspection verified that Fellows was no longer operating it process equipment, but continued to operate the boilers for minimal building heat (11, 12).

Monadnock Forest Products is a saw mill that produces cut hardwood lumber. MFP is located on 289 River Road in Claremont, NH. Monadnock Forest Products uses a Caterpillar diesel

generator to provide primary electrical power for the sawmill operation. As of 2003, the facility was no longer required to obtain an air permit (13).

Luzenac America (Luzenac) operated a talc ore refining operation on Route 44 in West Windsor, Vermont until mid 2004. The facility produced cosmetic grade talc powder. Luzenac's emission of criteria air pollutants (mostly particulate matter), was generated from onsite transportation of talc ore, as well as various milling, refining and drying steps. Particulate matter emissions were controlled using fabric filters (bag houses). Luzenac was sold to Williams & Company Mining Inc. in August, 2004. According to Vermont State records, the facility is currently unoccupied (14, 15, 16).

Springfield Hospital owns and operates an acute care hospital located at 25 Ridgewood Road in Springfield, Vermont. Emission sources at Springfield Hospital include two #4 fuel oil fired Johnson boilers, a Caterpillar diesel emergency generator, and an emergency water pump, laboratory exhausts, and four steam sterilization systems (for medical instruments). The aforementioned processes emit criteria air pollutants (nitrogen dioxide, sulfur dioxide, particulate matter, carbon monoxide) as well as small amounts of hazardous air pollutants including VOCs. Overall emissions are controlled by fuel usage and hours of operation limitations specified in Springfield Hospital's operating permit (17).

Connecticut River Development Corporation operates a heating plant at 28 River Street in Windsor, Vermont that provides heat for a variety of businesses tenants including a small woodworking shop and storage space. Currently, Connecticut River Development Corporation utilizes two #2 fuel oil-fired and four propane-fired radiant heaters. Prior to September 2000, a much larger #6 fuel oil-fired boiler was also in operation. The heating units have no pollution control devices, but are limited by the type and amount of fuel that can be burned annually in the facility's operating permit. The units emit criteria air pollutants (nitrogen dioxide, sulfur dioxide, particulate matter carbon monoxide) as well as VOCs (18, 19).

Grissom & River, LLC, (Grissom & River) is located on River Road in Claremont, NH. Grissom & River operates two oil-fired Bigelow boilers which supply heat to two business tenants: Eastern Bridge, LLC, and Sullivan Palatek. In 2004, Grissom & River renewed its State Permit to Operate, which stipulated the use of #4 (or higher grade) fuel oil, with a combined annual fuel consumption restriction of 600,000 gallons for both boilers. The units emit criteria air pollutants (nitrogen dioxide, sulfur dioxide, particulate matter carbon monoxide) as well as VOCs (20, 21).

Pike Industries, Inc. (Pike) operates a hot mix asphalt batch plant (#BP816) located on Ryder Corner Road in Newport, NH. BP816 was installed in 2000 and is located on 3-acres leased from Carroll Concrete/Newport Sand & Gravel. Pike utilizes an aggregate storage and handling system, an aggregate dryer, and hot oil heaters to make hot mix asphalt. The oil heaters burn #2 fuel oil and the aggregate dryer on-specification used oil. Pike operates and maintains a baghouse to minimize the emissions of particulate matter and toxic metals to meet permit conditions. The baghouse is fully operational at all times when #BP816 is operating (22).

Crown Point Cabinetry (Crown Point) manufactures custom kitchen, office, library, and bedroom cabinetry at its 462 River Road facility in Claremont, NH. In February 2005, CPC

discontinued operations at the former 153 Charlestown Road location in Claremont and moved to the River Road location. Dust from cutting, drilling, and sanding operations is controlled with a baghouse. Crown Point's coating process equipment (spray booths and coating machine and dryer) utilize a continuously-operated particulate filter system to control emissions. Crown Point also operates propane-fired boilers which supply heat for an oven that dries the coated wood (23).

Tanx, Inc. (Tanx) manufactured above-ground and underground storage tanks as well as tank "stacks" at 30 Crescent Street in Claremont, NH. The facility's welding, coating, and paint spraying operations emitted toxic air pollutants including styrene and other VOCs. Tanx's compliance status in 2001 resulted in the issuance of an administrative fine for alleged violations. Tanx subsequently ceased operation in 2002 (24).

Central Vermont Public Service Corporation - Unit #4 operates a standby electric power generating station on Route 131 in Ascutney, Vermont. Central Vermont Public Service Corporation operates a General Electric #2 oil-fired combined cycle gas turbine to generate electric power. The turbine emits criteria air pollutants and VOCs. Although the unit has no pollution control equipment, Central Vermont Public Service Corporation's air permit limits the sulfur content of the #2 fuel oil and limits the amount of fuel that can be burned annually (25).

Jones & Lamson Vermont Company (Jones & Lamson) owned the building located on 160 Clinton Street in Springfield, Vermont until late 2002. Prior to Jones & Lamson ownership, machine tool manufacturing operations were conducted onsite. Upon purchasing the property, Jones & Lamson operated the two #6 fuel oil-fired Dillon boilers for heating purposes. The boilers emitted criteria air pollutants and did not have any pollution control devices. According to available records, Jones & Lamson's emissions ceased in 1998. Jones & Lamson later sold the building around 2002 (26, 27).

Bryant Grinder Corporation (Bryant Grinder) operated a machine tool manufacturing company on 257 Clinton Street in Springfield, Vermont from 1910 until 2002. Bryant Grinder's manufacturing operations included metal fabrication, surface finishing (sandblasting), and spray paint coating. These processes combined with three #2 fuel oil-fired boilers emitted criteria air pollutants including nitrogen dioxide, sulfur dioxide, particulate matter, and carbon monoxide as well as VOCs and hazardous air pollutants. Minimal VOC emissions were also produced by three mineral spirits parts cleaners. Particulate emissions from sandblasting operations were controlled by a dust collector. A scrubber system was also utilized to limit emissions from the coating processes. Bryant Grinder operated until early 2002 (28, 29, 30).

Windsor Technology Park, located at 7 Everett Lane in Windsor, Vermont was formerly occupied by Cone-Blanchard Machine Company. Cone-Blanchard operated at the site until approximately 1995. Windsor Technology Park is a small business storage space that burns #2 heating oil in a boiler to provide space heating for tenants (31).

Customized Structures, Inc. (Customized Structures) manufactures custom modular, wood frame houses. Customized Structures constructs each house frame, installs electrical wiring, plumbing, sheet rock, insulation, and applies paint onsite. Customized Structures was founded in 1985 on Plain Road in Claremont, but later moved to 272 River Road site in 2003; formerly

occupied by Tambrands, Inc. Customized Structures heats its facility with three #4 fuel oil-fired boilers previously owned/utilized by Tambrands, Inc. The boilers emit criteria air pollutants and do not require pollution control equipment. The onsite spray booth also does not require an air permit (32, 33).

Sullivan Palatek manufactures portable air compressors and track drills on River Road in Claremont, NH. Sullivan Palatek leases its manufacturing space from Grissom & River, LLC, which shares the same building. Sullivan Palatek tests their fully-assembled diesel engine driven air compressor on test stands at the facility. Sullivan Palatek also spray-coats metal parts and bonds metal housings/small parts onsite. These processes emit criteria air pollutants, VOCs, as well as toxic air pollutants. Sullivan-Palatek was issued a DES air permit in July 2003 (34).

Lovejoy Tool Company, Inc. (Lovejoy) located on 133 Main Street in Springfield, Vermont, manufactures milling cutters and accessories. The facility emits particulate matter from grinding/cutting/milling processes which are controlled by a dust collector. Lovejoy also utilizes one onsite #4 fuel oil-fired boiler to heat the building and a heat treating oven operated on liquefied petroleum gas to prepare metal parts for quenching. These processes emit criteria air pollutants including oxides of nitrogen and sulfur dioxide. Lovejoy also emits small amounts of VOCs from the solvents, coolants, and other chemicals used onsite (35).

Newport Mills is a former textile mill located on 169 Sunapee Street in Newport, NH. A portion of the building is currently leased by a machine shop, with the remaining portion leased to Sturm Ruger as a warehouse for storage purposes. Newport Mills heats the building with two Dillon wood-fired boilers that emit criteria pollutant emissions including oxides of nitrogen and particulate matter (36).

Valley Regional Hospital is a nonprofit community hospital located on 243 Elm Street in Claremont, NH. The facility operates two boilers to heat the facility. Valley Regional Hospital also retains two permitted emergency back-up generators as an alternate power source during outages. All four units currently utilize #2 fuel oil as a fuel source, however, prior to 2002, the boilers used #4 fuel oil. The facility emits small amounts of criteria air pollutants including oxides of nitrogen (37, 38).

Grobet File Company (Grobet File) located on 957 Claremont Road in Charlestown, NH ceased operation in 2002. Grobet File manufactured carbide rotary tools, charcoal blocks, pencils, and metal tweezers. Grobet File utilized two Cleaver Brook #2 fuel oil- fired boilers to heat the facility. A November 2000 DES facility inspection revealed that Grobet File's manufacturing processes also emitted regulated air toxic pollutants and VOCs. As a result, DES requested that Grobet File evaluate the level of pollutants emitted by the facility. This evaluation was never completed, and facility operations ceased in September 2002 (39).

Vermont Machine Tool Corporation operates a machine shop that remanufactures and retrofits machine tools located at 65 Pearl Street in Springfield, Vermont. Vermont Machine Tool Corporation operates a hard-chromium electroplating tank, a spray booth, three parts cleaning units, acid/caustic tanks, and nine propane-fired space heaters. The facility emits criteria air pollutants as well as hazardous air pollutants including hexavalent chromium, and VOCs.

Chromium compound emissions are controlled by a fume suppressant to maintain the surface tension in the chrome plating bath (40).

Newport Sand & Gravel Company, Inc. operates a sand and gravel crushing operation located on Reeds Mill Road in Newport, NH. The facility produces particulate matter emissions from crushing operations and vehicular road travel onsite. These emissions are controlled by a fugitive emission control system. Roads are also sprayed with water to control dust within the property boundaries. Newport Sand & Gravel Company, Inc**.** was issued a state permit to operate in September 2005 (41).

Springfield Electroplating Company (Springfield Electroplating) operates a facility at 135 Main Street in Springfield, Vermont that anodizes and plates chrome, nickel, copper, and zinc onto metal parts. Springfield Electroplating also operates a wastewater evaporator to reduce the volume of hazardous waste liquid, a spray booth to coat parts, and a #2 fuel oil-fired boiler for process and space heat. The chromium electroplating tanks are equipped with a packed-bed dry scrubber and high efficiency particulate air (HEPA) filter to limit hexavalent chromium emissions. Springfield Electroplating's boiler emits criteria air pollutants and VOCs. Coating, degreasing and plating operations primarily emit hazardous air pollutants including nickel compounds, hydrogen chloride, nitric acid, zinc compounds, and copper compounds (42, 43).

Ellsworth Ice Cream operated at 45 Fairbanks Road in North Springfield, Vermont from 2003 until 2006. The facility was formerly owned and operated by Ben & Jerry's Homemade, Inc. (B&J). According to records, the site operated two #2 fuel oil-fired Bryan boilers for heating purposes resulting in emissions of small amounts of criteria air pollutants including oxides of nitrogen, SO_2, particulate matter, carbon monoxide and VOCs. EIC closed, and all equipment was auctioned off in December of 2006 (44, 45).

Whelen Engineering Company located on 99 Ceda Road in Charlestown, NH manufactures lighting and warning safety devices. According to DES records, Whelen Engineering Company obtained a permit for its one Caterpillar emergency back-up generator used for an alternate power source during outages. The facility emits small amounts of criteria air pollutants including oxides of nitrogen (46).

3.2 Sources of Emissions

DES routinely tracks the quantity of air pollutants emitted by all NH permitted stationary sources as part of its annual emissions inventory (examples of these pollutants include: particulate matter, oxides of nitrogen, sulfur dioxide, carbon monoxide and regulated toxic air pollutants). Because these air emissions are measured at the source, they do not directly reflect potential exposure levels in surrounding areas such as Claremont. Quantifying exposure levels attributable to a particular facility's emissions is further complicated by the presence of other sources of air pollutant emissions in the area including non-permitted industrial facilities, aircraft, trains, wood-burning stoves, home heating systems, and automobiles. Table 3-1 presents a list of 32 permitted air emissions sources located within a 15-mile radius of the DES monitoring site, along with their total emissions quantities from 1994 through 2005. (Table 3-1 does not include sources outside the 15-mile radius). The last three lines of Table 3-1 present the percentage of emissions from Wheelabrator and APC Paper as well as the remaining 30 permitted sites within a 15 mile

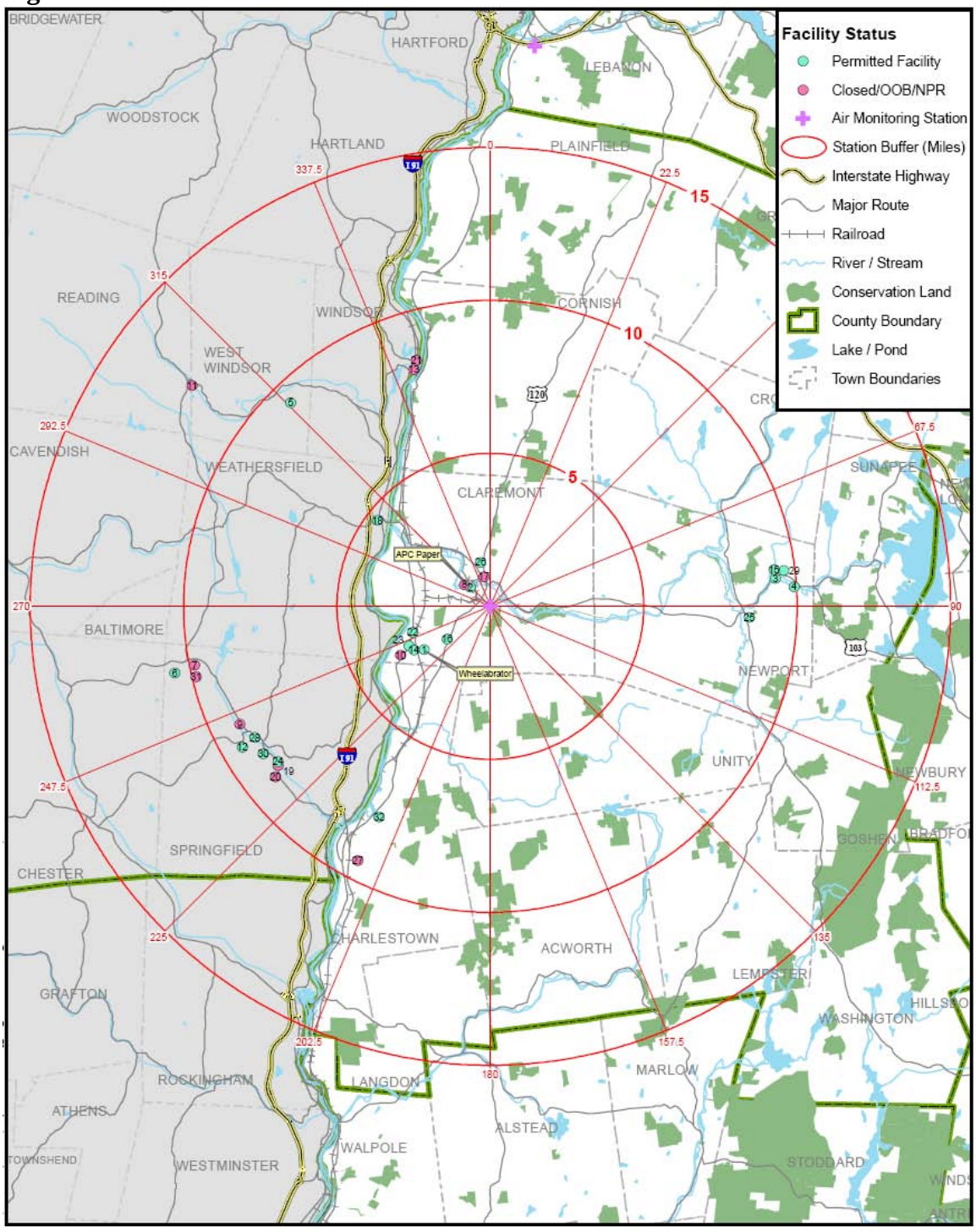
radius. Wheelabrator and APC Paper's total emissions during the twelve-year period (26.4% and 24.2% respectively), represent more than half of the total air emissions from permitted sources combined (47). The geographic location of each facility is presented in Figure 3-1. Each facility's location is keyed to its "Map Number" in Column 1 of Table 3-1.

Table 3-1. Emissions Inventory (tons per year) of permitted emissions sources within 15 mile radius of the Claremont Monitoring Station 1994-2005 (6).

#	Facility Name	*Total Emissions	Status
1	WHEELABRATOR CLAREMONT COMPANY	2969.7	Open
2	APC PAPER COMPANY INC	2722.6	Open
3	STURM RUGER & COMPANY INC	1227.3	Open
4	RUGER TITANIUM (Formerly DORR WOOLEN)	909.4	Open
5	ASCUTNEY MOUNTAIN RESORT	529.8	Open
6	CHURCHILL COATING CORPORATION	472.1	Open
7	KIOSKO, Inc.	446.5	NPR '04
8	HOMESTEAD INDUSTRIES INC	282.0	Closed '98
9	FELLOWS CORP. (North Springfield)	212.1	Closed '02
10	MONADNOCK FOREST PRODUCTS INC	162.7	NPR'03
11	LUZENAC AMERICA (West Windsor)	150.5	Closed '04
12	SPRINGFIELD HOSPITAL	111.2	Open
13	CONNECTICUT RIVER DEVELOPMENT CORPORATION	109.5	NPR'02
14	GRISSOM & RIVER LLC	106.4	Open
15	PIKE INDUSTRIES INC (Newport)	106.4	Open
16	CROWN POINT CABINETRY	95.2	Open
17	TANX INC	89.6	Closed '02
18	C.V.P.S.C. -(UNIT 4, Ascutney)	81.8	Open
19	JONES & LAMSON VERMONT CORP.	77.9	Closed '98
20	BRYANT GRINDER CORP.	59.7	Closed '02
21	WINDSOR TECHNOLOGY PARK	52.4	Open
22	CUSTOMIZED STRUCTURES INC (Formerly TAMBRANDS)	51.5	Open
23	SULLIVAN-PALATEK INC	43.4	Open
24	LOVEJOY TOOL COMPANY	41.1	Open
25	NEWPORT MILLS INC	34.9	Open
26	VALLEY REGIONAL HOSPITAL	29.9	Open
27	GROBET FILE COMPANY	24.3	Closed '02
28	VERMONT MACHINE TOOL (estimate)	22.7	Open
29	NEWPORT SAND & GRAVEL	21.0	Open
30	SPRINGFIELD ELECTROPLATING (estimate)	15.9	Open
31	ELLSWORTH ICE CREAM, Inc. (2004 only)	6.3	Closed '04
32	WHELEN ENGINEERING COMPANY (Previously PRECISION ASSEMBLIES CORP)	3.1	Open
WHEELABRATOR (% of air emissions - permitted sources)		26.4%	
APC PAPER (% of air emissions - permitted sources)		24.2%	
Remaining 30 (% of air emissions permitted sources)		49.5%	

*** - Total emissions figure is comprised of sulfur dioxide, oxides of nitrogen, carbon monoxide, particulate matter, & hazardous air pollutants**
NPR - No Permit Required

Figure 3-1.



Location of Permitted emissions sources near Claremont, NH

3.3 Other Potential Air Emission Sources – Backyard Burning

People usually burn their trash either because it is easier than hauling it to the local disposal site, or to avoid paying for regular waste collection service. Household burn barrels primarily used to burn trash receive limited oxygen, and thus burn at fairly low temperatures (48). Consequently, a great deal of smoke and other air pollutants are formed including: carbon monoxide, dioxin, heavy metals (i.e., arsenic, cadmium, chromium, copper lead, and mercury), oxides of nitrogen, particulate matter, polycyclic aromatic hydrocarbons, sulfur dioxide, VOCs, and ash (49).

Backyard burning is especially dangerous to human health because it releases air pollutants at ground level where they are readily inhaled or incorporated into the food chain (48). Pollutants such as dioxin and particulate matter released into the air through backyard burning can also settle on plants. These affected plants can then be eaten by residents, as well as meat and dairy animals, which store the dioxins in their fatty tissue (50). Pollutants may also seep from the resultant ash into surface water, groundwater, and food grown in ash-contaminated soil (49). Children playing in a yard or garden where ash is present can also incidentally ingest soil containing the pollutants (50). Open burning of residential trash materials was prohibited by law in New Hampshire, effective January 1, 2003 (51).

Due to poor combustion characteristics and lack of air pollution control equipment, burning trash in a burn barrel emits greater amounts of air pollution than equivalent amounts burned in a properly controlled municipal waste combustor (49). This knowledge was broadened in a 1999 EPA study. The EPA analysis estimated how many open-burning households it would take to equal the amount of dioxins/furans emitted by a moderately sized municipal waste combustion facility. The report found that about 3-37 households (depending on recycling efforts) burning their trash daily in barrels can produce average dioxin/furan emissions comparable to a modern 200 ton/day MWC facility capable of serving thousands of households (52).

In 2001 and 2004, NH DES gathered information from NH fire wardens regarding household trash burning. The survey results were used to assess the impact of a 2003 law prohibiting open burning of residential trash materials (53, 54). The survey results for Claremont indicate that 180 residential burn permits were issued in 2000, with approximately 20 additional homes burning without a permit (53). In 2004, the Claremont Fire Warden claimed that strict enforcement of the 2003 law eliminated the problem of backyard burning in Claremont (54). Conversely, a review of the DES Air Resources Division complaint log revealed that seven complaints were received regarding trash burning in indoor wood stoves; a practice not prohibited by law (55). This evidence suggests that residential trash burning is still occurring, albeit indoors.

3.4 Site History – Wheelabrator & APC Paper Company

Wheelabrator was first issued a construction permit in 1986 and most recently obtained a Title V Operating Permit in June 2004 to operate its two waterwall boiler units. Emissions from the combustion process are currently controlled using the following technologies; 1) an Evaporative Cooling System and Powdered Activated Carbon Injection System (PACIS) to control mercury and dioxin/furan emissions; 2) a Wet-Lime Injection Scrubber to reduce sulfur dioxide and acid gas emissions; and 3) Ryton Fabric Filters to control particulate matter (PM). Prior to this 2005

pollution control equipment upgrade required by federal regulations, the Wheelabrator site utilized a Thermocouple system, a Dry-Lime Injection Scrubber, and fabric filters to control air pollutant emissions (2).

As required by existing DES permits, the Wheelabrator site continuously monitors carbon monoxide (CO) oxygen, SO_2, particulate matter (by measuring opacity), as well as the PACIS carbon feed rate into the flue gas stream, steam flow, and temperature of the flue gas stream at the inlet of each baghouse. (2).

All monitoring information, monthly MSW combustion data, and other operational data are maintained in facility records in accordance with State and Federal requirements. In the event that monitored emissions exceed permitted thresholds, the Wheelabrator site must submit a permit deviation notification within 24 hours of occurrence. Follow-up reports must be submitted to DES within 10 days of the event. The notification and reports are reviewed and logged into a database that DES maintains for permitted sources of air pollution in New Hampshire (56). If appropriate, enforcement action may be taken.

DES oversees and witnesses the performance of annual "relative accuracy test audits" and audits facility records in order to ensure the accuracy of the Wheelabrator's continuous emissions monitoring system. DES also conducts full "Compliance Evaluations" at least every two years, witnesses annual compliance stack tests and reviews resultant stack test reports for accuracy. In addition to maintaining compliance with various State and Federal air quality regulations and permits, the Wheelabrator site is required to comply with the Mercury Reduction and Control Program specified in NH RSA 125-M (56).

APC Paper Company has been permitted since 1972 and obtained a Title V Operating Permit in February 2006 to operate its two Riley Stoker boilers and paper machine. The Title V Operating Permit specifies that APC shall comply with the National Ambient Air Quality Standards (NAAQS), limits #6 fuel oil sulfur content, stipulates a threshold on fuel oil use, and limits VOC emissions from its paper machine. APC's permit also requires annual boiler efficiency tests and facility-wide opacity tests (measure of PM). In addition, APC must adhere to stipulated record keeping and reporting requirements, and retain all required monitoring data records and supporting information onsite. DES also conducts full onsite "Compliance Evaluations" at least every four years as well as offsite records inspections (3).

3.5 DES Ambient Air Monitoring

In 1989, DES began monitoring criteria pollutants (PM, O_3, and SO_2) in the ambient air surrounding the Claremont area to ensure compliance with the National Ambient Air Quality Standards (57). Between 1999 and 2002, DES also began monitoring regulated toxic air pollutants including metals, carbonyls and VOCs. Ambient air monitoring is also used to assess potential impacts to human health and environmental quality in surrounding areas. The location of air monitoring stations is determined by a number of factors including air dispersion modeling analyses conducted by DES, logistics of access, security, and accessibility to electrical power. These monitoring data reflect the cumulative emissions from all local sources (e.g., businesses, oil/wood home heating, cars, trains, and backyard burning) and distant sources (e.g., power plants & metropolitan areas) (58). The current evaluation is based on data from the South Street

air monitoring station located in the southeast section of Claremont. South Street is the only air monitoring station currently in operation within the Claremont vicinity.

3.6 Land Use and Demographics

Claremont is a city located along the Connecticut River in Sullivan County in the western part of NH. It is the largest incorporated place in Sullivan County, and ranks 19th in population size among cities and towns in NH (59). There are four main arteries for traffic traveling through the center of Claremont including: 1) Route 120 from the north; 2) Routes 11 & 103 from the east; 3) Routes 12 & 11 from the south; and 4) Routes 12 & 103 from the west. Claremont is bounded on the north by Cornish, west by the State of Vermont, south by Charlestown and Unity, and east by Newport (60).

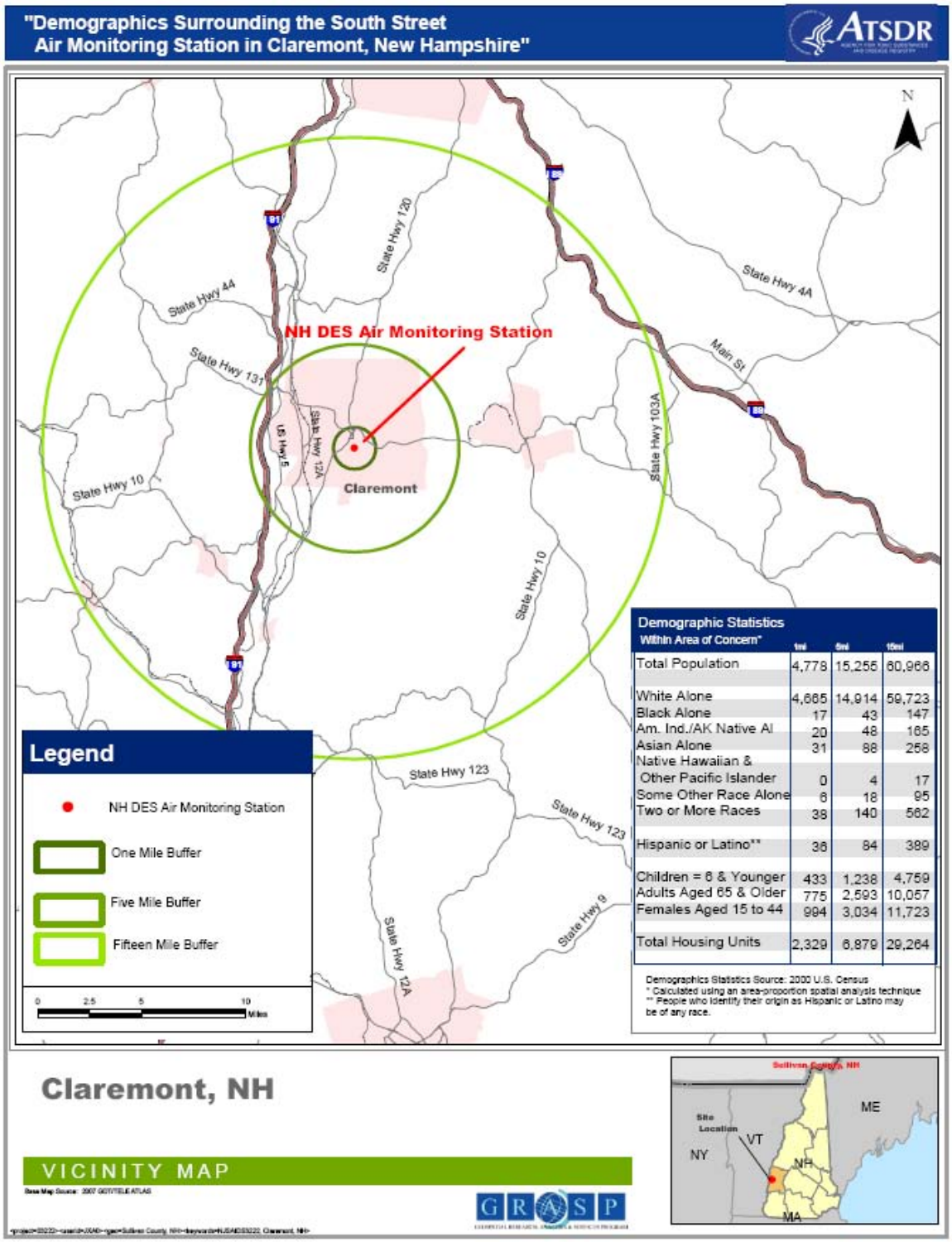
According to the 2000 US Census (Table 3-2), the population of Claremont is 13,151 (60). There are approximately 4778 people living within a 1-mile radius of the South Street air monitoring station and 15,255 living within a 5-mile radius (61). The city of Claremont population distribution is listed in Table 3-2.

Table 3-2. City of Claremont population by age and sex (59).

Age	Both Sexes		Sex	
	Number	Percentage	Male	Female
< 5	775	5.9%	411	364
5-14	1774	13.5%	895	879
15-44	5288	40.2%	2629	2659
45-64	3097	23.5%	1528	1569
65+	2217	16.9%	860	1357
Total	13151	100.0%	6323	6828

Source: 2000 US Census

Figure 3-2 (61).


"Demographics Surrounding the South Street
Air Monitoring Station in Claremont, New Hampshire"
ATSDR
N
NH DES Air Monitoring Station
Claremont
State Hwy 120
State Hwy 4A
State Hwy 44
State Hwy 131
State Hwy 10
State Hwy 103A
Main St
State Hwy 123
State Hwy 9
State Hwy 12A
US Hwy 5
91
89
Legend
NH DES Air Monitoring Station
One Mile Buffer
Five Mile Buffer
Fifteen Mile Buffer
0 2.5 5 10 Miles
Demographic Statistics
Within Area of Concern*
1mi 5mi 10mi
Total Population 4,778 15,255 60,966
White Alone 4,665 14,914 59,723
Black Alone 17 43 147
Am. Ind./AK Native Al 20 48 165
Asian Alone 31 88 258
Native Hawaiian & Other Pacific Islander 0 4 17
Some Other Race Alone 6 18 95
Two or More Races 38 140 562
Hispanic or Latino** 36 84 389
Children = 6 & Younger 433 1,238 4,759
Adults Aged 65 & Older 775 2,593 10,057
Females Aged 15 to 44 994 3,034 11,723
Total Housing Units 2,329 6,879 29,264
Demographics Statistics Source: 2000 U.S. Census
* Calculated using an area-proportion spatial analysis technique
** People who identify their origin as Hispanic or Latino may be of any race.
Claremont, NH
VICINITY MAP
GRASP
Site Location
ME
VT
NY
NH
MA

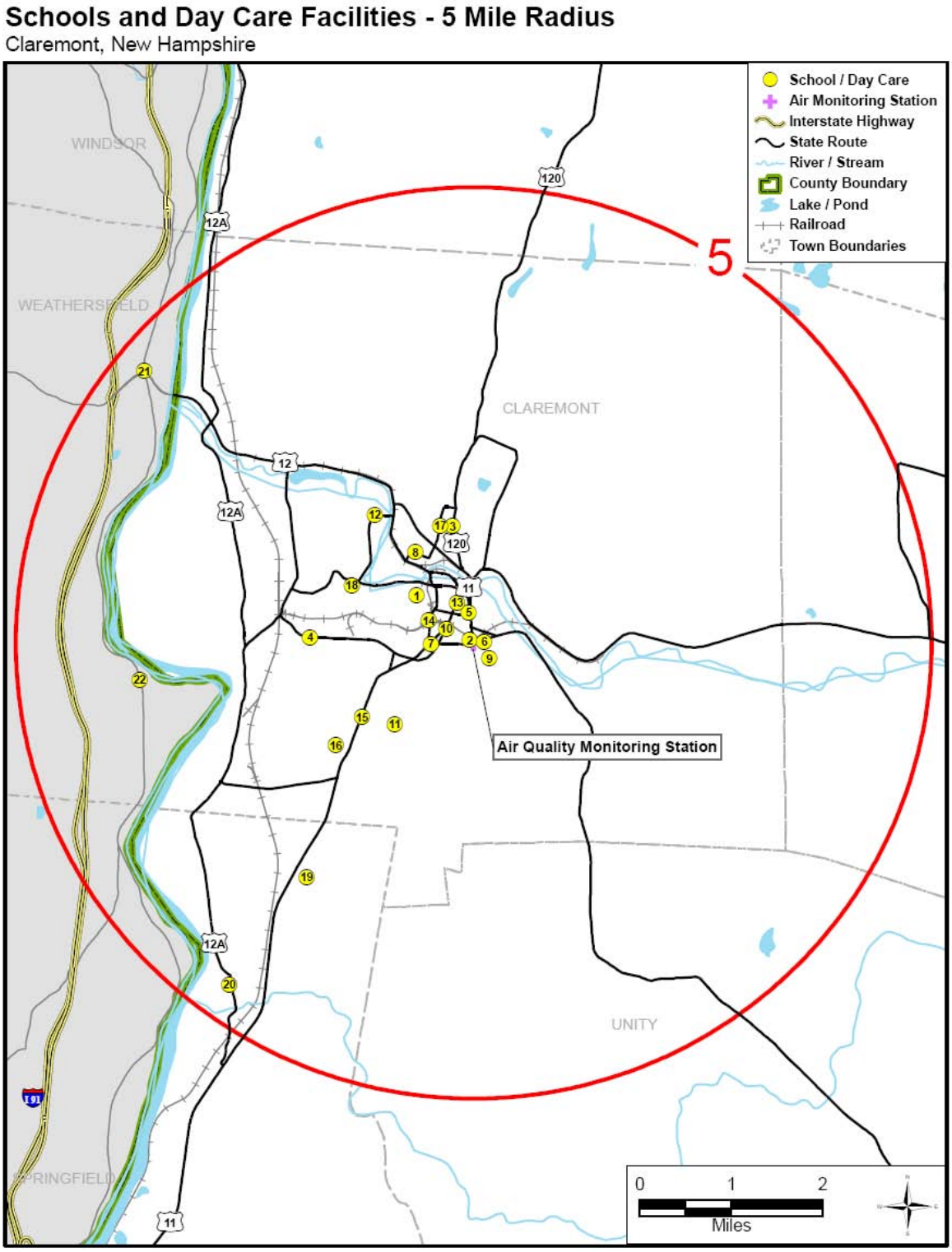
Children and senior citizens residing near the site are of special interest since they are considered "sensitive" to air pollution. That is, they may be affected by lower levels of air pollution or they may have more serious reactions to air pollutants. According to the 2000 US Census, 5.9% of the Claremont population is less than 5 years of age, while 16.9% is 65 years and older. In comparison, the statewide percentage of children less than 5 years of age is 6.1% and the percentage of adults 65 years and older is 12.0% (59).

Schools and child care facilities located near the site are listed in Table 3-3. Their geographic locations are plotted in Figure 3-3. Several parks are also located in the Claremont area including: 1) Moody Park; 2) Broad Street Park; 3) Veteran's Park; 4) Lacasse Park; 5) Barnes Park; 6) Arrowhead; 7) Factory Street Park; and 8) Monadnock Park (62).

Table 3-3. Schools and child care facilities near Claremont: 2006 (63, 64, 65, 66).

Map ID #	Facility Name	Map ID #	Facility Name
1	Bluff School	12	Picard's Family Day Care
2	Claremont Middle School	13	Pleasant Preschool
3	Disnard Elementary School	14	Smiling Faces Day Care
4	Maple Avenue School	15	Southwestern Community Service – Claremont Headstart
5	Stevens High School	16	Sunflower Child Care
6	Sugar River Valley Regional Technical Center	17	The Little Red School House of Montessori
7	Amy Tibbits Family Child Care	18	Tiny Tots of Claremont
8	Christine's Home Start	19	Wee Cater & Care
9	Claremont Parks & Recreation - Kinderfest	20	North Charlestown Community School
10	Connecticut Valley Child Care Center	21	Weathersfield Middle School
11	In the Beginning Child Care	22	Meeting Waters YMCA- Lewis Day Camp

Figure 3.3 (63, 64, 65, 66).



4.0 METHODS

This section describes the methods and data employed in this public health assessment. It begins by delineating the standard methods employed in PHAs to assess whether or not a contaminant is a potential health threat. This includes discussion of “completed exposure pathways” and their exact definition in this study. This is followed by a discussion of meteorological and environmental data: their sources, quality, and limitations. Finally, “potential pollutants of interest” are discussed in the context of DES-monitored pollutants, and air emissions of other facilities in the Claremont area.

4.1 Health Risk Assessment Methods

EHP uses a conservative, protective approach to determine whether levels of air pollution constitute a potential health hazard. In general this involves a two-step methodology that is used to evaluate most of the potential pollutants identified in this PHA. First, air monitoring data are gathered and a comprehensive list of site-related pollutants is compiled. Second, health-based comparison values (CVs) are used to identify pollutants that do not have a realistic possibility of causing adverse health effects. These are eliminated from further analysis. The remaining contaminants are deemed “pollutants of interest” and subjected to thorough scientific literature reviews to determine whether or not their levels present a public health hazard (67).

The CVs used in this report represent concentrations of contaminants that current scientific literature concludes are "harmless." CVs are conservative, and include ample safety factors in consideration of sensitive populations such as children, the elderly, and those with chronic respiratory disease. Therefore, CVs are protective of public health in the vast majority of exposure situations. If a contaminant level is lower than its CV, it is unlikely that harmful effects will result, and is eliminated from further analysis. If a pollutant exceeds its CV one or more times over the monitoring period, it is designated a “pollutant of interest” and examined in greater detail. This includes a comparative analysis and a thorough scientific literature review to determine whether or not its level presents a public health hazard. Because CVs are based on conservative assumptions, the presence of concentrations greater than a CV does not necessarily indicate that adverse health effects will occur among exposed populations (67).

Specific CVs used in this report include ATSDR Minimum Risk Levels (MRLs) for chronic inhalation, ATSDR Cancer Risk Evaluation Guides (CREGs), as well as EPA’s chemical-specific Reference Concentrations (RfCs), Reference Doses (RfDs), Lowest-Observed-Adverse-Effect Levels (LOAELs), and Cancer Slope Factors (CSFs). A MRL is an ATSDR estimate of daily human exposure to a dose of a chemical that is likely to be without an appreciable risk of adverse noncancerous effects over a specified duration of exposure. CREGs are estimated contaminant concentrations in a specific medium (i.e., air) which are estimated to result in one excess cancer per one million persons exposed over a lifetime. RfDs and RfCs are analogous to ATSDR MRLs. They are estimates of daily human exposure to a contaminant that are unlikely to result in adverse non-cancer health effects over a lifetime. LOAELs are the lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in humans or animals. Lastly, CSFs aid in the determination of a theoretical estimate of lifetime cancer risk associated with exposure to a “known”, “probable”, or “possible” human carcinogen. When there

is no established MRL, CREG, RfC, RfD or CSF, other sources for comparison can be used (e.g., regulatory values or reporting conventions such as the Air Quality Index) (67).

The CV comparison methodology is employed in this PHA for all potential pollutants. When a pollutant has no traditional CV (e.g., O_3, $PM_{2.5}$, and NO_2), EPA's Primary National Ambient Air Quality Standards (NAAQS) and Air Quality Index (AQI), as well as other state (i.e., California & Connecticut) and international (i.e., Canada) standards are employed for comparative purposes. Primary NAAQS set limits to protect public health, particularly sensitive groups such as children, the elderly, and those with asthma or other respiratory disease. The AQI is used for forecasting various levels of air quality. When ozone or $PM_{2.5}$ is predicted to reach a level that is "unhealthy for sensitive groups", DES declares an Air Quality Action Day to alert the public and encourage members of sensitive groups to take precautions to protect their health. The focus of these alerts is usually on regional events, not local pollution events.

4.2 Pathways of Exposure

Environmental contamination cannot affect a person's health unless there is a "completed exposure pathway." A completed exposure pathway exists when all of the following five elements are present: 1) a source of contamination; 2) transport through an environmental medium; 3) a point of exposure; 4) a route of human exposure; and 5) an exposed population. These five elements do not define exposure; rather they contribute to determining the probability of exposure (67).

The primary completed exposure pathway in this PHA is based on the following: 1) sources of contamination (all local and regional sources of air pollution, including Wheelabrator, APC, and 30 other sites); 2) transport through an environmental medium (ambient air); 3) a point of exposure (center Claremont is the only point of exposure considered in this PHA); 4) a route of human exposure (respiration/breathing); and 5) a receptor population (residents of the Claremont area). For purposes of this PHA, the South Street air monitoring station is assumed to be the surrogate for a human "receptor" that completes the exposure pathway.

An additional completed exposure pathway in this PHA is based on the ingestion of fish contaminated with mercury. All water bodies throughout the northeastern United States are subject to mercury pollution from local, regional, and distant industrial emissions. The mercury is ingested by fish which in turn are consumed by humans. This is the pathway by which mercury becomes a potential human health risk. It cannot be determined what amount of mercury contamination in area water bodies comes from any particular source, such as Wheelabrator, but air dispersion modeling conduct by DES has predicted that there is some contribution. This is discussed in the Public Health Implications Section 6.1.5.9.

4.3 Data Sources, Quality, Limitations

This section describes the meteorological and environmental data employed in this PHA, including data sources, intervals of reporting, measurement specifications, and protocols employed to handle missing values.

4.3.1 Meteorological Data

Meteorological conditions are major determinants of variations in levels of air pollution. They can influence the distance contaminants are transported, their level of concentration, and their rates of mixing and dispersion. For example, wind direction can affect the pathway a contaminant plume travels, while wind speed may influence how far the pollutants travel and alter their dispersion rates. Table 4-1 delineates conditions that influence point-source industrial contaminant plumes and subsequent ambient pollution levels. These factors may act independently, or in interaction with others in a complex manner (68). This PHA employs meteorological (MET) data primarily from the DES monitoring station in Claremont. Additional MET data from the nearby Springfield, Vermont airport were also utilized to supplement data gaps at the Claremont location.

Table 4-1. Meteorological conditions affecting dispersion of point source emissions (68).

Conditions Affecting the Contaminant Plume	Probable Outcome
Atmospheric Stability	Stagnant inversion conditions can cause pollutant buildup
Wind Speed	Light winds mean less dispersion, more concentrated plume
Wind Direction	Wind moves pollutants away from their source, thereby increasing the downwind concentrations
Variability of Wind Direction	Consistency of wind direction causes less dispersion
Precipitation	Cleans/scavenges gases and particulates
Temperature	Affects height of plume and location of ground contact
Time of Day	Calm night time hours produce less mixing and dispersion
Stack Gas Parameters	Affect plume rise and dispersion of contaminants

4.3.1.1 *Wind direction*

"Wind direction" refers to the prevailing direction from which the wind originates (i.e., wind blowing from southwest to northeast is a southwest wind). Wind direction used in this report was recorded every minute, and then averaged for a given hour. If the average wind speed in a given hour is 0 or 1 mph, wind direction is considered "Calm". This definition of calm is based on the specific calibration of DES wind speed sensors. Table 4-2 shows the eight cardinal wind directions employed in this study, along with the range of true north degrees associated with each. A wind direction is not associated with "calm" winds.

Wind direction data employed in this study are primarily from the Claremont monitoring station. This DES monitor is centrally located in downtown Claremont where the bulk of the general population lives, attends school, and conducts business. This monitor is approximately one mile away from APC and three miles from Wheelabrator. The use of Claremont monitoring site data assures the most accurate depiction of wind direction in central Claremont.

Table 4-2. Cardinal wind directions and degree ranges.

Direction	Cardinal Format	Degree Range
North	N	338-22
Northeast	NE	23-68
East	E	69-112
Southeast	SE	113-158
South	S	159-202
Southwest	SW	203-248
West	W	249-292
Northwest	NW	293-337

4.3.1.2 *Wind Speed*

Wind speed is defined as the rate at which air is moving horizontally past a given point. It is recorded in miles per hour or knots. Wind speed data employed in this study were primarily from the Claremont monitoring site. Data were recorded every minute, and then averaged for a given hour. Wind speeds in Claremont ranged between 0-14 mph during the study period. Wind speed data were used to verify wind directions and to correlate potential pollutant transport patterns from nearby industrial sources. Specifically, wind speeds with hourly averages greater than 1 mph were utilized to ascertain wind movements.

4.3.2 Environmental Data

Environmental data are primarily from the DES air monitoring station in Claremont.
SO_2 levels in Claremont are recorded continuously on a year-round basis and are reported as hourly averages. SO_2 data for this study were from the period January 1997 through December 2001. Ozone is collected during "ozone season" (April-September) on an hourly basis and was available from 1998 through 2006. $PM_{2.5}$ daily averages are recorded every three days and were collected from the period January 1999 through December 2006. The three-day interval is in accordance with EPA's protocol for PM data. Similar pollutant data, including SO_2, ozone, and $PM_{2.5}$ from Manchester and Portsmouth were also used for comparison purposes.

Air Toxics were also collected and reported as daily averages every 12 days. Air toxics metals (e.g., cadmium) were monitored in Claremont from January 2000 until December 2004 (nickel & lead sampling was extended to July 2005)**.** Air toxics VOCs (e.g., benzene) were monitored in Claremont from August 1999 until December 2006. Air toxics carbonyls (e.g., formaldehyde) monitored in Claremont from June 2002 until May 2006. Air toxics monitoring data collected during identical time frames in Portsmouth and Manchester were also used for comparative purposes.
Environmental data were produced by DES air monitoring programs for internal use and for submission to EPA. DES uses accepted monitoring techniques, employs an extensive review process, and adheres to quality assurance and quality control (QA/QC) protocols established by DES and EPA. Thus, the quality of ambient air data is adequate to support public health decisions.

4.4 Potential Pollutants of Interest

This section contains information about potential pollutants of interest associated with facility emissions within a 15-mile radius of the Claremont monitoring station. Most of the pollutants evaluated in this PHA satisfy three criteria: 1) they are emitted from nearby facilities; 2) they are (or were) monitored at the Claremont monitoring station; and 3) they were generally detected at reportable concentrations by the analytical laboratory (69, 70). Ozone, a seasonal pollutant that originates primarily south and west of New Hampshire, is also included in the assessment. It is not a pollutant directly emitted to the ambient air but is formed by photochemical reactions in the atmosphere. Ozone is monitored at several DES stations in NH, including those in Claremont, Manchester, and Portsmouth. Mercury, dioxins/furans and nitrogen dioxide are included in the PHA because they are emitted from the largest emissions source in the area (Wheelabrator) and were an expressed community concern during DES air permit hearings and comment letters. Carbon monoxide (CO) was not evaluated because it is not monitored in Claremont, and previous ambient air dispersion modeling analyses demonstrated that CO emissions from Wheelabrator were predicted to be 0.1% of the 1-hour and 0.09% of the 8-hour National Ambient Air Quality Standard (NAAQS) (71).

Mercury in ambient air is difficult to monitor because it is present in four forms in the atmosphere: precipitation, gaseous elemental form, particulate matter form, and reactive gas-phase mercury (RGM). Each form presents its own challenges relative to sampling and analysis. This is due primarily to the low detection limit required for analysis as well as the high cost. RGM is expected to represent roughly half of what may be present, however, it is also the most costly to sample and analyze for.

Dioxin and dioxin-like compounds in ambient air are very difficult to measure and have proven to be of little value in determining source contribution or levels of human exposure. Dioxin is present in the ambient air at extremely low concentrations, so sample collection must be conducted over periods of up to 30 days in order to collect measurable amounts. In addition, ambient dioxin monitoring requires expensive, specialized air sampling equipment, and samples can only be analyzed by a handful of specialized laboratories in North America, making ambient air measurements of dioxin extremely expensive. Furthermore, dioxin monitoring studies conducted in the past have only been able to demonstrate that levels are lower in rural areas and higher in urban areas, regardless of the presence of local dioxin emitting sources (72).

Ambient air sampling and analyzing mercury, dioxins/furans and nitrogen dioxide are beyond the scope of this study. As an alternative to monitoring them directly, DES estimated their “worst-case” ambient air levels through analytical air dispersion modeling analyses. Modeling analysis data are collected as a result of the local source stack testing (monitoring) requirements stipulated by DES. Table 4-3 lists all pollutants that were analyzed in this document to assess their impact on public health.

Table 4-3. Potential Pollutants of Interest in Claremont PHA (69, 70).

Criteria Pollutants (NAAQS)	VOC Hazardous Air Pollutants (HAPS)
sulfur dioxide	ethylene
$PM_{2.5}$	chloromethane
Ozone	MtBE
nitrogen oxide	total-xylenes
	toluene
Aldehydes	methylene chloride
Formaldehyde	chloroform
Acetaldehyde	1,2-dicloroethane
Acetone	1,1,1-trichloroethane
	trichloroethylene
Core Metals	acetonitrile
Cadmium	chlorobenzene
total chromium	a-pinene
Lead	methyl ethyl ketone
Nickel	benzene
Arsenic	ethyl benzene
Mercury	p&m xylenes
	o-xylene
Other	styrene
dioxins/furans	2,2,4-trimethylpentane
	p-dichlorobenzene

All monitored pollutants were measured at South Street in Claremont, NH.
Mercury, Nitrogen Dioxide, Dioxins/Furans were modeled by DES and not monitored directly.
NAAQS = National Ambient Air Quality Standards; VOC = Volatile Organic Compounds; $PM_{2.5}$ = Particulate Matter that is 2.5 micrometers or smaller in size.

5.0 RESULTS

This section presents findings from an analysis of meteorological and environmental data related to air quality in the Claremont area. Meteorological data on wind direction and wind speed are examined to assess the potential of permitted facility emissions to be transported to the Claremont area. Air quality data from DES air monitoring stations in Claremont and other sites are analyzed to determine air pollutant levels.

5.1 Meteorological Data Analysis

As noted in the Methods section (4.0), MET conditions can influence the transport and dispersion of local sources as well as regional air pollution levels. This PHA examines the impact of wind direction and wind speed on pollutant levels monitored at South Street in Claremont. Specifically, pollutant levels that exceeded health-based CVs and/or regulatory thresholds were examined in connection with wind direction.

5.1.1 Wind Direction

The prevailing wind direction in the Claremont area is from southwest to northeast (12.4% of the time). Wheelabrator as well as fourteen (14) additional permitted facilities are located southwest of the South Street air monitor. Meteorological data from South Street for the study period 2001 through 2006 also show that winds blow in a westerly direction 10.5% of the time (73) (Table 5-1).

Table 5-1. Hourly wind direction readings: South Street, Claremont Jan 2001-Dec 2006 (73).

Wind	Number of Observations	Percent of Total
North	1792	3.8
NE	679	1.4
East	2176	4.6
SE	1978	4.2
South	1326	2.8
SW	5811	12.2
West	4999	10.5
NW	2431	5.1
Calm	25807	54.4
Missing	473	1.0
Total	47472	100%

5.2 Analysis of Environmental Data: Ambient Air in Claremont

This section presents the results of an in-depth analysis of air quality in the center of Claremont. Results are presented for each pollutant of interest including sulfur dioxide, $PM_{2.5}$, ozone, nitrogen dioxide, mercury, dioxin/furans, and 27 air toxics.

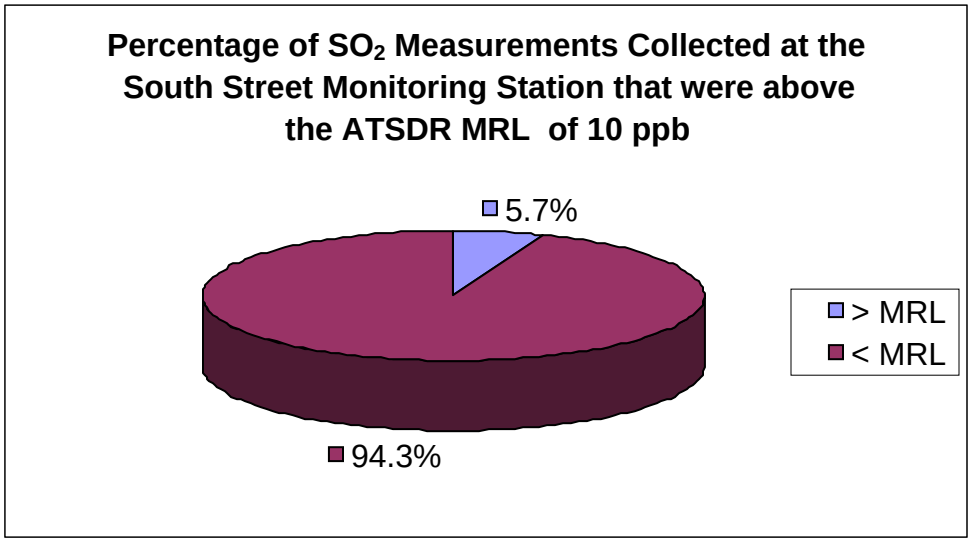
5.2.1 Sulfur Dioxide

This section presents an evaluation of ambient air concentrations of sulfur dioxide (SO_2) collected at South Street Station for the period January 1997-December 2001. The data consist of 24 separate 1-hour SO_2 measurements for each day during the five year study period (74). The data are first compared to the Agency for Toxic Substance's Minimum Risk Level (MRL) of 10 parts per billion (ppb) and the Lowest-Observed-Adverse-Effect- Level (LOAEL) of 100 ppb. The LOAEL represents the lowest level at which adverse health effects have been documented in scientific literature (75). Next, average hourly SO_2 levels at the South Street monitoring station are examined by wind direction. Finally, The South Street monitoring station data are compared to EPA's short and long-term National Ambient Air Quality Standards (NAAQS). The NAAQS designated as "primary" are employed in the analysis because they represent standards to protect public health, including the health of "sensitive populations" such as asthmatics, children, and the elderly (76).

5.2.1.1 *MRL and LOAEL Evaluation*

During the five-year study period, a total of 41,783, 1-hour sulfur dioxide measurements were collected at the South Street monitoring station. The highest and lowest 1-hour levels during the period were 66 and 0 ppb respectively. As shown in Figure 5.1, hourly SO_2 levels exceeded the 10 ppb MRL 5.7% of the time, while the 100 ppb LOAEL was never exceeded. When levels did exceed the MRL, they were an average of less than 16 ppb. A MRL is the point at which ATSDR warrants further examination of chemicals and their health effects. It is not a level at which adverse health consequences are normally expected. A LOAEL, on the other hand, is the lowest tested dose of a substance that has been reported to cause health effects (74, 75).

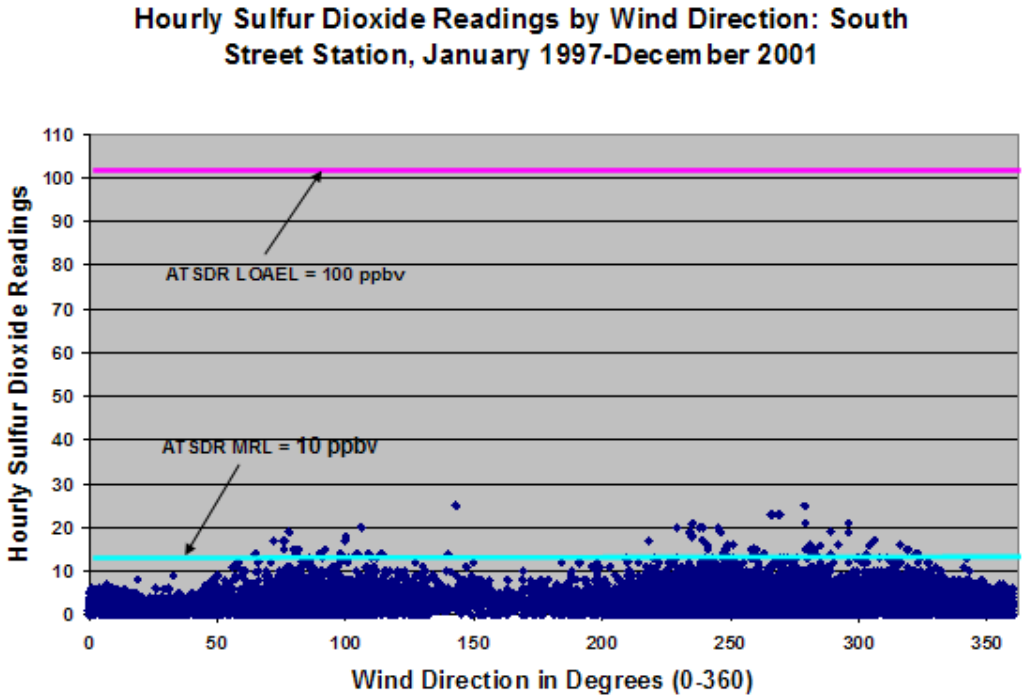
Figure 5.1 (74, 75).



5.2.1.2 *Average Hourly SO_2 by Wind Direction*

In accordance with ATSDR protocol, the occurrence of sulfur dioxide readings above the MRL prompted further examination of SO_2 in the Claremont area. Figure 5.2 illustrates the extent to which levels of SO_2 in Claremont are associated with particular wind directions. The scatter plot reveals that SO_2 levels are distributed over the entire wind direction spectrum. SO_2 levels exceeding the ATSDR MRL threshold form two broad bumps on the graph indicating that SO_2 levels are not likely associated with a specific source. Rather, SO_2 levels correlate with wide-band wind pathways, possibly originating from clusters of local, and/or regional emission sources. It is possible that ambient air pollutants such as nitrogen dioxide and air toxics behave in a similar manner (73, 74). In fact, the DES report *Air Pollution Transport and How It Affects New Hampshire* points out that "pollution generally decreases in concentration as it moves away from its source. However, when there are many sources of similar pollutants, and when conditions permit, there is a cumulative effect where the concentrations can actually build downwind (77)." Even so, SO_2 levels in Claremont are relatively low in comparison with health-based guidelines (74, 75).

Figure 5.2 (73, 74).



5.2.1.3 *South Street Monitoring Station SO_2 Levels: Comparison with EPA Standards*

The South Street monitoring station sulfur dioxide measurements were compared to EPA Primary NAAQS. These include both short-term (maximum 3-hour and 24-hour average) and long-term (annual) health-based regulatory benchmarks (Table 5-2). Data from the five-year study period show that all annual and maximum average readings from South Street Station were well within NAAQS. The maximum 3-hour SO_2 average during the study period was 58 ppb, compared to the NAAQS of 500 ppb. Of the 41783 hourly readings, none exceeded 66 ppb (74, 76).

The highest 24-hour SO_2 reading was 24 ppb which was well within the EPA standard of 140 ppb. Finally, "annual averages" for the years 1997 - 2001 were all well below the NAAQS of 30 ppb (74, 76).

Table 5-2. Average SO_2 levels collected at the South Street Monitoring Station compared to EPA NAAQS: Jan 1997-Dec 2001 (74, 76).

Year	Annual Average (ppb)	Maximum Average	
		24-Hour (ppb)	3-Hour (ppb)
1997	5	24	54
1998	4	24	58
1999	3	18	33
2000	4	16	30
2001	5	17	26
NAAQS	30	140	500

5.2.1.4 *SO_2 Levels: Monitoring Site Comparison*

Sulfur dioxide (SO_2) data collected at monitoring stations in Manchester and Portsmouth were also evaluated for the period 1997-2001. SO_2 levels at all three sites were well below all NAAQS thresholds. As shown in Tables 5-3A-C, the "annual averages" and "maximum 24-hour averages" in Claremont are slightly higher than Portsmouth in 3 out of 5 years, albeit by small amounts. All "annual average" levels were, however, lower than those measured in Manchester. Also, all but one "maximum 24-hour average" level was lower than in Manchester. The "maximum 3-hour average" data indicate that shorter-term SO_2 levels in Claremont are lower than in Manchester and Portsmouth. This is notable because "maximum 3-hour average" levels reveal the severity of short-duration exposures that may not be reflected in a longer-duration "maximum 24-hour" or "annual" averages. That is, pollutant "spikes" during a given day can be diminished when averaged with subsequent lower levels during that same day (74, 76).

Table 5-3A. Comparison of average SO_2 levels in Claremont, Manchester and Portsmouth: Jan 1997-Dec 2001 (74, 76).

Year	Annual Average (ppb)		
	Claremont	Manchester	Portsmouth
1997	5	8	4
1998	4	7	4
1999	3	5	4
2000	4	5	3
2001	5	7	4
NAAQS	30 ppb		

Table 5-3B. Comparison of average SO_2 levels in Claremont, Manchester and Portsmouth: Jan 1997-Dec 2001 (74, 76).

Year	Maximum 24-Hour Average (ppb)		
	Claremont	Manchester	Portsmouth
1997	24	38	21
1998	24	33	22
1999	18	17	24
2000	16	24	13
2001	17	20	13
NAAQS	140 ppb		

Table 5-3C. Comparison of average SO_2 levels in Claremont, Manchester and Portsmouth: Jan 1997-Dec 2001 (74, 76).			
	Maximum 3-Hour Average (ppb)		
Year	Claremont	Manchester	Portsmouth
1997	54	78	58
1998	58	62	63
1999	33	36	81
2000	30	53	50
2001	26	113	51
NAAQS	500 ppb		

5.2.1.5 *SO_2 Levels: Ambient Air Comparison*

Over the last several years, some Claremont residents have expressed health concerns regarding emissions from the Wheelabrator, Claremont facility. Accordingly, EHP sought to examine whether there were differences in ambient pollutant levels when Wheelabrator was not actively emitting. To test this hypothesis, EHP utilized the exact hourly timeframes during which one or both of Wheelabrator's boilers were offline. These "boiler down-time" data were then compared with available corresponding ambient air SO_2 levels from the South Street monitoring station in Claremont. EHP specifically targeted SO_2 data that were collected during periods of southwest wind activity for analysis (when pollutants theoretically are transported directly from Wheelabrator to the monitor). SO_2 data associated with southwest winds were also chosen to minimize interference from other area sources. EHP then categorized the corresponding average ambient SO_2 levels by hourly periods when: 1) boilers were "fully operational"; 2) either "boiler #1" or "boiler #2" was off-line; and 3) "both boilers" were offline. Data from each scenario are illustrated in Table 5-4 (74, 78).

The EHP comparison findings were largely inconclusive. That is, average ambient SO_2 levels were somewhat lower in Claremont when both boilers were offline, but were slightly higher when either one or the other boiler was offline. What is certain, however, is that hourly average SO_2 levels during the study period were lower than the ATSDR MRL (10ppb) and thus, not expected to cause adverse health consequences. EHP's evaluation was limited by the relatively small data timeframe available for analysis (14 months of corresponding data).

Table 5-4. Comparison of hourly ambient SO_2 concentrations during periods of southwesterly winds in Claremont, Jan 2001- Feb 2002 (74, 78).

Substance	Facility Fully Operational (ppb)	Either Boiler #1 or #2 Offline (ppb)	Both Boilers Offline (ppb)
Sulfur dioxide	4.3 (N=1187)	5.9 (N=42)	4.1 (N=21)

N= Number of corresponding samples used for comparison purposes

5.2.2 Fine Particulate Matter ($PM_{2.5}$)

Particulate matter ($PM_{2.5}$) samples are collected on filters that are then weighed. The $PM_{2.5}$ concentrations are then calculated by dividing the weight of the particulate mater on the filter by the volume of air that passed through the filter. The results are reported in micrograms of particles per cubic meter ($\mu g/m^3$) of collected air (79). The current analysis examines air monitoring data for fine particulate matter ($PM_{2.5}$) collected at the South Street monitoring station for the period January 1999-December 2006. The data include 441, 24-hour duration samples collected approximately every three to six days (depending on sample year). Individual samples ranged from 1.2µg /m^3 to 67.3µg /m^3. Data were converted to "annual" (12-month) averages for comparison to health-based NAAQS values (76, 80). Table 5-5 shows that $PM_{2.5}$ levels at the South Street monitoring station compare favorably to NAAQS. The "annual" and "24-hour" averages were all well below their respective NAAQS. (EPA recently lowered the 24-hour average from 65 to 35$\mu g/m^3$.) The "annual" averages were also all below tougher regulatory thresholds promulgated by the California Air Resources board (adjusted using EPA Criteria) (76, 81). The "24-hour" averages were also less than or equal to the more stringent Canadian standard in four of the six time periods (82).

Table 5-5. Annual* and 24-hour average $PM_{2.5}$ levels in Claremont compared to EPA NAAQS, California ARB Standard, and Canadian Standard: Jan 1999-Dec 2006 (76, 80, 81, 82).**

Period	Annual Average ($\mu g/m^3$)	24-hour Average ($\mu g/m^3$)
1999-2001	10.8	33.3
2000-2002	9.8	28.3
2001-2003	10.0	28.7
2002-2004	9.8	30.0
2003-2005	10.2	31.0
2004-2006	9.7	30.0
EPA NAAQS	15	35
California ARB Standard	11 - 11.5 (a)	------
Canadian Standard	-------	30 (b)

*** NAAQS Annual averages are based on the 3- year average of the weighted annual mean PM 2.5 concentrations.**
**** NAAQS 24-hour averages are based on the 3- year average of the 98th percentile of 24-hour PM 2.5 concentrations.**
(a) California Air Resources Board PM 2.5 Standard (adjusted to EPA criteria).
(b) Canadian Standard (standard criteria is the same as EPA).

$PM_{2.5}$ readings from the South Street monitoring station were also compared to EPA's "Air Quality Index" (AQI). AQI indicates how clean or polluted the air is, and what associated health effects might be of concern to residents of a particular region. AQI focuses on health effects that may be experienced within a few hours or days after breathing polluted air. EPA calculates the AQI for five major air pollutants regulated by the Clean Air Act: ozone, sulfur dioxide (SO_2), particulate matter, nitrogen oxides (NO_x), and carbon monoxide (CO). For each pollutant, the AQI is divided into six health-based air quality categories: 1) Good; 2) Moderate; 3) Unhealthy for Sensitive Groups; 4) Unhealthy; 5) Very Unhealthy; and 6) Hazardous (83, 84). As shown in Table 5-6, $PM_{2.5}$ levels in Claremont were "good" more than 84% (N=373) of the days that readings were taken. The "moderate" category accounted for an additional 14.7% of monitored days (N=65). EPA's cautionary statement for moderate particle pollution days is, "*Unusually*

sensitive people should consider reducing prolonged or heavy exertion." There were two daily averages for which $PM_{2.5}$ was "unhealthy for sensitive groups (USG)". The cautionary statement for USG reads: "*People with heart or lung disease, older adults, and children should reduce prolonged or heavy exertion.*" There was also one instance in which the daily average for $PM_{2.5}$ was "unhealthy". The cautionary statement for unhealthy particle pollution reads: *People with heart or lung disease, older adults, and children should avoid prolonged or heavy exertion. Everyone else should reduce prolonged or heavy exertion* (80, 83, 84). These cautionary statements can be found on the internet at: http://airnow.gov/index.cfm?action=aqibroch.aqi#aqipar. This "unhealthy" reading occurred on July 7, 2002, during a regional air quality event caused by forest fires in the Canadian providence of Quebec. Based on ambient air monitoring data from a network of monitors located through the country, this event traveled more than 700 miles to impact the city of Baltimore, MD (85). The $PM_{2.5}$ level averaged 67.3 µg/m^3 in Claremont on that day. This is on the lower end of the unhealthy range of 65.5-150.4 µg/m^3. The South Street monitor in Claremont has not recorded an AQI level above "moderate" since this event. Also, none of the daily averages in the two-year period reached "Very Unhealthy", or "Hazardous" levels (80, 83, 84).

Table 5-6. Distribution of average daily $PM_{2.5}$ levels by AQI category: South Street, Jan 1999-Dec 2006 (80, 83).

Year	Air Quality Index Category							
	Good		Moderate		Unhealthy for Sensitive Groups		Unhealthy	
	Number	%	Number	%	Number	%	Number	%
1999	38	79.2	8	16.7	2	4.2	0	0.0
2000	32	84.2	6	15.8	0	0.0	0	0.0
2001	49	87.5	7	12.5	0	0.0	0	0.0
2002	52	86.7	7	11.7	0	0.0	1	1.7
2003	48	81.4	11	18.6	0	0.0	0	0.0
2004	53	86.9	8	13.1	0	0.0	0	0.0
2005	51	83.6	10	16.4	0	0.0	0	0.0
2006	50	86.2	8	13.8	0	0.0	0	0.0
Totals	373	84.6	65	14.7	2	<1.0	1	<1.0
AQI Range	0.0 - 15.4 µg/m^3		15.5 - 40.4 µg/m^3		40.5 - 65.4 µg/m^3		65.5 – 150.4 µg/m^3	

5.2.2.1 Fine Particulate Matter ($PM_{2.5}$) – Monitoring Site Comparison

Fine particulate matter ($PM_{2.5}$) data collected at two additional DES air monitoring stations in Manchester and Portsmouth, NH (approximately 50 and 80 miles southeast of Claremont respectively) were also evaluated for the period 1999-2005. There were 274 days when $PM_{2.5}$ data were available from all three locations for comparison purposes. As shown in Table 5-7, the weighted annual averages of these comparable $PM_{2.5}$ levels in Claremont were lower than Manchester, and essentially the same as in Portsmouth. This finding is in line with studies demonstrating mean $PM_{2.5}$ levels in urban areas generally exceed those at nearby rural areas (80, 86).

Table 5-7. Average $PM_{2.5}$ levels from 274 comparable days in Claremont, Manchester and Portsmouth: Jan 1999-Dec 2005* (80).			
Year	Claremont ($\mu g/m^3$)	Manchester ($\mu g/m^3$)	Portsmouth ($\mu g/m^3$)
1999	12.1	13.5	12.1
2000	10.3	12.3	13.1
2001	10.6	11.7	10.7
2002	9.8	10.3	9.5
2003	9.5	10.7	9.6
2004	9.1	9.7	8.7
2005	10.5	10.5	9.7
Weighted Average	10.0	10.7	9.9

*** No data is available for Manchester after 12/31/2005 for comparison purposes.**

5.2.3 Ozone

This section presents an evaluation of ozone (O_3) data collected at South Street station for the period 1998 – 2006. The data include 1600 maximum 8-hour average samples collected daily as well as 1640 maximum 1-hour average samples. O_3 is monitored only during "ozone season", April through September, when long periods of sunlight and hotter temperatures can cause O_3 to form in higher concentrations (87).

The South Street monitoring station ozone measurements were compared to EPA Primary NAAQS. These include both short-term (maximum 1-hour average) and daily (maximum 8-hour average) health-based regulatory benchmarks (Table 5-8). Data from the study periods show that all maximum 8-hour and 1-hour average readings from the South Street monitoring station in Claremont met the NAAQS. The highest "maximum 8-hour O_3 averages" during the periods 2001-03 and 2002-04 were equal to the NAAQS of 0.08 ppm. All other years were below the NAAQS. The highest "maximum 1-hour O_3 average" during the year 2002 was also equal to the NAAQS of 0.12 ppm. All other years were below the NAAQS (76, 87).

Table 5-8. 8-hour* and 1-hour** average ozone levels in Claremont compared to EPA NAAQS, Jan 1998-Dec 2006 (76, 87).			
3-Year Period	Maximum 8-hour Average (ppm)	Year	Maximum 1-hour Average (ppm)
1998-2000	0.07	1998	0.09
1999-2001	0.07	1999	0.10
2000-2002	0.07	2000	0.10
2001-2003	0.08	2001	0.10
2002-2004	0.08	2002	0.12
2003-2005	0.07	2003	0.09
2004-2006	0.07	2004	0.11
EPA NAAQS	0.08 ppm	EPA NAAQS	0.12 ppm

*** NAAQS 8-hour averages are based on the 3- year average of the fourth-highest daily maximum 8-hour average ozone concentrations. The standard was changed to 0.075 ppm effective 3/12/08.**

**** The NAAQS 1-Hour standard is attained when the expected number of days per calendar year with the maximum hourly average concentration above 0.12 ppm is less than or equal to 1. This standard was revoked for all New Hampshire locations on June 15, 2005.**

5.2.3.1 Ozone (O_3) – Monitoring Site Comparison

Ozone (O_3) data collected at two additional DES air monitoring stations in Manchester and Portsmouth, NH were also evaluated for the 1998-2006 ozone seasons. As shown in Table 5-9A, 1-hour average ozone levels in Portsmouth were generally higher, and fluctuate more than at the Claremont and Manchester locations. The 8-hour average levels, (Table 5-9B) however, are consistent from location to location and fluctuate from period to period (76, 87).

Table 5-9A. Comparison of 1-hour average ozone levels in Claremont, Manchester and Portsmouth: 1998-2005 Ozone Seasons (76, 87).

Year	Claremont 1-hour Average (ppm)	Manchester 1-hour Average (ppm)	Portsmouth 1-hour Average (ppm)
1998	0.09	0.09	0.11
1999	0.10	0.09	0.13
2000	0.10	0.09	0.10
2001	0.10	0.12	0.08
2002	0.12	0.11	0.15
2003	0.09	0.09	0.08
2004	0.11	0.10	0.12
EPA NAAQS = 0.12 ppm			

The NAAQS 1-Hour standard is attained when the expected number of days per calendar year with the maximum hourly average concentrations above 0.12 ppm is less than or equal to 1. NOTE: The 1-hour average standard was revoked in New Hampshire in June 15, 2005.

Table 5-9B. Comparison of 8-hour average ozone levels in Claremont, Manchester and Portsmouth: 1998-2005 Ozone Seasons (over 3-year periods) (76, 87).

3-Year Period	Claremont 8-hour Average (ppm)	Manchester 8-hour Average (ppm)	Portsmouth 8-hour Average (ppm)
1998-2000	0.07	0.06	0.08
1999-2001	0.07	0.07	0.07
2000-2002	0.07	0.07	0.07
2001-2003	0.08	0.08	0.07
2002-2004	0.08	0.08	0.07
2003-2005	0.07	0.07	0.07
2004-2006	0.07	0.07	0.07
EPA NAAQS = 0.08 ppm			

NAAQS 8-hour averages are based on the 3- year average of the fourth-highest daily maximum 8-hour average ozone concentrations.

Eight-hour average ozone levels from the South Street monitoring station are compared with EPA's AQI categories (Table 5-10). Eight-hour averages were "good" more than 95% of the time. Exactly 4% of days during the ozone seasons were categorized as "moderate". EPA's cautionary statement for this category is, *"People who are unusually sensitive to ozone should consider reducing prolonged or heavy exertion outdoors."* There were only 5 days in the nine-year study period in which ozone was categorized as "unhealthy for sensitive groups" (USG). Each of these was in the low to mid-range of the "USG" category (0.085-0.104 ppm). During USG days, EPA advises that *"Active children and adults, and people with lung disease, such as asthma, should reduce prolonged or heavy exertion outdoors."* None of the ozone readings during the study period were categorized as "Unhealthy", "Very Unhealthy", or "Hazardous" (83, 87).

Table 5-10. Claremont 8-hour average ozone levels by AQI category: April – September 1998 through April – September 2006 (83, 87).

Year	Air Quality Index Category					
	Good		Moderate		Unhealthy for Sensitive Groups	
	Number	Percent	Number	Percent	Number	Percent
1998	177	96.7%	6	3.3%	0	0%
1999	172	95.0%	9	5.0%	0	0%
2000	176	97.2%	4	2.2%	1	<1%
2001	172	94.5%	10	5.5%	0	0%
2002	169	93.4%	9	5.0%	3	1.7%
2003	173	94.5%	10	5.5%	0	0%
2004	172	94.0%	10	5.5%	1	<1%
2005	179	97.8%	4	2.2%	0	0%
2006	180	98.4%	3	1.6%	0	0%
Totals	1570	95.7	65	4.0%	5	<1%
AQI Range	0-0.064 ppm		0.065-0.084 ppm		0.085-0.104 ppm	

An analysis of 1301 comparable eight-hour average ozone levels in Claremont, Manchester and Portsmouth was made according to AQI category. As shown in Table 5-11, Claremont had the highest percentage of "good" AQI days. Portsmouth had the highest percentage of "moderate" and "USG" days (83, 87). This increased percentage in Portsmouth may be explained by geographical features that affect air pollution transport. Specifically, a 2000 North American Research Strategy for Tropospheric Ozone (NARSTO) study documented the affect of coastal sea breeze. NARSTO revealed that coastal sea breezes can sweep ashore pollutants originally transported over the ocean parallel to the coastline. Specifically cited were high ozone levels experienced in coastal Maine after having been transported in pollution plumes from Boston, New York City, and other northeast corridor locations. Claremont specifically experiences elevated ozone levels most often when winds blowing from the south bring air pollution originating in the New York City metropolitan region into the area. Table 5-12 exhibits the regional same-day correlation between ozone levels through a direct comparison of USG Air Quality Index days in Claremont, Manchester and Portsmouth.

Table 5-11. Comparison of 1301 comparable eight-hour average ozone levels by AQI category in Claremont, Manchester, and Portsmouth: Apr-Sep 1998 and Apr-Sep 2006 (83, 87).

Location	Good		Moderate		Unhealthy for Sensitive Groups	
	Number	Percent	Number	Percent	Number	Percent
Claremont	1252	96.2%	44	3.4%	5	0.4%
Manchester	1243	95.5%	53	4.1%	5	0.4%
Portsmouth	1220	93.8%	69	5.3%	12	0.9%

Table 5-12. Comparison of "USG" and "unhealthy" ozone days in Claremont, Manchester, and Portsmouth: Apr-Sep 1998 and Apr-Sep 2006 (83, 87).

Date	Claremont AQI Value	Manchester AQI Value	Portsmouth AQI Value
8/5/98	34	38	124
8/6/98	21	37	122
5/31/99	82	n/a	111
6/24/99	79	n/a	114
7/16/99	85	n/a	156
7/17/99	90	n/a	104
8/25/99	43	56	122
6/10/00	111	87	37
6/19/01	97	135	n/a
6/21/02	66	82	111
6/26/02	82	90	101
7/14/02	59	79	101
7/22/02	56	116	114
8/11/02	69	82	101
8/12/02	95	109	140
8/13/02	56	101	135
8/14/02	124	111	150
8/15/02	104	79	87
9/14/02	104	74	40
7/22/04	127	124	79
7/30/04	69	66	135

5.2.4 Nitrogen Dioxide

In addition to analyzing criteria pollutant ambient air monitoring data, EHP evaluated theoretical "annual" ambient air nitrogen dioxide (NO_2) concentrations modeled by the DES, Air Resources Division, Air Dispersion Modeling Section (ADMS). Local NO_2 emissions were modeled because ambient air monitoring data were not available, and this contaminant was specifically mentioned as a contaminant of concern by local citizens. The ADMS modeling analysis used AERMOD software approved by the federal Environmental Protection Agency to predict

pollutant concentrations at more than five thousand receptor locations in the Claremont area (including at the Claremont monitoring site on South Street). Actual emission data collected from all 32 facilities located within the 15-mile radius were input into the AERMOD software. Local terrain features and recent meteorological data from Claremont, Keene and Springfield, Vermont were also used to simulate airflow in the region. The specific computer model employed was developed to produce conservative results in keeping with federal guidance. Therefore, the impacts generated by the model intentionally over-predict what would be expected by ambient air monitoring (90).

Since 11 of the 32 permitted facilities within a 15-mile radius were either closed, or had reduced emissions to levels below regulatory thresholds, ADMS modeled NO_2 for two time periods (1994–2004 and 2005), representing the available data period before and after the addition of significant emissions controls at the Wheelabrator facility. Because NO_2 is emitted by additional sources, DES also accounted for "background" emissions using modeling data derived from a regional air quality model referred to as CALGRID. CALGRID not only incorporates emissions from point sources (i.e., large permitted facilities), but also includes area sources (i.e., residential fuel use, etc), mobile sources (i.e., cars & trucks), and biogenic (i.e. natural) sources as well (91). Predicted CALGRID levels were added to the highest or "maximum impact" AERMOD values to produce a "worst-case" theoretical NO_2 ambient concentration in Claremont. This calculated theoretical concentration undoubtedly double-counts local point source emissions, but was nevertheless used as a conservative measure.

As shown in Table 5-13, this theoretical "worst-case" ambient NO_2 concentration was compared to the: 1) EPA "annual average" health-based regulatory Primary NAAQS benchmark; and 2) European Union's (EU) "annual average" Air Quality Targeting Standard (76, 92, 93). The EU standard was originally developed by the World Health Organization (WHO) after a comprehensive review of scientific evidence (94). The modeling value comparisons revealed the predicted annual "worst-case" concentrations were both within the NAAQS and EU standards.

Table 5-13. Predicted ambient air concentrations in Claremont compared to EPA Primary NAAQS and EU Air Quality Standard (76, 92, 93).

Nitrogen dioxide	Predicted Annual "Worst-Case" Concentration ($\mu g/m^3$)	EPA NAAQS ($\mu g/m^3$)	EU Air Quality Standard* ($\mu g/m^3$)
1994-2004	29.6 + 6 = 35.6**	100	40
2005	3.4 + 6 = 9.4**	100	40

*** Goal for "attaining" this nitrogen dioxide standard in most EU countries is 2010**

**** Worst-Case Concentration = EH&MS predicted Annual NO_2 Maximum Impact + CALGRID predicted Annual NO_2**

5.2.5 Air Toxics

This section presents an evaluation of data on air toxic pollutants collected between January 2000 and December 2006 at the South Street monitoring station and two other monitoring locations in Manchester and Portsmouth (95). These data were collected as part of a special DES project funded by EPA to investigate air toxics levels and variations in NH. Samples were collected for 24-hour durations every 12 days. Air toxics were selected for this analysis if they were included in the Toxic Emissions Inventories for facilities within the 15-mile radius, and

were measured at DES air monitoring stations (69, 70). Twenty-seven air toxics were included in the evaluation. Their levels were then compared to ATSDR and EPA cancer and chronic non-cancer CVs. Of the twenty-seven pollutants, the average daily concentration of seven exceeded their CVs and were analyzed further (Table 5-14, *italics*). The Public Health Implications Section of this report presents this more in-depth analysis.

When calculating the average daily air toxics concentration, air toxic pollutants not detected during a particular laboratory analysis round were included at one-half of their analytical detection limit. For example, if the analytical device was unable to detect the target compound, EHP assigned a value one-half of the instrument's lowest measurable quantity (detection limit).

Table 5-14. Ambient air toxics concentrations and comparison values: South Street Monitoring Station (95, 96, 97, 98).

Substance	Average Daily Concentration South Street ($\mu g/m^3$)	Cancer Comparison Value (CV) ($\mu g/m^3$)	Chronic Comparison Value (CV) ($\mu g/m^3$)
Benzene	*0.92*	*0.1(1)*	**30.0(5)**
Toluene	**1.83**	**None**	**300(3)**
Ethyl Benzene	**0.33**	**None**	**1000(5)**
Total Xylenes	**1.37**	**None**	**200(3)**
MtBE	**0.47**	**9.4(2)**	**2000(3)**
Ethylene	**1.65**	**None**	**None**
Chloromethane	**1.11**	**None**	**90(5)**
Methylene Chloride	**0.20**	**2.0(1)**	**1000(3)**
Chloroform	*0.09*	*0.04(1)*	**100(2)**
1,2-Dichloroethane	*0.06*	*0.04(1)*	**2000(3)**
1,1,1-Trichloroethane	**0.73**	**None**	**4000(6)**
Trichloroethylene	**0.081**	**1.2(7)**	**500(6)**
Acetonitrile	**0.52**	**None**	**60.0(5)**
Chlorobenzene	**0.07**	**None**	**50.0(2)**
a-pinene	**0.81**	**None**	**None**
Methyl ethyl ketone	**1.11**	**None**	**5000(5)**
Styrene	**0.09**	**None**	**900(3)**
2,2,4-trimethylpentane	**0.37**	**None**	**None**
p-dichlorobenzene	**0.13**	**0.22(2)**	**60.0(3)**
Formaldehyde	*3.02*	*0.08(1)*	**10.0(3)**
Acetaldehyde	*1.38*	*0.5(1)*	**9.0(5)**
Acetone	**3.32**	**None**	**30,000(3)**
Cadmium	**0.0003**	**0.0006(1)**	**3.5(4)**
Lead	**0.003**	**0.013(2)**	**1.5(4)**
Nickel (subsulfide)	**0.0036**	**0.0051(2)**	**0.09(3)**
Chromium (hexavalent)	*0.00132*	*0.0001(1)*	**0.1(5)**
Arsenic	*0.00089*	*0.0002(1)*	**0.03(2)**

(1) ATSDR CREG (2) EPA Oak Ridge National Lab PRG (3) ATSDR Chronic MRL/EMEG
(4) EPA Non-Cancer CV (5) EPA RfC (6) ATSDR Intermediate EMEG/MRL

5.2.5.1 Air Toxics – Monitoring Site Comparison

EHP compared the average ambient air toxics concentrations of the twenty-seven air toxics in Claremont, Portsmouth and Manchester. In general, Claremont concentrations compared

favorably with those of Manchester and Portsmouth. As shown in Table 5-15, only three pollutants in Claremont had average daily concentrations greater than those in the Manchester and Portsmouth locations (nickel, p-dichlorobenzene, and 1,1,1-trichloroethane). These three average daily concentrations, however, did not exceed a CV. Of the seven average daily air toxics concentrations that did exceed a CV in Claremont (Table 5-14, *italics*), six were lower than both Portsmouth and Manchester (benzene, chloroform, formaldehyde, acetaldehyde, chromium, and arsenic). The one remaining pollutants exceeding a CV in Claremont, 1,2-dichloroethane, was the same as those measured in Manchester (95, 96, 97, 98).

The DES *National Air Toxics Monitoring Grant Final Report* notes that the majority of annual average concentrations of air toxics measured at the five sampling sites in New Hampshire were similar regardless of location, population density, or dominant source type. In conclusion, air monitoring data of air toxics levels and trends in Claremont reveal no significant differences compared to other sites in the state (70).

Table 5-15. Comparison of average ambient air toxics concentrations in Claremont, Portsmouth and Manchester ((95, 96, 97, 98).).

Substance	Avg. Daily Concentration Claremont ($\mu g/m^3$)	Avg. Daily Concentration Portsmouth ($\mu g/m^3$)	Avg. Daily Concentration Manchester ($\mu g/m^3$)
Benzene (3)	0.92	1.01	1.16
Toluene (3)	1.83	4.00	2.63
Ethyl Benzene (3)	0.33	0.61	0.47
Total Xylenes (3)	1.37	2.50	1.84
MtBE (3)	0.47	2.82	1.61
Ethylene (3)	1.65	1.81	2.46
Chloromethane (3)	1.11	1.14	1.12
Methylene Chloride (3)	0.20	0.62	0.35
Chloroform (3)	0.09	0.12	0.11
1,2-Dichloroethane (3)	0.06	0.03	0.06
1,1,1-Trichloroethane (3)	0.73	0.26	0.18
Trichloroethylene (3)	0.08	0.34	0.08
Acetonitrile (3)	0.52	2.96	0.71
Clorobenzene (3)	0.07	0.07	0.07
a-pinene (3)	0.81	10.48	1.88
Methyl ethyl ketone (3)	1.11	1.78	1.27
Styrene (3)	0.09	0.30	0.18
2,2,4-trimethylpentane (3)	0.37	0.56	0.41
p-dichlorobenzene (3)	0.13	0.12	0.11
Formaldehyde (4)	3.02	4.05	3.27
Acetaldehyde (4)	1.38	8.22	1.98
Acetone (4)	3.32	5.09	4.01
Cadmium (1)	0.0003	0.0004	0.0004
Lead (2)	0.003	0.004	0.005
Nickel (2)	0.0036	0.0027	0.0035
Chromium (1)	0.00132	0.00139	0.00148
Arsenic (1)	0.00089	0.00115	0.00109

(1) Monitored at all sites 1/1/00 – 12/29/04 (2) Monitored at all sites 1/1/00 – 7/9/05
(3) Monitored at all sites 1/1/00 – 12/31/06 (4) Monitored at all sites 6/7/02 – 5/7/06

5.2.5.2 Air Toxics – Air Dispersion Modeling

Mercury and chlorinated dibenzo-p-dioxins/chlorinated dibenzofurans (CDDs/CDFs) were specifically mentioned as contaminants of concern by local citizens. These contaminants, however, were not monitored in Claremont. As a result, DES evaluated theoretical ambient air dispersion modeling levels for ambient air mercury and CDDs/CDFs developed by the DES ADMS. The DES air dispersion modeling analysis utilized the identical software and terrain/meteorological inputs described in Section 5.2.4 – "Nitrogen Dioxide" to predict pollutant concentrations. However, the basis for the emission rates that were input into the model were actual emission data collected from 1993, 2005 and 2007 emissions stack tests performed at Wheelabrator (99).

EHP utilized the highest, or "maximum impact" 24-hour and annual pollutant concentration levels predicted in the Claremont area. Specific CDD compounds (i.e., 1,2,3,7,9-HxCDD and 2,3,7,8-TCDD) that exhibit increased toxicity potential were also modeled separately for subsequent DES evaluation. All modeled levels were then compared to health-based CVs developed by DES, ATSDR, EPA, Connecticut, California, and Ontario, Canada. The modeled theoretical mercury and CDDs/CDFs levels are illustrated in Table 5-16A-B. The comparison reveals that all maximum impact modeled levels of mercury and CDDs/CDFs in Claremont from 1993 and 2007 compare favorably with all health-based CVs (98, 100, 101, 102, 103, 104).

Table 5-16A. Comparison of predicted ambient air mercury concentrations in the Claremont area with health-based CVs (98, 100, 101, 102, 103, 104).

Modeled Pollutant	Predicted Maximum Impact Concentrations		Health-based Standards ($\mu g/m^3$)	
	Annual ($\mu g/m^3$)	24-Hour ($\mu g/m^3$)		
Mercury (1993 emission data)	0.00141	0.0148	$0.2_{(1)}$	$0.09_{(2)}$
Mercury (2005 emission data)	0.0000518	0.000643	$0.2_{(1)}$	$0.09_{(2)}$

(1) NHDES – Annual & 24-Hour Ambient Air Limit (AAL)
(2) California Office of Environmental Health Hazard Assessment - Chronic Reference Exposure Level (REL)

Table 5-16B. Comparison of predicted ambient air CDD/CDF concentrations in the Claremont area with health-based CVs (98, 100, 101, 102, 103, 104).

Modeled Pollutant	Predicted Maximum Impact Concentrations		Health-based Standards ($\mu g/m^3$)
	Annual ($\mu g/m^3$)	24-Hour ($\mu g/m^3$)	
1,2,3,7,8,9-HxCDD (1993 emission data)	0.000000000288	N/A	0.00000074 (2)
1,2,3,7,8,9-HxCDD (2007 emission data)	0.000000000124	N/A	0.00000074 (2)
2,3,7,8-TCDD (1993 emission data)	0.00000000106	0.0000000112	0.000000064 (2)
	0.00000000106	N/A	0.000000064 (2)
2,3,7,8-TCDD (2007 emission data)	0.0000000000197	0.000000000243	0.000000064 (2)
	0.0000000000197	N/A	0.000000064 (2)
*CDD/CDF (TEQ) (1993 emission data)	0.00000000677	N/A	0.000001 (4)
	0.00000000677	N/A	0.00004 (5)
	N/A	0.0000000714	0.000005 (6)
*CDD/CDF (TEQ) (2007 emission data)	0.000000000302	N/A	0.000001 (4)
	0.000000000302	N/A	0.00004 (5)
	N/A	0.00000000372	0.000005 (6)

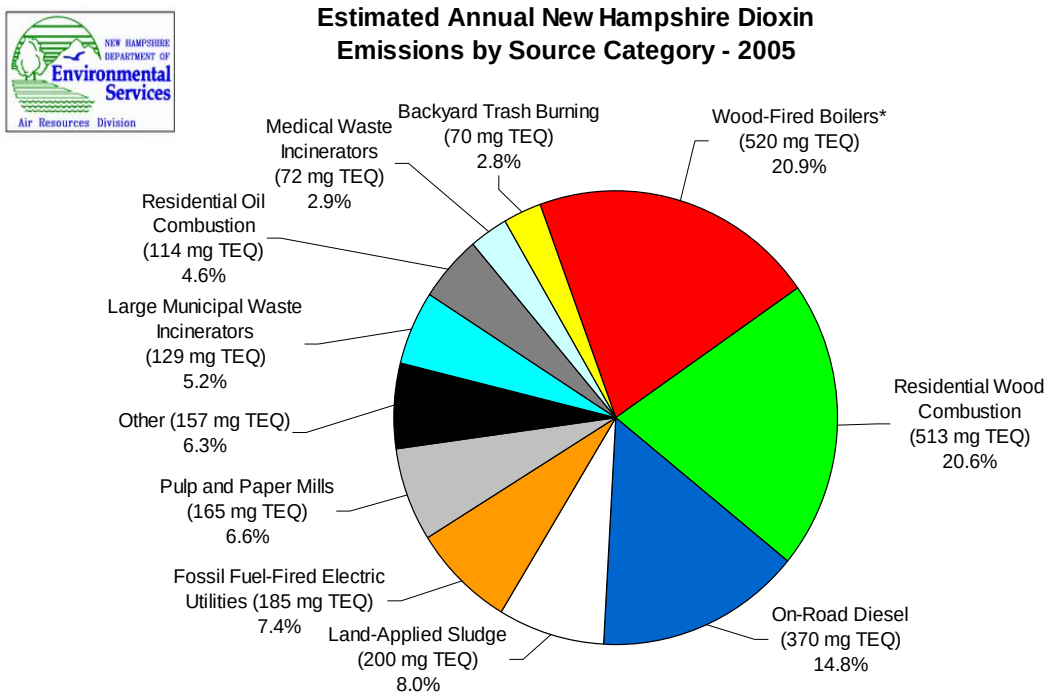
(1) NHDES – Annual & 24-Hour Ambient Air Limit (AAL)
(2) ATSDR - Cancer Risk Evaluation Guide (CREG)
(3) EPA Oak Ridge National Lab PRG
(4) Connecticut - Annual Ambient Air Limit
(5) California Office of Environmental Health Hazard Assessment - Chronic Reference Exposure Level (REL)
(6) Ontario, Canada – 24-Hour Ambient Air Quality Criterion
* Calculated level of exposure for all dioxin and furan compounds.

The DES air dispersion modeling results illustrated above provide CDD/CDF levels for comparison purposes, and reflect a worst-case exposure scenario. CDD/CDF's, however, are also emitted from additional sources. Figure 5-4 below provides a detailed breakdown of the sources in NH that emit CDDs/CDFs; with 56% from the following three categories combined: wood-fired boilers, residential wood combustion, and on-road diesel (105). Accordingly, EHP also accounted for additional CDD/CDF emission sources using background levels monitored by the National Dioxin Air Monitoring Network (NDAMN).

From June 1998 until December 2002, the NDAMN conducted CDD/CDF monitoring at 34 geographically distributed rural and remote sites throughout the United States. The purpose of the study was to obtain background ambient air levels of dioxin-like compounds. Results from rural sites indicated mean annual $CDD/CDF_{(TEQ)}$ levels ranging from 0.0000000104 - 0.00000001139 $\mu g/m^3$. EHP calculated a "worst case" cumulative annual exposure level for Claremont using the NDAMN's highest annual background level added to the highest predicted maximum impact concentration (modeled in 1993). This cumulative $CDD/CDF_{(TEQ)}$ level (0.00000000677 $\mu g/m^3$ + 0.00000001139 $\mu g/m^3$ = 0.0000000182 $\mu g/m^3$) compares favorably

with all health-based CVs in Table 5-16. In fact, this conservative estimate of actual CDD/CDF levels in Claremont is at least fifty times lower than all CVs established by Connecticut, California and Ontario (100, 101, 102, 103, 104, 106).

Figure 5-4 (105).



5.3 Summary of Environmental Data Results

Section 5.2 evaluated 33 potential pollutants of interest to determine whether they should be investigated further. Data from Claremont's South Street ambient air monitoring station were analyzed to assess levels of each pollutant in ambient air in Claremont. Based on this analysis, 13 pollutants of interest were subject to further examination in Section 6.0 below. This includes a review of the scientific literature on each pollutant: sulfur dioxide, $PM_{2.5}$, ozone, nitrogen dioxide, and 7 air toxics (benzene, chloroform, 1,2-dichloroethane, formaldehyde, acetaldehyde, chromium, arsenic) as well as mercury and CDDs/CDFs. Twenty of the air toxics occurred at low enough levels to conclude that they do not represent a health threat in the Claremont area and therefore are not included in Section 6.0.

6.0 PUBLIC HEALTH IMPLICATIONS

This section evaluates the public health implications of ambient air quality in Claremont. Analysis of DES air monitoring data identified 13 "pollutants of interest" out of the 33 contaminants originally considered. This section presents a literature review and summary of results for each pollutant of interest, and concludes with a discussion of childhood health considerations.

6.1 Pollutants of Interest

Following is a review of the scientific literature on health effects for each of the pollutants of interest listed below. The review is based on relevant environmental health studies and dose calculations (i.e., amount of contaminant that gets into a person's body). Detailed health evaluations are provided for the following contaminants: 1) sulfur dioxide (SO_2); 2) fine particulate matter ($PM_{2.5}$); 3) ozone (O_3); 4) nitrogen dioxide (NO_2) 5) air toxics (seven total); 6) mercury; and 7) dioxins/furans (CDDs/CDDs). Review of air toxics is restricted to those that exceeded a health-based comparison value (CV) in the initial assessment stage of this report.

6.1.1 Sulfur Dioxide

Sulfur dioxide, or SO_2, belongs to the family of sulfur oxide gases (SOx). Sulfur is prevalent in raw materials including crude oil, coal and ore. SOx gases are formed from the combustion of sulfur-containing fuel, such as coal, oil, diesel fuel, and gasoline. They are also created during the extraction of gasoline from oil, and metals from ore. Sulfur dioxide dissolves in water vapor to form sulfuric acid, and interacts with other gases and particles in the air to form sulfates and other compounds that can be harmful to people and the environment (107). It is estimated that sulfur dioxide concentrations can range from 0.4 - 1.9 ppb in very remote clean areas of the country to at least 2,300 ppb in industrial areas. Between 1986 and 1995, composite SO_2 averages in the U.S. decreased an estimated 37%, while SO_2 emissions declined 18% (75).

Inhalation is the primary route of exposure for sulfur dioxide. SO_2 is a highly water-soluble gas that is rapidly absorbed by mucosa of the nose and upper respiratory tract. This can cause lung function changes indicative of bronchoconstriction, the contraction of muscle fibers surrounding the airway, making its opening considerably smaller. Bronchial hypersensitivity can develop following a single exposure to very high concentrations of sulfur dioxide; a syndrome referred to as reactive airway dysfunction syndrome or RADS. Populations susceptible to sulfur dioxide often exhibit a different or enhanced response than others exposed to the same level in the environment. The reasons for this may include genetic makeup, age, health and nutritional status, and exposure to other toxic substances (e.g., cigarette smoke). Scientific literature suggests that the main risk for an adverse reaction to SO_2 is respiratory health status (e.g., asthmatic), not age or other factors. One particular study found similar effects of breathing sulfur dioxide in healthy senior citizens and healthy adolescents. The findings parallel other studies showing that elderly adults with preexisting respiratory or cardiovascular disease may be susceptible to increased risk of mortality associated with acute-duration exposure to sulfur dioxide (75).

According to the 2003 New Hampshire Behavioral Risk Factor Surveillance System, 7.2% of NH adults, and 12.4% of the state's children have asthma (108). As noted above, asthmatics are particularly sensitive to respiratory effects following acute exposure to sulfur dioxide. In fact, some sensitive asthmatics have been shown to respond to sulfur dioxide at concentrations as low as 100 ppb – Agency for Toxic Substances & Disease Registry (ATSDR) Lowest Observed Adverse Effect Level (LOAEL). These sensitive asthmatics may be more susceptible and responsive to sulfur dioxide due to their lower reserve of lung function. Although sensitivity is important, adverse health responses to sulfur dioxide are variable among individual asthmatics. For example, exercising asthmatics are recognized as the most susceptible group to sulfur dioxide inhalation and significant increases in airway resistance have been clearly demonstrated. In addition, pulmonary effects (usually assessed by measurement of increases in specific airway resistance or decreases in forced expiratory volume or forced expiratory flow) of sulfur dioxide can be significantly enhanced by exercise. Furthermore, sulfur dioxide-induced bronchoconstriction can be made worse by cold or dry air during physical activity (75).

Studies of the relationship between sulfur dioxide and lung cancer have concluded that there is little, if any, causal connection. Similarly, epidemiological studies of occupational or environmental exposure to sulfur dioxide and other cancer types show no evidence of increased cancer potential in humans (75).

The ATSDR Minimum Risk Level (MRL) (10 ppb) and minimal LOAEL (100 ppb) for sulfur dioxide were derived in part from a study in which exercising mild asthmatics were exposed to 100 ppb through a mouth piece for 10 minutes. The two most sensitive subjects of the ten experienced "some degree" of bronchoconstriction following exposure. The other subjects experienced no apparent reaction. The conservative MRL value (used for screening purposes) incorporates an uncertainty factor to address varying sensitivity among asthmatics and possible increased sensitivity in children. The minimal LOAEL is also a conservative, protective value. It represents the dose of sulfur dioxide for which health effects may be expected in exercising asthmatics (75).

Five years of hourly measurements collected at the South Street Station demonstrate that ambient air levels of sulfur dioxide in Claremont comply with all the EPA National Ambient Air Quality Standards (NAAQS). Of the 41,783 hourly sulfur dioxide measurements, all were well below the ATSDR LOAEL of 100 ppb. As noted above, this a level at which sensitive asthmatics may experience some degree of respiratory effect. In fact, the highest 1-hour level during the entire study period was 66 ppb (74, 75, 76).

6.1.2 Particulate Matter (PM)

Particulate matter (PM) is the term used for a mixture of solid particles and liquid droplets found in the air (109). This mixture can vary greatly in size, composition, and concentration, depending on the sources generating the particles and such factors as geographic location, topography of the locale, climate, season, day, and time of day (110). PM originates from a variety of combustion sources, including motor vehicles, power plants, incinerators, soil burners, flares and after-burners, industrial furnaces and boilers (109, 111). Natural sources such as pollen, bacteria, viruses, fungi, yeast, salt spray, soil from erosion also generate PM emissions (112). Indoor PM can be generated from cigarette smoke, home heating sources, and cooking. It can also originate

from outdoor PM sources that penetrate the indoor environment (110). Smaller ambient particles penetrate into indoor environments more effectively than coarse particles. (82) Because of the large number of sources, PM particles can be formed in many different ways and have widely varying compositions. Particles may contain hundreds of different elements in complex chemical compounds including metals, organic compounds, biological materials, positively or negatively charged ions, reactive gases, and the pure (or elemental) carbon particle core (110, 112, 113).

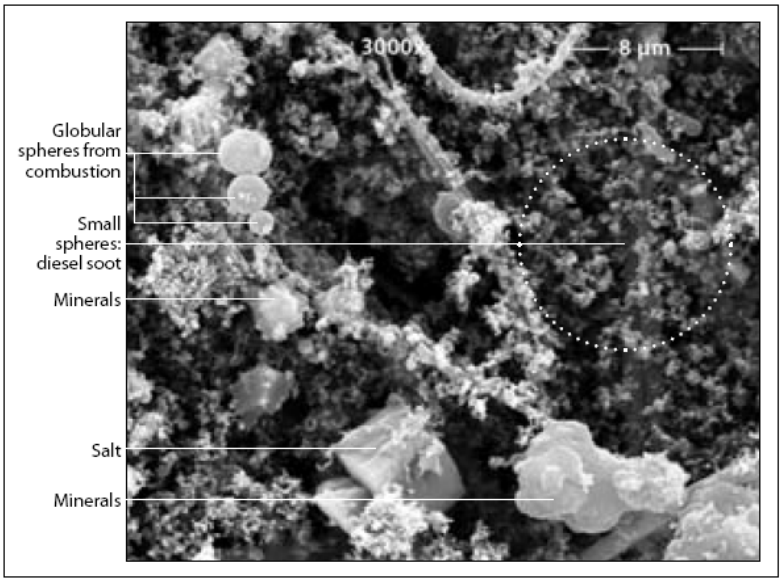
PM pollution ranges in size from tiny to microscopic. *Total suspended particulate matter* (TSP) refers to "all" particles in the atmosphere and was the first indicator used to represent suspended particles in the ambient air (112). "Coarse" particles fall between 2.5 microns and 10 microns in diameter and are called $PM_{10-2.5}$ (113). Coarse particles are generated mainly by mechanical processes that break down material from a variety of non-combustion sources into dust (110). "Fine" particles are 2.5 microns in diameter or smaller and are called $PM_{2.5}$. Fine particles are formed mostly by gases emitted from combustion processes. The gases condense to become a particle of the same chemical compound, or can react with other gases or particles in the atmosphere to form a particle of a different chemical compound (113).

Fine particles directly emitted into the atmosphere are referred to as "primary" $PM_{2.5.}$ Primary $PM_{2.5}$ pollution from local sources can have a significant effect on ambient concentrations in some locations. Current emissions inventories in the eastern U.S. region (consisting of New England, Delaware, Maryland, New Jersey, New York, Pennsylvania, and the District of Columbia) indicate that 25% of primary $PM_{2.5}$ results from residential wood combustion. Crustal sources, including fugitive dust emissions from construction activities, paved and unpaved roads, and agricultural tilling also contribute to primary $PM_{2.5}$ emissions. This crustal fraction of $PM_{2.5}$ is also influenced by road maintenance such as wintertime salting and sanding. (86)

"Secondary" $PM_{2.5}$ is formed from precursor gases reacting in the atmosphere or through the addition of PM to pre-existing particles. (86) Examples of secondary particle formation include the conversion of: 1) sulfur dioxide (SO_2) to sulfuric acid (H_2SO_4) droplets that further react with ammonia (NH_3) to form various sulfate particles; 2) nitrogen dioxide (NO_2) to nitric acid (HNO_3) which reacts further with ammonia to form ammonium nitrate particles; as well as 3) the condensation and oxidation of hydrocarbon molecules (organic carbon) to form organic aerosols. The ammonia emissions required for these reactions are largely from agricultural sources and livestock production, but also include area and mobile sources (86).

Sulfate accounts for one-half to two-thirds of total $PM_{2.5}$ mass on high PM days in rural areas of the eastern U.S. region. Even on low PM days, sulfate generally accounts for the largest fraction (40% or more) of total $PM_{2.5}$ mass in the region. After sulfate, organic carbon consistently accounts for the next largest fraction of total $PM_{2.5}$ mass. Organic carbon is typically 20-30 percent of the total $PM_{2.5}$ mass on high-level $PM_{2.5}$ days, but can contribute as much as 40 percent at rural sites on low $PM_{2.5}$ days likely because of naturally occurring organic emissions from vegetation (e.g., terpene emissions from coniferous forests). The organic carbon contribution to $PM_{2.5}$ in the Eastern U.S. is likely to include manmade pollution transported from a distance, from local sources, as well as naturally occurring organic emissions. Nitrate (NO_3), elemental carbon and fine soil typically account for the remainder (<10 percent) of overall $PM_{2.5}$ mass in the eastern U.S. region (86). An example of PM on the microscopic levels is depicted in Figure 6-1 below.

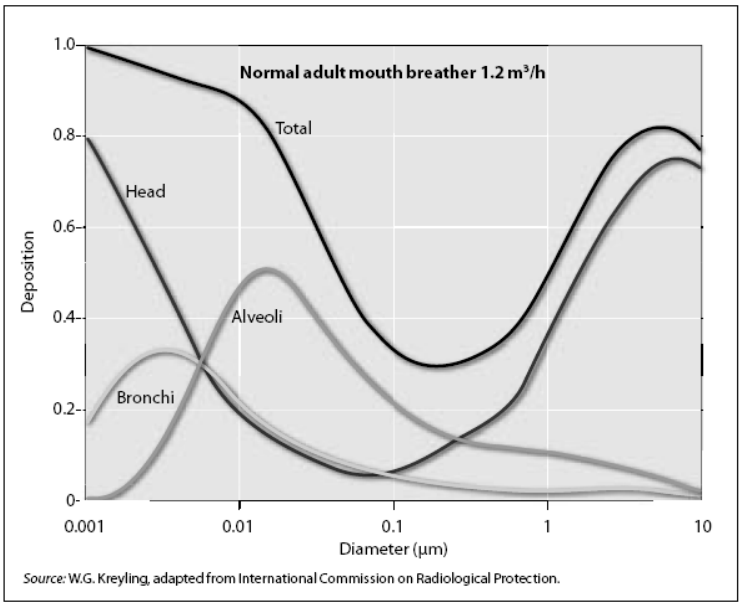
Figure 6-1. Electron micrograph of PM sampled on a filter near a roadway. (94)



Fine particles can remain suspended in the air for a long time and travel long distances. Large high pressure weather systems covering hundreds of thousands square miles are the source of classic severe $PM_{2.5}$ episodes in the eastern U.S., particularly in summer. These systems create favorable conditions for the formation of sulfate (initially emitted as SO_2 from coal-fired power plants) which is then transported west to east over long distances into the eastern U.S. region. This adds to the existing local source and naturally occurring background pollution that may be already contributing to poor air quality. Every $PM_{2.5}$ air pollution episode, however, is unique. The amount of area-specific pollution accumulation and additive transport burden is influenced by local terrain (e.g., rivers, mountains and valley breezes). The relative influences of the transport pathways and local emissions also vary by hour, day and season (86).

PM size plays a role in how exposed individuals are affected. Larger, coarse particles, interacting with receptors on nerve cells in the airways, are trapped and removed by the nose and throat through sneezing, coughing, spitting, or swallowing (110, 111). Fine $PM_{2.5}$ particles, also called "respirable particles", pass through the nasal passage and trachea entering deep-lung capillaries and air sacs (alveoli) (112, 113). Ultra-fine particles (less than 0.1 micron in diameter) are small enough to slip through the lung into the blood stream, circulating like oxygen molecules themselves (113). If these particles are soluble in water, they pass directly into the blood stream within minutes. If they are not soluble in water, they are retained in the deep lung for long periods (months or years) (111). For these reasons the National Research Council, in 1979, said that measuring particles by weight, without regard to particle size, has "little utility for judging effects." Particle size is everything when it comes to air pollution and health. This has led EPA to promulgate the $PM_{2.5}$ nationwide standard to reduce exposure to fine particulate matter (75).

Figure 6-2. Deposition probability of inhaled particles in the respiratory tract according to particle size (94).



PM mixtures are variable and extremely complex. They depend on the source of the particles. Attempting to identify which components of PM result in a particular adverse effect is extremely challenging. Furthermore, ambient air contains gaseous pollutants such as ozone that can exert adverse effects similar to those ascribed to components of PM. The choice of appropriate endpoints of PM effects is also complicated both by variations in the solubility of PM particles (in the lung) and the potential mechanisms by which individual PM mixture components cause toxic effects (110).

Levels of particulate matter vary during the course of the day, and peak values can be quite high. Few studies have evaluated the effect of these short-term "spikes." However, at least one epidemiological study of children with asthma suggests that changes in symptoms and lung function correlate more strongly with 1-hour peaks than with 24-hour average concentrations (75).

The main target of PM exposure is the respiratory system (114). Scientific studies have linked PM, especially primary and secondary $PM_{2.5}$, with a series of significant health problems, including: premature death; respiratory related hospital admissions and emergency room visits; aggravated asthma; acute respiratory symptoms, including aggravated coughing and difficult or painful breathing; chronic bronchitis; decreased lung function (i.e., shortness of breath); and work and school absences (109). Fine particles and aerosol acidity appear to have stronger association with respiratory effects than coarse particles (82) Particle deposition in the airways can also trigger responses that potentially result in changes in tissues and organs at sites progressively farther away from the initial stimulus. For instance, studies in humans and other species have linked PM exposure with changes in cardiac function, including inducing arrhythmias and increasing the incidence of heart attack (110). $PM_{2.5}$ can also bypass conductive airways and deliver materials such as reactive organic chemicals that adsorb onto the particle core, deep into the lung (86).

Persons sensitive or susceptible to PM comprise a large fraction of the U.S. population. These include people with respiratory disease, heart disease, or diabetes; older people; young children; and populations experiencing heightened exposure levels (e.g., those engaged in outdoor work or exercise) (115) According to the World Health Organization and others, there is no scientific evidence that particle pollution has any minimum threshold at which human health is not affected, particularly among more sensitive populations (116).

Health effects from long-term exposure to ambient $PM_{2.5}$ levels were studied in the Harvard Six Cities Study (8,111 adults in the northeast and Midwest U.S. for 14-16 years beginning in the mid-1970's), and an American Cancer Society study (552,138 adults in 154 U.S. cities from 1982 to 1989). Both studies found that higher ambient $PM_{2.5}$ levels were associated with increased mortality from all causes. Differences between all-cause mortality in the "most polluted" city and the "least polluted" city were 26% and 17%, respectively. A report prepared for the Canadian Council of Ministers of the Environment also investigated the associations between long-term exposure to ambient PM and lung cancer. Three of the four studies reviewed in the report demonstrated a significant association between chronic exposures to $PM_{2.5}$ and lung cancer incidence or mortality. The Canadian report also investigated the relationship between long-term exposure to air pollution and respiratory symptoms, lung function changes, and new cases of asthma (incidence) among children from Southern California communities. It found a significant association between PM and adverse respiratory endpoints (82).

Recent epidemiologic studies clearly delineate an association between long-term exposure to $PM_{2.5}$ and reduced lung function growth in children. Susceptibility studies also show that children who had asthma, and those who spent more time outdoors, seem to be more at risk than those without asthma, or those who spent less time outdoors. Studies furthermore illustrate that following a decrease in particle air pollution, there was a substantial reduction in the prevalence of children's respiratory illness (82)

In 2006, EPA published revised NAAQS for $PM_{2.5}$. Based on the latest scientific, health and technical information, EPA has changed the 24-hour $PM_{2.5}$ standard from 65 to 35$\mu g/m^3$, but has retained the existing annual standard of 15$\mu g/m^3$. As part of its review process, EPA solicited public comment on alternative standards as well as other approaches to selecting the standards (117). A study published by the Northeast States for Coordinated Air Use Management (NESCAUM) assessed the public health implications of compliance with alternative EPA standards. NESCAUM estimated the potential benefits to the general population and susceptible subgroups in the northeastern United States (Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island & Vermont). The study recommended that the most appropriate 24-hour and annual standards would be 30 and 12 $\mu g/m^3$, respectively. NESCAUM asserts that implementing such standards would provide a stringent level of short- and long-term protection for a substantial proportion of both the Northeast and U.S. populations (118).

Air monitoring data from South Street in Claremont between January 1999 and December 2006 reveal that:

- "Annual" and "24-hour" average $PM_{2.5}$ concentrations meet EPA NAAQ standards, and are below levels normally associated with adverse health outcomes (76, 80, 81, 82).

- "Annual" averages were all lower than more stringent regulatory thresholds promulgated by the California Air Resources board (adjusted using EPA Criteria) and standards recommended by NESCAUM (81, 118).
- "24-hour" averages were less than or equal to the more stringent Canadian standard in four of the six time periods (82).
- Comparable monitored days in Claremont, Manchester and Portsmouth revealed that the cumulative $PM_{2.5}$ average in Claremont was lower than in Manchester, and essentially the same as in Portsmouth (80).
- Of the 441 days in which $PM_{2.5}$ was monitored during the study period, 65 (14.7%) were in the "moderate" category of the Air Quality Index (AQI). At this level, EPA advises, *"Unusually sensitive people should consider reducing prolonged or heavy exertion"* (80, 83).
- There were two days (<1%) in which the level of $PM_{2.5}$ reached a level categorized as "Unhealthy for Sensitive Groups" (i.e., asthmatics and those with preexisting heart or lung disease). At this level, EPA advises, "*People with heart or lung disease, older adults, and children should avoid prolonged or heavy exertion"* (80, 83).
- There was also one instance (<1%) whereby the daily average for which $PM_{2.5}$ was on the lower end of the "unhealthy" range of 65.5-150.4 $\mu g/m^3$ (67.3$\mu g/m^3$). The cautionary statement for unhealthy $PM_{2.5}$ pollution reads: *People with heart or lung disease, older adults, and children should avoid prolonged or heavy exertion. Everyone else should reduce prolonged or heavy exertion*. This "unhealthy" reading occurred on July 7, 2002, during a regional air quality event (related to the catastrophic forest fires in Canada) where elevated $PM_{2.5}$ levels were experienced in parts of every New England state (80, 83).

6.1.3 Ozone

Ozone (O_3) is a colorless gas that is formed mainly as a result of the interaction between VOCs (i.e., hydrocarbons and nitrogen oxides) in the presence of heat and sunlight. Ozone is one of the major air pollutants in industrialized areas and cities with a large number of motor vehicles. In fact, more than half of the ingredients needed to produce ozone come from motor vehicle exhaust and evaporative emissions. Ozone is slow to form and slow to dissipate. It forms most often in mid-morning, and begins to dissipate in late afternoon or early evening (119). After it forms, winds may carry ozone long distances causing elevated levels over wide regions, including rural areas (120).

Ozone reacts with biological membranes in both the upper and lower respiratory tract (121). Symptoms from exposure to low concentrations of ozone include eye, nose, throat, and lung irritation which can cause coughing and wheezing (119). Increased bronchial responsiveness (an alteration of lung function – mainly in expiratory flow) has been observed following 7-hour exposures to 80, 100, or 120 ppb (with moderate exercise); and to 1-hour exposure to 350 ppb of ozone. Responses occur almost immediately following exposure to ozone and can persist for at least 18 hours. Human population studies indicate that people living in communities with high background ozone levels experience a greater decrease in lung function over a five-year period than people living in communities with lower background levels. These studies are consistent with animal studies in suggesting that long-term exposure to ozone may result in impaired lung

function. Animal evidence also suggests that exposure to ozone may increase susceptibility to bacterial infections of the respiratory system (121).

Some people are more sensitive to the effects of ozone than others. Children, the elderly, and individuals with existing lung disease, including asthma, bronchitis, and emphysema, are more sensitive to lower levels of ozone (120). Preliminary results of a 2008 National Research Council report also indicate that the effect of "acute" ozone exposure on mortality is likely to be larger than average in persons with pre-existing disease, especially lung and heart diseases (122). Athletes and workers who are more active outdoors also can be affected when ozone levels are high. When ozone levels are elevated, chances of being adversely affected increase the longer a person is active outdoors and the more strenuous the activity that person engages in. Exertion generally causes one to breathe harder and faster. When this happens, more ozone is taken into the lungs that may reach tissues susceptible to injury. Children have some unique susceptibilities to ozone exposure because they are more likely to spend time outside in active play during warm sunny days and they have smaller and undeveloped lungs. Scientists also have found that about one of every three individuals without a preexisting medical condition is sensitive to the effects of ozone (120).

No synergism has been observed between ozone and either nitrogen dioxide or sulfuric acid in terms of impaired respiratory function. There is also no human information available regarding the carcinogenic effects of ozone exposure, and animal studies are inconclusive (121).

Nine years of ozone measurements collected in 1998-2006 at the South Street air monitor demonstrate that ambient air levels of ozone in Claremont met air quality standards. Ozone levels, categorized by EPA's AQI, were "good" almost 96% of the time. Claremont ozone levels were also categorized as "good" a higher percentage of comparable days than in Manchester and Portsmouth (+0.7% and +2.4% respectively). About 4% of ozone 8-hour averages reached the "moderate" category, for which EPA advises, *"People unusually sensitive to ozone should consider reducing prolonged or heavy exertion outdoors."* There were five occurrences (<1% of the time) when the ozone level was "Unhealthy for Sensitive Groups (USG)." During each one of these days, regional air quality was also affected, resulting in elevated levels of ozone pollution in Manchester and in Portsmouth. These regional pollution events were, thus, not attributable to local sources in Claremont (76, 83, 87). In fact, two of the USG days in Claremont (August 14-15, 2002) occurred during a five-day regional ozone event discussed in a New England Air Quality Study (NEAQS). The study demonstrated that coastal meteorological factors were responsible for transporting accumulated pollutants into coastal New Hampshire that previously moved off shore (88). EPA's cautionary statement for this "Unhealthy for Sensitive Groups" level of ozone is, *"Active children and adults, and people with lung disease, such as asthma, should reduce prolonged or heavy exertion outdoors."* Despite rare USG occurrences, human chamber and toxicologic studies have yielded strong evidence that short-term exposure to ozone can exacerbate lung conditions, causing illness and hospitalization, and can potentially lead to even death. Epidemiologic studies have also found that exposure to ozone is associated with adverse lung and heart effects (122). Thus, citizens are encouraged to adhere to the recommendations outlined in DES' Air Quality Action Days (discussed in Section 6.1.3.1 below).

6.1.3.1 DES Advisories - PM and Ozone

DES issues daily advisories on ozone and $PM_{2.5}$ levels for each of NH's ten counties. When there are indications that either or both of these contaminants can reach unhealthy levels, DES issues warnings for appropriate populations (Air Quality Action Days). Claremont residents are encouraged to follow the public health precautions issued on days when these pollutants are expected to be high.

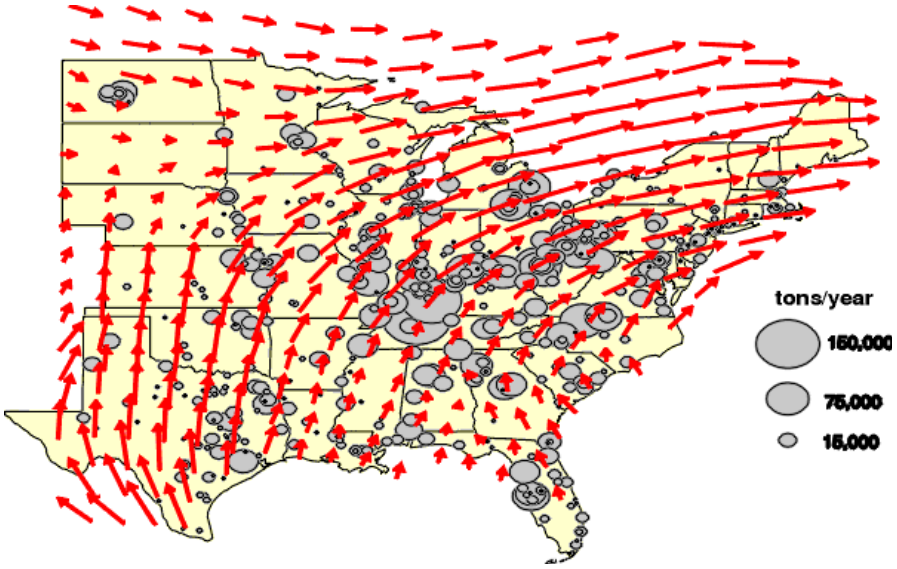
Meteorological conditions supporting ozone production and transport can also be associated with elevated $PM_{2.5}$ levels during April through September (ozone season). This seasonal correlation between ozone and $PM_{2.5}$ indicates that adverse health effects (especially in sensitive populations) may result from these infrequent, short-term events. Local sources likely contribute somewhat to ozone and $PM_{2.5}$ levels measured in Claremont. Results from DES' extensive regional modeling analyses of major air pollution episodes revealed, however, that transport from out-of-state pollution sources accounts for 92 percent to nearly 100 percent of New Hampshire's ozone and $PM_{2.5}$ air pollution when unhealthy air occurs in the state (77). These seasonal pollution events that necessitate the issuance of DES' Air Quality Action Days (AQAD) originate for the most part to the south and west of NH, and spread throughout the state and region.

6.1.4 Nitrogen Dioxide

Nitrogen dioxide (NO_2) is a nonflammable gas with a strong, harsh odor that turns reddish-brown in color at temperatures above 70°F. Nitrogen dioxide and other nitrogen oxides (NOx) are released to the air from gasoline and diesel engines (cars, trucks, generators, lawnmowers and yard equipment, snowmobiles, power boats, etc), home furnaces (gas and oil), wood stoves, electrical power plants, industrial processes (engraving, arc welding and electroplating), explosives (dynamite blasting), and fertilizers (123, 124). Nitrogen dioxide is also found in tobacco smoke, so people who smoke or breathe in second-hand smoke may be exposed. Additionally, higher levels of NOx are usually found in households that burn wood or use kerosene heaters and gas stoves (123).

Nitrogen dioxide can block the transmission of light, reducing visibility in urban areas and on a regional scale. It is broken down rapidly in the atmosphere by reacting with other substances commonly found in the air. After it is released from a source, NO_2 mixes in the atmosphere where it is oxidized and acidified into nitric acid. The resultant nitric acid can react further with ammonia to form an ammonium nitrate particle, and/or is removed from the air primarily through precipitation falling as acid rain and snow (86, 123, 124). Nitrogen dioxide also reacts with certain VOCs in the presence of strong sunlight (ultraviolet wavelengths) to form ozone. Thus, reducing NO_2 emissions is critical to reducing ozone (123, 124). Figure 6-3 illustrates the typical wind patterns when ozone reaches unhealthy levels in the Northeast and New Hampshire. The circles indicate the location and magnitude of nitrogen oxide (NOx) emissions from the major pollution stationary sources – electric power plants (77).

Figure 6-3 (77).



People are primarily exposed to nitrogen dioxide by breathing air. Low levels of nitrogen dioxides in the air can irritate your eyes, nose, throat, and lungs, possibly causing you to cough and experience shortness of breath, tiredness, and nausea. Low levels can also result in fluid build-up in the lungs 1 or 2 days after exposure. Breathing high levels of nitrogen oxides can cause rapid burning, spasms, and swelling of tissues in the throat and upper respiratory tract, reduced oxygenation of body tissues, a build-up of fluid in your lungs, and death. Nitrogen dioxide causes changes in the genetic material of animal cells, but it is uncertain whether human exposure causes developmental effects (123). The health risks from nitrogen dioxide may potentially result from NO_2 itself or its reaction products (e.g., O_3, PM, and nitric acid). Epidemiologic studies of NO_2 exposures from outdoor air are limited in being able to separate these effects. Nevertheless, the World Health Organization (WHO) recognized the importance of NO_2 as a key component for the rise of secondary toxic pollutant concentrations in ambient air. The potential of NO_2, in mixtures, to enhance the effects of other environmental pollutants including allergens was thus considered when WHO developed their health-based standard (employed in Section 5.2.4) (125).

The United States Department of Health and Human Services (USDHHS), the International Agency for Research on Cancer (IARC), and the EPA have not classified nitrogen oxides, including NO_2, for potential carcinogenicity (123).

The potential for health effects to occur was evaluated through a comparison with health-based CVs developed by EPA and the European Union (EU) (76, 92, 94). The theoretical “worst-case” ambient NO_2 concentration modeled for the Claremont area (1994-2004 and 2005) were both within the NAAQS and EU standards. *Therefore,* adverse *health effects are not expected from ambient air exposure to nitrogen dioxide levels modeled in Claremont*.

6.1.5 Air Toxics

This section presents a detailed review of the scientific literature and of findings of this PHA for nine air toxics: benzene, chloroform, 1,2-dichloroethane, formaldehyde, acetaldehyde, arsenic, chromium, mercury, and dioxins/furans (CDD/CDF). The other chemicals included in this report are not reviewed below because it was determined in the initial stages of the analysis that they do not represent a health threat in the Claremont area.

6.1.5.1 *Benzene*

Benzene is commonly found in the environment with industrial processes being the main source. Exposure of the general population to benzene is mainly through breathing air that contains the toxic. Benzene levels in the air can increase from industrial emissions, waste and storage operations, motor vehicle exhaust (about 20% of the total nationwide exposure), and evaporation from gasoline service stations. Tobacco smoke also contains high levels of benzene; with about 50% of all benzene exposure nationwide resulting from smoking tobacco or from exposure to environmental ("secondhand") tobacco smoke (127).

Benzene causes problems in the blood. Human studies show that chronic inhalation exposure to benzene can result in harmful effects in the tissues that form blood cells, especially the bone marrow. Excessive exposure to benzene can be harmful to the immune system, increasing the chance for infection and perhaps lowering the body's defense against cancer of the blood-forming organs such as leukemia. USDHHS categorizes benzene as a known carcinogen (127).

The average ambient air concentration of benzene at South Street during the study period (0.92 ug/m^3) exceeded the ATSDR cancer comparison value (CV) (0.1 ug/m^3), but was virtually identical to the average ambient benzene background levels measured in New Hampshire (0.89 ug/m^3) (70, 95, 98). It was also lower than the average benzene levels measured at the Manchester and Portsmouth air monitors (1.16 and 1.01 ug/m^3 respectively) (95). Based on available data, there is no evidence that local permitted sources have a significant impact on benzene levels in the ambient air in Claremont. *Lifetime exposure to benzene levels at South Street would result in a theoretical excess cancer risk of 2.9 cases if one million people were exposed. This would have no detectable effect on cancer rates in the Claremont area now or in the future.*

The potential for non-carcinogenic health effects of benzene was also evaluated through comparison with EPA's Reference Concentration (RfC) of 30 ug/m^3 and an average daily dose calculated for benzene. Average ambient benzene concentrations measured in Claremont were below the RfC, and the average daily inhalation dosage was less than the EPA Reference Dose (RfD) (95, 97). Furthermore, human studies of non-cancer health outcomes related to benzene have shown no adverse hematological effects (i.e., blood diseases) at levels even 2000 times higher than those recorded at South Street. Therefore, *non-cancer health effects are not expected from this exposure* (127).

6.1.5.2 *Chloroform*

Chloroform is a colorless liquid with a pleasant, non-irritating odor and a slightly sweet taste. Most of the chloroform found in the environment comes from chemical manufacturing, paper mills, and from sewage treatment and water-treatment plants. Chloroform, when emitted to the air, persists in the air, but is eventually broken down. Chloroform was also one of the first inhaled anesthetics to be used during surgery, but it is not used for anesthesia today (128).

Most research on inhalation exposure to chloroform in humans is based on clinical reports describing health effects in patients under anesthesia. In humans, chloroform affects the central nervous system (brain), liver, and kidneys after a person breathes air or drinks liquids that contain large amounts of chloroform. Breathing elevated levels of chloroform for a short time also causes fatigue, dizziness, and headache. Based on animal studies, USDHHS concludes that chloroform may reasonably be anticipated to be a carcinogen. EPA has also determined that chloroform is a probable human carcinogen. These studies are based on oral, not inhalation exposure. However, because chloroform has identical toxicological end points following oral or inhalation exposure, CVs based on oral exposure to chloroform can be used to evaluate inhalation exposure (128).

The average ambient air concentration of chloroform at South Street during the study period (0.09 ug/m^3) exceeded the ATSDR cancer CV (0.04 ug/m^3). It was however, lower than the average chloroform levels measured at both the Manchester and Portsmouth air monitors (0.11 and 0.12 ug/m^3 respectively) as well as the statewide background level (0.16 ug/m^3) (70, 95, 98). These results present no evidence that local sources have a significant impact on chloroform levels in the ambient air in Claremont. *Lifetime exposure to chloroform levels at South Street would result in a theoretical excess cancer risk of less than 1 case if one million people were exposed. This would have no detectable effect on cancer rates in the Claremont area now or in the future.*

The potential for adverse non-carcinogenic health effects of chloroform was also evaluated through comparison with an EPA Chronic CV of 100 ug/m^3 and an average daily dose calculated for chronic chloroform inhalation. Average ambient air concentrations measured in Claremont were below the CV, and the average daily inhalation dosage was less than the RfD. The LOAEL for chloroform is 110,000 times higher than the South Street level. Scientific literature also documents that average background concentrations of chloroform range from 2 to 5 micrograms per day in rural areas, to 6 to 200 micrograms per day in cities ((95, 97, 128). *Therefore, it is unlikely that inhalation of chloroform in the ambient air in Claremont would result in adverse non-cancer health effects*.

6.1.5.3 *1,2-Dichloroethane*

1,2-Dichloroethane, also called ethylene dichloride, is a manufactured liquid that is not found naturally in the environment. It evaporates quickly at room temperature and has a pleasant smell. 1,2-Dichloroethane is one of the most widely produced chemicals in the world. It is predominantly used to manufacture vinyl chloride which is, in turn, used to make plastic and vinyl products including polyvinyl chloride (PVC) pipes, construction and packaging materials, furniture and automobile upholstery, wall coverings, housewares, and automobile parts. It was

formerly used in some cleaning solutions and pesticides; some adhesives, such as those used to glue wallpaper or carpeting; and some paint, varnish, and finish removers. 1,2-Dichloroethane is also used as a solvent and is added to leaded gasoline to remove lead. In the past, it was also found in small amounts in products that industries used to clean cloth, remove grease from metal, and break down oils, fats, waxes, resins, and rubber (129).

1,2-Dichloroethane is released to the environment, primarily as an ambient air contaminant, during its production and use. Ambient air levels near urban areas range between 0.10–1.50 ppb. When in the ambient air, 1,2-dichloroethane breaks down by reacting with other compounds and has an estimated reaction half-life of about 73 days. 1,2-Dichloroethane usually remains in the air for more than 5 months before it is completely broken down. It may also be removed from air in rain or snow. Since it stays in the air for a while, the wind may carry it over large distances (129).

Humans are exposed to 1,2-dichloroethane primarily from the inhalation of ambient air near industries where it is manufactured or used. Inhalation exposure may also occur during cooking, bathing, showering, and dishwashing if it is present in drinking water. Old products made with 1,2-dichloroethane can be a source of exposure, although probably not at levels that cause harmful health effects. Experiments in animals show that when 1,2-dichloroethane is inhaled, it circulates to many organs of the body, but is usually excreted in the breath within 1 or 2 days. The metabolized breakdown products of 1,2-dichloroethane leave the body quickly in the urine (129).

People who inhale large amounts of 1,2-dichloroethane often developed nervous system disorders and liver and kidney disease. Lung effects were also seen, and people died from heart failure after high levels were inhaled. This information resulted mostly from case reports of people who died following acute exposure to high levels by inhalation. Thus, the levels that caused these effects are unknown, but were probably high. Studies in laboratory animals also found that breathing large amounts of 1,2-dichloroethane produced the same effects as seen in humans. The lowest air concentrations that produced liver and kidney effects in animal studies were 100 ppm and 400 ppm respectively for intermediate-duration exposures (129).

Exposure to 1,2-dichloroethane has not been associated with cancer in humans. It is also uncertain whether breathing 1,2-dichloroethane causes cancer in animals. Animal testing, however, revealed that the ingestion of water contaminated with 1,2-dichloroethane was associated with an increased risk of cancer. For this reason, USDHHS has determined that 1,2-dichloroethane may reasonably be expected to cause cancer. EPA has also categorized 1,2-dichloroethane as a probable human carcinogen (129).

The average ambient air concentration of 1,2-dichloroethane at South Street during the study period (0.06 ug/m^3) exceeded the ATSDR cancer CV (0.04 ug/m^3). A monitoring site comparison, however, found that the average ambient air concentrations of 1,2-dichloroethane in Claremont were the same as in Manchester and twice the level monitored in Portsmouth (95, 98, 129). Based on analysis of available data, there is no evidence that local permitted sources have a significant impact on 1,2-dichloroethane levels in the ambient air in Claremont. *Lifetime exposure to 1,2-dichloroethane levels at South Street would result in a theoretical excess cancer*

risk of less than 1 case if one million people were exposed. This would result in no detectable effect on cancer rates in Claremont now or in the future.

The potential for non-carcinogenic health effects of 1,2-dichloroethane was also evaluated through comparison with the ATSDR Chronic CV of 2000 ug/m^3 and an average daily dose calculated for 1,2-dichloroethane (95, 98). Average ambient 1,2-dichloroethane concentrations measured in Claremont were below the CV, and the average daily inhalation dosage calculated by DES was less than the RfD. Therefore, *non-cancer health effects are not expected from this exposure*.

6.1.5.4 *Formaldehyde*

Formaldehyde is a colorless, flammable gas at room temperature with a pungent, distinct odor. Formaldehyde is released to the ambient air from both natural and industrial sources. Combustion processes account directly or indirectly for most of the formaldehyde entering the environment. Direct combustion sources include power plants, incinerators, refineries, wood stoves, and diesel and gasoline-powered engines. Formaldehyde is also used in the production of embalming fluid, fertilizer, paper, particle board and plywood, resins, cosmetics, as well as agriculture, rubber, latex, wood preservation, leather, metal (foundry), and the photographic film industries. Natural sources of formaldehyde include forest fires, animal wastes, microbial products of biological systems, and plant volatiles (130).

Median ambient formaldehyde concentrations are estimated to be between 2.5 - 7.4 ug/m^3 (2–6 ppb) in suburban areas, and 12.3 – 24.6 ug/m^3 (10–20 ppb) in urban or industrial areas. Formaldehyde concentrations in urban atmospheres are usually highest during, or shortly after, periods of high vehicular traffic with downwind locations spiking later in the same day. These daily changes in formaldehyde concentrations were found to be consistent with initial direct vehicles emissions followed by secondary photochemical production (from photochemical oxidation of hydrocarbons or other formaldehyde precursors released from combustion processes) and, ultimately, atmospheric removal (breakdown) (130).

Generally, indoor residential formaldehyde concentrations are significantly higher than outdoor ambient air concentrations. Formaldehyde is released into indoor air from many home products including latex paint, new carpets/carpet-cleaning agents, particle board, furniture, cosmetics, fiberglass products, plastics/laminates, glues and adhesives, lacquers, paper, and some permanent press fabrics. Indoor concentrations of formaldehyde are increased by un-vented gas or kerosene heaters and smoking tobacco products indoors. Families can reduce their risk of exposure to formaldehyde by:

1. removing the sources of formaldehyde;
2. not using un-vented heaters, such as portable kerosene heaters;
3. not smoking indoors;
4. washing new clothes made from permanent press fabrics; and
5. providing adequate ventilation when using consumer products, or when installing pressed wood products, new carpets, or new furniture (130).

Inhalation exposure to formaldehyde can be irritating to the upper respiratory tract (nose and throat) and eyes, with the lungs being a secondary target at high exposure levels. However, because formaldehyde is rapidly metabolized (detoxified), concentrations normally encountered in ambient or workplace atmospheres do not usually result in adverse effects in other parts of the body. The effects of formaldehyde inhalation have been shown to be similar between normal or asthmatic individuals (either at rest or after exercise), however conflicting data may require further study of potentially sensitive populations. The chronic inhalation MRL is based on a minimal LOAEL for mild damage to the nasal tissue in chemical workers exposed to formaldehyde. In 1991, EPA determined that formaldehyde is a probable human carcinogen (Group B1) based on limited evidence in humans and sufficient evidence in laboratory animals (130).

The average ambient air concentration of formaldehyde at South Street during the study period (3.02 ug/m^3) exceeded the ATSDR cancer CV (0.08 ug/m^3), but was within typical background levels, and is lower than in most conventional homes. The Claremont level was also lower than the average formaldehyde levels measured at both the Manchester and Portsmouth air monitors (3.27 and 4.05 ug/m^3 respectively) (95, 98, 130). These results present no evidence that local sources have a significant impact on formaldehyde levels in the ambient air in Claremont. *Lifetime exposure to formaldehyde levels at South Street would result in a theoretical excess cancer risk of 16 cases if one million people were exposed. This would result in no detectable effect on cancer rates in the Claremont area now or in the future.*

The potential for non-carcinogenic health effects of formaldehyde was also evaluated through comparison with the ATSDR Chronic CV of 10.0 ug/m^3 and an average daily dose calculated for formaldehyde. Average ambient formaldehyde concentrations measured in Claremont were below the CV, and the average daily inhalation dosage calculated by EHP was less than the RfD. A review of the literature shows that harmful health effects do not begin to occur until formaldehyde levels are more than 90 times higher than those recorded at South Street (95, 98, 97, 130). *Therefore, non-cancer health effects are not expected from this exposure*.

6.1.5.5 *Acetaldehyde*

Acetaldehyde is widely distributed in the environment. It has a pungent odor at high concentrations, but has a fruity and pleasant odor at dilute concentrations. Acetaldehyde is used in the production of perfumes, polyester resins, and basic dyes. Acetaldehyde is also used as a fruit and fish preservative, as a flavoring agent, and as a denaturant for alcohol, in fuel compositions, for hardening gelatin, and as a solvent in the rubber, tanning, and paper industries. Acetaldehyde is created naturally by plant respiration, but is also formed by incomplete wood combustion in fireplaces and woodstoves (the two highest sources of emissions) as well as coffee roasting, burning of tobacco, vehicle exhaust fumes, and coal refining and waste processing (131).

Individuals are exposed to acetaldehyde by breathing ambient air. Symptoms of chronic intoxication of acetaldehyde in humans resemble those of alcoholism (acetaldehyde is formed in the body from the breakdown of alcohol). In hamsters, chronic inhalation exposure to acetaldehyde has produced changes in the nasal mucosa and trachea, growth retardation, slight anemia, and increased kidney weight. Human data regarding the carcinogenic effects of

acetaldehyde are inadequate. However, acetaldehyde is considered a probable human carcinogen by EPA (Group B2) based on animal studies that have shown tumor growth in rats and in hamsters. The RfC for acetaldehyde is 9.0 ug/m^3 based on rat studies (131).

The average ambient air concentration of acetaldehyde at South Street during the study period (1.38 ug/m^3) exceeded the ATSDR CREG comparison value (0.5 ug/m^3) (95, 98, 131). The Claremont level was lower than the average acetaldehyde levels measured at both the Manchester and Portsmouth air monitors (1.98 and 8.22 ug/m^3 respectively) (95). These results present no evidence that local sources have a significant impact on acetaldehyde levels in the ambient air in Claremont. *Lifetime exposure to acetaldehyde levels at South Street would result in a theoretical excess cancer risk of 1.2 cases if one million people were exposed. This would result in no detectable effect on cancer rates in Claremont now or in the future*.

The potential for non-carcinogenic health effects of acetaldehyde was also evaluated through comparison with EPA's RfC of 9.0 ug/m^3 and an average daily dose calculated for acetaldehyde. Average ambient acetaldehyde concentrations (1.38 ug/m^3) measured in Claremont were below the CV, and the average daily inhalation dosage calculated by EHP was also less than the RfD. Scientific literature shows that the lowest human equivalent levels at which adverse health effects result from exposure to acetaldehyde are 12,200 times higher than those recorded at South Street (95, 97, 131). Therefore, *non-cancer health effects are not expected from this exposure*.

6.1.5.6 *Chromium*

Chromium is a naturally occurring element found in rocks, animals, plants, soil, and in volcanic dust and gases. Chromium is also released into the atmosphere mainly by anthropogenic stationary point sources, including industrial, commercial, and residential fuel combustion, via the combustion of natural gas, oil, and coal. Additional anthropogenic sources of chromium air emissions include the metal industries, cement-producing plants, erosion of asbestos brake linings that contain chromium, incineration of municipal refuse and sewage sludge, and emission from chromium-based automotive catalytic converters (132).

Chromium is present in the environment in several different forms (or "valence states"). The most common forms are chromium (0), trivalent [or chromium (III)], and hexavalent [or chromium (VI)]. Chromium (III) occurs naturally in the environment and is an essential nutrient required by the human body. However, chromium (VI) and chromium (0) are generally produced by industrial processes (by the oxidation of chromium (III) compounds). In general, chromium (VI) is more toxic than chromium (III). Of the estimated 2,700–2,900 tons of chromium emitted to the atmosphere annually from anthropogenic sources in the United States, <1% is in the hexavalent form (132).

In air, chromium compounds are present mostly as fine dust particles. The level of chromium in air is generally low. According to a study by Fishbein, the atmospheric total chromium concentration [both chromium (III) and chromium (VI)] in the United States is typically <0.01 ug/m^3 in rural areas and 0.01 - 0.03 ug/m^3 in urban areas. Chromium is primarily removed from the atmosphere by fallout and precipitation. According to Nriagu, the residence time of chromium in the atmosphere is expected to be <10 days (132).

The respiratory tract in humans is a major target of inhalation exposure to chromium compounds. When chromium particles in the air are inhaled, they can be deposited in the lungs. Particles that are deposited in the upper part of the lungs are likely to be coughed up and swallowed. However, particles deposited deep in the lungs are likely to remain long enough for some of the chromium to pass through the lining of the lungs and enter the bloodstream. Once in the bloodstream, chromium is distributed to all parts of the body. Chromium will then pass through the kidneys and be eliminated in the urine in a few days (132).

Occupational exposure to high levels of chromium (VI) compounds has been associated with increased risk of respiratory system cancers, primarily bronchogenic and nasal. The inhalation risk may be exacerbated by cigarette smoking or exposure to environmental (secondhand) tobacco smoke. On the other hand, studies have shown that inhaling small amounts of chromium (VI) for even long periods of time does not cause a problem in most people. An epidemiologic study by Axelsson and Rylander found no indication that residence near two chromium industries was associated with increased lung cancer risk. Based on occupational and animal studies, USDHHS has categorized certain chromium (VI) compounds as “known human carcinogens”. Hexavalent chromium is categorized by EPA as a human carcinogen via the inhalation route. Trivalent chromium is not (132).

The average ambient air concentration of chromium at South Street during the study period (0.00132 ug/m^3) exceeded the ATSDR cancer CV (specific for the hexavalent form) comparison value (0.00008 ug/m^3). The Claremont level was, however, slightly lower than the average chromium levels measured at both the Manchester and Portsmouth air monitors (0.00148 and 0.00139 ug/m^3 respectively). Since South Street air monitoring data are reported as total chromium, respective concentrations of hexavalent and trivalent chromium are not known. As noted earlier, less than one percent of chromium emitted from man-made sources is in the hexavalent form (95, 98, 132). To approximate a worst-case scenario, however, the assumption of this analysis is that all of the total chromium reported was in its most toxic form (hexavalent chromium). *Lifetime exposure to these hypothetical worst-case hexavalent chromium levels at South Street would result in a theoretical excess cancer risk of 6.5 cases if one million people were exposed. This would result in no detectable effect on cancer rates in Claremont now or in the future.*

The potential for chronic non-carcinogenic health effects of chromium was also evaluated through comparison with EPA’s RfC of 0.1 ug/m^3 and an average daily dose calculated for chromium (VI) particulates. Average ambient chromium concentrations measured in Claremont were below the RfC, and the average daily inhalation dosage calculated by EHP was less than the RfD. The lowest LOAEL for less serious respiratory effects related to chromium (VI) is 1,500 times higher than the South Street level. The lowest NOAEL for the renal effects in humans exposed to the less toxic trivalent chromium is almost 57,000 times higher than levels recorded in Claremont (95, 97, 132). *Therefore, non-cancer health effects are not expected from exposure to chromium at levels detected in ambient air.*

6.1.5.7 *Arsenic*

Arsenic is a naturally occurring element that is found in the environment (i.e., soil, rocks, and minerals) combined with other elements such as oxygen, chlorine, and sulfur. Arsenic combined with these elements is called inorganic arsenic. Arsenic combined with carbon and hydrogen is referred to as organic arsenic, which is usually less harmful than the inorganic forms. Larger arsenic particles enter the air from windblown dust and soil as well as volcanic eruptions. Anthropogenic (man-made) sources of arsenic also include nonferrous metal smelting, coal, oil and wood combustion, and municipal waste incineration. This man-made arsenic is attached to fine particles (<2.5 µm) and may be transported through the air for many days and over long distances. Mean ambient air arsenic levels in urban areas range from 0.020 to 0.030 ug/m^3. A more regional average annual ambient air arsenic concentration measurement collected at Nahant, MA (between September 1992 and September 1993) was 0.0012 µg/m^3; with 75% of the arsenic particles less than 2.5 µm. This concentration of arsenic is greater than that of the Claremont area (0.00089 µg/m^3) (133).

Most cases of human toxicity from arsenic have been associated with exposure to inorganic arsenic. The most common inorganic arsenical in air is arsenic trioxide (As_2O_3) which was used for comparative purposes in this paper. This is a conservative assumption because South Street monitoring data are reported as total arsenic, and the respective amounts of each arsenic compound cannot be determined. An additional conservative assumption concerns the bioavailability of inhaled arsenic. Bioavailability refers to the fraction of the inhaled amount of arsenic that is actually absorbed into the body; the lower the bioavailability of an inhaled toxin, the less toxic its effect. Studies have shown that the amount of arsenic bioavailable to humans is less than levels monitored in the environment, so the actual dose is lower. Therefore, inhalation of arsenic from ambient air is usually a minor exposure route for the general population (133).

Inhalation of inorganic arsenic is associated with sore throat, lung irritation (possibly leading to laryngitis, bronchitis, or rhinitis), adverse skin effects (dermatitis, warts, and corns) as well as circulatory and peripheral nervous disorders. Evidence from several epidemiologic studies demonstrates that inhalation exposure to inorganic arsenic also increases the risk of several lung cancers in humans (epidermoid carcinoma, small cell carcinoma, and adenocarcinoma). However, most studies involved occupational exposure to large doses of arsenic trioxide dust in air at copper smelters and mines, and arsenate exposure at chemical plants. Several environmental and health organizations including EPA and USDHHS have concluded that inorganic arsenic is carcinogenic to humans (133).

The average ambient concentration of arsenic at South Street during the study period (0.00089 ug/m^3) exceeded the ATSDR cancer CV of 0.0002 ug/m^3. This level was, however, less than those measured in both the Manchester and Portsmouth locations (95, 98). *Lifetime exposure to arsenic levels at South Street (based on the worst-case scenario of exposure to inorganic arsenic) would result in a theoretical excess cancer risk of 1.6 cases if one million people were exposed. This would result in no detectable effect on cancer rates in the Claremont area now or in the future.*

The potential for non-carcinogenic health effects of arsenic was also evaluated through comparison with an EPA Chronic CV of 0.03 ug/m^3 and an average daily dose calculated for

chronic arsenic inhalation. Average ambient arsenic concentrations measured in Claremont were below the CV, and the average daily inhalation dosage calculated by EHP was less than the RfD. The LOAEL for inorganic arsenic is more than 7,000 times higher than the South Street level (95, 96, 98, 133). *Therefore, adverse non-cancer health effects from arsenic are not expected, even in the worst-case scenario (that all arsenic measured is in its inorganic form).*

6.1.5.8 *Mercury*

Mercury occurs naturally in the environment and exists in several forms including: metallic mercury (also known as elemental mercury), inorganic mercury, and organic mercury (i.e., methylmercury). Approximately 80% of the total mercury released to the air from human activities is elemental mercury. Elemental mercury is primarily from fossil fuel combustion, mining, smelting, and solid waste incineration. The remaining 20% is released to the soil from the application of fertilizers and fungicides, as well as air contaminant deposition from forest fires, volcano eruptions, and municipal solid waste incineration (e.g., discarded batteries, electrical switches, or thermometers). Mercury is also released to water from industrial wastewater discharges. The major target organs of elemental mercury-induced toxicity are the kidneys and the central nervous system. Typical levels of mercury in urban air (0.01-0.02 ug/m^3) do not pose a health risk through inhalation (134). Based on 1993 and 2007 emissions, the "annual" and "24-hour" maximum impact ambient mercury concentrations modeled for the Claremont are below DES and California health-based standards (99, 100, 103). *Therefore, health effects are not expected to occur from inhalation exposure to mercury*.

The general population is most commonly exposed to mercury from eating fish containing methylmercury in their tissues. After mercury compounds are released into the environment and deposited in water and sediment (washed out of the air by precipitation), microorganisms such as bacteria, phytoplankton in the ocean, and fungi convert it to methylmercury. In aquatic environments, methylmercury subsequently accumulates in fish to levels that are many times greater than levels in the surrounding water. The primary effect of methylmercury exposure in humans is neurotoxicity. Methylmercury can cause adverse developmental effects in young children because, once it enters the body, it easily passes into the developing brain. Furthermore, methylmercury can accumulate in an unborn baby's blood at concentrations higher than in the mother, and can be passed from a mother's breast milk to a nursing infant (134). Accordingly, EHP has issued a fish consumption advisory which outlines specific local water bodies where fish have shown to be contaminated with methylmercury. EHP's advisory also provides safe eating guidelines (limits on certain fish types and sizes) (135).

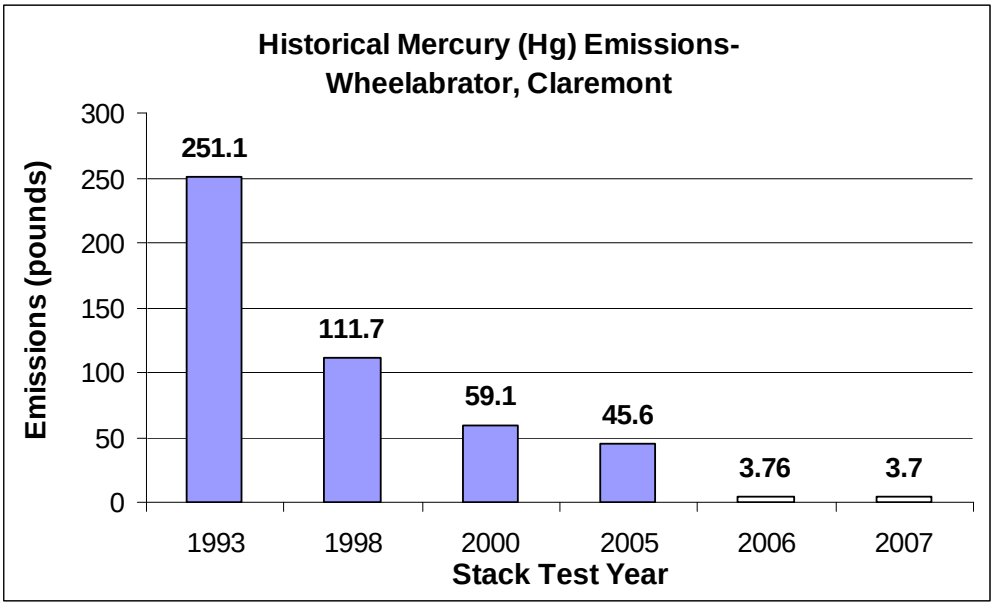
Since 1998, statewide mercury emissions in New Hampshire have been reduced by approximately 60% through a number of projects and regulatory actions initiated by industry, DES, the NH legislature, and the federal government. These initiatives have resulted in reductions from coal-fired power plants, municipal waste combustors, and medical waste incinerators. DES' mercury reduction plan also was instrumental in the elimination of mercury contained in batteries and product packaging, the promotion of mercury-containing waste recycling, and prohibiting mercury-containing pesticides. DES also promulgated stringent limits for municipal waste combustion facilities that exceed those of the US EPA (0.028 mg/DSCM vs. 0.080 mg/DSCM). Information concerning these initiatives is available at: http://www.des.nh.gov/nhppp/merc20.htm (136,137). A new law which took effect on January 1,

2008 prohibits the disposal of mercury-containing products at landfills, transfer stations and incinerators. Figure 6-4 exhibits the downward trend in mercury emissions from the Wheelabrator, Claremont facility since 1998. The data utilized in Figure 6-4 was collected during six separate facility stack tests required by DES, and conducted between 1993 and 2007 (99).

There is no doubt that some of the mercury deposited in New Hampshire's lakes and streams originates from sources within the State. Unfortunately, current methods of evaluating links between the emission, transport, and deposition of mercury in particular water bodies are not highly accurate. In addition, water bodies exhibit a wide variation in their propensity to convert mercury from its inorganic to organic state, regardless of the amount deposited (137). In fact, a recent study entitled "Biological Mercury Hotspots in the Northeastern U.S. and Southeastern Canada", provided three factors believed to be the major mechanisms contributing to mercury hotspots: 1) elevated atmospheric deposition from local sources; 2) high landscape sensitivity; and 3) large water level manipulations (138).

Despite these mercury deposition difficulties, EHP established a program in spring 2008 to collect fish samples from ponds and lakes in the greater Claremont area for subsequent mercury analysis. This EHP project aims to address local resident concerns by evaluating the risk associated with mercury-in-fish levels in Claremont area water bodies. EHP will publish these findings in a future health consultation document which will be disseminated to the public. DES will also utilize this mercury-in-fish data to supplement fish consumption advisories and protect human health. Furthermore, mercury data may aid in establishing trends in fish mercury levels over time. For further information regarding this fish collection project, please contact the EHP at (603) 271-1370.

Figure 6-4 (99).



6.1.5.9 *Dioxin/Furans*

Chlorinated Dibenzo-p-Dioxins - General Information

Chlorinated dibenzo-p-dioxins (CDDs) are a family of 75 different compounds with varying effects. CDDs are divided into eight groups of chemicals based on the number of chlorine atoms in the compound. For example, tetra-chlorinated dioxin (TCDD) and octa-chlorinated dioxin (OCDD) contain four and eight chlorine atoms respectively. 2,3,7,8-TCDD (chlorine atoms on the 2,3,7 & 8 positions of the molecule) is one of the most toxic of the CDDs to mammals and has received the most attention. Thus, 2,3,7,8-TCDD serves as a prototype for the CDDs. CDDs with toxic properties similar to 2,3,7,8-TCDD are called “dioxin-like” compounds. CDDs are most often found in mixtures rather than as single compounds in the environment and human activities are believed to be the predominant source (139).

Aside from small amounts required for research purposes, CDDs are not purposely manufactured by industry. They are, however, unintentionally produced by industrial, municipal, and domestic incineration and combustion processes. CDDs are also naturally produced from the incomplete combustion of organic material by forest fires or volcanic activity. CDDs (mainly 2,3,7,8-TCDD) furthermore may be formed during the chlorine bleaching process used by pulp and paper mills (139). The EPA’s Maximum Available Control Technology (MACT) standards enacted under the Clean Air Act (CAA) have reduced dioxin emissions by 89% nationally since 1987. New Hampshire was also the first state in the nation to adopt a dioxin reduction strategy in early 2001. Currently, the uncontrolled burning of residential waste is believed to be the largest source of CDDs entering the environment in the United States (140, 141).

CDDs are widespread environmental contaminants. They are found at very low levels in the environment, and are usually measured in micrograms or picograms per cubic meter ($\mu g/m^3$) or (pg/m^3). Most people are exposed to very small background levels of CDDs when they breathe air, or have skin contact with materials contaminated with CDDs. However, the vast majority of CDD and Chlorinated Dibenzofuran (CDF) exposure is associated with ingested food (primarily meat, dairy products, and fish). These food sources are affected because dioxin binds to organic carbon in soils, sediments, and atmospheric particles, and readily bioaccumulates into the fatty tissues of animals. According to the United Nations Environment Programme’s (UNEP) document “Dioxin and Furan Inventories,” the major pathway of human exposure to CDD and CDF compounds is via ingestion of food (>95%). The report concluded that the uptake of CDDs/CDFs through water and soil, inhalation, and dermal contact are of minor concern (142). People who eat food grown or harvested from contaminated areas are at risk of increased exposure. However, the actual intake of CDDs from food harvested in an affected area depends on the amount and type of food consumed, and the level of contamination (139).

Once in your body, CDDs can be found in most tissues; with the highest amounts found in the liver and body fat. The body can store these CDDs for many years before eliminating them. Many studies have examined how CDDs can affect human health. Recent studies have measured 2,3,7,8-TCDD levels in the blood or fat tissue of exposed populations to estimate the extent of past exposures. The most obvious health effect encountered in persons exposed to relatively large amounts of 2,3,7,8-TCDD was a severe skin disease called chloracne (acne-like lesions generally on the face and upper body). Epidemiologic data available for 2,3,7,8-TCDD, however,

have not allowed a determination of the minimum threshold dose required for the production of chloracne. A number of other health effects have been reported from exposure to the most toxic CDDs (e.g., liver effects, as well as pulmonary, neurological and kidney disorders). But they were not seen as chronic effects, or were effects seen long-term in only one population of exposed persons (143). Even so, EPA has determined that the most toxic CDD compound (2,3,7,8-TCDD) is a probable human carcinogen. 2,3,7,8-TCDD is carcinogenic in animals, and, in highly exposed workers, increased overall cancer death rates have been reported (139). For this reason, EHP utilized a CV specific to cancer health effects during the modeling comparisons in Section.

Chlorinated Dibenzofurans- General Information

Chlorinated dibenzofurans (CDFs) are a family of chemicals (135 individual compounds or congeners) that contain one to eight chlorine atoms attached to the carbon atoms of the parent chemical, dibenzofuran. CDFs, with chlorine atoms at the 2,3,7,8-positions, are especially harmful. Like CDDs, CDFs are not deliberately produced by industry (except for small amounts used for research and development). Rather, CDFs are produced as unwanted impurities of certain products and processes that utilize chlorinated compounds. Only a few of the 135 CDFs have been studied to assess their toxicity (144).

Small amounts of CDFs enter the environment from accidental fires or breakdowns of PCB-containing capacitors, transformers, and other electrical equipment. CDFs are also formed by burning municipal and industrial waste, coal, wood, or oil, and are produced as unwanted compounds during the manufacture of wood treatment chemicals, some metals, and paper products. Like CDDs, CDFs do not dissolve in water very easily, breakdown very slowly in the environment, and can remain in soil for years. Cattle that eat plants contaminated by air-deposited CDFs may produce milk and yield meat with greater CDF amounts. Birds and mammals living near CDF-contaminated water bodies, as well as humans that ingest the fish are subsequently exposed. Eating large amounts of fatty fish from water containing CDFs may increase the amount of exposure. Exposure to CDFs from air and drinking water is less than that from food (144).

CDFs are often found in association with CDDs, which cause similar toxic effects. The health effects of CDFs were mostly derived from studies of accidental poisonings where people ate high doses in food cooked with polychlorinated biphenyl (PCB)-contaminated oil containing CDFs. Skin and eye irritations (i.e., acne), darkened skin color, and swollen eyelids with discharge, developed weeks or months after exposure. CDFs also caused vomiting and diarrhea, anemia (a blood disease), more frequent lung infections, numbness and other effects on the nervous system, and mild changes in the liver. Many of the same health effects that occurred in the people accidentally exposed also occurred in experimental or laboratory animals that ate CDFs; animals fed CDFs had body weight loss, and their stomachs, livers, kidneys, and immune systems were seriously injured. Some fed high doses also died. CDFs also caused birth defects and testicular damage in animals. The Environmental Protection Agency has not classified the carcinogenicity of CDFs (139, 144).

Toxic Equivalent Factor (TEF) and Toxic Equivalency Quotient (TEQ)

CDDs and CDFs occur in the environment together, are highly persistent compounds, and are resistant to microbial degradation. 2,3,7,8-TCDD is one of the most toxic and extensively studied of the CDDs, and serves as a prototype for the toxicologically relevant or "dioxin-like" CDDs. Using information learned from animal studies, scientists express the toxicity of dioxin-like CDDs as a fraction of the toxicity attributed to 2,3,7,8-TCDD. For example, the toxicity of dioxin-like CDDs and CDFs can be ½, or $^{1}/_{10,}$ or any fraction of that of 2,3,7,8-TCDD. Scientists call that fraction a Toxic Equivalent Factor (TEF). The toxic potency of a mixture of congeners (i.e., the TEQ) is the sum of the products of the TEFs for each congener and its concentration in the mixture. Thus, TEQs represent 2,3,7,8-TCDD toxic equivalents for mixtures of CDDs and/or CDFs (144).

The potential for chronic and cancer health effects to occur was evaluated through comparison with health-based CVs developed by DES, ATSDR, EPA, Connecticut, California, and Ontario, Canada. Maximum impact CDD/CDF concentrations modeled for the Claremont area in the years 1993 (worst-case: early operation) and 2007 (worst-case: recent) were well below all health-based CVs. The calculated "worst case" cumulative annual exposure level for Claremont (NDAMN highest annual background level + the 1993 DES highest predicted maximum impact level) was also at least two orders of magnitude lower than all applicable CVs (99, 100, 101, 102, 103, 104). *Therefore, health effects are not expected from ambient air exposure to CDD/CDF levels in Claremont*.

6.1.6 Summary: Public Health Implications of Pollutants of Interest

The public health implications of the 13 pollutants of interest are summarized below.

- Sulfur dioxide (SO_2) – Ambient air levels of SO_2 recorded in Claremont during the five-year study period were all below EPA and ATSDR health-based thresholds, and are not expected to result in adverse health effects.

- Fine particulate matter ($PM_{2.5}$) – Levels of $PM_{2.5}$ recorded in Claremont during the seven-year study period are not expected to result in adverse health effects among members of the general public. Annual and 24-hour average $PM_{2.5}$ levels were below the established health-based EPA, California and Canadian standards. There were, however, some days during which $PM_{2.5}$ reached The Air Quality Index's (AQI) "moderate" category. EPA recommends that *"unusually sensitive people should consider reducing prolonged or heavy exertion"* during moderate $PM_{2.5}$ days. There were also two instances in 1999 when the average daily $PM_{2.5}$ reached a level defined as "unhealthy for sensitive groups" such as those with heart or lung disease, older adults, and children. During one occasion, the daily average for $PM_{2.5}$ was characterized as "unhealthy". The cautionary statement for unhealthy particle pollution reads: *People with heart or lung disease, older adults, and children should avoid prolonged or heavy exertion. Everyone else should reduce prolonged or heavy exertion.* This particular event was regional in nature and therefore not associated with emissions from local sources.

- Ozone – Levels of ozone recorded in Claremont during the nine-year study period are not expected to result in adverse health effects among members of the general public. All maximum 8-hour and 1-hour average readings from South Street in Claremont met health-based EPA standards. There were, however, several days during which ozone reached AQI's "moderate" category. EPA recommends that *"people unusually sensitive to ozone should consider reducing prolonged outdoor exertion"* during moderate ozone days. There were five days during which the 8-hour average ozone reading reached a level defined as "unhealthy for sensitive groups" such as active children and adults, and people with respiratory disease (such as asthma). As with most ozone episodes, these were multi-state events attributable to regional sources and not associated with local sources.

- Nitrogen Dioxide – Cumulative levels of nitrogen dioxide modeled for the Claremont area are not expected to result in adverse health effects. The predicted annual "worst-case" ambient NO_2 concentration was within the health-based US and EU standards.

- Air Toxics – Levels of air toxics recorded during the study period are not expected to result in adverse health effects. Air toxics levels in Claremont were also consistently lower than those from other air monitors across the state regardless of season, wind direction, and other factors. The levels recorded in Claremont, as well as across the state, are expected to have no effect on rates of non-cancer diseases. Their effect on cancer rates across the state is expected to be undetectable now and in the future.

- Mercury – Ambient air mercury levels modeled for the Claremont area are not expected to result in adverse health effects. Theoretical "worst-case" ambient mercury concentrations are below DES and California health-based standards. Since 1998, mercury emissions in New Hampshire have been reduced by approximately 60%.

  The general population is most commonly exposed to mercury from eating fish containing methylmercury. EHP established a program in spring 2008 to collect fish samples from ponds and lakes in the greater Claremont area for subsequent mercury analysis. EHP will analyze these data and publish the findings in a future health consultation document.

- Dioxins/Furans (CDDs/CDFs) – Ambient air concentrations of CDD/CDF modeled for the Claremont area are not expected to result in adverse health effects. Maximum impact CDD/CDF concentrations modeled for the years 1993 and 2007 were below DES, ATSDR, EPA, Connecticut, California, and Ontario, Canada's health-based standards. A calculated "worst case" cumulative annual exposure level was also at least two orders of magnitude lower than all applicable standards.

6.2 Child Health Considerations

There are many differences between children and adults with respect to potential adverse effects of air pollution. During exercise, children take in 20-40% more air per unit body weight than do adults in comparable activities. When air pollution is at higher levels, children are therefore more susceptible to its effects. Children spend more time outside than adults, and are often outdoors

during periods when air pollution is at its highest (e.g., late afternoon summer days when ozone levels peak). The typical adult spends 85 to 95 percent of their time indoors, compared to less than 80 percent for children. When playing outside, children also generally exert themselves more than adults.

One of the most important differences between adults and children with regard to air pollution is that children are growing and developing. Along with their increasing body size, children's lungs are growing and changing (145). The human lung contains more than 40 different kinds of cells. Each of these cell-types is important to health and fitness. Air pollution can temporarily or permanently damage lung cells. If cells that play a role in the development of a child's lung are damaged by air pollution, then the lung may not achieve full growth and function as the child matures to adulthood.

Children are also more susceptible to short-term effects of air pollution. A study of asthmatic children who engage in competitive sports in twelve California communities showed that those living in areas with high pollution levels were more likely to experience asthma exacerbation events than their counterparts in low-pollution areas (145). Although Claremont is not a "high-pollution area" as defined in the California study, it does experience occasional air pollution events during which asthmatic children should take appropriate precautions.

The use of conservative CVs in this public health assessment ensures that the health interests of children are taken into account at every step in this evaluation. Parents, school administrators, educators, and other custodial adults should adhere to the recommendations of DES "Air Quality Action Days" (AQAD) and be cognizant of health symptoms related to air pollution. DES disseminates information regarding forecasted AQADs through formal press releases, and posts the information on the DES website at: (www.des.nh.gov). Daily air quality information is also available at: http://www.des.nh.gov/airdata/air_quality_forecast.asp. Finally, Claremont area parents and other adults should also be aware of the conclusions and recommendations of this report, particularly those addressing local air pollution events.

7.0 HEALTH OUTCOME DATA REVIEW

A study carried out by EHP in 2006 concluded that for residents of the City of Claremont in 1987-2001, cancer rates for 24 major cancer types were all within their expected ranges based on corresponding rates for the state as a whole. Analysis of trends over that 15-year period revealed a substantial improvement in the total cancer rate for Claremont. During the 1997-2001 period, the only cancer type whose observed number of cases was significantly different from the expected was female breast cancer. There were 23% **fewer** breast cancers than expected among Claremont females during this period. The study is available at: http://www.atsdr.cdc.gov/HAC/PHA/HCPHA.asp?State=New%20Hampshire

An updated cancer study will be completed within the next several months. EHP will also explore the use of hospitalization data to characterize other health concerns expressed above. Finally, birth defects data from the newly established Birth Conditions Registry will become available in 2009.

8.0 COMMUNITY HEALTH CONCERNS

When performing any public health assessment, EHP gathers health concerns from people living in the vicinity of the site. The health concerns that people express help direct the focus of the evaluation. Health concerns of Claremont area residents were expressed in two ways: 1) residents voiced concerns during DES public hearings; and 2) residents submitted concerns in writing during the public comment period for air permits issued to local industrial sources. The concerns of the residents are categorized by issue and addressed below.

Health Effects Concerns:

- Resident is concerned with the impact the Claremont incinerator is having on the health of surrounding communities with regard to cancer, birth defects, metal poisoning, neurotoxicity and kidney and liver diseases.
- Resident is concerned with high cancer rates and increased numbers of learning disabilities in Sullivan County. Residents of Claremont are believed to be suffering ill health as a direct result of trash being burned at the Wheelabrator trash incinerator.
- Resident claims that she has noticed a marked increase in various cancers and illnesses such as asthma, and other diseases such as ALS and MS in Claremont residents living downwind from Wheelabrator.

*Reply (to 3 concerns listed above): Among the health concerns listed above, data sources are currently available only for cancer. A study carried out by EHP in 2006 concluded that for residents of the City of Claremont in 1987-2001, cancer rates for 24 major cancer types were all within their expected ranges based on corresponding rates for the state as a whole. Analysis of trends over that 15-year period revealed a substantial improvement in the total cancer rate for Claremont. During the 1997-2001 period, the only cancer type whose observed number of cases was significantly different from the expected was female breast cancer. There were 23% **fewer** breast cancers than expected among Claremont females during this period.*

An updated cancer study will be completed within the next several months. EHP will also explore the use of hospitalization data to characterize other health concerns expressed above. Finally, birth defects data from the newly established Birth Conditions Registry will become available in 2009.

Mercury and Dioxin Emission Concerns:

- Resident is concerned that Wheelabrator is releasing health-threatening amounts of mercury and dioxin into the air.
- Resident is concerned with the effects of dioxins and furans that are a being emitted by Wheelabrator.
- Citizen commented that “there is no doubt that incinerators threaten the public's health and welfare by emitting persistent pollutants like dioxin and metals."
- Citizen stated that EPA reports show that mercury and dioxin emissions from the Claremont incinerator threaten the health and welfare of Claremont area citizens.

Reply (to 4 concerns listed above): EHP's comprehensive evaluation of ambient air mercury and dioxin levels in the Claremont area found no evidence that ambient air emissions are likely to cause chronic adverse health effects to local residents. The EHP analysis developed "worst-case" exposure scenarios using "maximum impact" values during both historical and more recent time frames. EHP also utilized health comparison values from a number of reputable domestic and foreign sources. Actual stack test data, from Claremont's largest source of dioxin and mercury, further show that emission levels have been in compliance with applicable state and federal regulatory standards. Mercury emission levels have also decreased over time.

General Health Concerns:

- Resident is concerned with family health problems such as asthma and difficulty in breathing that she feels are directly related to the incinerator in Claremont, NH located 0.5-miles away.
- Working on Waste citizens' group is concerned with the local emissions of gases, liquids, particulate matter, dioxin and other noxious materials.
- Resident is concerned with the impact of incinerator emissions on the respiratory health of my family, neighbors and of the communities in the region.
- Resident fears "the potential serious side effects of these poisons on the health of my family" because "the entire city of Claremont is predominantly downwind of this industry."
- Resident expressed concern over the impacts of facility air pollution emissions on the respiratory health of members of the local population – resulting in Claremont-area residents having higher rates of respiratory disease than in other areas of the state.

Reply (to 5 concerns listed above): This PHA finds no evidence that the combined emissions from all local sources in the Claremont area are likely to cause chronic adverse health effects to residents. According to the best and most objective scientific research, levels of air contaminants detected in Claremont do not pose a risk for developing chronic respiratory disease (such as asthma or COPD), and do not increase the risk of developing cancer.

There are, however, rare occasions when the air quality in the Claremont area may pose a risk to "sensitive populations" – those with asthma or other existing chronic respiratory disease. These occasions are largely attributable to regional ozone and particulate pollution "events" that originate primarily in metropolitan areas south and west of NH and affect the entire northeast region. It is during these peak air quality events that residents statewide should take precautions to minimize prolonged exertion.

Unacceptable Risk Concerns:

- Resident believes that the health hazards presented by the Claremont incinerator pose an unacceptable risk and that it should be shut down.
- Working on Waste citizens' group reiterated its position that the risks from the incinerator are totally unacceptable and that public health will be protected in Claremont only through its closure.

- Resident believes the incinerator poses an unnecessary and an avoidable risk which cannot be offset by a conceivable benefit to the public."

Reply (to 3 concerns listed above): EHP's evaluation of ambient air data found no evidence that chronic adverse health effects would likely occur from inhalation exposure in the Claremont area. EHP explored whether measurable differences in ambient air contaminant levels existed during periods when the Wheelabrator – Claremont facility was off-line (not combusting municipal solid waste). That is, when the facility is not emitting pollutants, does the DES monitor reflect a drop in contaminant levels?

Specifically, EHP compared Wheelabrator's boiler downtime records with available ambient air monitoring data (hourly SO_2). Although the comparison findings were largely inconclusive, (SO_2 levels were somewhat lower when both boilers were offline, but were higher when either one or the other boiler was offline) all levels during the study period were consistently well below those associated with adverse health effects.

Concerns Related to Mercury & Dioxin in Food:

- Resident is concerned with local mercury emissions; specifically as they relate to limiting the consumption of NH's freshwater fish.
- Residents expressed concerns with respect to emissions of mercury and dioxin that may be emitted into the air by the facility at low levels, but can be deposited locally, build up in the environment, and result in negative health effects to those exposed.
- Resident is concerned about the long term deposition and build-up in the food chain of heavy metals, dioxin, and other pollutants.

Reply (to 3 concerns listed above): Some of the mercury and dioxin deposited in Claremont area lakes and ponds likely originates from local and statewide sources. Identifying the sources and fractional amounts of these contaminants that ultimately end up in the food chain is, however, very complex and not highly accurate. For example, the propensity to convert mercury from its inorganic to organic state (methylmercury - the type found in fish tissue) is believed to be influenced by a number of waterbody-specific factors. Notwithstanding, since 1998, mercury emissions in New Hampshire have been reduced by approximately 60% statewide. There has also been a sharp downward trend in mercury emissions from the Wheelabrator - Claremont facility during this timeframe.

More recently, EHP established a program in spring 2008 to collect fish samples from ponds and lakes in the greater Claremont area for subsequent mercury analysis. EHP intends to use mercury-in-fish data to evaluate the health risk from consumption of fish and to address local resident health concerns. Provided that an adequate number of fish are collected for a meaningful analysis, EHP will publish the findings in a future health consultation. This data may also aid in establishing trends in fish mercury levels over time. Dioxin ambient air monitoring was not part of this initiative because of limited resources. Dioxin is, however, monitored through periodic stack tests at the Wheelabrator facility.

9.0 CONCLUSIONS

The overall conclusion of this report is that ambient air in Claremont does not present a health hazard to the general population. During the study period, the Claremont area was in compliance with all National Ambient Air Quality Standards, including those for the four criteria pollutants examined in this report: sulfur dioxide, particulate matter less than 2.5 microns in diameter ($PM_{2.5}$), ozone, and nitrogen dioxide. There are infrequent days when air pollution levels in the Claremont area may result in adverse health effects among asthmatics or other sensitive groups – especially if they are exercising or otherwise exerting themselves outdoors. Ozone air pollution events originate from regional and distant sources and are transported long distances primarily by southerly winds in summer months. $PM_{2.5}$ events usually share the same origin and transport characteristics as ozone events.

Analysis of five years of hourly measurements from the South Street monitoring station reveal that ambient air SO_2 levels were all below Environmental Protection Agency (EPA) health-based limits and thresholds associated with adverse health effects. The Environmental Health Program (EPA) therefore concludes that levels of sulfur dioxide in the Claremont area pose *no apparent public health hazard*. This is a category in the Agency for Toxic Substances & Disease Registry's (ATSDR) Hazard Classification System that "applies to sites where exposure to site-related chemicals might have occurred in the past or is still occurring, but *the exposures are not at levels likely to cause adverse health effects*."

Ozone and fine particulate matter ($PM_{2.5}$) pose *no apparent public health hazard* to residents of the Claremont area. According to EPA Air Quality Index categories, ozone levels in the Claremont area during the nine-year study period were "good" almost 96% of the time, "moderate" 4% of the time, and "unhealthy for sensitive groups" 5 times. For "moderate" ozone days, EPA provides the following cautionary statement: "*People who are unusually sensitive to ozone should consider reducing prolonged or heavy exertion outdoors*."
During events categorized as "unhealthy for sensitive groups", the cautionary statement is, "*Active children and adults, and people with lung disease, such as asthma, should reduce prolonged or heavy exertion outdoors*." Elevated ozone events occur primarily during the summer when the prevailing winds are out of the south, southeast, or southwest. Ozone events are regional, as confirmed by the high correlation in their day-to-day levels across the state, and often across the New England Region.

Analysis of eight-years of $PM_{2.5}$ monitoring data in Claremont revealed that AQI levels were "good" more than 84.6% of the time, "moderate" 14.7%, "unhealthy for sensitive groups" twice, and "unhealthy" once. EPA's cautionary statement for "moderate" $PM_{2.5}$ days is, "*Unusually sensitive people should consider reducing prolonged or heavy exertion.*" For days categorized as "unhealthy for sensitive groups", EPA advises: "*People with heart or lung disease, older adults, and children should reduce prolonged or heavy exertion.*" When PM2.5 reaches "unhealthy" levels, EPA advises: "*People with heart or lung disease, older adults, and children should avoid prolonged or heavy exertion. Everyone else should reduce prolonged or heavy exertion.*" This and other $PM_{2.5}$ events are primarily regional, as indicated by the high correlation of levels in Claremont with those at Manchester and Portsmouth.

The EHP analysis of modeled concentrations of nitrogen dioxide in the Claremont area concludes that they pose *no apparent public health hazard.* Cumulative "worst-case" exposure levels were all below all applicable health-based thresholds.

Analysis of almost seven years of monitoring data for 27 additional air toxics suggests that they pose *no apparent public health hazard* to any groups in the Claremont area. Claremont air toxic levels are expected to have no effect on rates of cancer or non-cancer diseases (See Section 7.0 – Health Outcome Data Review). Air toxics levels at South Street were also consistent with those from other air monitors across the state regardless of season, wind direction, and other factors.

Levels of mercury in ambient air are difficult to monitor. DES modeling of mercury concentrations in ambient air in the Claremont area concludes that they pose *no apparent public health hazard* through inhalation. Mercury can be a concern, however, through fish consumption. Mercury from local, regional, and distant industrial sources is deposited in water bodies, converted to methyl mercury through natural processes, and is ingested by fish where it bioaccumulates. Consumption of these fish in large quantities may pose a health hazard, especially to children and pregnant women. EHP launched an initiative in spring 2008 to obtain fish samples in the greater Claremont area and analyze them for mercury. The results of this forthcoming study will be published in a health consultation and disseminated to the public. In the meantime, EHP urges residents to follow the statewide fish advisory to minimize exposure to mercury.

The EHP analysis of modeled concentrations of dioxins/furans (CDD/CDF) in the Claremont area concludes that they pose *no apparent public health hazard* through inhalation. Predicted "worst-case" exposure levels were all below all applicable health-based thresholds.

Finally, a review of cancer incidence the City of Claremont in 1987-2001 revealed no significant elevation in any type of cancer (http://www.atsdr.cdc.gov/HAC/PHA/HCPHA.asp?State=New%20Hampshire).

10.0 RECOMMENDATIONS

Based on the conclusions of this report, the following public health recommendations will be implemented by DES:

- Continue inspections and monitoring of all regulated facilities in the Claremont area to assess compliance with applicable air quality regulatory requirements.

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- Continue to issue DES Air Quality Action Days (AQAD) encouraging residents, especially children, the elderly, and those with asthma or other respiratory conditions to avoid prolonged outdoor activity and take precautions to protect their health. On AQADs, residents are also encouraged to conserve energy and electricity, and to minimize driving. NH Air Quality information is available at: www.airquality.nh.gov

- Continue to distribute information on the State Law that prohibits uncontrolled residential trash burning and other items that emit excessive amounts of pollution to the ambient air.

Area residents concerned with local air quality should contact DES if they suspect individuals are burning prohibited items. DES will respond to citizen complaints.

- Continue to encourage local recycling and energy efficiency measures to reduce pollution in the Claremont area.

- Encourage use of fuel in woodstoves, fireplaces, or outdoor wood boilers that is appropriate for each heating device and adequately "seasoned."

- Continue to encourage residents interested in obtaining daily regional air quality information to register for EPA's AIR NOW website: http://www.airnow.gov

- Continue DES efforts to advise residents to limit their exposure to environmental mercury by following the recommendations of the NH Statewide Fish Consumption Advisory. The Advisory recommendations are included in the fact sheet "NH Fish Consumption Guidelines" on the DES website: http://des.nh.gov/factsheets/ehp/ard-ehp-25.htm

11.0 PUBLIC HEALTH ACTION PLAN

The purpose of the Public Health Action Plan is to ensure that the current document not only identifies exposure potentials and possible health risks, but also provides a plan of action to mitigate and prevent adverse human health effects resulting from exposures to air pollutants. The first section of the Public Health Action Plan contains a description of completed and ongoing actions taken to mitigate air pollution. The second section presents a list of public health actions planned for the future.

Actions Completed

1. DES has responded to, and investigated, approximately 53 citizen complaints from residents regarding Claremont-area facilities since 1989.

2. In 1989, DES began monitoring the ambient air in Claremont to ensure compliance with the National Air Ambient Air Quality Standards (NAAQS).

3. From January 2000 through December 2006, DES collected air toxics data in Manchester, Claremont, and Portsmouth.

4. In 1986, 1995, and 2003, DES conducted five public hearings regarding the Wheelabrator – Claremont's air quality permits.

5. In 1998, DES enacted a Mercury Reduction Strategy containing recommendations for reducing man-made releases of mercury into the environment. The strategy targeted dental clinics, hazardous waste generators, hospitals/health care facilities, manufacturing facilities, municipalities, utilities, and waste-to-energy facilities

6. In 2001, DES enacted a Dioxin Reduction Strategy to reduce statewide dioxin emissions by 50% by 2003. The strategy recommended more environmentally safer methods of medical waste disposal, reducing the use of chlorine-treated materials, measuring dioxin emissions from wood-burning utilities, and encouraging the replacement of older wood-burning stoves with new, more efficient models.

7. In 2002, DES worked with the New Hampshire Legislature to pass HB 253. The bill required "small" municipal waste combustors (burning 100-250 tons/day of municipal waste) to meet the State's mercury emission limit (0.028 mg/dscm) sooner than originally required by RSA 125-M.

8. DES worked with the New Hampshire Legislature to pass a January 1, 2003 law prohibiting the open burning of residential trash materials.

9. DES worked with Wheelabrator in 2005 to control facility emissions using: 1) an Evaporative Cooling System and Powdered Activated Carbon Injection System (PACIS) to control mercury and dioxins/furans; 2) a Wet-Lime Injection Scrubber to reduce sulfur dioxide and acid gas; and 3) Ryton Fabric Filters to control particulate matter (PM).

10. In 2005, DES worked with the New Hampshire Legislature to pass HB 414. The bill required "small" municipal waste combustors (burning 100-250 tons/day of municipal waste) to achieve the updated and more stringent "large" unit (>250 tons/day) Federal emission limits.

11. DES was instrumental is promoting legislation to prevent disposal of mercury- containing products in municipal solid waste. On January 1, 2008, the disposal of mercury-containing products at landfills, transfer stations and incinerators is prohibited

Actions Planned

1. EHP will update health outcome reports for Claremont as additional years of cancer incidence and hospitalization data become available.

2. DES will continue to support efforts in the NH Legislature to achieve additional reductions in statewide air emissions. HB 1673-FN was recently passed by the Legislature and signed into law by the Governor in March 2006. This bill requires the installation of scrubber technology at NH's largest power plant no later than July 2013 which will reduce mercury emissions by 80%.

EHP will reevaluate and expand the Public Health Action Plan as needed. New environmental, health outcome data, or the results of implementing the above actions may warrant additional actions at this site.

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