New York State Department of Health
Center for Environmental Health

HEALTH CONSULTATION

LAFARGE CEMENT PLANT
RAVENA, ALBANY COUNTY NEW YORK

SUMMARY OF ENVIRONMENTAL DATA AND EXPOSURE PATHWAY EVALUATION; HEALTH RISK ASSESSMENTS; AND HEALTH OUTCOME DATA

PUBLIC COMMENT DRAFT

November 2010 **CERCLIS No. NYD002069557**

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Center for Environmental Health
Under a Cooperative Agreement with
Agency for Toxic Substances and Disease Registry

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TEXT ACRONYMS

AAQS	Ambient air quality standards
ACHD	Albany County Health Department
ADD/ADHD	Attention Deficit Disorder/Attention Deficit Hyperactivity Disorder
AGCS	Annual Guideline Concentrations
ATSDR	Agency for Toxic Substances and Disease Registry
CAAA	Clean Air Act Amendments
CASE	Community Advocates for Safe Emissions
CDC	United States Centers for Disease Control and Prevention
CKD	Cement kiln dust
CO	Carbon monoxide
COPD	Chronic obstructive pulmonary disease
DEIS	Draft Environmental Impact Statement
EJ	Environmental Justice
EPCRA	Emergency Planning and Community Right to Know Act
EPHT	Environmental Public Health Tracking
ESP	Electrostatic precipitator
HAPS	Hazardous air pollutants
HC	Health Consultation
HMR	Heavy Metals Registry
HOD	Health Outcome Data
Lafarge	Lafarge Building Materials, Inc.
MACT	Maximum Achievable Control Technology
NAAQS	National Ambient Air Quality standard
NO_x	Oxides of Nitrogen or Nitrogen oxides
NY	New York
NYCRR	New York Codes Rules and Regulations
NYS DEC	New York State Department of Environmental Conservation
NYS DOH	New York State Department of Health
NYS DOS	New York State Department of State
NYS ED	New York State Education Department
OLDR	Occupational Lung Disease Registry
PAC	Polycyclic aromatic compounds (see also PAHs)
PAHs	Polycyclic aromatic hydrocarbons (see also PAC)
PBT	Persistent, Bioaccumulative, and Toxic
PCBs	Polychlorinated biphenyls
PCDD	Polychlorinated dibenzodioxins (dioxins)
PCDF	Polychlorinated dibenzofurans (furans)
PHA	Public Health Assessment
PM	Particulate matter
PM_{10}	Particulate matter with an aerodynamic diameter 10 micrometers or less
$PM_{2.5}$	Particulate matter with an aerodynamic diameter 2.5 micrometers or less
PPM	Parts per million
PSD	Prevention of Serious Deterioration
RCS	Ravena-Coeymans-Selkirk
RIBS	Rotating Intensive Basin Survey
RTR	Risk and Technology Review
SEDCAR	Strategic Evaluation, Data Collection, Analysis and Reporting

SGC	Short-term Guideline Concentrations
SO_2	Sulfur dioxide
SPDES	State Pollution Discharge Elimination System
SVOCs	Semi-volatile organic compounds
TDF	Tire-derived fuel
TEOM	Tapered element oscillating microbalance
TRI	Toxics Release Inventory
TSP	Total suspended particulates
US	United States
US EPA	United States Environmental Protection Agency
VOC	Volatile organic compounds

SUMMARY

Introduction

In 2009, Community Advocates for Safe Emissions (CASE) requested that the New York State Department of Health (NYS DOH) investigate the impact on community health posed by the cement plant located in Ravena, Albany County. As a result, the Agency for Toxic Substances and Disease Registry (ATSDR) and the NYS DOH are conducting a public health assessment (health assessment) for communities potentially affected by contaminants released from the cement plant, currently owned and operated by Lafarge Building Materials Inc.

The goal of the health assessment is to evaluate whether chemicals released from the cement plant might harm people's health. Chemicals might harm health only if 1) they are present in environmental media (e.g., air, soil) that people might contact; and 2) the contaminant concentration in those media exceeds levels that are considered to be protective of public health. If chemical concentrations in environmental media are found to exceed concentrations that might harm health, a health assessment characterizes the nature and degree of the risk to health. A health assessment does not include study of specific health effects in people. However, a health assessment may include a recommendation for a study of health effects in a population if it concludes that additional study is warranted based on the nature of risk to health identified.

ATSDR and NYS DOH are using a sequential, two-phased approach to complete this health assessment. Phase one is completion of this Health Consultation (HC) report. Phase two is completion of a Public Health Assessment (PHA) report.

This HC includes a summary of all available environmental information about chemical releases from the cement plant and consideration of this information to identify ways people might be exposed to chemicals released from the plant (i.e., exposure pathways). This HC also characterizes community health concerns, and also includes descriptions of the limited health risk assessments available for the cement plant that provide information about what is already known about possible risk for adverse health effects that could result from exposure to cement plant-related contaminants. Finally, this report includes descriptions of available health data for residents of areas around the plant. The health information is presented to illustrate what types of health outcomes might be evaluated if chemical releases from the cement plant are found to potentially increase the risk for adverse health effects in phase two of the health assessment, and further study is recommended.

Phase two of the health assessment, the PHA report, will include evaluation of people's possible exposures to chemicals from the cement plant through the exposure pathways identified in this HC. This will include estimating concentrations of cement plant-related chemicals in media (other than dust) that people might contact, and evaluating whether those concentrations approach or are higher than levels that might increase the risk for adverse health effects. ATSDR and NYS DOH will evaluate the public health implications of the cement plant based on these analyses and other relevant exposure and health-related information to make recommendations, as warranted, for further study or public health action. Final analyses and conclusions about the risk for adverse health effects from cement plant-related contaminants along with relevant recommendations will be summarized in the PHA report.

Conclusions reached by ATSDR and NYS DOH in this phase one HC are summarized below.

Conclusion 1 – Environmental Data and Exposure Pathways

Available environmental data about the cement plant identify two exposure pathways through which people might contact contaminants from the cement plant. These are an air exposure pathway and settled dust exposure pathways.

Exposures to cement plant-related contaminants in other environmental media (public drinking water, groundwater, soil, on-site cement kiln dust, surface water, sediment or fish) are not likely or expected.

Basis for Decision

Air Exposure Pathway – Estimated and measured releases of multiple contaminants, including mercury and other metals, to air from the cement plant stack are available. Air in the surrounding community may contain these contaminants, and people residing, working or attending school may be exposed to these contaminants through inhalation.

Settled Dust Exposure Pathways – Available information indicates that prior to 2001 dust generated from the cement plant moved off-site and settled in the area near the cement plant. Operations at the plant continue to generate dust, although the extent to which dust from the plant moves off-site presently has not been evaluated. People residing, working or attending school near the Ravena cement plant may contact settled dust originating from the cement plant through skin contact, accidental ingestion or inhalation. These potential pathways will be evaluated further in the PHA.

Incomplete Exposure Pathways – Although cement kiln dust (CKD) is present on the Ravena cement plant property, and some groundwater, soil and sediment samples on the Ravena cement plant property contain cement plant-related contaminants, people in the surrounding community are not likely to contact these media. Other available data indicate that neither surface water (Coeymans Creek) on the Ravena cement plant property nor fish in nearby water bodies contain cement plant-related contaminants. Exposure pathways involving drinking water, groundwater, on-site soil or CKD, surface water, sediment or biota are incomplete and will not be considered in the PHA.

Next Steps

Air Exposure Pathway – Exposure to chemicals released to air from the cement plant will be evaluated in the PHA. Using site-specific air dispersion modeling NYS DOH, in collaboration with NYS DEC, will use available emission rates for chemicals released from the cement plant kiln stack to estimate maximum air concentrations at ground level in the surrounding community (where people would breathe it). These concentrations will be compared to chemical-specific health comparison values in the PHA.

Settled Dust Exposure Pathways – The presence of cement plant-related settled dust in the community will be evaluated in the PHA. If settled dust originating from the cement plant is likely to be present and exposures appear possible, the possible risk for health effects from exposure to settled dust will be qualitatively described.

Conclusion 2 – Health Risk Assessments

Although available health risk assessments suggest that air emissions from the cement plant are not likely to increase the risk for adverse health effects, they are an incomplete basis for drawing conclusions about the risk from cement plant air emissions.

Basis for Decision

Available health risk assessments applicable to the Ravena cement plant evaluate the health risk from exposure to multiple contaminants prior to 1988; the health risk to children from exposure to potential lead emissions; and the health risk to the general public from exposure to potential lead, cadmium, mercury, selenium and zinc emissions. However, these risk assessments are limited to few chemicals, and in most cases, do not reflect actual (past or current) operating conditions at the cement plant.

Next Steps

Available, limited risk assessments will not be evaluated further in PHA. Exposures to all chemicals measured at the stacks at the cement plant under recent operating conditions will be assessed in the PHA as noted above (Conclusion 1). Based on comparison of modeled estimated exposures to health comparison values, the risk for adverse health effects from the cement plant will be evaluated.

Conclusion 3 – Health Data

Overall, health outcome rates for the ZIP codes around the cement plant appear to be similar to rates across New York State. The HOD presented here cannot rule out the occurrence or absence of increased health outcome rates in the smaller geographic areas with potentially higher impacts from the cement plant. These data do however illustrate the types of health outcomes that could be evaluated on a smaller geographic scale in the community if phase two (the PHA) indicates some areas around the plant may have air contaminant levels exceeding health comparison values.

Basis for Decision

Most readily available HOD are coded to the ZIP code where individuals live. Air dispersion modeling illustrates that the geographic area likely to be affected by air emissions from the plant is smaller than any of the ZIP codes for which HOD are readily available. Readily available HOD cannot be used to assess the possible impact of the cement plant on community health because these data do not describe populations potentially impacted by the plant. However, the HOD summarized illustrates the types of health outcomes that could be evaluated on a smaller geographic scale if the PHA indicates some areas around the plant may have air contaminant levels above health comparison values.

Next Steps

The PHA will compare modeled, estimated ground-level air concentrations of chemicals released from the cement plant at the location (point) of maximum impact in the community with health comparison values. If these comparisons suggest that levels approach or exceed health comparison values, further evaluation of health outcomes, in areas defined by air dispersion modeling as being impacted by the plant, will be considered and recommended as warranted.

For More Information

If you have questions about this document or NYS DOH's ongoing work on the Lafarge cement plant in Ravena, please contact Bettsy Prohonic of the NYS DOH at 518-402-7530. If you have questions about the Lafarge cement plant, please contact Don Spencer of the NYS DEC at 518-357-2350.

1.0 INTRODUCTION

The cement plant in Ravena, Albany County, N.Y., has been in operation since 1962. At various times, members of the public have raised concerns about the cement plant through complaints to the Albany County Health Department (ACHD), New York State Departments of Health (NYS DOH) and Environmental Conservation (NYS DEC), newspaper articles, public meetings and in oral and written comments provided during hearings related to permitting of the plant. In 2009, Community Advocates for Safe Emissions (CASE) requested that the NYS DOH investigate the impact on community health posed by the cement plant, which is currently operated by Lafarge Building Materials Inc. (hereafter referred to as the Ravena cement plant).

Based on concerns raised in the past and in discussions between CASE and NYS DOH, it was determined that the Agency for Toxic Substance and Disease Registry (ATSDR) Public Health Assessment (PHA) is a useful framework for addressing health concerns about the cement plant. Representatives from NYS DOH and CASE met on several occasions in 2009 and 2010. At the meetings, they discussed how to work together to address concerns about the Ravena cement plant through the health assessment process, and explored how to provide opportunities for all interested stakeholders, in addition to members of CASE, to participate.

1.1 The Public Health Assessment Process

A PHA is a report which evaluates available information about contaminants (e.g., chemicals, particulates) present at, or released from, a site or facility to assess their impact on human health, and to develop recommendations for additional study and/or actions to prevent or mitigate human health effects, as warranted (ATSDR, 2005).

Contaminants in the environment might harm health if:

- they are present in environmental media (e.g., air, water, soil) that people might contact; and
- their concentrations in environmental media are high enough to harm health.

A PHA therefore first describes whether site-related contaminants are present in environmental media. If site-related contaminants are present in environmental media, a PHA then describes the ways people might contact media containing site-related contaminants. Ways people might contact site-related contaminants are called *exposure pathways*. An *exposure pathway* consists of:

- the source of contaminants released to the environment;
- the environmental medium (air, water, soil, biota) that is contaminated;
- a point of exposure where contact with contaminated media may occur;
- a route of exposure (ingestion, inhalation, skin contact) through which contaminants can enter or contact the body; and
- a population of people who may be exposed to contaminants at a point of exposure.

A *complete exposure pathway* exists when all the components of an exposure pathway are present. A *potential exposure pathway* exists when some, but not all, of the components are present. The identification of complete and potential exposure pathways for a site or facility is called an *exposure evaluation*.

If the exposure evaluation finds that people might contact site-related contaminants because an exposure pathway exists, a PHA then evaluates whether such contact might harm health. This is done by evaluating whether concentrations of site-related contaminants in environmental media approach or exceed concentrations that might harm health. This evaluation is called a *health effects evaluation*. For complete and potential exposure pathways, the *health effects evaluation*:

- compares media concentrations of contaminants at points of exposure *(locations where contact with contaminated media may occur)* to *health-based comparison values*; and/or
- estimates exposure doses of contaminants *(amounts of contaminants people might get into or on their bodies)* based on-site-specific exposure conditions, and then compared to *health-based comparison values.*

Health-based comparison values are concentrations of contaminants in air *($\mu g/m^3$)*, water *($\mu g/L$)* or soil *(mg/kg)* that are unlikely to cause harmful health effects in exposed people. Sometimes health comparison values are doses, the amount of a contaminant people might get into their body *(mg/kg body weight)*, rather than the contaminant concentrations in environmental media. Health comparison values for most environmental contaminants of human health concern have been developed by federal and state agencies (e.g., U. S. Environmental Protection Agency [US EPA], ATSDR, NYS DOH, NYS DEC).

For any exposure pathway, if contaminant concentrations in environmental media (or doses) at points of exposure are lower than health comparison values, then that exposure pathway is considered unlikely to harm health. If contaminant concentrations in environmental media (or doses) at points of exposure are higher than health comparison values, then those exposure pathways are further evaluated to better characterize whether and how they might harm health; and, to determine whether further studies or public health responses are needed. Sometimes, further study involves evaluating specific health outcomes in populations where exposures to specific contaminants approach or exceed health comparison values. A more detailed description of the PHA process is available at www.atsdr.cdc.gov/com/pha.html.

1.2 The Public Health Assessment Process for the Cement Plant in Ravena NY

The health assessment for the Ravena cement plant is being completed in two phases summarized in two reports. The first phase is summarized in this Health Consultation (HC) report which includes a summary of all available environmental data and information about the cement plant over its 48 years of operation, and completion of an exposure evaluation. Based on this information, complete and potential exposure pathways are identified. This HC also includes summaries of community concerns and other available risk assessments and analyses, and description of types of health outcome data (HOD) that are available for communities surrounding the plant. This additional information provides background about the Ravena cement plant and community that will help to focus recommendations for additional studies or actions, if warranted, during phase two of the health assessment.

Phase two of the health assessment will be summarized in a PHA report and will include completion of the health effects evaluation. Based on the health effects evaluation, and considering other analyses and information about the community, the phase two PHA report may also include recommendations for further studies or public health actions (e.g., actions to reduce possible exposures, conduct additional environmental or health studies, provide health services or education).

This phase one HC report:

- provides a comprehensive review and summary of all available environmental data and other relevant information and analyses (e.g., previous health risk assessments) about the cement plant;

- identifies complete and potential exposure pathways for evaluation in the health effects evaluation during phase two of the health assessment;

- summarizes the health concerns that have been raised about the plant and the types of HOD that are readily available for the communities surrounding the cement plant; and

- provides an opportunity for stakeholders to understand the health assessment process for the Ravena cement plant, and to provide their input, recommendations and comments.

To complete this report, pertinent records from the US EPA, the NYS DEC, NYS DOH, and NYS Department of State (NYS DOS), the ACHD and the Ravena-Coeymans-Selkirk (RCS) School District were sought and reviewed. NYS DOH invited representatives from the community, including CASE and Friends of Hudson, and from Lafarge Building Materials Inc. (Lafarge) to provide any pertinent records or other information NYS DOH may not have known about or did not have access to. Finally, other independent investigators who have reportedly obtained, or are in the process of obtaining, environmental data or other information potentially relevant to this review were invited to share their findings (NYS DOH, 2009a;b; 2010).

In preparing this report, NYS DOH staff members also met with elected officials of the Village of Ravena and towns in the vicinity of the cement plant (Coeymans, Schodack, Bethlehem), the RCS School Board, the Environmental Manager and Citizen Liason Panel of Lafarge and physicians and other health care providers practicing in Ravena. NYS DOH staff listened to community perspectives about the cement plant and also developed a list of stakeholders (e.g., local governmental bodies, individuals and community groups) with concerns about the plant.

2.0 CEMENT PLANT BACKGROUND

2.1 Site Location within the Region

The Ravena cement plant is located in the Town of Coeymans, Albany County (Figure 1). The plant is bordered by United States (US) Route 9W to the west; Coeymans Creek, NYS Thruway and the Hudson River to the east; and open land to the north and south (Figure 2).

The total area owned by Lafarge is 3,274 acres and includes a limestone quarry to the west of the site on an escarpment directly above and west of the RCS Middle-Senior High School complex (Figure 2). US Route 9W and a strip of undeveloped cement plant property separates the school complex and the Ravena cement plant itself. The extent of the cement manufacturing facility is approximately 230 acres and includes stockpiled limestone, coal and petroleum coke storage areas, manufacturing and office buildings, storage silos that hold finished product prior to shipping, employee parking, four on-site cement kiln dust (CKD) landfill cells (one active), a wastewater treatment plant and leachate settling ponds (Figure 3). An elevated conveyor system transports raw limestone from the quarry across US Route 9W to the manufacturing facility. A conveyor system also extends from the facility to the Hudson River where finished product is loaded onto shipping barges. A CSX train track is located on the western edge of the manufacturing facility with a spur contained within the facility (Figure 2).

2.2 Cement Making Process

The Ravena cement plant has been manufacturing cement under different owners since 1962. It operated initially as Atlantic Cement, then as Blue Circle Cement (referred to in some documents as Blue Circle Atlantic) from 1985 to 2001, and as Lafarge from 2001 to the present. The Lafarge cement plant can manufacture up to approximately 2 million tons (4.2 billion pounds) of

Portland cement per year making it one of the largest cement manufacturing facilities in the nation.

Lafarge currently uses a wet process to produce cement. Crushed limestone mined from the Lafarge quarry, is mixed with water (storm, groundwater and/or river water depending on weather conditions) and additives (bauxite, iron ore, low carbon fly ash) to create slurry that is pumped into holding tanks, and then to blending tanks for homogenization. Following homogenization and blending, the slurry enters one of two rotary kilns where it is heated. A solid fuel mixture of coal and coke or liquid fuel oils heats the kilns. Within the kiln, the slurry is calcined (a high temperature heating process to remove water and any volatile chemicals) at temperatures of 700–900 ºC. At higher temperatures, the resulting calcium oxide (lime) reacts with the silicate, alumina and iron minerals. At approximately 1350 ºC the process of sintering occurs (i.e., minerals are heated to the liquid phase). Burning and sintering are complete between 1400 ºC and 1450 ºC. This results in a material called clinker, greenish black pieces about the size of large marbles. Clinker is moved to separate storage units called clinker coolers. After cooling, the clinker is ground and mixed with up to 5 percent gypsum to create the finished product known as Portland cement (Environmental Quality Management Inc., 2009).

Detailed descriptions of all emission sources at the cement plant are described in NYS DEC Permit Review Reports available at www.dec.ny.gov/dardata/boss/permits. Emissions can occur from controlled sources such as kiln and clinker cooler stacks; from vents associated with raw material mills, finish mills and storage silos; and, from other sources (referred to as fugitive sources) that may be controlled by methods such as shrouds (covers) and wash stations.

Kiln emissions contain a variety of gases and particulates, including hazardous air pollutants (HAPs) (air pollutants known or suspected to cause cancer or serious health effects, such as reproductive effects or birth defects, or adverse environmental effects (see www.epa.gov/ttn/atw/allabout.html) which vary depending upon the raw material and fuel used. CKD is a fine-grained, solid, highly alkaline particulate material present in kiln exhaust. Two electrostatic precipitators (ESP) control particulate emissions from the kiln stack. Clinker cooler emissions are primarily CKD which may also contain metal HAPs. Fabric filter baghouses control the particulate CKD emissions from the clinker coolers.

Reported fugitive emissions from the cement plant (under Atlantic, Blue Circle and Lafarge ownership) have been predominantly particulates (including dust), but have also included methanol and sulfuric acid and sometimes lead and mercury (see US EPA TRI Explorer at www.epa.gov/triexplorer). Transport of raw materials (e.g., limestone from the quarry) and intermediate and final product using trucks and conveyors can also be a source of fugitive particulate emissions (including dust). Methods used to control fugitive dust emissions include covered conveyor belts and railcar sheds, dust shrouds, water spray for dust suppression on unpaved roads and around storage piles, street sweeping on paved roads and wash stations to remove dust from cement trucks before departure. Fabric filter baghouses now control all raw and finished product-material transfer point emissions (NYS DEC, 2006b).

The CKD is removed from the precipitators and baghouses, reused in cement manufacture or landfilled on-site using a variety of disposal methods, some of which have been associated with fugitive particulate emissions (ACHD memorandum, 1973). Fabric filter baghouses control all CKD transfer points as of April 1998 (NYS DEC, 2006b). In the past, disposal of CKD was by addition of water to form a slurry and then placement of the slurry in an on-site landfill. This reduced the opportunity for fugitive dust emissions, but greatly increased the volume of material for disposal. Current disposal of CKD involves pelletization of the CKD (i.e., adding enough water to moisten dust) before placement into the landfill (Figure 2).

Landfill leachate (liquid that moves through, or drains from, a landfill) is piped to on-site settling ponds where suspended particulates are removed through settling. After settling, the alkaline (pH 8–13) leachate is pumped to an on-site wastewater treatment plant for adjustment to neutral pH (pH 6–9). If the manufacturing plant needs process-cooling water, the treated leachate is mixed with additional water and pumped to the plant for use as cooling water. If cooling water is not needed, the treated leachate is discharged to the Coeymans Creek, as allowed under a permit granted by the NYS DEC under NYS Solid Waste Management Facility Regulations (6 New York Codes Rules and Regulations [NYCRR] Part 360).

2.3 Other Activities

Callanan Industries leases a portion of the Lafarge property adjacent to US Route 9W at the northwestern side of the cement plant property (Figure 2) and operates under a separate NYS

DEC Air Pollution Control-Air State Facility Permit (at: http://www.dec.ny.gov/dardata/boss/afs/permits/401240005000018.pdf). Callanan Industries uses limestone that is unusable in the cement manufacturing process to create aggregate used in asphalt for commercial sale. Based on personal observation by NYS DOH staff and anecdotal reports, dust is present along US Route 9W near the Callanan Industries entrance. Emissions or releases of dust from Callanan Industries or other industrial, commercial, or transportation sources in the Ravena area are not reviewed here because this phase one HC report focuses on releases from the Ravena cement plant.

2.4 Permits, Inspections, Enforcement and Legal Actions

In 1962 when the Ravena cement plant began operations, it was subject to state law 6 NYCRR Part 220 Portland Cement Plants, promulgated on June 29, 1961, to regulate emissions or releases. Over time, additional laws, regulations and permit conditions applicable to the Ravena cement plant and enforced by NYS DEC and US EPA were promulgated to control air emissions, discharges to water bodies, landfilling of waste materials, storage of waste materials and wastewater and leachate collection and treatment. Failure to comply with applicable regulations can result in enforcement actions by NYS DEC or federal agencies (e.g., US EPA, Department of Justice). These actions can involve additional administrative requirements, fines or shutdown of operations until achievement of compliance. A table summarizing the NYS DEC permit-related notices and enforcement actions from 1992 to April 2010 that we were able to document is presented in Appendix A.

A recent enforcement action is a legal settlement encompassing 13 facilities owned by Lafarge and two subsidiaries, including the Ravena facility (US Department of Justice, 2010). The ruling requires that the Ravena cement plant reduce its emissions of sulfur dioxide (SO_2) and nitrogen oxides (NO_x), and is part of a broad federal effort to reduce air pollution from industrial sectors (e.g., cement manufacturing, glass manufacturing, acid production and coal-fired power). US EPA did not cite the Lafarge Ravena plant for any federal Clean Air Act violations that led to the 2010 settlement. Clean Air Act violations at other Lafarge facilities were the basis for the compliance case (personal communication June 2010, Tom Gentile, NYS DEC).

Local residents took legal action against the Ravena cement plant in 1970 (Boomer v. Atlantic

Cement). The Appellate Court agreed with the plaintiff that dirt, smoke and vibrations from the Atlantic Cement plant did constitute a nuisance. The lower court awarded monetary settlements for property damage. The Appellate Court also upheld a lower court ruling rejecting an injunction against Atlantic Cement to prevent the problem in the future.

2.5 Geography and Meteorology

As shown on Figure 1, the cement plant is in the Town of Coeymans and west of Coeymans Creek. It is at an elevation of 200–225 feet above sea level. To the west of the plant, the Helderberg Mountains rise to about 1,000 feet above sea level and run in a north-south orientation. Rolling terrain (200–600 feet above sea level) extends from the base of the Helderberg's eastward to the Coeymans Creek and Hudson River. Groundwater generally flows southeast across the site toward the Coeymans Creek and Hudson River (Blue Circle Atlantic 1988 Draft Environmental Impact Statement [DEIS]).

Based on meteorological data from the Albany International Airport, prevailing winds for the Albany region, on an annual basis, are from the south at an average wind speed of eight miles per hour. Prevailing winds in the Ravena area, based on meteorological data obtained at meteorological reporting stations within several miles of the cement plant (in Glenmont and New Baltimore), are from the south and northwest. Research performed in 2003 using meteorologic stations at locations further south in the Hudson Valley also reported winds "channeling up (south to north) the valley" (Fitzjarrald, 2006). Details on wind directions recorded for the area are presented and discussed in Appendix B.

3.0 COMMUNITY HEALTH CONCERNS

NYS DEC, NYS DOH and ACHD records indicate that concerns about the possible impact of dust releases from the cement plant in the community were noted several times from the late 1960s to the early 2000s. The complaints reflected concerns about property damage due to dust as well as about respiratory effects and asthma associated with dust releases from the plant. In several instances complaints led to air and/or dust sampling (described below).

Members of the public voiced concerns about the possible impact of the cement plant on community health at public meetings and at a legislative public hearing held by the NYS DEC in 2005 to discuss Lafarge's application to modify their Title V permit[1] to allow the use of tire derived fuel (TDF). Concerns were also noted in written comments on the application during a public comment period, including emissions of heavy metals, polychlorinated biphenyls (PCBs), volatile organic compounds (VOCs), dioxins, furans and other tire components. Commenters also noted concerns about the possible contribution of emissions to cancer, Parkinson's disease, asthma, altered intelligence quotients (IQ), rheumatoid arthritis, lupus and other health conditions.

Concerns about the possible impact of mercury emissions from the cement plant on the health of school children and employees at the RCS Middle and High Schools were raised with the RCS school district Superintendent in 2008 by individuals representing CASE. Concerns were also raised by members of CASE during a RCS Board of Education meeting in 2009, during which staff from NYS DEC and NYS DOH discussed estimated mercury emissions from the plant and possible associated health effects.

Members of CASE continue to express concern about possible adverse health effects in their community resulting from current or past exposures to contaminants released from the Ravena cement plant to air, water and soil. CASE has noted specific concerns about releases of mercury and other metals (e.g., cadmium, lead, nickel), dioxins, furans, polycyclic aromatic compounds (PACs), ammonia, hydrochloric acid and solvents. CASE is concerned about possible health effects in children such as autism, attention deficit disorder/attention deficit hyperactivity disorder (ADD/ADHD), other neurological and/or behavioral disorders, asthma and other respiratory diseases, and childhood cancer (Ewing's sarcoma). CASE has also noted concerns about all forms of adult cancer, Alzheimer's, Parkinson's and depression.

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[1] Title V of the Clean Air Act Amendments established a facility-based operating permit program combining all regulated emission sources at a facility into a single comprehensive permit. Title V Permits are required for all facilities with air emissions greater than major stationary source thresholds. NYS enacted amendments to Environmental Conservation Law Articles 19 (Air Pollution Control) and 70 (Uniform Procedures), and amended regulations 6 NYCRR Parts 200, 201, 621 and 231. With this demonstration of authority, NYS DEC received delegation of the Title V operating permit program from the US EPA. Today's air pollution control permitting program combines the federal air operating permitting program with long-standing features of the state program (i.e., pre-construction permitting requirement and assessment of environmental impacts pursuant to the State Environmental Quality Review Act). For each major stationary source facility, NYS DEC issues a Title V Facility Permit, a comprehensive permit containing all regulatory requirements applicable to all sources at the facility. Title V permits dictate all applicable environmental regulations. Title V permits are documents containing all enforceable terms and conditions as well as any additional information, such as the identification of emission units, emission points, emission sources and processes. Permits also may contain information on operation procedures, requirements for emission control devices as well as requirement for satisfactory state of maintenance and repair to ensure the device is operating effectively. Permits also specify the compliance monitoring requirements, recordkeeping and reporting requirements for any violation of applicable state and federal emission standards. Title V Permits can be viewed at www.dec.ny.gov/chemical/32249.htm.

In addition to a PHA, CASE has requested that a biomonitoring and/or body burden investigation to include blood, hair and/or urinary porphyrin testing for members of the community be conducted. CASE has also requested that statistical analyses of medical and health statistics of the community versus other communities be completed.

NYS DOH and ATSDR are completing a public health assessment for the Ravena cement plant to address the community concerns noted above. A public health assessment systematically identifies whether and how people are exposed to contaminants released from a site or facility and whether such exposures might harm health. There are already large amounts of environmental data and other analyses describing environmental releases from the plant over its nearly 50 years of operation. These data and analyses have resulted from NYS DEC regulatory oversight and responses to community requests. The first phase of the public health assessment, summarized in this report, presents and evaluates this information to assess what is already known about possible ways people might be exposed to contaminants from the plant; what types of health risk analyses have been done to assess whether exposures might harm health; and, what health outcome data might be readily available if the cement plant is found, during phase two of the PHA, to cause exposures that might harm health.

4.0 ENVIRONMENTAL DATA AND EXPOSURE PATHWAY EVALUATION

4.1 Air

Air contaminant data are available in different forms that provide different kinds of information. The types of air data available for the Ravena area are ambient air quality data, particulate and dust sampling data and source-specific air emissions data.

Ambient air quality data are collected from monitors at sampling locations that best characterize community or regional exposures and to reflect all sources affecting that location. Contaminant data from ambient air quality monitors (expressed in units of concentration e.g., parts per million [ppm], or micrograms per cubic meter of air [mcg/m^3]) are used to support enforcement of federal or state ambient air quality standards (AAQS), and in some cases, to allow for timely public reporting of ambient air quality. National Ambient Air Quality Standards (NAAQS) are levels of particulate-matter (PM_{10} and $PM_{2.5}$) and other criteria pollutants (NO_x, SO_2, ozone, lead and carbon monoxide) in air that are established and enforced by the federal government for the protection of human health and welfare. NAAQS are established, regularly reviewed and if warranted, revised by the US EPA. A chronological description of State and national AAQ objectives or standards for particulates and SO_2 are included in Appendix C.

Source-specific air emissions data are emissions related to a specific source; for example, air emissions data from stack tests. Stack emission data describe the amount of a substance (particulate or gas) leaving the stack over a specific length of time (for example, grams per second or pounds per year). Stack emissions represent concentrated levels of the substance released. Without appropriate modeling to account for dispersion, stack emissions do not represent ground-level concentrations to which workers or the general population might be exposed. An analogous situation occurs when aerosol sprays are used. The concentration of chemicals will be greatest at the point they leave the container and will be lower as they are diluted with the surrounding air.

4.1.1 Ambient Air Quality

4.1.1.1 NAAQS Ambient Air Quality Monitoring

Determination of compliance with NAAQS is done on a regional basis. Ravena is located in Albany County, and is in the Albany-Schenectady-Troy NAAQS region. Currently, this region meets all NAAQS except the eight-hour NAAQS standard for ozone. Ozone is not emitted directly from the cement plant or other facilities in the area. Ozone is formed in the atmosphere through chemical reactions involving sunlight, heat, volatile organic chemicals and NO_x.

4.1.1.2 Settleable Particulates, Total Suspended Particulates (TSP) and SO_2 (1960s, 1970s and 1980s)

Currently, there are no ambient air quality monitors for criteria pollutants in the RCS area. However, TSP monitors and/or dustfall jars for settleable particulates were located on rooftops of the RCS Junior-Senior High School (now called RCS Middle-High School) and the Becker and Pieter B. Coeymans Elementary Schools in the 1960s, 1970s and 1980s. (TSP monitors collect particles up to 100 micrometers in aerodynamic[2] diameter; dustfall jars collect particles that fall into an open-top glass jar.) NYS DEC reports summarize the data from those TSP monitors and dustfall jars (NYS DEC, 1974; 1976; 1981). One report contained a single year of SO_2 data, collected on the roof of Becker Elementary School (NYS DEC, 1976).

Tables 1, 2 and 3 summarize the ambient air monitoring data from the Coeymans area for settleable particulates, TSP and SO_2, respectively. These tables also include results of ambient air quality sampling at locations in Albany that characterize ambient air at nearby urban locations for comparison with Ravena data.

In general, levels of TSP, settleable dust and SO_2 at Coeymans locations were similar to, or lower than, levels at the Albany locations during the 1960s, 1970s and 1980s. For example, Table 1 shows that settleable particulate levels generally exceeded the prevailing NYS AAQ objective at both the Coeymans and Albany sites prior to 1973. Between 1973 and 1976, settleable particulate levels in both Albany and Coeymans appear to be similar and to generally meet prevailing NYS AAQS. Table 2 shows that in the 1960s, TSP concentrations in Albany were higher than at the RCS Junior-Senior High School, and TSP concentrations in both areas exceeded the prevailing NYS AAQ-objective. Some Albany sites exceeded the NYS AAQS for TSP during the 1971–1975 period, and one site exceeded the NYS AAQS in 1979. Neither the high school nor the elementary school in Coeymans exceeded the NYS AAQS for TSP after 1965. Table 3 shows that no exceedances of the NYS AAQS for SO_2 occurred at the Becker Elementary School in 1976 (the only year for which data was located) or at the ACHD in 1975 or 1976.

4.1.1.3 Fine Particulate Sampling (2009)

NYS DEC uses Tapered Element Oscillating Microbalances (TEOM, a type of particulate air monitor) to provide real-time data for monitoring and forecasting fine particulates ($PM_{2.5}$, or particles with an aerodynamic diameter of 2.5 micrometers or less) in ambient air. The nearest TEOM monitors to the Ravena cement plant are at the Town offices in Stuyvesant (Columbia

[2] A particle's size, shape and density will determine whether it will ever become airborne and also will determine what conditions would cause the particle to settle out of the air (be deposited) or be carried along by air movement. Commonly, particles are characterized by their aerodynamic diameter. A particle's aerodynamic diameter, is not the specific width of the particle in cross-section, but is instead how that particle behaves in air in relation to a sphere of known diameter and density. It is possible for particles with cross-sectional widths across a range of values to behave like a sphere of a specific density and diameter.

County) and at the ACHD offices (Albany County). The Stuyvesant monitor, located about eight miles south-southeast of the Ravena cement plant, collected fine particulate data from July 2009 until May 2010. The ACHD location, 10 miles north of the cement plant, has been operating since 1999. A graph of fine particulate monitoring results for the two TEOMs located at Stuyvesant and the ACHD, presented in Appendix D, illustrates that fine particulate concentrations at the two locations are similar over this time period.

4.1.2 Community Environmental Studies – Particulates

4.1.2.1 Settleable Dust and TSP Sampling (1968–1969 and 1971)

In 1968, the ACHD received 22 citizen letters expressing concerns about dust (primarily) or odor in the Ravena-Coeymans area. Some letters indicated the cement plant as the source of the dust, other letters did not. In response, NYS DOH staff reviewed operations at the Ravena cement plant and the air pollution controls that were in place and in use, made unannounced inspections and inspections in response to complaints, and conducted an environmental study (NYS DOH, 1969).

A dustfall jar, a TSP sampler (operated Monday-Saturday), and two directional TSP samplers were placed on the roof of the Pieter B. Coeymans Elementary School. One directional TSP sampler operated when winds were from the northwest (to characterize potential contributions from the cement plant); and the other directional sampler operated when winds were from the south (to characterize contributions from sources south of the school). In addition, sampling for settleable particulates occurred at a private residence located along US Route 9W west of the cement plant.

Data from the monitors were compared to the NYS AAQ Standard for settleable particulates and NYS AAQ objectives for TSP applicable at that time (see Appendix C) although the sampling protocols did not conform to NYS AAQ standard requirements.[3] The NYS DOH report

[3] The data collected and presented in the 1969 NYSDOH and 1971 NYS DEC reports provide information about ambient air quality but are not strictly comparable to ambient air standards. AAQS are based upon specific sampling protocols and an assessment of compliance with them requires data that are collected in accordance with those sampling protocols (i.e., for annual standards, sampling based on 12 months of sampling, samples collected with the required sampling frequency). The sampling for these studies occurred for only short periods and did not adhere to every day, every other day or every sixth day as are specified in the various standards. The 1971 NYS DEC study collected data for one calendar quarter (January-March) and at each location had data for most of 42 sampling days. There are 30-day, 60-day, and 90-day and annual NYS standards for TSP. With regard to sampling requirements, TSP data are collected: every sixth day, year round for comparison with the annual standard (minimum of 50 samples), every other day for comparison to the 60 and 90 day samples (minimum of 24 or 36 samples

concluded that both the school and residence sites exceeded the NYS AAQS for settleable particulate in all months, the school site exceeded the NYS AAQS annual standard for TSP, and sources from the south and the north each contributed to air quality at that location (NYS DOH, 1969).

From January through March 1971, the NYS DEC collected ambient air samples from monitors at the Pieter B. Coeymans Elementary School and at the RCS Junior-Senior High School (NYS DEC, 1971). Reasons for this study were the previous sampling results, citizen complaints about dust from the cement plant and collection of monitoring data for ongoing (at that time) NYS DEC hearings involving Atlantic Cement. At the Pieter B. Coeymans Elementary School, sampling included a dustfall jar, a continuous TSP monitor and a directional TSP monitor configured to collect samples when winds were from the north. At the RCS High School, sampling included a dustfall jar, a continuous TSP sampler and a directional TSP sampler configured to operate when winds were from the north. The settleable particulates exceeded NYS AAQS at both schools. The report concluded that the TSP results at the high school met the applicable NYS AAQS TSP standard, and that the Pieter B. Coeymans Elementary School site exceeded the 50th percentile NYS TSP standard (NYS DEC, 1971).

4.1.2.2 Settled Dust Sampling (1982–1983, 1997, and 2000–2001)

From September 1982 through June 1983, the ACHD received complaints (predominantly about dust with one complaint of a sulfur odor) from members of the community around the cement plant. ACHD enlisted the assistance of NYS DEC staff to collect two sticky tape samples of settled dust from two private properties near the cement plant. NYS DEC also collected representative dust samples at the cement plant near key process operations that were likely sources of fugitive dust emissions. Off-site and cement plant dust samples were compared to: assess the origin of off-site dust, to confirm a specific operational point from which off-site dust may have originated and to allow dust control abatement efforts to focus on a specific on-site source. One residential sample was microscopically consistent with cement dust, but was not definitively attributable to a specific on-site cement plant source. The other residential sample

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respectively) and every day for comparison with the 30-day standard (minimum of 24 samples). A complete data set with respect to the annual standard would have at least 50 of the possible 60 samples. While the average numerical value from this short-term sampling period does exceed the numerical value of the annual standard, the monitoring itself does not meet the requirements for comparison with an annual standard, or with 30, 60 or 90-day standards. The sampling results, from the 1971 report come closer to meeting the sampling requirements with respect to the 30-day standard and appear to have been in compliance with the 30-day TSP standard.

was determined to be pollen (NYS DEC memorandum, January 17, 1983).

In 1997, NYS DEC staff collected three dust samples at three properties near the cement plant where residents complained of dust. NYS DEC also collected three potential source material samples at three locations (clinker cooler, cement mill and precipitator) within the cement plant facility for comparison. Microscopic evaluation found that the dust from two of the properties were similar to the clinker cooler dust. The third sample contained some clinker cooler dust and biological and other materials not associated with cement production (NYS DEC memorandum, August 21, 1997). These sampling results were the basis for a consent order (NYS DEC v. Blue Circle Cement Inc., 1997) requiring payment of a $5,000 fine and submission of a baghouse maintenance plan (see Appendix A).

NYS DEC received dust complaints from residents near the Ravena cement plant, then operated by Blue Circle, in August and September 2000. NYS DEC staff collected dust samples from several properties and from three process points (dust dump, clinker cooler, ball mill) at the facility and submitted the samples to the NYS DEC microscopy laboratory for analysis. The results of the microscopic analysis confirmed that dustfall from the facility had occurred beyond the plant property lines. As part of an August 2001 Consent Order, Blue Circle paid a $276,000 penalty for air pollution infractions (see Appendix A). The Consent Order referenced air contaminants landing on neighboring properties in August, September and October 2000.

4.1.2.3 Future Fence-line Monitoring for Proposed Plant Modernization

Lafarge has submitted a DEIS for proposed cement plant modernization. The NYS DEC is requiring a comprehensive NAAQS compliance demonstration for PM_{10} and $PM_{2.5}$, which are regulated as Prevention of Serious Deterioration (PSD) pollutants, if the plant is granted the permit for modernization. To demonstrate compliance with NAAQS PSD regulation, Lafarge committed to the installation of PM_{10} and $PM_{2.5}$ monitors at the northwestern edge of the Ravena cement plant and at the RCS Middle-High School. A TEOM instrument will produce hourly readings of PM_{10} and $PM_{2.5}$ and daily concentrations will be transmitted to NYS DEC. A 10-meter meteorological tower will be installed in conjunction with the two monitors to record wind speed and direction, and temperature. If the modernization plan proceeds, monitoring will start when the new kiln system commences operation and will continue for at least one year.

4.1.3 Emissions Data

Source-specific air emissions data are submitted by operators of the cement plant to US EPA and NYS DEC. Air emissions information submitted to the US EPA include data in the Toxic Release Inventory (TRI) database (1988–2009). Information submitted to NYS DEC includes annual emission statements (2002–2008) required under the NYS DEC Title V permit, stack test emission rates to support applications to use waste solvent and TDF, estimated stack emission rates to support an application for a permit to modernize the cement plant and stack emission rates for dioxins, furans and particulates to support air compliance demonstrations.

4.1.3.1 Toxics Release Inventory (TRI) Data

Since 1988, US EPA has required certain facilities to report their storage and handling of toxic chemicals to the TRI under the Emergency Planning and Community Right to Know Act (EPCRA) program (US EPA, 2001). Under section 313 of EPCRA, operators of the Ravena cement plant provide annual reports on the amount of EPCRA section 313 chemicals the facility released into the environment (either routinely or as a result of accidents) or managed as wastes at the facility. Businesses are not required to measure or monitor releases under EPCRA section 313, but can use available emissions or other data, or can report "reasonable estimates." Reporting requirement thresholds vary by specific chemical or chemical class (e.g., polyaromatic compounds [PACs], dioxins) and can change in response to revisions to EPCRA[4]. The analytes reported to TRI over the years have also changed with changes in regulations.

TRI statements are available for total (stack and fugitive) facility air emissions (in pounds/year) for the Ravena cement plant on US EPA's TRI website (www.epa.gov/triexplorer) and are summarized and explained in Table 4. Reports for more analytes appear for the years after 2000, following implementation of new EPCRA reporting requirements for persistent, bioaccumulative toxicants (PBTs).

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[4] For many of the EPCRA section 313 chemicals, the reporting threshold is *de minimis*, either 1 percent (e.g., methanol, sulfuric acid, hydrochloric acid, ethylene glycol, ammonia, chromium, manganese) or 0.1 percent concentration (lead compounds) in mixtures. For others, (i.e., PBTs) the threshold is expressed by mass, for example, 0.1 gram (dioxins), 10 pounds (mercury and mercury compounds), or 100 pounds (PACs).
US EPA defines designations that businesses use to describe how submitted emission estimates are derived. In the case of the Ravena cement plant, estimates were derived using either monitoring data (M), other approaches such as engineering calculations (O), emissions factors (E), mass-balance calculations (C), or in two instances prior to 1991, no estimate basis is available. TRI data for the cement plant is available from 1988 to 2007 (first and latest year for which TRI data are available on us EPA's website).

4.1.3.2 NYS DEC Title V Facilities Annual Emissions Reporting Data

Major facilities in NYS are required to report facility total emissions due to combustion and industrial processes for the substances listed on their Title V permit, for criteria pollutants and HAPS and for any other regulated contaminant to the NYS DEC under Sub-chapter A, Part 201 of NYCRR (www.dec.ny.gov/regs/4294.html). Since 1996, these reported emissions are entered in a NYS DEC database. Table 5 summarizes total annual emissions (in pounds/year) for the Ravena cement plant for the years 1996–2008, provided by NYS DEC.

4.1.3.3 Stack Test and Estimated Emissions Data

In 1987, Blue Circle Atlantic reported stack emission rates (grams/second) for twelve chemicals and chemical groups in an application to NYS DEC to burn waste solvent fuel in the kilns at the Ravena cement plant (Blue Circle Atlantic, 1988). The application was eventually modified and then withdrawn (notation on NYS DEC database printout). Table 6 summarizes emissions estimates (short-term maximum emission rates) in the 1987 application.

In response to a request from NYS DEC, Lafarge reported stack emission rates (in pounds/hour) for an extensive list of air toxics in a 2004 application for a NYS DEC permit to use TDF at the Ravena cement plant (summarized in Lafarge Modernization Application, 2009). Emission rates were provided for several metals and inorganics, twenty-five organics, eighteen individual polycyclic aromatic hydrocarbons (PAHs) and eleven PCB congeners under conditions representative of 2003 operations and are summarized in Table 7. Table 7 also includes contaminant concentrations at the stack based on the emission rates. NYS DEC granted Lafarge a permit to use TDF, although TDF has not been used.

In an application for a permit for modernization of the cement plant, Lafarge provided stack emission estimates for the Ravena cement plant assuming three different operating conditions (Lafarge Modernization Application, 2009). The first condition estimated emissions assuming the current facility ran at its maximum operating capacity. The second condition estimated baseline emissions for the period August 2004 through July 2006 using the stack test emissions rates (in pounds/hour) obtained in 2004 (Table 7) and during actual operation. The third condition estimated future emissions after modernization. The capacity of clinker production after modernization is estimated to be 150 percent of existing capacity and 164 percent of actual production during the 2004–2006 baseline period. Emission rates (tons/year) for all three conditions in the modernization permit application are summarized in Tables 8a-c.

Table 9 summarizes limited kiln stack emission rates from tests conducted in the past seven years for assessment of dioxins and furans in kiln stack emissions submitted as part of air permit compliance demonstrations required under Title V (Air Control Technologies, 2005; 2005a; 2007; 2008). A summary of stack test emission rates for particulates released from the clinker cooler exhaust stacks (2006) and kiln stack (2005) obtained to demonstrate compliance with 1999 US EPA regulations for the Portland Cement Manufacturing Industry (Air Control Technologies, 2006; 2007; 2007a) is in Table 10.

4.1.3.4 Dispersion Modeling for the Lafarge Application for Plant Modernization

Lafarge used the dispersion model (AERMOD) currently recommended by US EPA for refined modeling of facility impacts and baseline emissions data for current plant operation (Table 8b), to estimate dispersion of total particulate releases from the cement plant's two kilns and two clinker coolers. Sources of fugitive particulate releases other than the kiln and clinker cooler stacks, such as on-site roadways, were not included in the modeling assessment because these releases occur at lower elevations and are not well dispersed. These dispersion modeling analyses are presented in the DEIS submitted in conjunction with the Air Permit Application for Ravena Modernization Project. Appendix E describes this modeling in greater detail.

Dispersion of estimated particulate concentrations in the surrounding community, given current plant operation, is described and illustrated in Appendix E as annual or 24-hour concentration contours reflecting 10 percent of the concentration at the point of maximum impact on cement plant property. The 24-hour 10 percent impact concentration contour is used to identify ZIP Code areas for which HOD are summarized in Section 6.0 below.

4.1.4 Study to Assess the Sources and Distribution of Mercury

Based on the mercury stack emissions reported in the application for a permit modification to use

TDF (Table 7), the NYS DEC concluded that Lafarge was the largest known source of mercury emissions in NYS. Because of that finding, NYS DEC began efforts to control mercury from the cement plant and asked Lafarge to undertake a study to evaluate mercury concentration from all raw materials, fuels and emissions. Lafarge worked with NYS DEC to develop the protocol which was approved by the NYS DEC on March 19, 2008. The purpose of the study was to identify the contribution of mercury from each individual raw material and fuel to the total mercury emissions from the cement manufacturing process. Lafarge sampled raw material, clinker, CKD, fuels and stack emissions for mercury speciation and content using innovative analytical methods having low detection limits (Environmental Quality Management Inc., 2009).

Results of this study are summarized in Table 11. Study results show that local limestone is the largest source of mercury in the Ravena cement manufacturing process; the mercury in stack emissions is almost entirely elemental mercury; and stack emissions are the primary mercury emission source.

4.2 Drinking Water

The area immediately surrounding the Ravena cement plant, the cement plant and the Village of Ravena are connected to a public water supply, which obtains water from the Hannacroix Creek which in turn, is fed by the Alcove Reservoir. The public water intake point on the Hannacroix Creek is located in Greene County, southwest and upgradient of the Ravena cement plant. The Ravena public water supply is monitored monthly, quarterly or annually (depending on the parameter) by the ACHD for VOCs, total coliforms, color, turbidity, odor, pH, conductivity, alkalinity, hardness, nitrate, iron, manganese, chloride, sulfate, sodium fluoride and arsenic. Other than exceedances of some VOCs relating to the chlorination of the water (i.e., trihalomethanes), no exceedances of drinking water standards in finished water have occurred (personal communication from T. Brady [ACHD] to C. Bethoney [NYS DOH], October 2009).

The quarry maintains its own drinking water well, which is monitored by the ACHD. The quarry supply well is tested every three years for numerous analytes and other parameters including PCBs, pesticides, halogenated VOCs, aromatic VOCs, hardness, metals, alkalinity, color, corrosivity, cyanide, nitrite, pH, total dissolved solids, turbidity and coliforms. Other than detection of VOCs associated with on-site chlorination of water (i.e., trihalomethanes and haloacetic acids) at levels of no concern, no detections of other analytes have occurred. (Personal communication from T. Brady [ACHD] to C. Bethoney [NYS DOH], May 2010).

We found no readily available information on the locations or characteristics of the private drinking water wells in the RCS area. Routine monitoring of private wells is not required by state or federal regulation (other than for coliform bacteria at installation), so information on possible contamination of private wells is unlikely to exist.

4.3 Groundwater

NYS Solid Waste Management Facility Regulations (6 NYCRR Part 360) mandate that landfills be monitored for potential contamination of groundwater downgradient of the landfill. US EPA and NYS DEC currently monitor 22 groundwater monitoring wells for chemical analytes and other parameters for this purpose. Figure 4 illustrates the monitoring well locations, and Table 12 summarizes monitoring results for the wells. These results indicate an impact of the landfill on underlying groundwater. However, the flow of groundwater underlying the landfill is retarded by the nature of the soil and a landfill leachate perimeter collection system (personal communication from T. Reynolds [NYS DEC] to J. Storm [NYS DOH], September 27, 2010).

US EPA sampled on-site groundwater monitoring wells during a 2006 inspection to determine whether there had been PCB or other releases to groundwater or surface water following an earlier transformer oil spill (Weston, 2006). Groundwater samples were drawn from on-site monitoring wells and analyzed for inorganics (metals) and 65 semi-volatile organic compounds (SVOCs) as part of the 2006 site inspection (Weston, 2006). The analytical results for inorganics appear in Table 13. For the SVOCs analysis, only one compound, phenol (51 micrograms per liter [μg/L]), was found above detection limits, and only in one monitoring well (data not shown). As noted above, the perimeter collection system prevents off-site migration of groundwater.

4.4 Surface Water and Sediment

NYS DEC designates both the Coeymans Creek and the Hudson River, at the point where the Coeymans Creek enters, as Class C waterbodies. A Class C designation means that the best waterbody use is for fish propagation and survival; that waterbody quality shall be suitable for primary and secondary contact recreation, although other factors may limit the use for those purposes; and, that with approved treatment, the waterbody can provide potable drinking water (see 6 NYCRR Part 701.8). There are no public drinking water supplies that use water from Coeymans Creek; but it is unknown whether any private individual(s) obtain(s) drinking water from the Coeymans Creek.

Leachate associated with the on-site landfill is treated at the on-site wastewater treatment plant and discharged to Coeymans Creek under a State Pollution Discharge Elimination System (SPDES)[5] permit via SPDES Outfall No. 003 (Figures 1 and 2). NYS DEC monitors the Coeymans Creek quarterly for possible site-related contaminants. Tables 14a-b summarize surface water monitoring results for the Coeymans Creek and up- and down-gradient of SPDES Outfall No. 003. NYS DEC has not observed an impact of the treated landfill leachate on Coeymans Creek, although current discharge from Outfall No. 003 frequently contravenes the NYS DEC's effluent criteria governing thermal discharges in 6 NYCRR Part 704. NYS DEC is currently completing a SPDES permit modification that will address this issue (personal communication from J. Malcolm [NYS DEC] to C. Bethoney [NYS DOH], June 10, 2010).

US EPA collected sediment samples from on-site ponds, the Coeymans Creek and the Hudson River as part of 1994 and 2006 site inspections (Weston, 1994; 2006). Some potentially CKD-related components were detected in sediment samples. These data are summarized in Table 15.

4.5 Soil

PCBs were detected in soil (120 micrograms Arochlor 1260 per gram of soil, one sample) in 1994 in an area of the Ravena cement plant site where activities to reclaim used transformer oil occurred. The contaminated area was remediated and all PCB-containing oil and parts were disposed of off-site (Weston, 1994). Sampling of soil in the previously PCB contaminated area in 2006 indicated no PCB contamination (Weston, 2006). These reports also contain information about concentrations of inorganic substances in CKD and on-site soil which are summarized in Table 16.

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[5] NYS has a program, approved by the US EPA, for the control of wastewater and stormwater discharges in accordance with the Clean Water Act. Under NYS law, the program is known as the SPDES and is broader in scope than that required by the Clean Water Act in that it controls point source discharges to groundwaters as well as surface waters.

The NYS DEC Spill Response Programs database indicates that 108 chemical and/or petroleum spills have been reported on the manufacturing portion of the Ravena cement plant site, the quarry, the loading dock area in and along the Hudson River or the land leased to Callanan Industries over the 1986–2009 period (www.dec.ny.gov/cfmx/extapps/derexternal/index.cfm?pageid=2 accessed on 10/1/2009). Table 17 lists the chemicals and products (mostly petroleum) spilled and the number of times they were reported. Causes of the spills include equipment malfunction, human error and traffic accidents. In some cases, the cause of the spill and composition of the compound is unknown. All these spills were remediated.

4.6 Biota

4.6.1 Fish

NYS DEC collects fish samples each year from different waterbodies and analyzes them for a suite of chemical contaminants, in some cases including heavy metals, pesticides and other chemicals released by industrial activities. NYS DEC fish sampling typically focuses on water bodies with known or suspected contamination, water bodies susceptible to contamination, popular fishing waters and waters where trends in fish contamination are being monitored. Also, testing focuses on those species that are most likely to be caught and eaten by sport anglers.

NYS DOH annually reviews the NYS DEC testing results for fish, including those taken from the Hudson River, to determine whether a fish consumption advisory should be issued or revised for a given water body and fish species, based on the concentration of contaminants in the fish. When reviewing the data, NYS DOH compares contaminant levels in fish advisory guidelines and federal marketplace standards (as available) for a contaminant and considers other factors such as potential human exposures and health risks, location, type and number of samples. The existence of a specific fish advisory for a specific water body indicates that harmful levels of contaminants are present in fish from that waterbody, but in most cases, the contamination source has not been identified.

Searches of records and contacts with NYS DEC staff revealed that with the exception of Hudson

River PCB data, very limited sampling data are available for fish from waterbodies around the Ravena cement plant. Some fish sampling data are available for the Coeymans Creek, Feuri Spruyt (see Figure 1) and the Hudson River between the Troy Dam and Catskill. Table 18 summarizes available fish contaminant data for the Coeymans Creek and Feuri Spruyt and for a water body outside the Ravena area (for comparison purposes).

The NYS DEC data for fish from the Hudson River indicate that fish from almost 200 miles of the Hudson River (downstream of Hudson Falls, including the Hudson River near the Ravena cement plant) contain elevated concentrations of PCBs. This contamination is mostly due to past upstream industrial uses of PCBs at Hudson Falls and Fort Edward. Due to this contamination, NYS DOH has issued restrictive fish consumption advisories for much of the Hudson River, including the portion near the Ravena cement plant, for more than 30 years. Overall, PCB levels in Hudson River fish vary considerably by fish species and collection time and location. For example, 10 largemouth bass collected near Catskill in 1992 had an average PCB level of 5.9 parts per million (ppm) (range, 0.62–12 ppm); while 15 largemouth bass caught in the same area in 2005 had an average PCB level of 0.34 ppm (range, 0.01–0.95 ppm). PCB levels in fish from Coeymans Creek and Feuri Spruyt are generally in the 2005 range. Although PCB levels exceed levels in fish from a waterbody in a relatively pristine comparison area, they are below levels for which a fish consumption advisory would be issued.

NYS DEC has collected some data on other contaminants (e.g., mercury and cadmium) in Hudson River fish. The highest average mercury concentration in Hudson River fish caught near Catskill was 0.78 ppm (range, 0.77–0.79 ppm) in two striped bass caught in 1980. NYS DEC has collected a small amount of data on cadmium levels in fish from this vicinity, and cadmium levels tend to be low; e.g., the average cadmium level in five American eel caught in the Catskill vicinity in 1997 was 0.06 ppm (range, 0.04–0.09 ppm). To date, the data for PCBs is more extensive, because the PCB contamination in Hudson River fish is the basis for the restrictive fish advisory.

Based on the presence of PCBs in Hudson River fish, NYS DOH has issued fish consumption advisories for the Hudson River between the Troy Dam and Catskill and for Coeymans Creek from the Hudson River upstream to the waterfalls in the Hamlet of Coeymans. NYS DOH advises that women of childbearing age and children under the age of 15 should not eat fish of any species from this portion of the Hudson River and from the Coeymans Creek downstream of the Coeymans waterfall (first barrier to fish movement upstream from the Hudson River). Other people (women beyond childbearing age and adult males) should eat no fish except alewife, blueback herring, rock bass and yellow perch (no more than one [1/2 pound] meal per month) from these waters. The Coeymans Creek above the waterfall in the Hamlet of Coeymans and Feuri Spruyt are subject to the NYS DOH general fish advisory, which covers all other fresh waterbodies in NYS and recommends that people eat no more that four meals per month of fish from these waters.

4.6.2 Other Biota

The NYS DEC Rotating Intensive Basin Survey (RIBS) sampled water quality (water column chemistry, macroinvertebrates, sediment and invertebrate analysis and toxicity evaluation) in the Coeymans Creek in 2003 (http://www.dec.ny.gov/chemicals/36470.html). Survey data indicated that overall water quality has minor impacts, but is supportive of aquatic life and recreational uses. The study also indicated nutrient enrichment (phosphorous) and silt/sediment as the main types of pollutant, the suspected sources were agricultural and urban/stormwater run-off.

4.7 Additional Data and Studies

4.7.1 Samples Collected in the RCS Area

NYS DEC provided analytical reports for samples identified as mineral material; conveyor fallout; water, sediment, soil, plant material and various mammalian organs (see Appendix F). These samples were collected by Mr. Ward Stone, who has indicated in public statements they were collected in the RCS area near the Ravena cement plant and analyzed on behalf of CASE. NYS DEC does not have information such as sampling protocols or locations, or the required laboratory certifications[6] for these samples. Without this information, it is difficult to use these

[6] The NYS Environmental Laboratory Approval Program (ELAP) is mandated by Article 5, Title I of the Public Health Law to ensure the quality, accuracy and reliability of environmental testing performed in NYS. Certification includes, but is not limited to: Potable water, Non-potable water, Solid and Hazardous Waste and Air and Emissions. The law requires that the State of New York, or any political subdivision of the state, in contracting with a laboratory for environmental analysis, must use a laboratory holding ELAP certification for that analysis. In addition, the Public Health Law requires that all the following testing must be performed only in ELAP-approved laboratories:

- testing required by the Sanitary Code, including public drinking water, swimming pools and bathing beaches;
- testing required by the Environmental Conservation Law for water, air and solid and hazardous waste;
- all remaining environmental analysis in NYS; and
- bacteriological and chemical testing of bottled water sold or distributed in NYS.

The accreditation process: Laboratories wishing to enter the program submit a completed application package. This describes the categories, sub-categories and analytes for which certification is desired, and requires the laboratory to furnish information on the education and training of analytical results in evaluating cement plant releases for the purpose of a PHA.

4.7.2 Biomonitoring Research Study

In May 2010, Dr. Michael Bank of the Harvard School of Public Health invited adults and children seven years of age or older living within an approximate ten mile radius of Ravena to provide hair and blood samples for heavy metal analyses, including mercury. Volunteers were also asked to complete a questionnaire focusing on possible exposures to mercury, including indoor mercury spills, dietary seafood and occupational exposures. According to a summary of the research Dr. Bank shared with the NYS DOH, this research is being conducted in collaboration with CASE who "is seeking to identify and quantify the potentially hazardous substances being emitted from the Lafarge stacks and the quarry. Additionally, CASE is seeking information related to source apportionment, fate, and transport of the identified pollutants of concern and their potential health effects on community members, particularly children." According to the consent form provided to volunteers for this study, the purpose of this research study is to "measure environmental contaminants, such as mercury in [your] hair and blood samples; to increase awareness among participants and the general public about these contaminants." Aggregate results of the biological samples collected by Dr. Bank are anticipated to be shared with the public.

4.8 Conclusions - Environmental Data and Exposure Pathways

Table 19 summarizes all environmental data for the Ravena cement plant discussed above, and identifies complete or potential exposure pathways that might result in people's exposures to contaminants from the plant.

To identify exposure pathways for each environmental medium (e.g., air, water, surface water, sediment, soil, biota), we first determined whether contaminants present in the media are from

key personnel. Laboratories are required to provide a list of the approved methods of analysis that will be used. On receipt of a satisfactory completed application package, and following the satisfactory analysis of proficiency test samples, the laboratory is issued interim certification. As soon as possible after a laboratory has been admitted to the program, it is inspected using a standard checklist. If any deficiencies are noted, continued certification is dependent on the correction of deficiencies in a timely manner.
Laboratory inspections occur approximately once every two years. However, ELAP retains the right to revisit each laboratory, and may reinspect if there is a complaint about data quality or if the laboratory has an unusually large number of deficiencies.
Laboratories are required to perform satisfactorily in regularly-scheduled proficiency testing using samples prepared by ELAP or samples purchased from approved providers. Proficiency testing occurs twice yearly in each of the categories (potable water, non-potable water, solid and hazardous waste and air and emissions) but the program retains the right to challenge laboratories with additional proficiency testing.

the Ravena cement plant (i.e., source-specific). Environmental media that contain contaminants from the cement plant were further considered to identify points of exposure where people might contact these media, and routes of exposure through which people might get contaminants present in these media in or on their bodies. We also evaluated the exposure pathway for settled dust by considering evidence that there may be settled dust originating from the cement plant in the community. Complete or potential exposure pathways noted on Table 19 will be considered during phase two of the health assessment, completion of the PHA.

4.8.1 Potential or Complete Exposure Pathways

There are historical ambient air monitoring and sampling data for particulates in the RCS area. However, these data are not useful for evaluating exposures to particulates released from the Ravena cement plant because these ambient air particulate data reflect releases from multiple sources in the area (i.e., particulates measured do not originate solely from the Ravena cement plant).

There is a considerable amount of information identifying emission rates and air concentrations of specific chemicals released to air from the cement plant, from the stacks where they are released. This information suggests the Ravena cement plant is a source of contaminants in air that people in the surrounding community might breathe. This potentially complete air exposure pathway will be evaluated further in the phase two PHA.

Available information indicates that prior to 2001, dust generated from the plant moved off-site and settled in the area surrounding the cement plant. Operations at the plant continue to generate dust. Multiple dust mitigation strategies are in place to limit dust fallout in the Ravena area. Potential exposure pathways involving settled dust released from the cement plant will be evaluated further in the PHA.

4.8.2 Incomplete Exposure Pathways

Exposure pathways to contaminants released from the Ravena cement plant in drinking water, groundwater, surface water, sediment, soil or biota are incomplete. Public drinking water in the RCS area is routinely monitored and does not contain cement plant-related contaminants. On-site groundwater contains cement plant-related contaminants originating from the on-site landfill. However, this water is restricted to a perimeter containment system and is not expected to migrate off-site. Therefore, community exposures to cement plant-related contaminants in groundwater are unlikely.

Similarly, limited soil sampling conducted on-site indicates some cement plant-related chemicals (e.g., calcium, potassium), but there are no expected off-site points of exposure (unless they blow off as dust). Quarterly monitoring of surface water (Coeymans Creek) has indicated no impact of the CKD landfill on surface water quality. Although limited sediment samples on- and off-site contain some inorganic, potentially cement plant-related chemicals (e.g., calcium, potassium), there are no expected points of exposure to sediment in the community. Finally, available information about fish and invertebrates in surface water near the Ravena cement plant do not indicate the presence of plant-related contaminants. Exposure pathways involving drinking water, groundwater, on-site soil or CKD, surface water, sediment or biota will not be considered further in the PHA.

5.0 AVAILABLE HEALTH RISK ASSESSMENTS

Several health risk assessments have evaluated the possibility that emissions from the Ravena cement plant may harm human health. Briefly, a human health risk assessment quantifies exposure and provides a quantitative estimate of the risk of observing a specific adverse health effect (carcinogenic or non-carcinogenic) after a quantified exposure to a specific environmental agent. A PHA uses risk assessment methods, but also qualitatively characterizes the level of concern based on the magnitude of the health risk estimates.

5.1 Health Risk Assessment in Blue Circle Atlantic DEIS

In 1989, the NYS DOH provided comments to the NYS DEC on a health risk assessment contained in a 1988 DEIS submitted by Blue Circle Atlantic as part of a State Environmental Quality Review of a proposed permit modification for use of supplemental fuels (NYS DOH, 1989). NYS DOH does not have the complete DEIS, but NYS DOH comments note that the project initially proposed the use of waste solvents as a fuel source, was resubmitted in 1988 as a proposal to use waste solvents and waste oil (hazardous waste) as supplemental fuels at the

Ravena cement plant, and was withdrawn in 1994 without ever receiving NYS DEC approval. The risk assessment includes emission estimates for an array of analytes (see Table 6). The risk assessment concluded that the use of supplemental fuels would not increase the risk above the risk level associated with the existing permit conditions. NYS DOH comments on the risk assessment in the DEIS noted that toxicological properties of some of the chemicals emitted were lacking, there were inadequacies in the justifications for some of the assumptions used in the exposure assessment, there were errors in the hazard identification and risk characterization steps and the draft risk assessment did not account for cumulative exposure from multiple exposure routes.

5.2 NYS DOH Response to a Request for Assessment of Community Lead Exposures

In 2005, NYS DOH received and responded in writing to a letter from a physician noting concerns about the impacts of lead emissions on the community from the proposed addition of TDF to the list of approved fuels for the cement plant. To address the citizen's concerns, NYS DOH conducted an assessment of potential lead impacts from the Ravena cement plant. The assessment considered the following:

- the maximum (off-site) estimated lead concentration in air resulting from facility emissions using TDF;
- the estimated resultant lead concentration in soil;
- homegrown produce and locally produced beef and dairy products;
- estimated incidental ingestion of soil;
- consumption of homegrown produce and locally produced dairy and beef products; and
- assumed that children were the most sensitive receptors.

Using standard exposure models and a US EPA model that predicts blood lead levels based on the modeled exposures, the maximum estimated increase in a child's blood lead level was less than one-tenth of a microgram of lead per deciliter of blood, which is considered clinically insignificant.

5.3 Health Risk Assessment for Metals Released when Using TDF

In 2003, NYS DEC requested that Lafarge test kiln stack emissions for a list of specific compounds, including cadmium, lead, mercury, selenium and zinc. Lafarge conducted the stack test in 2004 (see Table 7). In August 2005, NYS DEC staff modeled emissions for these five metals from the kiln stack assuming the use of TDF[7]. The highest metal content reported in studies of tire composition were used in the dispersion modeling to produce maximum estimates of emissions of metals present in TDF. The resulting maximum concentrations at ground level in the surrounding community were compared to NYS DEC's short-term and annual guideline concentrations (SGCs and AGCs)[8]. SGCs and AGCs are air concentrations that are protective of human health.

Two screening level air dispersion models (Air Guide-1 [AG-1] Screen; US EPA's Screening Air Dispersion Model version 3.0 [SCREEN3]), and one refined dispersion model (the Industrial Source Complex Long Term Model, Version 2 [ISCLT 2]) were used to estimate ground-level

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[7] The following passage describes NYS DEC's health risk screening for the Ravena cement plant application to use tires as an alternative fuel, as presented in the NYS DEC Responsiveness Summary. "As part of the state environmental quality review process for the proposed Title V permit modification the Department of Environmental Conservation (the Department) conducted an Air Guide-1 analysis (DAR -1) to assess the potential for adverse public health impacts. (1) An Air Guide 1 analysis is a conservative public health risk screening tool created and used by the Department for the assessment of the risk posed from the inhalation of ambient air toxics. The Air Guide 1 process involves the identification and determination of the emission rates of air toxics emissions from the source under review, the dispersion modeling of the air toxic emissions to predict annual and short-term impacts, and the comparison of these predicted impacts to numerical guidelines which were developed to be protective of public health.
Lafarge (the applicant) conducted an Air Guide-1 evaluation in accordance with the Department's policy to assess the potential public health impacts associated with the proposed modification (the use of TDF) of the Ravena facility. With respect to air emissions upwind or downwind from the Ravena facility in terms of ambient air quality impacts, particularly downwind, the dispersion modeling of the air toxic emissions was conducted by Lafarge per Appendix B of the DEC Air Guide-1 policy. This analysis provides a very conservative estimate (i.e. tends to over predict) of ambient impacts irrespective of wind speed or direction or specific location. It simulates impacts as if all locations are downwind of the facility. The results provided by the applicant and verified by the Department indicated that the emissions impacts were predicted to be below 10% of the applicable health based AGCs and short-term guideline concentrations (SGCs) used by the Department to assess public health impacts.
In addition, the Department conducted a more refined dispersion modeling analysis using the EPA ISCLT2 model and predicted lower maximum emission impacts which were less than 1% of the applicable health based AGCs and SGCs used by the Department to assess public health impacts. In summary, the dispersion modeling indicates that the predicted impacts of all the metal emissions are considerably below the SGCs/AGCs even when considering the worst-case scenario and maximum potential impact. Following permit issuance, baseline stack test emissions (without TDF) will be compared to required stack test emissions (with TDF) to further verify the predicted emissions and ambient impacts."

[8] The AGCs and SGCs contained in Air Guide-1 were developed to be protective of public health and are based upon the most recent toxicological information currently available. These values were updated after a comprehensive review by the Department and the NYS DOH in December 2003. The SGCs were developed to protect the general population from one hour exposures that can result in adverse acute health effects. The AGCs were developed to protect the general population from annual exposures which can result in adverse chronic health effects that include cancer and non-cancer endpoints. These guidelines are very conservative and are intended to protect the general public including sensitive subpopulations from adverse health effects that may be induced by exposure to ambient air contaminants. The procedures which are used by the Department to derive these guidelines are contained in Appendix C of the DEC Air Guide-1 policy." NYS DEC Description of Air Pollution Control Permitting Program, accessed via http://www.dec.ny.gov/permits/6069.html January 2010.

metal concentrations off-site. Screening models provide conservative estimates (i.e., likely overestimates) of ground-level concentrations. Screening models do not use site-specific meteorological information but assume all locations are downwind of the source. Refined models use site-specific meteorological and other information and therefore provide more accurate estimates of ground-level concentrations.

Table 20 summarizes the modeling results for concentrations off-site and at ground level in the surrounding area where concentrations are estimated to be the highest (i.e., the point of maximum impact) as a percentage of the AGC. Screening models indicate maximum concentrations of all metals in the surrounding area were less than five percent of their AGCs. The refined, site-specific model indicates concentrations of all metals were less than 0.2 percent of their AGCs. The low percentages indicate that the estimated concentrations fall well below health comparison values.

NYS DEC used the American Meteorological Society (AMS) /EPA Regulatory Model (AERMOD) component of the US EPA's Human Exposure Model-3 (HEM-3 Version 1.01) to do one-hour dispersion modeling for mercury and zinc, also assuming high metal content in TDF. NYS DEC modeled mercury because it is the only metal among the five for which the Department has derived a SGC. Zinc concentrations were modeled because the future emissions using TDF were estimated to increase significantly. There is no SGC for zinc, so NYS DEC used the SGC for zinc oxide, the form of zinc most likely to be present in the air. Table 21 provides the SGCs and the modeling results of the one-hour dispersion modeling as percent of SGC, and the distance to maximum off-site impact**.** Results indicate that estimated concentrations fall well below health comparison values.

5.4 US EPA Risk and Technology Review (RTR) 2009

In June 2009, US EPA released a draft document titled "RTR Risk Assessment Methodologies: for Review by the US EPA's Science Advisory Board" (US EPA, 2009). The RTR program is an important PHA tool used by the US EPA to determine the residual human health risks associated with specific source categories, after application of the maximum achievable control technology (MACT) standards. The RTR included two case studies as examples of regulated facilities, MACT: Petroleum Refining Sources and Portland Cement Manufacturing. For the RTR, US

EPA selected the Ravena cement plant to represent the Portland cement source category because it was a facility with reported emissions of dioxins and mercury, and it had specific geographic characteristics and available data for basic multi-pathway exposure scenarios (including consumption of produce, animals and fish). The report illustrates the methodology using generic cement plant emissions and facility-specific emission point information, to examine the potential for health impacts to occur in mixed-use zoning (i.e., agricultural, residential, commercial) communities surrounding Portland cement plants. This report illustrates the methodologies and types of analyses that could be applied to assess possible human health risks from any Portland cement plant. The report is not a final US EPA multi-pathway human health risk assessment specifically for the Ravena cement plant.

5.5 Conclusions - Health Risk Assessments

Several assessments are available that address the health risk associated with air emissions from the Ravena cement plant. These include:

- A health risk assessment in the DEIS submitted to the NYS DEC to support the 1988 application for a permit to use waste solvents and waste oil as fuel. This risk assessment found that these alternative fuels would not increase health risk compared to permitted conditions at the time (although NYS DOH found the analyses in the DEIS to be incomplete);

- An estimate of health risk associated with predicted lead emissions from the cement plant assuming use of TDF. This estimated that children's blood lead levels might be increased by less than one-tenth of microgram of lead per deciliter of blood, considered to be clinically insignificant;

- An air risk assessment of modeled emissions of cadmium, lead, mercury, selenium and zinc from the cement plant (using 2004 kiln stack test emissions rates and assuming the use of TDF). This assessment found that estimated air concentrations of these metals at ground level in the surrounding community were less than five percent of their health-based comparison value (AGCs); and

- An analyses in a RTR: Risk Assessment Methodologies report which illustrates the generic methodologies and types of analyses that could be applied to quantitatively assess human health risks from any Portland cement plant. This risk assessment does not specifically estimate health risk that could result from contaminants specifically released from the Ravena cement plant.

Together, these health risk assessments suggest that air emissions from the Ravena cement plant are not likely to harm health. However, they are an incomplete basis for drawing conclusions about the possible health risk from the cement plant because they are limited to few chemicals and, in most cases, do not reflect actual (past or current) operating conditions at the cement plant.

6.0 HEALTH OUTCOME DATA

This section describes the types of community-wide health outcome information that is readily available for the ZIP codes surrounding the cement plant. The types of health outcomes presented could be examined if further study is recommended when phase two of the PHA is complete.

6.1. Sources of Community-wide Health Data

A variety of types of HOD are available for describing health in a specific community. These data can be used to estimate incidence (a measure of new cases of disease in a population during a specific time period) or prevalence (a measure of all existing cases of a disease in a population during a specific time period) of diseases or conditions (i.e., health outcomes) in specific geographic areas. Estimated incidence or prevalence of health outcomes in a population or community can be compared with expected incidence or prevalence using information from the general population or another appropriate population. Among the highest quality HOD available for these types of analyses are vital statistics (births and deaths), and cancer and birth defect data because these data are reported consistently across the state in compliance with requirements of legally-mandated statewide databases and registries. Hospitalization data, which are also available in a statewide database, are useful for assessing the burden of some types of disease in communities. However, hospitalization data are less accurate for measuring disease incidence or prevalence than vital statistics or cancer and birth defect data because some people with specific conditions or diseases are not hospitalized, and others are hospitalized repeatedly. Data on children's blood lead levels are available and useful for understanding lead exposure in communities because a 1994 law mandates testing and reporting of children's blood lead levels.

NYS DOH has used these types of HOD for many years to conduct community health assessments that evaluate disease patterns or trends. Recently, the Environmental Public Health Tracking (EPHT) project and the NYS Environmental Justice (EJ) HOD Workgroup recommended these health data for inclusion in environmental health tracking projects and EJ health outcome assessments. The EPHT project is a multi-state effort sponsored by the US Centers for Disease Control and Prevention (CDC) to develop and make data available about environmental and health outcome indicators. The EJ HOD Workgroup is part of a joint NYS DEC and NYS DOH project to develop and provide guidance on evaluation and review of available HOD when NYS DEC reviews an application for a facility or power plant. Both the EPHT project and the EJ HOD Workgroup recommended evaluating health outcomes from the health data sources above based on completeness and accuracy of data, coverage, timeliness, public health significance and possible links to environmental exposures.

Another source of data that may be useful for assessing children's health is the NYS Education Department's (NYS ED) Strategic Evaluation, Data Collection, Analysis and Reporting (SEDCAR). This program tracks and tabulates the number of children in NYS receiving special education services for disabilities by school district, and publishes information annually for 13 subcategories of disability by age group (developmental disabilities are defined is section 4410(1) part 200.1 of the Education Law http://www.emsc.nysed.gov/specialed/lawsregs/2001-2005-809.pdf). These data are available to the public through the NYS ED website. However, any disability or age group with fewer than five children is suppressed (i.e., not shown), to preserve confidentiality (NYS ED, 2009).

Neither the EPHT project nor the EJ HOD Workgroup included these NYS ED data in the top category of health data sources. This is largely because of differences in identification, classification and reporting of disabilities between public school districts that can lead to apparent variation in rates of disabilities among districts due to reporting differences, rather than to actual differences in the rates of disabilities. There is also uncertainty in disability rates for public school districts because children with special education needs who do not attend public schools may be included in disability counts but not in the enrollment counts of the district. In addition, parents may choose to relocate to districts they believe are better able to provide service for children with disabilities, thus inflating the rates in these districts. Both the EPHT project and EJ HOD Workgroup, however, noted the potential usefulness of these data and the desirability of reevaluating the quality of these data for use in the future. Meanwhile, NYS ED has been working with school districts to identify, correct and standardize identification and reporting of disabilities.

The New York State Environmental Facilities and Cancer Mapping Project (http://www.health.state.ny.us/statistics/cancer/environmental_facilities/mapping/) was recently added to the NYS DOH public website. This interactive mapping tool shows the number of people diagnosed with 23 types of cancer and the population within geographic areas that are smaller than ZIP codes. It also shows the locations of environmental facilities in the same geographic areas. While this tool shows the number of people diagnosed with cancer for the years 2003–2007 in small geographic areas of NYS, it does not currently provide age-adjusted cancer data incidence rates so is not useful for understanding whether rates are different from expected rates in any particular area.

6.2 Presentation of Community-wide Health Data

Health records often contain a ZIP code of residence, which allows rapid identification of HOD at the geographic level of ZIP codes. Hence, readily available data are described here for the five ZIP codes surrounding the Ravena cement plant. These ZIP codes each have at least 40 percent of the population within an area that air dispersion modeling indicates might be potentially affected by air releases from the plant. (See discussion below and Appendix E.) This five ZIP code area is larger than the area potentially affected by the cement plant. These ZIP codes are 12143, Ravena; 12158, Selkirk; 12046, Coeymans Hollow; 12156, Schodack Landing and 12087, Hannacroix. Figure 5 shows the boundaries of the five ZIP codes.

The types of HOD presented include incidence or prevalence of health outcomes for each ZIP code as well as for all ZIP codes combined. Statewide incidence or prevalence of health outcomes are included to provide a broad comparison and put the rates presented in context. It is emphasized that these data are presented here to illustrate the types of health outcomes that can be further evaluated if phase two of the PHA suggests that releases from the Ravena cement plant may harm health. Further evaluation may involve obtaining HOD for smaller geographic areas and for additional time periods.

Descriptions and definitions of the health outcomes summarized are presented in Table 22. The HOD include the past five to ten years, depending upon the years of data readily available. If analyses during phase two of the PHA indicate that evaluation of certain HOD is recommended, additional years of data can be obtained. Here, rates for each of the health outcomes were calculated for each of the five ZIP codes, all ZIP codes combined (for most outcomes) and for NYS excluding NYC. (NYC is excluded from health data for the Upstate and Long Island areas because of its socioeconomic and demographic differences.) Statewide rates are not provided for the developmental disabilities data because appropriate statewide summary data are not available due to the complexity and uncertainties associated with these data. Age-adjusted rates were calculated for respiratory and cardiovascular hospitalization rates because these outcomes are strongly influenced by age. Rather than rates, the Cancer Registry provided the number of cases observed in the five ZIP code areas and the number of cases expected in a population of similar size and age. This is consistent with the usual practice of the NYS DOH Cancer Surveillance Program, which uses observed versus expected numbers because rates per population based on very small numbers (which is often the case with some cancers) are difficult to interpret.

Estimated or expected health outcome rates in NYS excluding NYC are presented only to provide a general context for the numbers and rates for the five ZIP code areas. Differences in health outcomes across the areas compared may not be meaningful. Statistical tests of similarities or differences between areas are necessary and are not provided. Apparent differences between the observed and expected numbers as well as apparent differences between rates of health outcomes in the five ZIP code areas and statewide rates may be due to multiple factors, including differences in known individual risk factors such as smoking for these various health outcomes. In addition, especially for outcomes with small numbers, apparent differences are likely to occur simply due to chance fluctuations. If additional health outcome evaluation and comparative statistical analyses are recommended during phase two of the PHA, an appropriate study area and comparison area(s) would be selected for statistical analyses.

6.3 Demographic Information for ZIP Codes Surrounding the Ravena Cement Plant

Table 23 shows, based on the 2000 Census, about 15,000 people live within the five ZIP code area (see Figure 5). The two larger ZIP codes in the area (12143, 12158) each have a little over 6,000 people, while the three smaller ZIP codes (12046, 12156, 12087) each have between 600 and approximately 1,300 people. The five ZIP code area is somewhat less ethnically diverse than the rest of the State, excluding NYC, with only about 8 percent of the population considering themselves as members of minority groups compared to 18 percent statewide. These 2000 Census data also show that a lower percentage of the five ZIP code area population (6.4 percent) is living below the poverty level than in the rest of the state, excluding NYC (9.7 percent).

6.4 Health Outcome Data for Zip Codes Surrounding the Ravena Cement Plant

6.4.1 Respiratory and Cardiovascular Disease Hospitalizations

Table 24 summarizes respiratory and cardiovascular disease hospitalization numbers and age-adjusted rates per population for the ten-year period, 1997–2006. The numbers of hospitalizations are large enough for presentation by ZIP code. Among the respiratory disease categories, chronic obstructive pulmonary disease (COPD), frequently associated with smoking, has the highest number of hospitalizations, with more than 300 for all ZIP codes combined. Cardiovascular and other circulatory disease hospitalizations include a much larger number than other disease codes evaluated, with more than 2,000 hospitalizations in the ten-year period.

6.4.2 Cancer Incidence

Observed and expected numbers of cancer cases for 2002 through 2006 are summarized in Table 25. These seven cancer types (including two age groups for breast cancer and two sub-types of leukemia) are the cancer types recommended by the EPHT program for evaluation because of possible links to environmental causes. The number of cases of childhood cancer is too small to include in the table without compromising confidentiality. This number was slightly lower than what would be expected in a population this size. The most frequently occurring types of cancer diagnosed among women are breast and lung cancer, with most other types showing five or fewer observed cases for the five-year period 2002–2006. For men, lung and bladder cancer are the most commonly occurring types examined, with no other types showing more than five cases from 2002–2006.

NYS DOH Cancer Registry staff were contacted about concerns that a rare form of childhood cancer, known as Ewing's sarcoma, was elevated in the RCS area. Ewing's sarcoma is a type of bone tumor which occurs mostly in children. Incidence peaks in the teenage years during a period of rapid bone growth. While the more common form of bone cancer, osteosarcoma, mainly affects the ends of the long bones in the arms and legs, Ewing's sarcoma more frequently affects the flat bones in the chest and pelvis, and the middle of the long bones. Causes of Ewing's sarcoma are unknown. Staff checked the NYS DOH Cancer Registry files for cases of Ewing's sarcoma reported since 2000 in the five ZIP code area near the Ravena cement plant plus an additional ZIP code (12054). The actual number of cases identified was too low to determine any unusual patterns in a population this size. The rarity of Ewing's sarcoma makes increases in incidence difficult to detect and verify (there is about one case per 250,000 children under age 20 in all of NYS excluding NYC). Cancers diagnosed most frequently in children under 20 are leukemia, brain and other nervous system cancers and lymphomas, including Hodgkin's lymphoma. Bone cancers, soft tissue cancers and many others are diagnosed less frequently. On average, a total of 934 cancers of all types were diagnosed annually in children under age 20 in NYS between 2003 and 2007. Of these, approximately 17 cases of Ewing's sarcoma were diagnosed each year.

CASE has noted there are four or five individuals with Ewing's sarcoma in the community. We have been unable to verify these cases and have asked CASE for more information.

6.4.3 Perinatal and Child Health

Perinatal (the time around birth) and childhood health outcome counts and rates are summarized in Table 26. In the 10-year period 1998–2007, 124 pre-term births occurred in the 5 ZIP codes, comprising about 8 percent of births. Births categorized as low birth weight, a category that overlaps with preterm birth, occurred at a lower rate, comprising about 5 percent of births. Fourteen birth defects were reported among births occurring in the five-year period from 2000–2004.

The rate per 1,000 children tested for lead (under 6 years old) who had blood lead levels greater than or equal to 10 micrograms per deciliter (μg/dL) is presented in Table 26 for the 5 ZIP codes combined for the time period 2005–2007. Figure 6 shows that the number of children with elevated blood lead levels has declined dramatically since 1998 in both the state and the five ZIP codes examined.

6.4.4 Special Education Services for Disabilities

Acknowledging the previously described uncertainties associated with the Special Education Services for Disabilities data from the NYS ED SEDCAR, information about these data is summarized in Table 27. Data for developmental disabilities, including autism, for the RCS school district for a five school-year period, 2003–2008 are included. The four schools in the district and in the five ZIP code areas are the RCS Middle-High School, the Albertus W. Becker Elementary School and the Pieter B. Coeymans Elementary School (Figure 7). Information from the NYS ED's annual school report card database was used to obtain enrollment information for the districts to use as a denominator (NYS ED, 2009). Table 27 shows the percentages of enrolled children identified as having disabilities. The data are grouped into five categories for which totals were available from the NYS ED data: autism, emotional disturbance, learning disability, mental retardation and "other health," which includes ADD and ADHD among many others conditions. A total number for the listed disabilities combined can not be calculated from the available data due to suppression of any disability group with fewer then five children. As stated previously, no statewide percentages are presented here because appropriate statewide total percentages are not currently available.

6.5 Other Community Health Information

As part of this review, the NYS DOH Bureau of Occupational Health (BOH) searched records from its Occupational Lung Disease Registry (OLDR) to locate reports that might be associated with the Ravena cement plant. Since 1990, Public Health Law requires that clinical evidence (e.g., laboratory result or doctor diagnosis) of occupational lung disease in a citizen of NYS must be reported to the NYS DOH OLDR. There have been no cases of lung disease reported to the OLDR related to the Ravena cement plant.

The NYS DOH BOH also searched records from its Heavy Metals Registry (HMR) to locate reports that might be associated with the Ravena cement plant. Public Health Law requires that certain clinical test results for arsenic, cadmium, lead and mercury be reported to NYS DOH HMR (http://www.nyhealth.gov/environmental/workplace/part22.htm) when a clinical test result (in blood or urine) exceeds a mandatory reporting level. The NYS DOH BOH contacts and interviews individuals with elevated levels of arsenic, cadmium, lead and mercury in their blood or urine to assess the source of exposure and discuss how exposures can be reduced.

There are 40 reports in the HMR for residents of the five ZIP codes around the Ravena cement plant covering the period from 1984 to the present. These include 1 report for arsenic, 6 reports for mercury and 33 reports for lead. The 1 arsenic report was attributable to occupational exposure, and 12 of the lead reports were attributable to occupational or home renovation exposures. Sources of mercury exposure for all 6 mercury reports and for 21 lead reports are unknown.

There have been limited evaluations of health outcomes in the community and among workers at the Ravena cement plant. In 1989, the NYS DOH conducted a cancer investigation for the Town of Coeymans, including the Village of Ravena, for the years 1976–1986 (NYS DOH, 1989). The investigation found cancer incidence was similar to what would be expected for an area with similar size and population density in NYS. In another evaluation, mortality among workers at the Ravena cement plant was reviewed based on union records supplied to the NYS DOH spanning a period from approximately 1964–1988 (personal communication). Although the proportion of workers who died from cancer seemed higher than normal, many of the causes of death could not be verified through searches of mortality records or Cancer Registry reports, and no formal study was conducted.

6.6 Conclusion - Health Outcome Data (HOD)

HOD are readily available for five ZIP code areas around the Ravena cement plant that were identified as being partially within a geographic area potentially affected by air emissions from the plant. The types of HOD summarized include:

- numbers and rates of respiratory and cardiovascular disease hospitalizations;

- numbers and rates of perinatal health outcomes (outcomes that occur around the time of birth);
- incidence rate of elevated blood lead levels in children less than 6 years old;
- observed and expected numbers of cancer cases; and
- numbers and rates of students in the RCS school district receiving services for developmental disabilities.

Overall, the health outcome rates across the ZIP codes summarized appear to be similar to rates across New York State. However, ZIP codes for which HOD are provided do not necessarily reflect the population with greatest estimated exposures to contaminants released from the plant. The HOD presented here cannot rule out the occurrence or absence of increased health outcome rates in the smaller geographic areas with potentially higher impacts from the cement plant. If evaluations during phase two of the PHA indicate that some areas around the plant may have had exposures to contaminants from the plant that are of health concern (i.e., concentrations that approach or exceed health comparison values), the types of HOD summarized may be recommended for further study.

7.0 CHILD HEALTH CONSIDERATIONS

The ATSDR Child Health Considerations emphasize examining child health issues in all of the agency activities, including evaluating child-focused concerns through its mandated public health assessment activities. ATSDR and NYS DOH consider children when evaluating exposure pathways and potential health effects from environmental contaminants. We recognize that children are of special concern because of their greater potential for exposure from play and other behavior patterns. Children sometimes differ from adults in their sensitivity to the effects of hazardous chemicals, but whether there is a difference depends on the chemical. Children may be more or less sensitive than adults to health effects from a chemical, and the relationship may change with developmental age.

The proximity of the Ravena cement plant to the RCS Middle-High School illustrates the need to consider children as a potentially vulnerable population in phase two of the health assessment.

An available health risk assessment evaluated the effect of lead released to air from the proposed use of TDF at the cement plant on children's blood lead levels and estimated that a very small, clinically insignificant, increases in blood lead might occur. However, potential vulnerability of children to other chemicals released from the plant has not yet been explicitly considered. The health effects evaluations conducted during phase two of the health assessment will consider the unique physical and behavioral qualities of children that might make them more vulnerable to chemicals from the Ravena cement plant.

8.0 CONCLUSIONS

8.1 Environmental Data and Exposure Pathways

Available environmental data about the Ravena cement plant identify two exposure pathways through which people might contact contaminants from the cement plant (summarized in Table 19). These are pathways associated with air and settled dust. Estimated and measured releases of multiple contaminants, including mercury and other metals, to air from the cement plant stack are available. Air in the surrounding community may contain these contaminants; and, people residing, working or attending school may be exposed to these contaminants through inhalation.

Available information indicates that prior to 2001 dust generated from the cement plant moved off-site and settled in the area near the cement plant. Operations at the plant continue to generate dust. Multiple dust mitigation strategies are in place to limit dust fallout in the Ravena area. People residing, working or attending school near the cement plant may contact settled dust originating from the cement plant through skin contact, accidental ingestion or inhalation. These potential pathways will be evaluated further in the PHA.

Exposures to Ravena cement plant-related contaminants in other environmental media (public drinking water, groundwater, soil, on-site cement kiln dust, surface water, sediment or fish) are not likely or expected. Although CKD is present on cement plant property, and some groundwater, soil and sediment samples on cement plant property contain cement plant-related contaminants, people in the surrounding community are not likely to contact these media. Other data indicate that neither surface water (Coeymans Creek) on plant property nor fish in nearby water bodies contain cement plant-related contaminants. Exposure pathways involving drinking water, groundwater, on-site soil or CKD, surface water, sediment or biota are incomplete and will not be considered in the PHA.

8.2 Health Risk Assessments

Available health risk assessments applicable to the Ravena cement plant evaluate the health risk from exposure to multiple contaminants prior to 1988; the health risk to children from exposure to potential lead emissions; and the health risk from exposure to potential lead, cadmium, mercury, selenium and zinc emissions. However, these risk assessments are limited to few chemicals, and in most cases, do not reflect actual (past or current) operating conditions at the cement plant. Therefore they are an incomplete basis for drawing conclusions about the risk from cement plant air emissions.

8.3 Health Data

Readily available HOD from NYS DOH and NYS ED databases are available for ZIP codes surrounding the Ravena cement plant. However, air dispersion modeling illustrates that the geographic area likely to be affected by air emissions from the plant is smaller than any of the ZIP codes for which HOD are readily available. Therefore, readily available HOD cannot be used to assess the possible impact of the cement plant on community health. However, the HOD summarized illustrates the types of health outcomes that could be evaluated on a smaller geographic scale in the community if the PHA indicates some areas around the plant may have air contaminant levels exceeding health comparison values.

9.0 PUBLIC HEALTH ACTION PLAN

The information presented in this phase one report provides the basis for completion of the PHA for the Ravena cement plant during phase two. Next steps for moving from phase one to phase two of the PHA are described below:

1. NYS DOH will seek comment from all stakeholders about the content of this HC report.

   Stakeholders are invited to read, review and comment on the information contained in this report. Opportunities for comment will be provided during public meetings to be scheduled in the Towns of Coeymans and Schodack. People will also be able to comment in writing during a 45-day public comment period.

In particular, NYS DOH is asking the public to:

- identify or provide other environmental data or information pertinent to a health assessment for the Ravena cement plant that are not included in this HC report;
- note any questions about the information presented in this HC that should be addressed in the final HC;
- comment on the complete and potential exposure pathways identified for evaluation in the PHA; and,
- comment on approaches for the PHA.

2. NYS DOH will finalize this HC based on public comments.

   NYS DOH will consider public comments in finalizing this HC. Phase two of the health assessment will be based on the exposure pathways identified and other information contained in the final phase one report.

3. NYS DOH will complete the PHA for the Ravena cement plant based on the final HC. Phase two will consider comments received on the phase one report, and the phase two PHA will first be released as a draft for public comment.

4. To complete the PHA for the Ravena cement plant, NYS DOH will complete a health effects evaluation. A health effects evaluation is an assessment of the risk for adverse health effects that could result from exposure to cement plant-related contaminants.

   - For the air exposure pathway, estimated air concentrations of cement plant-related contaminants that people might contact will be compared to health comparison values. NYS DOH will use the emissions rates for chemicals measured at the stack in 2004 in site-specific, refined air dispersion models to estimate air concentrations over short- and long-term time periods. If contaminant concentrations in air at points of exposure (i.e., at locations where people may contact the media) are lower than health comparison values, then the modeled exposure is estimated to pose a minimal risk and that contaminant will be considered unlikely to harm health. Further evaluation of it will not be recommended. If, however the estimated air concentration of a contaminant approaches or exceeds health comparison values, the contaminant will be further evaluated to characterize the health risk, and to determine whether further studies or public health responses are warranted.

- If further study is recommended in the PHA based on the risk posed by Ravena cement plant-related contaminants in air, the prevalence of certain health outcomes among those residing within specific areas impacted by air releases from the plant may be considered and compared to the prevalence of those outcomes in populations not impacted by air releases from the plant.

- For the settled dust exposure pathway, NYS DOH will evaluate whether settled dust originating from the Ravena cement plant might be present in the nearby community. If settled dust from the cement plant is likely to be present, NYS DOH will qualitatively assess the risk for health effects for a settled dust pathway, and determine whether further studies or public health responses are warranted.

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FIGURES

Figure 1. Topographic Map Showing the Location of the Lafarge Facility, Locations of Air Monitors at ACHD and at Stuyvesant Town Offices.

Figure 2. Ravena Cement Plant Map.

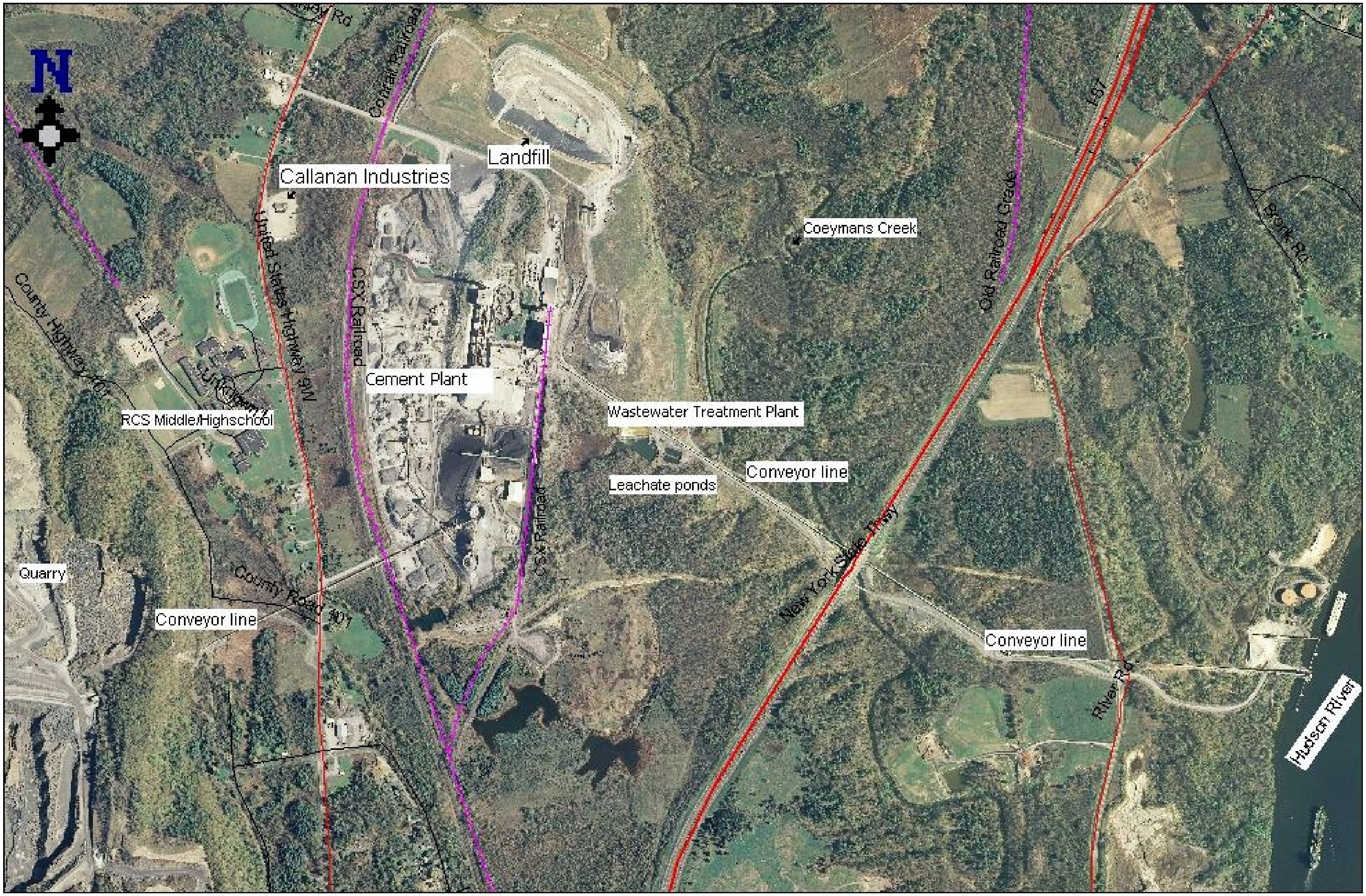


Figure 3. Overhead View of Processes on, and adjacent to the Ravena Cement Plant Site.

Figure 4. Lafarge Groundwater Monitoring Wells.

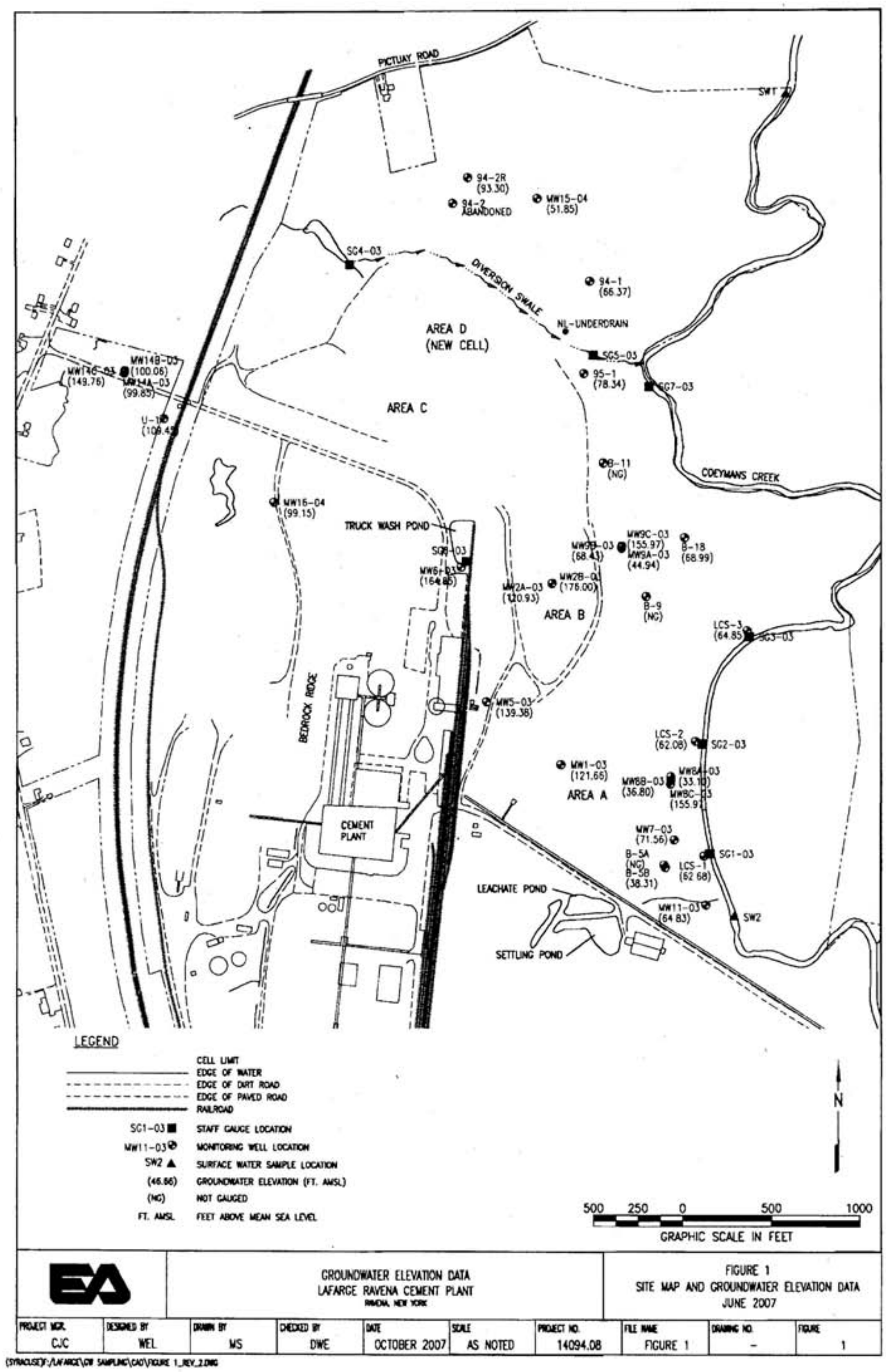


Figure 5. ZIP Codes Selected for Health Outcome Summary. At Least 40% of Populations in ZIP Codes Selected are Within the Area Where Air Pollutant Levels are Estimated (from Air Dispersion Modeling) to be Equal to or Greater than 10% of the Level at the Point of Maximum Impact.

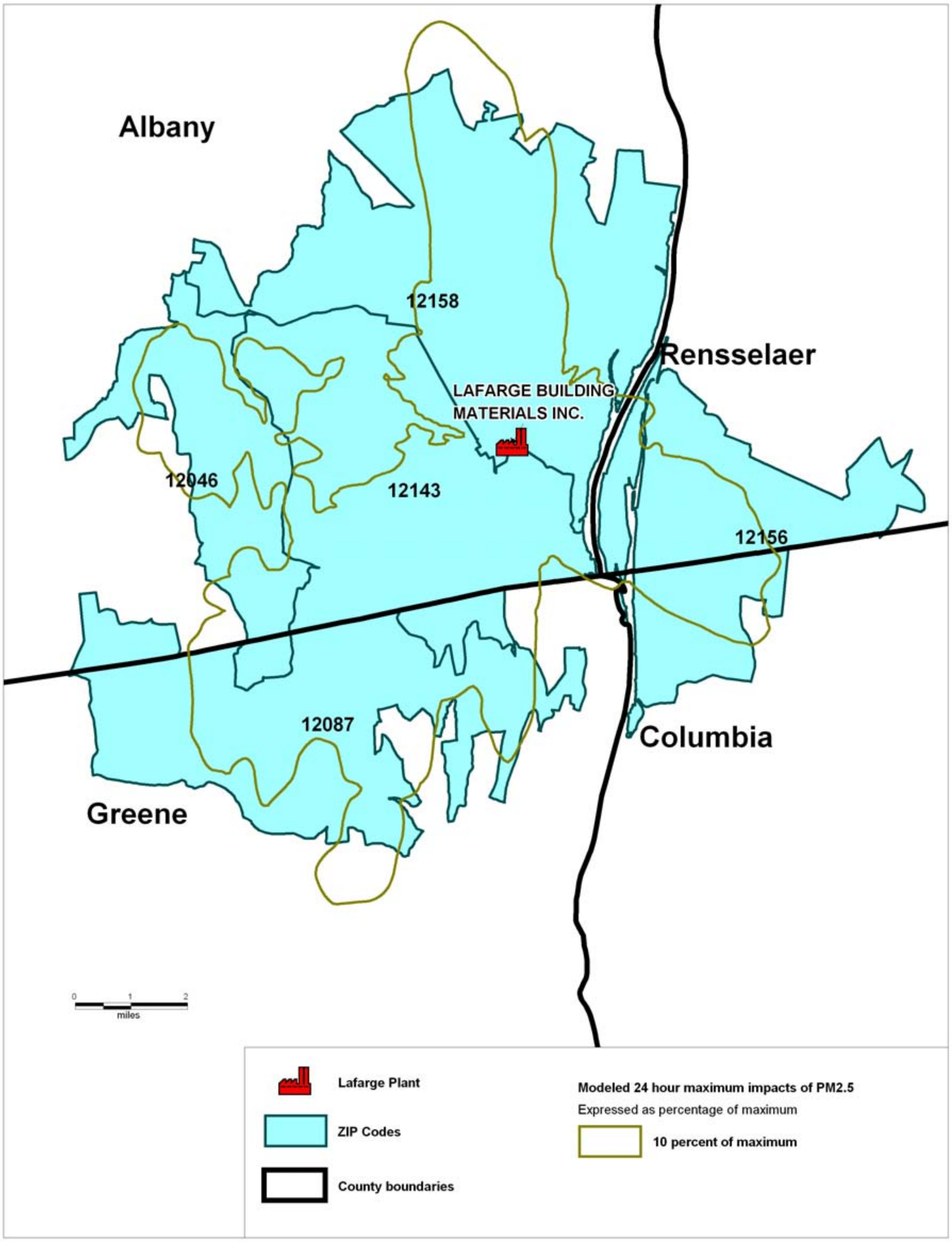
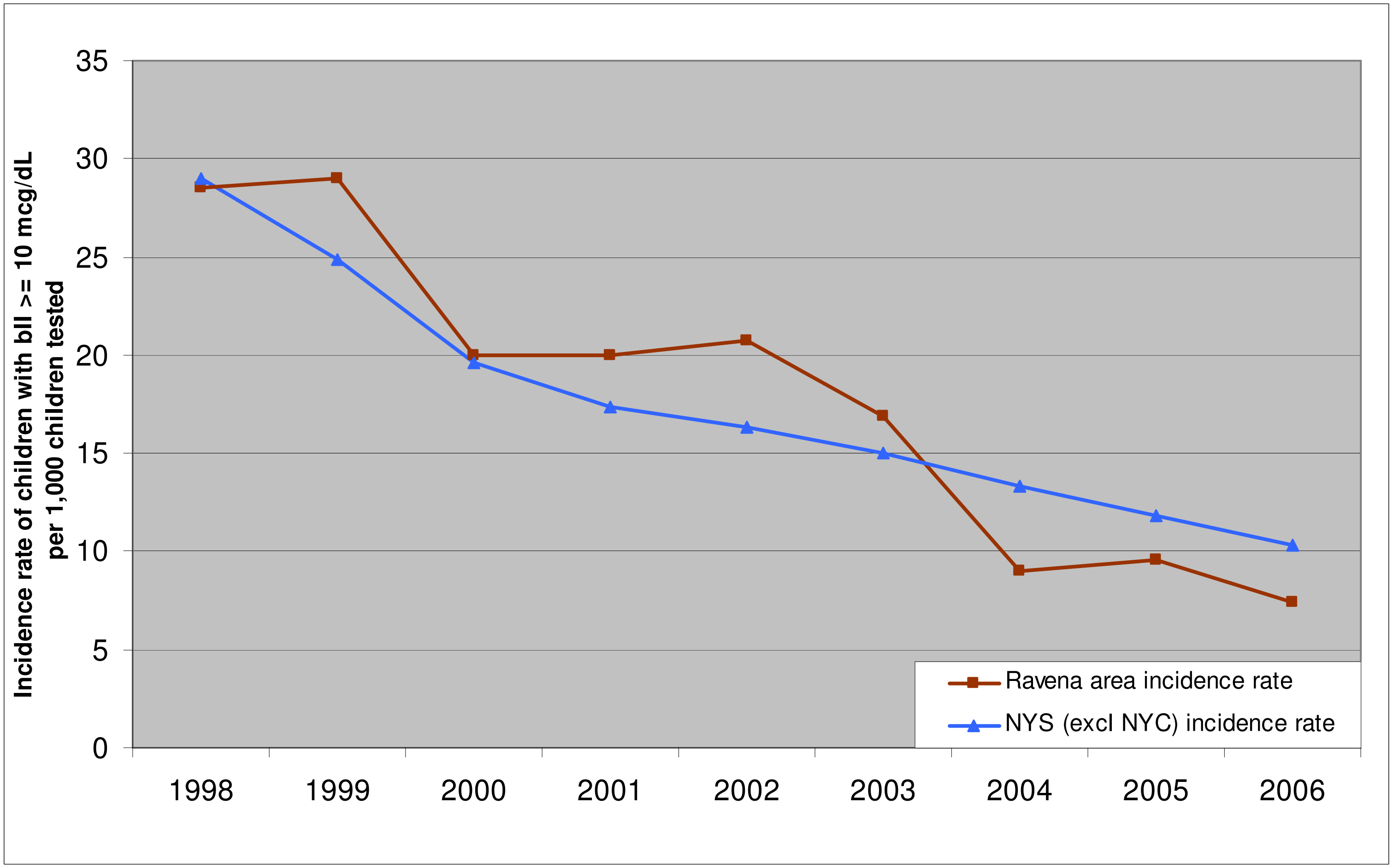
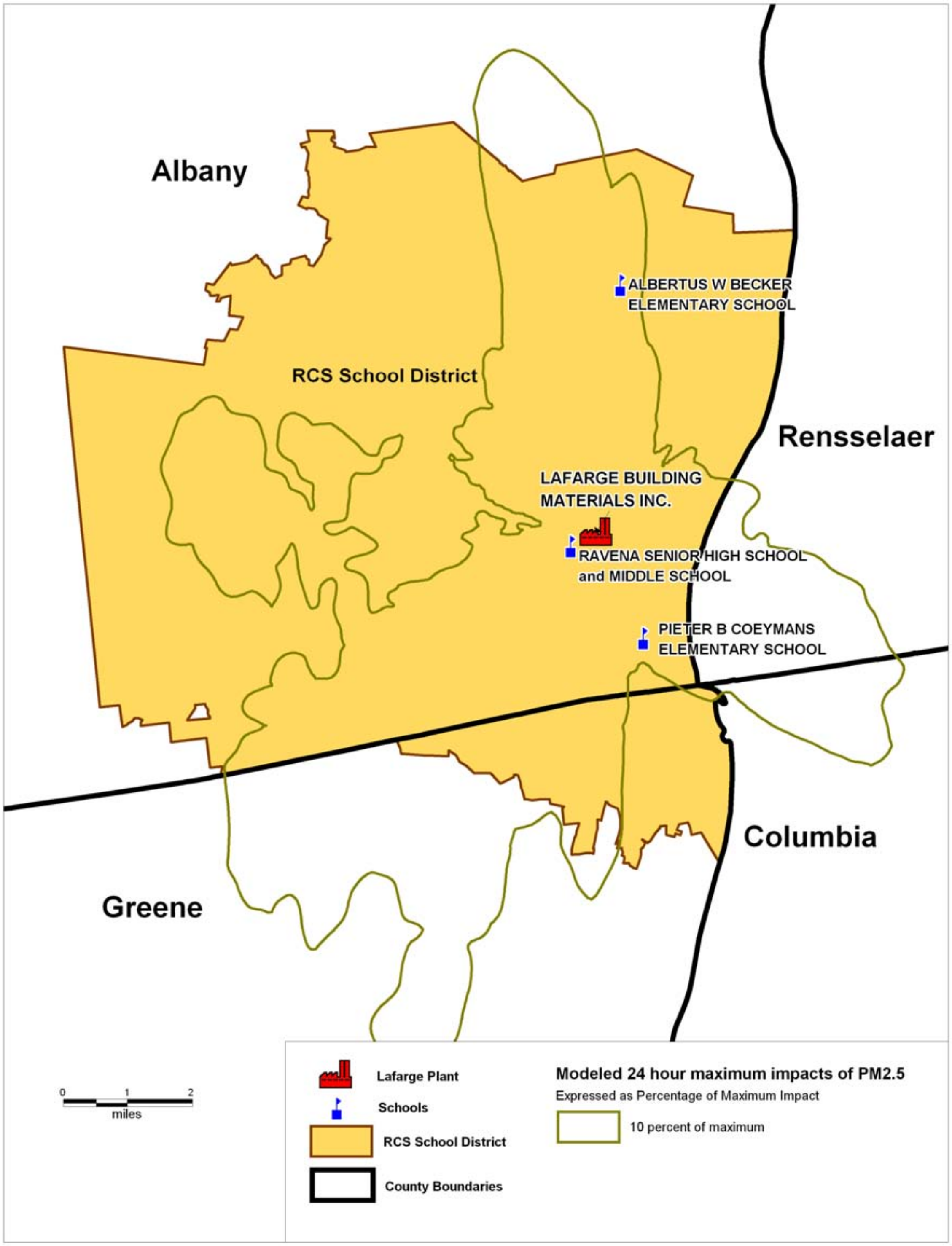


Figure 6. Incidence Rate of Elevated Blood Lead Levels (bll >= 10 mcg/dL) among children under age 6, 1998 to 2006, in the five Ravena area Zip Codes (combined)*: ZIP Codes 12143 (Ravena); 12158 (Selkirk); 12046 (Coeymans Hollow); 12156 (Schodack Landing); 12087 (Hannacroix) and in NYS (excluding NYC).



*Ravena area data represent 3 year moving average to compensate for year to year variability due to small numbers.
Incidence Rate: The total number of children under age six, identified for the first time with a confirmed blls >= 10 mcg/dL divided by the total number of children under age six that had lead tests in that given year, multiplied by 1,000.
NYS (excluding NYC) incidence data from: *Eliminating Childhood Lead Poisoning in New York State: 2006-2007 Surveillance Report.* Figure 3.

Figure 7. Ravena-Coeymans-Selkirk (RCS) School District.



TABLES

Table 1. NYS DEC Ambient Air Monitoring Settleable Particulates (Dustfall Jar) Units are milligrams/square centimeter/month.

Monitor Location	Prevailing Annual NYS AAQS [1]	Annual Arithmetic Mean mg/cm^2/month									Prevailing Annual NYS AAQS [2]	Annual Arithmetic Mean mg/cm^2/month			
		1964	1965	1966	1967	1968	1969	1970	1971	1972		1973	1974	1975	1976
Albany Co 84 Holland Ave.	0.4	0.4	**0.6**	**≈ 0.5**	**≈ 0.7**	**≈ 0.7**	**< 0.6**	**< 0.7**	**< 0.6**	**0.6**	0.40/0.60	0.43	0.36	0.32	0.28
Albany Co 65 N. Pearl St.	0.4	**≈ 0.9**	**< 1.1**	**≈ 1.1**	**≈ 1.2**	**≈ 1.2**	**≈ 0.9**	**≈ 1.1**	**0.9**	**< 0.8**	0.40/0.60	na	na	na	na
Albany Co HD Green Street		na	na	na	na	na	na	na	na	na	0.40/0.60	na	na	0.41	0.37
Becker Elementary	0.3	na	na	na	na	na	na	na	0.2	<0.3	0.30/0.40	0.21	0.21	0.19	0.24
RCS Jr/Sr High	0.4	**≈ 0.8**	**< 1.2**	**≈ 1.0**	**≈ 1.2**	**2.2**	**≈ 1.4**	**≈ 1.4**	**0.5**	**< 0.6**	0.40/0.60	0.37	0.43	0.28	0.34
RCS PB Coeymans Elementary	0.3	na	na	na	na	na	na	**< 1.6**	**0.4**	**0.5**	0.30/0.45	0.42	0.51	0.32	0.35 [3]

Sources: NYS DEC. Trends in Air Quality Settleable Particulates 1964–1972. 1974 Report No. BAQS-55 (values derived from graph in report)
New York State Air Quality Report Continuous and Manual Air Monitoring Systems Annual 1976 DAR-77-1

[1] The NYS Ambient Air quality objective or standard varied by location. Each county delineated boundaries that established prevailing standards.
[2] Form of the standard in 1972: 50th percentile value/84th percentile value
[3] Denotes violation of NYS AAQS 50th percentile value (7 or more 30 day averages greater than AAQS).
Bold font indicates value above the prevailing objective (prior to 1968) or standard (after 1968)
na - not available, the monitoring station was not in operation.

Table 2. NYS DEC Ambient Air Monitoring Total Suspended Particulates (TSP) reported in micrograms per cubic meter (μg/m^3).

Monitor Location	Prevailing Annual NYS AAQS [1]	50% / 84% [1] μg/m^3			Prevailing Annual NYS AAQS [2]	Geometric Mean μg/m^3										
	50% / 84% μg/m^3	1964	1965	1966	Geometric mean μg/m^3	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Albany 84 Holland Ave.	65/100 [3]	**74/118**	**86/146**	**82/139**	65	**67**	59	57	51	50	41	42	37	na	42	44
Albany 65 N. Pearl St.	65/100 [3]	**124/186**	**124/174**	**130/208**	65	**124**	**118**	**101**	**85**	na	na	na	na	na	na	na
Port of Albany	65/100 [3]	na	na	na	65	na	**108**	**102**	**76**	**75**	58	51	na	**77**	65	58
Albany CO HD Green St.	65/100 [3]	na	na	na	65	na	na	**93**	**69**	**66**	53	52	51	62	62	56
RCS Jr/SR High	65/100 [3]	**82/139**	**90/144**	na	65	60	58	61	44	41	40	40	39	43	39	40
RCS PB Coeymans Elementary	65/100 [3]	na	na	na	55	na	53	53	52	42	41	na	na	na	na	na

Sources: NYS DOH Statistical analyses air quality data 1964/1965/1966
NYS DEC New York State Air Quality Report Continuous and Manual Air Monitoring Systems Annual 1976 DAR-77-1

[1] NYS Ambient Air Quality Standard (AAQS) levels and classifications were not yet officially adopted. Prior to 1971 the format of the Air Quality Objective was a 50th percentile, 84th percentile approach of one year of data (12 monthly samples).

[2] The NYS ambient Air quality standard varied by location. Each county delineated boundaries that established annual standards of either 75 (dense urban), 65, 55, or 45 (rural) μg/m^3 for their county. The Federal annual standard was 75 μg/m^3 annual geometric mean, and the 24-hour standard was 260 μg/m^3 maximum not to be exceeded more than once per year. Values in excess of the NYSAAQ Objective or Standard appear in **bold** font; NA data is not available.

[3] Standard classifications not yet officially adopted NYS DEC. New York State Air Quality Report Continuous and Manual Air Monitoring Systems Annual 1981 DAR-82-1.

na - not available, the monitoring station was not in operation.

Table 3. NYS DEC Ambient Air Monitoring Data for Sulfur Dioxide 24-hour Average (ppm).

Monitor Location	Annual Average (ppm)		1976 24-hour average (ppm) [1]		
	1975	1976	Max	2nd highest	3rd highest
Albany Co 84 Holland Ave.	0.017	0.016	na [2]	na	na
Albany Co HD Green St.	0.021	0.023	0.065	0.059	0.056
Becker Elem	na	0.008	0.037	0.030	0.029

Source: NYS DEC. NYS Air Quality Report Continuous and Manual Air Monitoring Systems Annual 1976. DAR-77-1.
[1] NYS AAQS and EPA NAAQS for SO_2: 24-hour average of 0.14 ppm, not to be exceeded more than once per year.
[2] not available

Table 4. TRI Emissions Data for Ravena Cement Plant 1988–2009 (reported in pounds per year [lbs/yr] or grams per year g/yr).

1988–1999

Substance	Units	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Methanol	lbs/yr	250	35000 (O)	70000	4 (O)	5200 (C)	9900 (C)	14000 (O)	15200 (O)	14200 (O)	35357 (O)	38653 (O)	52510 (O)
Sulfuric Acid (1994 and after 'Acid Aerosols' Only)	lbs/yr	1000	0	250									

2000–2009

Substance	Units	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009 [1]
Methanol	lbs/yr	52272 (O)	38000 (C)								
Dioxin and Dioxin-Like Compounds (Grams)	g/yr	1.89 (M)	1.89 (M)	1.87 (O)	2.01 (M)	0.93 (M)	0.89 (M)	0.92 (M)	2.2 (M)	2.6 (M2)	0.94 (M2)
Hydrochloric Acid (1995 and After 'Acid Aerosols' Only)	lbs/yr	36657 (E)	180000 (M)	142153 (O)	114364 (M)	113000 (M)	113000 (M)	120000 (M)	120000 (M)	100000 (M2)	350000 (M2)
Mercury	lbs/yr	38.4 (O,M)	37.1 (O,M)	37 (O)	396.4 [2] (M)	380 [2] (O)	380 [2] (O)	400.07 [2] (O)	160 [3] (O)	140 [4] (O)	140 (O)
Lead Compounds	lbs/yr		74 (O)	29 (O)	69.98 (M)	58 (O)	615 (O)	626 (O)	611 (O)	524 (O)	374 (O)
Polycyclic Aromatic Compounds	lbs/yr		20 (O,E)	0 (O,E)	153.99 (M)	150 (M)	170 (M)	170 (M)	170 (M)	140 (M2)	140
Ammonia	lbs/yr				126093 (O)	125000 (O)	124000 (O)	130000 (O)	140000 (O)	110000 (O)	80000 (O)

Source: US EPA. Toxic Release Inventory (TRI) Explorer accessed via Internet www.epa.gov/triexplorer.

Estimates were derived using either monitoring data (M), other approaches such as engineering calculations (O), Emissions factors (E), Mass-balance calculations (C) or in a few instances prior to 1995, no estimate basis was provided. The M code was replaced in 2007 by codes M1 (estimates based on continuous monitoring data or measurements) and M2 (estimates based on periodic or random monitoring data or measurement). Ethylene Glycol, Chromium and Manganese although listed on TRI reports in some years, did not provide the amounts released.

Cement Plant ownership changed from Blue Circle to Lafarge in 2001.

[1] Data from 2009 are preliminary and may not reflect actual 2009 values if EPA has not completed processing submissions. (http://www.epa.gov/triexplorer/preliminarydata.html).

[2] Mercury emissions for 2003–2006 calculated using 2004 stack test emission factor for mercury (1996–2002 estimates used 1996 stack test emission factors).

[3] Mercury emissions calculated using the mass-balance calculations from the 2007 EPA Materials Study.

[4] Mercury emissions calculated using the mass-balance calculations from the 2008 Mercury Study (Environmental Quality Management Inc., 2009).

Table 5. Ravena Cement Plant Annual Emissions (NYS DEC Title V Reporting Data) Facility Totals (Combustion & Industrial Processes) in Pounds Per Year (unless otherwise noted).

Analyte	1993	1994 [1]	1995	1996 [2]	1997 [2]	1998	1999	2000	2001	2002 [2]	2003 [2]	2004	2005	2006 [2]	2007 [2]	2008
Formaldehyde														0.13		
Benzene														0.26		
Naphthalene														0.03		
Ethylbenzene														0.01		
Toluene														0.08		
Xylenes (m,o,p)														0.01		
Carbon Monoxide **(1000s of lbs/year)**	872		908	889	219	225	229	223	220	207	1,850	1,834	1,869	877	1,275	1,228
Lead			416	406	85	85	88	82	81	80	296	293	300	304	303	160
Mercury			15	15	39	39	39	38	37	37	389	385	392	398	161	139
Silver			46	45	7	7	7	7	7	7	3	3	3	3	3	3
Arsenic			8	8	106	106	105	102	101	100	179	177	180	183	183	154
Beryllium			485	474	1	1	1	1	1	1	0	0	0	0	0	0
Cadmium			31	30	8	8	8	8	8	8	14	14	14	15	15	12
Chromium			10,928	10,677	33	33	33	32	32	31	25	25	28	26	26	22
Iron			374	411	104	107	106	115	79	76	100	11	45	95	10	147
Sulfur Dioxide **(millions of lbs/ year)**	28		20	23	33	24	31	26	36	30	23	24	24	23	23	19
Selenium			62	60	511	510	504	491	487	480	6,459	6,399	6,514	6,618	6,610	5,565
Oxides Of Nitrogen **(millions of lbs/year)**	22		22	21	23	23	14	10	10	11	11	10	10	10	11	9
Unspeciated VOCs **(1000s of lbs/year)**	47		49	46	51	52	53	52	51	48	405	434	431	425	430	354
Unspeciated Particulates **(1000s of lbs/year)**	716		1,897	1,893	2,116	2,257	2,328	2,385	2,305	2,067	2,209	2,157	2,157	2,081	2,040	1,968

Source: Emission Statements submitted to NYS DEC or from printouts from NYS DEC database.
[1] Emissions reporting not reflected in NYS DEC permitting system.
[2] Year to year changes in reported emissions may not necessarily reflect changes in operation, but rather a change in reporting.
This can result from having previously reported emissions at the maximum allowable in the permit (1996 and prior years) or using default assumptions, to reporting emissions based upon actual operation and/or on stack testing.

Table 6. Short-term Kiln Stack Maximum Emission Rates Blue Circle Atlantic from the Supplemental Fuels Application 1987.

Pollutant	Operation	
	One Kiln	Two Kilns
Emission Rate	(grams/second)	(grams/second)
Particulates [1]	10.08	20.16
Sulfur Dioxide [2]	189	378
Hydrogen Chloride [3]	3.78	7.56
Lead [3]	0.005	0.01
Arsenic [3]	<0.000018	<0.000036
Cadmium [3]	<0.00009	<0.00018
Chromium [3]	<0.00018	<0.00036
PCDDs [3]	<0.000018	<0.000036
PCDFs [3]	<0.000018	<0.000036
Nitrogen Dioxide [4]	289	577
Carbon Monoxide	35.91	71.82
Volatile Organic Compounds[5]	0.2	0.41

[1] Particulate emissions are based on allowable emission rates.
[2] Sulfur dioxide emissions were developed from monitored SO_2 in flue gas.
[3] HCL, metals, PCDD and PCDF emissions developed from US EPA test data from a similar plant.
[4] Nitrogen oxide emissions from stack gas monitoring on-site.
[5] VOC emissions from US EPA AP-42.

Table 7. Kiln Stack Emission Rates and Emission Concentrations at Stack Exit from 2004 Stack Test.

Analyte	Emission Rate pounds/hour	Stack Emission Concentration	Analyte	Emission Rate pounds/hour	Stack Emission Concentration
Metals		**µg/m³**	**PCBs**		**ng/m³**
Antimony	0.0024000	1.75	PCB-77	≈ 0.000000205	≈ 0.147
Arsenic	0.0244000	17.7	PCB-81	<0.0000000145	<0.010
Barium	0.0046000	3.35	PCB-105	0.000000455	0.327
Beryllium	<0.0000335	<0.024	PCB-114	<0.0000000330	<0.024
Cadmium	0.0019400	1.41	PCB-118	0.000001680	1.210
Total Chromium	0.0034700	2.53	PCB- 123	0.000000017	<0.012
Hexavalent Chromium	<0.000125	<0.092	PCB-126	<0.0000000332	<0.024
Cobalt	<0.000275	<0.201	PCB-156/157	0.000000375	0.270
Copper	0.0040100	2.92	PCB-167	0.000000220	0.158
Lead	0.0404000	29.4	PCB-169	<0.0000000267	<0.019
Manganese	0.0108000	7.88	PCB-189	0.000000056	<0.041
Mercury	0.0530000	38.6	**Criteria Pollutants/Other**		**ppmvd**
Nickel	0.0027000	1.97	Sulfur dioxide	3073.00	840.1
Selenium	0.0881000	64.2	Nitrogen oxides	1481.00	562.8
Silver	0.0004510	0.329	Carbon monoxide	252.40	157.1
Thallium	0.0168000	12.2	Total hydrocarbons	na	25.4
Vanadium	0.0024700	1.80	Methane	na	3.58
Zinc	0.0712000	51.8	Non-methane hydrocarbons	55.2 (as propane)	21.82
PAHs		**mg/m³**			**mg/m³**
Naphthalene	0.0634000	0.0371	PM_{10}	29.3	20.6
2-Methylnaphthalene	0.2910000	0.209	Filterable PM	26.9	19.7
Acenaphthylene	0.1200000	0.0864	Hydrogen chloride	15.6	10.8
Acenaphthene	0.0067000	0.00482	Acetaldehyde	≈ 0.093	≈ 0.068
Fluorene	0.0190000	0.0137	Formaldehyde	<0.481	<0.351
Phenanthrene	0.1530000	0.110	Acrolein	<3.74	<2.73
Anthracene	0.0066000	0.00475	Benzene	≈ 2.62	≈ 1.91
Fluoranthene	0.0167000	0.0121	Vinyl chloride	<1.43	<1.05
Pyrene	0.0047400	0.00341	Fluoride	<0.0108	<0.076
Benzo(a)Anthracene	0.0008860	0.000632	Ammonia	17.20	11.8
Chrysene	0.0018900	0.00136			**ng TEQ/m³**
Benzo(b)Fluoranthrene	0.0009750	0.00072	Dioxins and furans	na	0.054
Benzo(k)Fluoranthene	0.0001440	0.000104			
Benzo(e)Pyrene	0.0015700	0.00113			
Benzo(a)Pyrene	0.0002520	0.000181			
Perylene	0.0000350	0.0000252			
Indeno(1,2,3-cd)Pyrene	0.0000922	0.0000664			
Dibenzo(a,h)Anthracene	0.0000658	0.0000474			
Benzo(g,h,i)Perylene	0.0002270	0.000164			

Source: NYS DEC Memorandum Syed Mehdi to Bruce Van Houten subject: stack test report.
M^3 -dry standard cubic meter(dscm), µg/M^3 -microgram per dry standard cubic meter, ng - nanogram, TEQ/M^3 -nanograms (ng) Toxic Equivalent Quantity per dscm, ppm vd - part per million volumetric dry

Table 8a. Emissions Assuming Operation at Full Capacity For Current (Wet Process) for Lafarge.

	Emissions (tons/year)								
Emission Unit	**PM (TSP)**	**PM_{10}**	**$PM_{2.5}$**	**SO_2**	**NO_x**	**CO**	**VOC**	**Lead**	**Fluoride**
Existing Kilns	474.38	442.12	397.17	12899.94	5682.01	1053.90	235.08	0.17	0.46
Existing Clinker Coolers	121.78	102.29	54.80	na					
Miscellaneous Point Sources	324.37	272.47	145.97	na					
Process Fugitive Emissions	25.84	12.15	1.89	na					
Storage Piles	6.68	3.34	0.50	na					
Quarry Operations	32.36	12.03	2.71	na					
Plant and Quarry Roads	232.05	64.59	6.92	na					
Total	1217.46	908.99	609.95	12899.94	5682.01	1053.90	235.08	0.17	0.46

Source: Lafarge Modernization Application documents 2009.
na - not applicable

Table 8b. Baseline Emissions (August 2004-July 2006) for Lafarge from the 2009 Netting Analysis in the Modernization Application Materials.

	Emissions (tons/year)								
Emission Unit	**PM (TSP)**	**PM_{10}**	**$PM_{2.5}$**	**SO_2**	**NO_x**	**CO**	**VOC**	**Lead**	**Fluoride**
Existing Kilns	434.82	405.22	364.03	11825.45	5223	965.95	215.43	0.16	0.42
Existing Clinker Coolers	114.08	95.83	51.34	na					
Misc Equipment (to be shut down [1])	138.7	116.51	62.41	na					
Existing Equipment (to remain [2])	159.23	133.76	71.66	na					
Process Fugitive Emissions	24.07	11.31	1.76	na					
Storage Piles	6.68	3.34	0.5	na					
Quarry Operations	24.45	8.69	2.09	na					
Plant and Quarry Roads	166.99	46.32	5.01	na					
Total	1069.02	820.98	558.8	11825.45	5223	965.95	215.43	0.16	0.42

Source: Lafarge Modernization Application documents 2009.
[1] Equipment operating during the baseline period, but which would not be operational after modernization.
[2] Miscellaneous Equipment that would remain in operation after modernization.
na - not applicable

Table 8c. Estimated Emissions with Modernization (Dry Process) and Operation at Full Capacity.

	Emissions (tons/year)								
Emission Unit	**PM (TSP)**	**PM_{10}**	**$PM_{2.5}$**	**SO_2**	**NO_x**	**CO**	**VOC**	**Lead**	**Fluoride**
Kiln System	297.85	259.19	164.94	1996.96	3231.43	3512.42	254.44	0.25	1.26
New Miscellaneous Point Sources	437.3	367.33	196.78	na					
Existing Miscellaneous Point Sources	78.76	66.15	35.44	na					
Process Equipment Fugitive Emissions	28.42	13.35	2.08	na					
Storage Piles	8.06	4.03	0.60	na					
Quarry Operations	36.11	13.21	3.05	na					
Plant and Quarry Roads	284.44	78.82	8.56	na					
Total	1170.94	802.09	411.47	1969.27	3232.08	3512.77	254.44	0.25	1.26

Source: Lafarge Modernization Application documents 2009.
na - not applicable

Table 9. Dioxin and Furan Emission Rates from Kiln Stack (Kiln 1&2) Tests (2004–2008).

Analyte	Year	Average Emission Rate (range) ng TEQ [1]/dry standard cubic meter (dscm)	
PCDD/PCDF	2004 (February)	0.0541 (0.0352 – 0.0684)	**Emission Limit [2] = 0.20 ng TEQ/dscm**
	2005 (March)	0.0219 (0.0040 – 0.0484)	
	2005 (September)	0.0423 (0.0151 – 0.0827)	
	2007 (November)	0.2444 (0.1146 – 0.4659 [3])	
	2007 (without "outlier")	0.1336 (0.1146 – 0.1526)	
	2008 (March)	0.0983 (0.0733 – 0.1190)	

Source: Air Control Technologies Compliance Demonstration for Portland Cement MACT Dioxins and Furans Kilns #1 & #2. Reports prepared for Lafarge North America 2005, 2007, 2008.

[1] TEQ/dscm nanograms (ng) Toxic Equivalent Quantity per dry, standard, cubic meter.

[2] Emissions Limit 40 CFR Part 63 §63.1342.

[3] This value was stated to be a probable outlier.

Table 10. Particulate Emissions Rates from 2005 Kiln Stack Test and 2006 Clinker Cooler Stack Test.

Analyte	Clinker Cooler 1		Clinker Cooler 2		Kiln Stack	
	Emission Rate pounds/hour	Emission Concentration [1] mg/m^3	Emission Rate pounds/hour	Emission Concentration [1] mg/m^3	Emission Rate pounds/hour	Emission Concentration [1] mg/m^3
Filterable Particulate [2]	5.43	15.97	13.87	41.19	52.08	35.87
Condensable Particulate [3]	na				63.36	43.97
Total Particulate					115.44	79.61

Source: Air Control Technologies 2006 Filterable Particulate Matter Clinker Coolers 1&2. Report prepared for Lafarge North America. August 2006. Air Control Technologies 2007 Filterable and Condensable Particulate Matter Emissions Evaluation Report prepared for Lafarge North America July 2007.

[1] Emission concentration converted from data expressed as grains per dry standard cubic meter, using the conversion factor 64.799 milligrams/grain.

[2] Filterable particulate –solid or liquid material at stack temperature, can be captured on a filter.

[3] Condensable particulates- particulates that form from the condensation of stack vapor or gaseous emissions at stack exit.

na- not applicable

Table 11. Mercury Inputs, Emissions and Speciation of Mercury (Hg) in Stack Emissions: Ravena Cement Plant Process.

Average Mercury Input Distribution (4 sampling events)		
	Pounds of Hg from this source on an annual basis	**% of Annual Total**
Limestone	95.3	57
Bauxite	6.25	4
Fly Ash	17.48	10
Mill Scale	2.97	2
Coal	44.89	27
Coke	0.48	0
Mercury Emissions Distribution		
	Pounds of Hg from this source on an annual basis	**% of Total**
Stack Emissions	160.32	91
Cement Kiln Dust	12.03	7
Type I/II Clinker	4.38	2
Speciation of Mercury from Exhaust Stack (Kilns1 & 2)		
	$\mu g/m^3$	**grams/hour**
Elemental	17.27	11.37
Oxidized	0.23	0.15
Particle -bound	<0.015	<0.010
Total	17.5	11.52

Source: 2009 Environmental Quality Management Inc. Report on the Voluntary Effort to Assess the Sources and Distribution of Mercury, Lafarge Building Materials Inc. Ravena Cement Plant, Ravena, New York.

Table 12. On-Site Monitoring Well Results (1990–2009) Analytical Results in Milligrams per Liter (mg/L), Except pH.

Analyte	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Antimony	na [1]	na	nd [2]–0.08	nd	nd	nd–0.07	nd–0.01	0.03–0.07	nd	nd
Arsenic	0.03–0.17	nd–0.12	nd–1.2	nd–0.03	nd–0.04	nd–0.12	nd–0.06	nd–0.19	nd–0.04	nd–0.13
Cadmium	nd	na	nd	nd	nd	nd	nd–0.01	nd	nd	nd
Chromium (total)	0.02–0.11	nd–0.03	nd–0.02	nd–0.08	nd–0.05	nd–0.05	nd–0.04	nd–0.03	nd	nd–0.06
Lead	0.01–0.13	nd–0.05	nd–0.04	nd–0.42	nd–0.08	nd–0.07	nd–0.05	nd–0.02	nd–0.13	nd–0.06
Potassium	4.4–18	na	2.6–41.2	nd–27	0.88–77.6	2.65–52.7	1.57–28.1	2.9–77.9	2.3–139	nd–32.3
Sodium	11–98	na	21.2–46.8	12–34	31–497	20.9–61.3	12.7–38.1	41.4–72.3	35–85.7	13.9–91.3
Chloride	13–81	8–96	13–110	15–110	28–120	7–188	12.1–121	12.9–144	4.08–140	14–260
Sulfate	85–370	150–310	120–630	110–750	157–860	65–1020	84–677	105–750	100–640	180–1010
Total Dissolved Solids	460–1100	500–790	460–1000	570–1700	498–1800	638–2150	440–1450	363–1670	495–1670	500–2450
pH	7.1–7.5	6.3–7.7	6.71–7.9	6.43–7.84	6.05–7.46	6.42–7.85	6.1–8.85	6.35–8.47	5.93–11.37	5.7–7.52
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Antimony	nd	nd	nd	nd	nd–0.08	0.02–0.56	nd	nd	nd	nd
Arsenic	nd–0.46	nd–0.05	nd–0.07	nd–0.03	nd–0.19	nd–0.05	nd	nd	nd–0.802	nd–0.010
Cadmium	nd	nd	nd	nd	nd–0.08	nd–0.01	nd	nd	nd–0.009	nd
Chromium (total)	nd–0.03	nd–0.01	nd–0.02	nd–0.02	nd–0.072	nd–0.18	nd	nd	nd–0.032	nd–0.013
Lead	nd–0.39	nd–0.01	nd–0.02	nd–0.03	nd–0.85	nd–0.07	nd	nd	nd–0.012	nd
Potassium	2.84–89.8	2.22–55.3	2.82–315	2.68–8580 *	nd–24900 *	0.06–23	1.55–424	1.81–472	1.15–8070 *	1.46–355
Sodium	11.6–153	37.4–68.4	20.6–216	15.5–1820 *	13.9–2810 *	10.1–1795 *	48.3–154	23.6–94.5	29–181	28.9–78.1
Chloride	5.1–240	24.8–263	5.1–378	3.7–2770 *	1.93–3380 *	4.42–2500 *	5–363	3–385	7–2410 *	13–380
Sulfate	35–850	44.7–836	47–1700	23–12600 *	nd–11100 *	1–11000 *	nd–2130	nd–2080	nd–8770 *	nd–1900
Total Dissolved Solids	320–1210	525–1800	558–3430	505–30900 *	204–26300 *	150–29000 *	508–3330	375–3240	545–23900 *	155–3410
pH	6.1–7.63	6.05–7.67	na	6.82–12.47	6.25–13.7	5.71–12.84	6.4–7.9	6.4–8.0	6.5–13 *	6.0–7.8

Reference: Email of groundwater monitoring reports received from John Reagan, of Lafarge (Years 1990–2005) and 2006–2009 Groundwater monitoring reports received from NYS DEC.

[1] na - not analyzed for.

[2] nd - not detected.

* high total dissolved solids - high turbidity.

Table 13. Inorganic Content of Groundwater (GW) from On-site Monitoring Wells.

	Concentration (microgram per liter)			
Sample Analyte	GW01 Background [1]	GW02 Background	GW03	GW04
Aluminum	nd [2]	200	9600	4100
Arsenic	nd	nd	nd	115
Barium	nd	nd	nd	nd
Beryllium	nd	nd	nd	nd
Cadmium	nd	nd	nd	nd
Calcium	91,000	180,000	320,000	29,500
Chromium	nd	nd	20	nd
Cobalt	nd	nd	nd	nd
Copper	nd	nd	nd	nd
Iron	810	850	18,000	nd
Lead	nd	nd	nd	nd
Magnesium	73,000	170,000	160,000	nd
Manganese	180	160	970	nd
Mercury	nd	nd	nd	1.6
Nickel	nd	nd	nd	190
Potassium	nd	nd	27,000	13,000,000
Selenium	nd	nd	nd	50
Silver	nd	nd	nd	nd
Sodium	34,000	86,000	250,000	1,950,000
Thallium	nd	nd	nd	nd
Vanadium	nd	nd	nd	140
Zinc	nd	nd	nd	nd

Reference: 2006, Weston, R.F., Final Site Inspection Prioritization Report: Atlantic Cement, Coeymans, New York.

[1] Wells are indicated as being background if they are upstream of the CKD landfill in the general direction of GW flow.

[2] nd - not detected above analytical detection limits.

Table 14a. Up-gradient Surface Water Monitoring Results from Coeymans Creek (1990–2003) Results in Milligrams per Liter (mg/L), Except pH.

Analyte	1990	1991	1992	1993	1994	1995	1996
Antimony	na [1]	na	nd [2]	nd	na	0.06	nd
Arsenic	nd	nd	nd	nd	nd	nd	nd
Cadmium	na	na	nd	nd	nd	nd–0.01	nd
Chromium (total)	nd	nd	nd	nd	nd	nd	nd
Lead	nd	nd	nd–0.01	nd	nd–0.01	nd	nd
Potassium	3.5	na	2.9	5.2–22	1.91	3.58	26.4
Sodium	51	na	41.4	87–120	50.3	26.5	50
Chloride	84	40–92	44–83	72–230	66–96	48–169	67.3–82.7
Sulfate	56	46–150	56–88	60–140	36–71	44–100	22–101
Total Dissolved Solids	400	230–530	300–460	410–710	312–486	253–1230	299–732
pH	8.1	8.1–8.6	6.71–8.5	7–8.1	7.95–8.15	7.92–8.4	8–8.58
	1997	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Antimony	0.03	nd	nd	nd	nd	nd	nd
Arsenic	nd	nd	0.02	nd	nd	nd	nd
Cadmium	nd	nd	nd	nd	nd	nd	nd
Chromium (total)	nd	nd	nd	nd	nd	nd–0.01	nd
Lead	nd–0.01	nd	nd	nd–0.02	nd	nd	nd
Potassium	6.45	2	nd	2.57	4.68	2.87	1.66
Sodium	33.3	37.6	30.1	21.2	41.5	50.6	23.3
Chloride	49.9–94.4	51.4–93.3	69–110	52–60	72–299	70–136	38–97
Sulfate	37–78	33–80	22–130	27–270	44–88	38–71	18–56
Total Dissolved Solids	317–403	328–491	300–540	240–300	390–770	408–495	258–548
pH	8.23–8.8	6.9–8.88	7.36–8.13	7.39–8.17	7.04–7.9	na	na

Reference: Email of groundwater monitoring reports received from John Reagan, of Lafarge (Years 1990–2005) and 2006–2009. Groundwater monitoring reports received from NYS DEC.

[1] na - not analyzed for.

[2] nd - not detected.

Table 14b. Up- and Down-gradient Surface Water Monitoring Results from Coeymans Creek (2004–2009) Results in Milligrams per Liter (mg/L), Except pH.

Analyte	2004		2005		2006		2007		2008		2009	
	Up-gradient	Down-gradient	Up-gradient	Down-gradient	Up-gradient	Down-gradient	Up-gradient	Down-gradient	Up-gradient	Down-gradient	Up-gradient	Down-gradient
Antimony	0.03–0.04	0.03–0.04	nd	nd–0.01	na	na	na	na	na	na	na	na
Arsenic	nd	nd	nd–4.16	nd–5.52	na	na	na	na	na	na	na	na
Cadmium	nd	nd	nd	nd	na	na	na	na	na	na	na	na
Chromium (total)	nd	nd	nd	nd	na	na	na	na	na	na	na	na
Lead	nd–7.75	nd	nd	nd–0.01	na	na	na	na	na	na	na	na
Potassium	3.58	18.3	144	509	2.49	16.6	2.56–3.82	11.1–33.3	2.49–3.16	8.58–24.4	1.96	11.0
Sodium	40.2	203	29.2	97.5	na	na	na	na	na	na	na	na
Chloride	33.2–85.7	140–380	2–100	49–95	47	52	62–134	70–136	45–78	50–79	74	85
Sulfate	na	4.61–37.8	na	29–200	28	75	41.4–68	70–275	26–47	39–62	29	56
Total Dissolved Solids	na	280–444	na	230–900	338	402	490–520	540–775	285–390	355–425	268	382
pH	na	5.13–8.51	6.94–8.42	6.94–8.96	8.1	8.2	7.6–8.6	6.6–8.5	7.9–8.6	7.6–8.0	7.5	7.6

Reference: Email of groundwater monitoring reports received from John Reagan, of Lafarge (Years 1990–2005) and 2006–2009 Groundwater monitoring reports received from NYS DEC.

[1] na - not analyzed for.

[2] nd - not detected.

Table 15. On- and Off-site Sediment Samples (1994, 2006) - Inorganic Analysis (milligrams per kilogram [mg/kg]).

Analyte	Concentration (mg/kg)						
	1994		2006				
	Coeymans Creek Upstream [1]	Coeymans Creek Downstream [2]	Coeymans Creek Upstream	Coeymans Creek Downstream	On-site Pond [3]	Hudson River North of Loading Dock	Hudson River South of Loading Dock
Aluminum	6,420	12,800	8,700–12,000	10,000–16,000	17,000	7,500–14,000	7,500–11,000
Antimony	nd [4]	nd	nd	nd	nd	nd	nd
Arsenic	3.9	7.0	5.1–7.0	5.8–6.7	7.7	3.4–10	4.8–6.7
Barium	33	80.4	55–82	68–91	93	30–84	39–71
Beryllium	0.35	0.86	nd–0.68	0.6–0.93	0.84	nd–0.7	nd
Cadmium	nd	nd	nd	nd	nd	nd	nd
Calcium	7,570	27,500	6,900–14,000	12,000–14,000	18,000	2,100–11,000	3,600–11,000
Chromium	11.4	19.0	12–17	15–19	19	9.7–46	15–16
Cobalt	7.8	15.0	10–12	10–13	14	7.1–8.7	nd–7.2
Copper	12.5	20.2	16–27	23–28	29	8.3–42	10–17
Iron	15,800	26,800	19,000–25,000	22,000–31,000	31,000	16,000–25,000	11,000–18,000
Lead	7.9	18.0	12–15	11–12	12	5–54	11–27
Magnesium	3,370	5,970	3,900–5,400	5,100–6,600	7,500	3,100–5,300	2,600–11,000
Manganese	330	852	530–700	600–830	600	150–450	470–610
Mercury	nd	nd	nd–0.67	nd	nd	nd–0.25	nd
Nickel	14.6	23.8	18–26	22–27	29	14–21	11–17
Potassium	890	1,890	1,600–1,700	1,800–2,800	2,600	1,200–1,800	1,100–11,000
Selenium	nd	nd	nd	nd	nd	nd	nd
Silver	nd	nd	nd	nd	nd	nd	nd
Sodium	296	433	nd	nd	nd	nd–1,100	nd–760
Thallium	0.84	2.6	nd	nd	nd	nd	nd
Vanadium	11.6	23.1	17–21	20–28	26	15–70	14–16
Zinc	44.6	73.5	52–78	69–75	77	47–180	62–80

Reference: 1994, Weston, R.F., Final Site Inspection Prioritization Report: Atlantic Cement, Coeymans, New York, and 2006, Weston, R.F., Final Site Inspection Prioritization Report: Atlantic Cement, Coeymans, New York.

[1] Upstream of the cement kiln dust (CKD) landfill.
[2] Downstream of the CKD landfill.
[3] On-site south of the conveyor that goes from quarry to plant.
[4] nd - not detected above analytical detection limit.

Table 16. Soil - Inorganic Analysis (milligrams per kilogram [mg/kg]).

Analyte	Concentration				
	1994		2006		
	On-site Sample Locations [1]	Targeted Sample On-site Location [2]	CKD Waste Sample	Background [3]	On-site Sample [4]
Aluminum	15,600–16,200	11,000–17,400	11,000–12,000	13,000–15,000	2,900–18,000
Antimony	nd [5]	nd	nd	nd	nd
Arsenic	7.2–8.2	6.2–7.0	8.5–8.6	5.1–8.3	7.9–20
Barium	72.1–141	53.3–106	100	50–67	66–74
Beryllium	0.86–0.94	0.57–1.0	0.61–0.63	0.56–0.77	nd–0.79
Cadmium	nd	nd	1.5–1.8	nd	nd
Calcium	6,900–53,100	25,900–29,400	290,000–300,000	26,000–29,000	12,000–160,000
Chromium	22.2–24.1	18.7–22.5	61–62	18–21	16–60
Cobalt	9.8–13.3	9.4–13.5	nd	6.7–11	6.7–9.0
Copper	25.8–33.3	24.3–33.1	55	18–19	35–86
Iron	26,900–31,300	23,800–29,900	11,000	20,000–24,000	26,000–58,000
Lead	26.7–144	9.2–22.7	150–180	25–27	11–40
Magnesium	3,940–3,990	6,540–9,770	14,000	3,000–3,500	840–10,000
Manganese	479–1,040	535–710	450	470–1,100	290–430
Mercury	nd	nd	nd	nd–0.074	nd–0.086
Nickel	17.9–24.8	24.3–25.8	20–21	15–17	22–50
Potassium	1,350–1,530	1,400–2,750	21,000–22,000	1,200	1,000–2,000
Selenium	nd	nd	17–21	nd	nd
Silver	nd	nd	8.1–9.5	nd	nd–2.1
Sodium	316–319	340–497	2,600–2,800	nd	nd–510
Thallium	2.3–3.3	2.7–3.4	nd	nd	nd
Vanadium	30.9–32.1	25.8–28.4	31	25–30	15–57
Zinc	92.5–327	65.8–231	500–550	81–84	82–170

Reference: 1994, Weston, R.F., Final Site Inspection Prioritization Report : Atlantic Cement, Coeymans, New York., and 2006, Weston, R.F., Final Site Inspection Prioritization Report: Atlantic Cement, Coeymans, New York.

[1] Samples not adjacent to active operations.
[2] Suspected location of PCB contamination from transformer decommissioning.
[3] Contractor description of on-site sample.
[4] Cement plant operation related samples (e.g., near stockpiles).
[5] nd - not detected above analytical detection limit.

Table 17. Summary of Chemical and Petroleum Spill Data from NYS DEC Bureau of Environmental Remediation's Spill Response Programs Database (1986–2009) for the Ravena Cement Plant.

Spill Compound	Number of Times Reported *
Hydraulic Oil	42
Diesel Fuel	18
Lubricating Oil	13
Fuel Oil	12
Motor Oil	5
Gasoline	5
Non-polychlorinated biphenyl Oil	5
Unknown Petroleum	3
Waste Oil	3
Gear/Spindle Oil	2
Transmission Fluid	2
Transformer Oil	1
Antifreeze	1
Sulfuric Acid	1
Unknown Foam	1

* 108 spills were reported during this time frame, with some spills containing more than one compound (i.e., one spill reported - contained transmission fluid and gasoline due to a traffic accident).

Table 18. NYS DEC Fish Contaminant Sampling for Coeymans Creek (2007) and Feuri Spruyt (1983).

Location	Year	Species	Length (average and range, in inches)	Contaminant Concentration (in parts per million, ppm)		
				PCBs	Chlordane	Mercury
Feuri Spruyt	1983	American Eel	22 (21–24)	0.71 (0.50–0.91)	0.007 (0.006–0.008)	0.3 (0.26–0.34)
Feuri Spruyt	1983	Brown Trout	9.2 (6.8–12)	0.27 (0.18–0.47)	0.003 (0.002–0.005)	0.15 (0.12–0.18)
Coeymans Creek (upstream of Pictuay Rd.)	2007	Brown Trout	10 (7.6–17)	0.19 (0.08–0.37)	nd	0.07 (0.02–0.14)
Coeymans Creek (at Rte 396 Bridge)	2007	Brown Trout	12 (10–16)	0.32 (0.09–0.56)	nd	0.06 (0.01–0.21)
Battenkill (for comparison purposes)	1999	Brown Trout	12 9.8–18)	0.047 (0.031–0.077)	nd	0.12 (0.07–0.21)

Source: NYS DEC, 2010. NYS DEC database on chemical contaminants in fish.
nd - not detected

Table 19. Summary of Environmental Data Available for Ravena Cement Plant and Exposure Pathways.

Type of Data	Observations	Do Observations Describe a Complete or Potential Exposure Pathway for Cement Plant Contaminants
AIR		
Ambient Air Monitoring		
Particulates (Tables 1, 2 and Appendix E)		
RCS Junior-Senior High School Settleable (1964–1976) Total Suspended Particulates (TSP) (1964–1965, 1971–1976)	Historic settleable particulate and TSP levels; data not collected in all years at all locations. Levels exceeded NYS Ambient Air Quality Standards (AAQS) or objectives at some locations in some years; data reflect regional particulate levels, and are not solely attributable to the cement plant.	No
Pieter B. Coeymans Elementary Settleable (1972–1976) TSP (1970–1976)		
W. Becker Elementary Settleable (1971–1976)		
Stuyvesant and Albany NY Fine particulates ($PM_{2.5}$) (2009–2010) (Appendix D)	Levels below NAAQS at both locations; both locations are outside area likely to be affected by cement plant; data reflect regional particulate levels, and are not specifically relevant or attributable to the cement plant.	
Sulfur dioxide (SO_2)		
Becker Elementary Schools (1971–1981) (Table 3)	SO_2 levels did not exceed NYS AAQS; data reflect regional SO_2 levels and are not specifically relevant to cement plant.	
Settled Surface Dust		
NYS DEC sampling (1982–1983, 1997, 2000–2001)	Cement and clinker cooler settled dust present on private property near the cement plant in the past; information limited in scope and time.	Yes (potential)

Table 19 (Continued).

Type of Data	Observations	Do Observations Describe a Complete or Potential Exposure Pathway for Cement Plant Contaminants
AIR (CONTINUED)		
Emissions Estimates		
Toxics Release Inventory (TRI) (1988–2007) (Table 4)	Emission estimates in pounds per year (lbs/yr) for 2–6 substances; basis for emission estimates varies.	Yes (complete)
NYS DEC Title V Facility Annual Emissions Reports (1996–2008) (Table 5)	Emission estimates (lbs/yr) for 14 'permitted' substances; basis for emission estimates varies.	
Stack Emission Rates		
Kiln Stack Maximum Emission Rates (1987) (Table 6)	Kiln stack emission rates in grams per second (gms/sec) for 12 substances; basis of emission rates varies.	
Kiln Stack Test (2004) (Table 7)	Kiln stack emission rates in pounds per hour (lbs/hr) for multiple substances.	
Baseline Emissions (2004–2006) (Table 8b)	Kiln, clinker cooler, and fugitive particulate emissions in tons/year for TSP, PM_{10}, $PM_{2.5}$, SO_2, NO_x, CO, VOC, lead, fluoride.	
Kiln Stack Tests (2004–2008) (Table 9)	Kiln stack emission rates in nanograms per cubic meter of air (ng/m^3) for PCDD/PCDF.	
Kiln and Clinker Cooler Stack Tests (2005, 2006) (Table 10)	Kiln and clinker cooler stack particulate emission rates (lbs/hr).	
Special Study		
Sources and Distribution of Mercury (2008) (Table 11)	Provides site-specific mercury content of limestone, additives, fuel, stack emissions, kiln dust, and clinker; mercury emissions in grams per hour (g/hr) and mercury speciation of emissions.	No (supporting information)

Table 19 (Continued).

Type of Data	Observations	Do Observations Describe a Complete or Potential Exposure Pathway for Cement Plant Contaminants
DRINKING WATER		
On-site Drinking Water	Public drinking water; monthly, quarterly, annual monitoring; no levels above the drinking water standards; non-employee exposures unlikely.	No
GROUNDWATER		
On-site Groundwater Monitoring Wells (1990–2009) (Table 12)	Annual monitoring for pH, TDS, 9 metals and inorganics; landfill perimeter collection system intercepts groundwater; no off-site migration.	No
On-site Groundwater Monitoring Wells (MWs) Upgradient and Downgradient of CKD Landfill (1994, 2006) (Table 13)	Levels for 22 inorganics and 65 SVOCs; no evidence of off-site migration.	
SURFACE WATER AND SEDIMENT		
Surface Water (Coeymans Creek, 1990–present) (Table 14)	Quarterly monitoring for pH, TDS, no impact of cement plant evident.	No
Coeymans Creek, Hudson River, on-site pond (1994, 2006) (Table 15)	Levels for 23 inorganic analytes; no impact of cement plant evident.	

Table 19 (Continued).

Type of Data	Observations	Do Observations Describe a Complete or Potential Exposure Pathway for Cement Plant Contaminants
SOIL		
On-site Soil, Cement Kiln Dust (1994, 2006), (Table 16)	Levels of 23 inorganic analytes in on-site soil samples; some levels may be elevated near on-site stockpiles or active operations; non-employee exposures unlikely.	No
NYS DEC Database (Table 17)	Mandatory reporting of spills; all spills remediated; no evidence of off-site migration of spilled materials; non-employee exposures unlikely.	
BIOTA		
Fish		
Coeymans Creek Fish (2007, Table 18)	Limited data; no evidence of cement plant impact.	No
Feuri Spruyt (1983, Table 18)	Limited data; no evidence of cement plant impact.	
Hudson River Fish	Extensive PCB data; limited data for mercury, cadmium contamination; not attributable to cement plant.	
Other		
Coeymans Creek Invertebrates and Macroinvertebrates (2003 Rotating Intensive Basin Survey)	Limited data, water quality supportive of aquatic life and recreational uses; impacts not cement plant-related.	No

Table 19 (Continued).

Type of Data	Observations	Do Observations Describe a Complete or Potential Exposure Pathway for Cement Plant Contaminants
ADDITIONAL DATA AND STUDIES		
Miscellaneous Samples Collected in the RCS Area (Appendix F)	Inorganic analyses of mineral material, conveyor fallout, water, sediment, soil, plant material, mammalian organs; insufficient information about sampling protocol and locations, and analytical laboratory certification.	Unknown
Biomonitoring Research Study	Analyses of metals in hair and blood from people residing within 10 miles of the cement plant.	Study results not yet available

NAAQS- National Ambient Air Quality Standards
PCDD/PCDF - polychlorinated dibenzodioxins and polychlorinated dibenzofurans

Table 20. Maximum Annual Ground-level Air Concentrations of Metals Assuming Tire-derived Fuel.

Contaminant (CAS number)	AGC	Dispersion Model					
		US EPA SCREEN3		AG-1 Screen		AG-1 ISCLT2	
	μg/m³	Estimated Concentration [2] μg/m³	% of AGC	Estimated Concentration [2] μg/m³	% of AGC	Estimated Concentration [2] μg/m³	% of AGC
Cadmium (7440-43-9)	0.0005 [1]	0.000022	4.4	0.0000085	1.7	0.00000095	0.19
Lead (7439-92-1)	0.38	0.00095	0.25	0.0038	0.1	0.000418	0.11
Mercury (7439-49-2)	0.3	0.00057	0.19	0.00024	0.08	0.0000273	0.0091
Selenium (7782-49-2)	20	0.008	0.04	0.002	0.01	0.00028	0.0014
Zinc (7440-66-6)	50 [1]	0.01	0.02	0.015	0.03	0.00175	0.0035

Estimated Distance to Point of Maximum Impact in Meters (miles)	1090 (0.67)	NA	10,000–12,141 (6.2–7.5)

Source: NYS DEC Division of Air Resources

[1] The AGCs for cadmium and zinc have been updated since this modeling was done. The 2007 updated values are 0.00027 μg/m³ for cadmium and 45 μg/m³ for zinc. The modeled concentrations of Cd represent roughly 8.1, 3.1 and 0.35% of the 2007 AGC for US EPA Screen 3, AG-7 screen and AG-74SCLT2, respectively. The modeled concentrations of zinc represent roughly 0.022, 0.03, and 0.0039% of the 2007 AGC for zinc for US EPA Screen 3, AG-7 screen and AG-1 ISCLT2, respectively.

[2] These air concentrations are calculated using the model results (percent of guidance concentration) multiplied by the 2003 guidance concentrations. (ex, 4.4% = 0.044; 0.044 x 0.0005 μg/m³ = 0.000022 μg/m³).

AGC - Air Guideline Concentration.

Table 21. Short-term (1-hour) Ground-level Air Concentrations of Metals Assuming Tire-derived Fuel.

Contaminant (CAS number)	SGC	Estimated Concentration	US EPA HEM [1]	Distance to point of Maximum impact
	μg/m³	μg/m³	% of SGC	meters
Mercury (7439-49-2)	1.8	0.468	0.26	12400
Zinc (7440-66-6)	380	9.12	0.024	

Source: NYS DEC Division of Air Resources
[1] Human Exposure Model
SGC - Short term guideline concentration

Table 22. Descriptions and Definitions of Health Outcomes Examined.

Respiratory Diseases	**ICD-9 codes (International Classification of Disease, Ninth Edition)**
Asthma Total (493)	493.00–493.92 Asthma hospitalizations – all ages
Asthma Childhood (493) (<15)	493.00–493.92 Asthma hospitalizations – among children less than 15 years old
Chronic Bronchitis (491)	491.0–491.9 Chonic bronchitis hospitalizations
COPD (490-496 excluding 493)	490 Bronchitis not specified as acute or chronic 491.0–491.9 Chonic bronchitis hospitalizations 492.0, 492.8 Emphysema hospitalizations 496 COPD not otherwise specified
Cardiovascular Diseases (CVD)	**ICD-9 codes**
Myocardial Infarction (410)	410.00-410.99 Acute Myocardial Infarction (heart attack) hospitalizations
Diseases of the Circulatory System (390–459)	390-392 Acute rheumatic fever 393-398 Chronic rheumatic heart disease 401–405 Hypertensive disease 410–414 Ischemic heart disease (includes acute myocardial infarction) 415–417 Diseases of pulmonary circulation 420–429 Other forms of heart disease 430–438 Cerebrovascular disease 440–448 Diseases of the arteries,arterioles and capillaries 451–459 Diseases of the veins, lymphatics and other diseases of the circulatory system
Perinatal Health	
Low Birthweight (LBW)	Singleton birth weighing less than 2500 g (about 5.5 lbs)
Preterm Birth	Singleton birth occurring before 37 weeks gestation
Term LBW	Low birth weight birth occurring among full term singleton births
Sex Ratio	Ratio of male to female births among full term singleton births
Birth Defects	Total of 45 birth defects combined which are tracked by the NYS DOH Environmental Public Health Tracking Network (EPHT). These include, but are not limited to, certain neural tube defects (NTDs), eye and ear deformities, heart defects, Cleft lip/cleft palate, gastrointestinal and genitourinary tract defects, limb deficiencies, abdominal wall defects and chromosomal abnormalities. For details see link below. https://apps.health..ny.gov/statistics/environmental/public_health_tracking/tracker/birth_defects/about/glossary.jsp

Table 22 (Continued).

Childhood Blood Lead	
Incidence Rate of Children Less than 6 years old with Elevated Blood Lead Levels	The total number of children under age six, identified for the first time with a confirmed blood lead level greater than 10 m/dL among of children under age six that had lead tests (Incidence rate is per 1,000 children tested).
Cancer	**ICD-O-3 (International Classification of Disease for Oncology, Third Edition)**
Female Breast all ages	C500:C509 (Excl. M-9050:9055, 9140, 9590:9989)
Female Breast 0-50	Same as above limited to women 0-50 years of age
Female Breast 50+	Same as above limited to women over 50 years of age
Lung and Bronchus	C340:C349 (Excl. M-9050-9055, 9140, 9590:9989)
Urinary Bladder (including in situ)	C670:C679 (Excl. M-9050:9055, 9140, 9590:9989)
Brain (and other Nervous System)	C710:C719 (Excl. M-9050:9055, 9140, 9530:9539, 9590:9989) C700:C709 C720:C729
Thyroid	C739 (Excl. M-9050:9055, 9140, 9590:9989)
Non-Hodgkin's Lymphoma	M-9590:9596, 9670:9671, 9673, 9675, 9678:9680, 9684, 9687, 9689:9691, 9695, 9698:9702, 9705, 9708:9709, 9714:9719, 9727:9729 (9823, 9827) all sites except C420, C421, C424
Leukemia combined	M-9826, 9835:9837, 9823, 9820, 9832-9834, 9940 M-9840, 9861, 9866, 9867, 9871:9874, 9895:9897, 9910, 9920, 9891, 9863, 9875, 9876, 9945, 9946, 9860, 9930, 9801, 9805, 9931,9733, 9742, 9800, 9831, 9870, 9948, 9963, 9964 ,8927
Chronic Lymphocytic Leukemia	M-9823
Acute Myeloid Leukemia	M-9840, 9861, 9866, 9867, 9871:9874, 9895:9897, 9910, 9920

Table 22 (Continued).

Developmental Disabilities	Regulations of the Commissioner of Education - Section 200.1 - Definitions
Autism	Autism means a developmental disability significantly affecting verbal and nonverbal communication and social interaction, generally evident before age 3, that adversely affects a student's educational performance. Other characteristics often associated with autism are engagement in repetitive activities and stereotyped movements, resistance to environmental change or change in daily routines and unusual responses to sensory experiences. The term does not apply if a student's educational performance is adversely affected primarily because the student has an emotional disturbance as below. A student who manifests the characteristics of autism after age 3 could be diagnosed as having autism if the criteria in this paragraph are otherwise satisfied.
Emotional Disturbance	Emotional disturbance means a condition exhibiting one or more of the following characteristics over a long period of time and to a marked degree that adversely affects a student's educational performance: (i) an inability to learn that cannot be explained by intellectual, sensory, or health factors; (ii) an inability to build or maintain satisfactory interpersonal relationships with peers and teachers; (iii) inappropriate types of behavior or feelings under normal circumstances; (iv) a generally pervasive mood of unhappiness or depression; or (v) a tendency to develop physical symptoms or fears associated with personal or school problems. The term includes schizophrenia. The term does not apply to students who are socially maladjusted, unless it is determined that they have an emotional disturbance.
Learning Disability	Learning disability means a disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, which manifests itself in an imperfect ability to listen, think, speak, read, write, spell or to do mathematical calculations, as determined in accordance with section 200.4(j) of this Part. The term includes such conditions as perceptual disabilities, brain injury, minimal brain dysfunction, dyslexia and developmental aphasia. The term does not include learning problems that are primarily the result of visual, hearing or motor disabilities, of mental retardation, of emotional disturbance or of environmental, cultural or economic disadvantage.
Mental Retardation	Mental retardation means significantly subaverage general intellectual functioning, existing concurrently with deficits in adaptive behavior and manifested during the developmental period that adversely affects a student's educational performance.
Other Health	Other health-impairment means having limited strength, vitality or alertness, including a heightened alertness to environmental stimuli, that results in limited alertness with respect to the educational environment, that is due to chronic or acute health problems, including but not limited to a heart condition, tuberculosis, rheumatic fever, nephritis, asthma, sickle cell anemia, hemophilia, epilepsy, lead poisoning, leukemia, diabetes, attention deficit disorder or attention deficit hyperactivity disorder or tourette syndrome, which adversely affects a student's educational performance.

Table 23. Demographics of Five Ravena Area ZIP Codes, the RCS School District and NYS Excluding NYC Based on Estimates from the 2000 US Census.

Census Demographic	12143 Ravena	12158 Selkirk	12046 Coeymans Hollow	12156 Schodack Landing	12087 Hannacroix	All 5 ZIP Codes Combined	RCS School District	NYS Excluding NYC
Total Population [1]	6,247	6,276	649	838	1,366	15,376	14,505	10,968,179
Percent Male	48.6	48.6	53	50	51.1	49.1	48.6	48.8
Percent Female	51.4	51.4	47	50	48.9	50.9	51.4	51.2
Age Distribution [1] (%)								
<6 years	8	8.6	5.9	6.2	6.6	7.9	7.9	7.7
6–19 years	21.8	23.2	26	21.1	21.7	22.5	22.3	20.1
20–64 years	57.9	57.9	58.4	58.8	60	58.2	58.2	58.3
>64 years	12.3	10.3	9.7	13.8	11.7	11.4	11.7	13.8
Race/Ethnic Distribution [1] (%)								
White	94.1	90.7	99.2	96.3	97.4	93.3	93.4	84.9
Black	2.3	6	<1	1.7	<1	3.5	3.6	8.1
Native American	<1	<1	<1	<1	<1	<1	<1	<1
Asian	<1	1.1	<1	1	<1	<1	<1	2.4
Pacific Islander	<1	<1	<1	<1	<1	<1	<1	<1
Other	1	<1	<1	<1	<1	<1	<1	2.4
Multi-Racial	2	1.5	<1	<1	1.1	1.6	1.6	1.8
Percent Hispanic	3.7	2.8	1.8	1	1	2.9	3.2	6.4
Percent Minority *	7.8	11.3	2.3	4.3	2.9	8.4	8.5	18.3
Economic Description [2]								
Median Household Income	$44,179	$51,522	$59,814	$53,865	$47,681	$49,163	$50,280	$47,641
Percent Below Poverty Level	7.3	5.7	5.7	5.1	6.9	6.4	6.4	9.7

US Bureau of the Census. *2000 Census of population and housing summary file 1(SF1)*. US Department of Commerce. 2001.
US Bureau of the Census. *2000 Census of population and housing summary file 3 (SF3)*. US Department of Commerce. 2002
* Minorities include Hispanics, African Americans, Asian Americans, Pacific Islanders, Native Americans, Multi-Racial and Other Americans.

Table 24. Numbers and Estimated Rates of Age-adjusted Respiratory and Cardiovascular Disease Hospitalizations for Residents of the Five Ravena Area ZIP Codes and in NYS Excluding NYC from 1997–2006.

Disease (ICD-9-CM code)	12143 (Ravena)	12158 (Selkirk)	12046 (Coeymans Hollow)	12156 (Schodack Landing)	12087 (Hannacroix)	All 5 Ravena Area ZIP Codes Combined	NYS Excluding NYC
Respiratory Disease	Number (Estimated Rate *)	Number (Estimated Rate *)	Number (Estimated Rate *)	Number (Estimated Rate *)	Number (Estimated Rate *)	Number (Estimated Rate *)	Estimated Rate *
Asthma Total (493)	52 (8.4)	69 (11.0)	5 (6.7)	1 (1.0)	11 (8.1)	138 (9.1)	12.4
Asthma Childhood (493) (<15 years old)	12 (9.1)	37 (28.2)	3 (21.6)	0 (0.0)	1 (3.7)	53 (16.7)	20
Chronic Bronchitis (491)	120 (18.9)	88 (15.1)	16 (25.2)	16 (15.1)	11 (8.8)	251 (16.6)	14.4
COPD (490–496 excluding 493)	152 (24.0)	106 (18.1)	21 (32.2)	24 (22.)	13 (10.7)	316 (20.9)	17.6
Cardiovascular Disease (CVD)							
Myocardial Infarction (410)	99 (16.0)	102 (16.3)	7 (9.8)	21 (23.8)	23 (16.6)	252 (16.5)	24.5
CVD and Other Circulatory Diseases (390–459)	950 (152.4)	810 (135.1)	89 (131.6)	145 (170.0)	195 (149.0)	2,189 (144.8)	185.7

Data Sources – Number of hospitalizations from NYS DOH Statewide Planning and Research Reporting System
Population data are from yearly Claritas ZIP Code population estimates.
* Hospitalization rates are per 10,000 person years and are standardized to the US Standard Million, 2000.
COPD = Chronic Obstructive Pulmonary Disorder.

Table 25. Observed and Expected Numbers of Cancer Cases for Five ZIP Codes (Combined) in the Ravena Area: ZIP Codes 12143 (Ravena); 12158 (Selkirk); 12046 (Coeymans Hollow); 12156 (Schodack Landing); 12087 (Hannacroix) from 2002–2006.

Cancer	Males		Females	
Site	Observed	Expected *	Observed	Expected *
Female Breast (all ages)	-	-	69	58.7
Female Breast 0–50	-	-	18	14.8
Female Breast 50+	-	-	51	43.9
Lung and Bronchus	39	29.1	21	26.2
Urinary Bladder	12	16.3	4	5.6
Brain	3	3.5	1	2.6
Thyroid	1	2.7	5	7.7
Non-Hodgkin's Lymphoma	5	9.3	14	7.9
Leukemia (all types combined)	2	6.4	5	4.7
Chronic Lymphocytic Leukemia	0	2.5	0	1.7
Acute Myeloid Leukemia	2	1.7	1	1.4

Data Source: Observed and expected number of cases from the NYS Cancer Registry. Population data used to calculate expected cases are based on yearly Claritas ZIP code population estimates. Data are provisional as of January 2009.
Population data used to calculate expected cases are based on yearly Claritas ZIP code population estimates.
* Expected numbers are adjusted to the US standard million and calculated based on age specific cancer rates for residents of NYS excluding NYC.

Table 26. Perinatal and Childhood Health Outcome Numbers and Estimated Rates in the Five Ravena Area ZIP Codes Compared to NYS Excluding NYC Estimated Rates.

	Data Years	12143 (Ravena)	12158 (Selkirk)	12046 (Coeymans Hollow)	12156 (Schodack Landing)	12087 (Hannacroix)	All 5 Ravena Area ZIP Codes Combined	NYS Excluding NYC
Perinatal Health		Number (Estimated Rate)					Number (Estimated Rate)	Estimated Rate
Low Birthweight [1]	1998–2007	32 (5.4)	35 (4.7)	0 (0.0)	3 (4.9)	7 (6.3)	77 (4.9)	5.46
Preterm Birth [1]	1998–2007	45 (7.6)	59 (8.0)	6 (9.7)	4 (6.6)	10 (8.9)	124 (7.9)	9.24
Term LBW [2]	1998–2007	11 (2.0)	8 (1.2)	0 (0.0)	1 (1.8)	5 (4.9)	25 (1.7)	2.14
Sex Ratio [3]	1998–2007	276 (1.0)	356 (1.1)	37 (1.9)	26 (0.8)	56 (1.2)	751 (1.1)	1.04
Birth Defects (all EPHT) [4]	2000–2004	4 (1.33)	8 (1.97)	0 (0.00)	2 (5.13)	0 (0.00)	14 (1.69)	1.82
Lead [5]								
Incidence Rate of Children Less Than 6 Years Old with Elevated Blood Lead Levels [6]	2005–2007	–	–	–	–	–	3 (7.4)	10.4

Data sources: NYS DOH Vital Statistics; NYS DOH Congenital Malformations Registry; NYS DOH Lead Reporting.
[1] Rate per 100 singleton births.
[2] Rate per 100 singleton full term births.
[3] Ratio of number of male to the number of female births among full term births.
[4] Prevalence per 100 Live Births. List of all birth defects examined can be found in NYS DOH's Environmental Public Health Tracker – See Table 20.
[5] Incidence Rate per 1,000 children tested statewide blood lead level incidence from "Eliminating Childhood Lead Poisoning in New York State: 2006-2007 Surveillance Report" - Table 2a http://www.nyhealth.gov/environmental/lead/exposure/childhood/surveillance_report/2006-2007/.
[6] Elevated blood lead level defined as a blood lead level greater than or equal to 10 mcg/dL.

Table 27. Average Annual Number and Percentage of Students Receiving Services for Developmental Disabilities in RCS School District for 2003–2008.

	RCS	
Disability	**Average Annual Number**	**Percent**
Autism	15.4	0.68
Emotional Disturbance	43.0	1.90
Learning Disability	149.4	6.60
Mental Retardation	8.2	0.36
Other Health	66.2	2.93

Source: NYS ED SEDCAR

Note: Similar data for an appropriately matched school district are not readily available for comparison with RCS School District data (see text). Depending upon the findings of phase two of the PHA, comparison of the RCS School District data with appropriately matched comparison school districts may be done.

APPENDICES

APPENDIX A. NYS DEC ACTIONS

Appendix A, Table 1. NYS Department of Environmental Conservation Air Pollution Enforcement Actions.

Ownership and Year	Infraction/Cause	Monetary Fine	Remedy
Atlantic Cement			
1972	No specific information.	No record of fine	Requirement of stack testing (mentioned in DEC Internal Memorandum dated May 25, 1973).
Blue Circle Atlantic Cement			
1992	Failure to report opacity exceedances/malfunctioning of opacity monitors.	$6,000 fine	Provide written monthly reports of malfunctions and provide a Preventive Maintenance Plan for the Electrostatic Precipitators (ESP).
1997 (June)	Failure to submit compliance plan for control of nitrogen oxides from the kiln stack and to have that plan include demonstration of technically feasible Reasonably Available Control Technology.	$24,000 fine	Required submission of compliance plan to include: installation and reporting of results for NOx and Opacity Continuous Emissions Monitoring (CEM).
1997 (October)	Dust in the Town of Ravena was found to have originated from the Clinker Coolers.	$5,000 fine	Requirement of submission of baghouse maintenance plan.
1999	Amendment to June 1977 Consent Order.	No record of fine	Amendment related to data collection and reporting from the NOx CEM.
2001	Air contaminants falling off-site, dust reaching property line, Air and Non-air related failures in timely auditing and reporting requirements.	$276,000 fine	Schedule and conditions for completing required testing, reporting, maintenance, evaluations, audit reports, requirement of a study to determine conditions under which secondary plumes occur, and other remedies for the infractions noted in the Consent order.
Lafarge Building Materials			
2005	CKD noted outside landfill boundary.	$7500 fine	Clean up and Mitigation measures required.
2007	Missing visible emissions observations.	$3,500 fine	Compliance with permit observation requirements and additional reporting requirements.
2008 (June)	Omissions in labeling and storage of on-site hazardous waste, posting on-site and notification of hospitals of emergency information related to potential waste related injuries.	No record of fine	Corrected July 2008.
2010	Missing visible emissions observations.	$18,000	As in 2007.

References by Year:

NYS DOH Field memorandum June 14, 1973. Richard Sheremeta For the record. Department of Health Albany County. NYS DEC v. Blue Circle Cement Inc., Order on Consent 1992. File No. R4-1342-92-05., NYS DEC v. Blue Circle Cement Inc., Order on Consent 1997. File No. R4-1950-97-03, NYS DEC v. Blue Circle Cement Inc., Order on Consent 1997a. File No. R4-1998-97-09. NYS DEC v. Blue Circle Cement Inc., Order on Consent 1999. File No. R4-1950-97-03. NYS DEC v. Blue Circle Cement Inc., Order on Consent 2001. File No. R4-2000-1115-160. NYS DEC v. Lafarge North America, Order on Consent 2007 File No. R4-2006-1213-167. NYS DEC v. Lafarge North America, Order on Consent 2010 File No. R4-2010-0302-16.

APPENDIX B. RAVENA NY AREA WIND ROSES

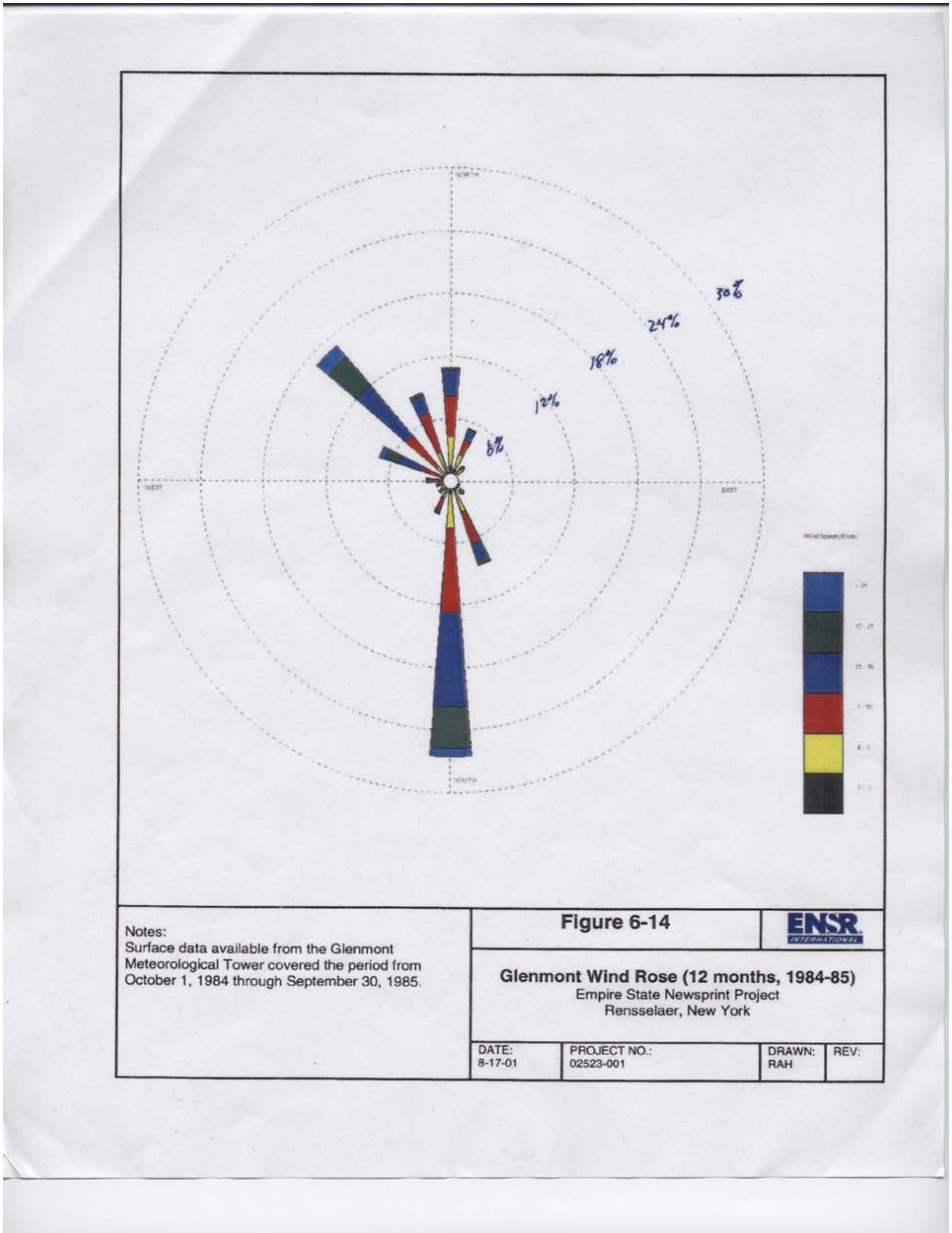
WIND ROSE

A wind rose is a diagram that shows the direction the wind blew from during a certain time period, typically for a year or longer, using spokes originating from a common center. Depending on the wind rose, the wind direction may be indicated by using compass points (e.g., north, south, north-northwest, etc), or can be indicated by degrees on a circle (where east is 90 degrees, south is180 degrees, west is 270 degrees and north is 0 or 360 degrees). The length of each spoke on a wind rose indicates how often the wind comes from that direction. A longer spoke means the winds come from that direction more frequently. A wind rose can also provide information about wind speed by using different markings or colors along each spoke to show the amount of time winds of different speeds are observed from that direction.

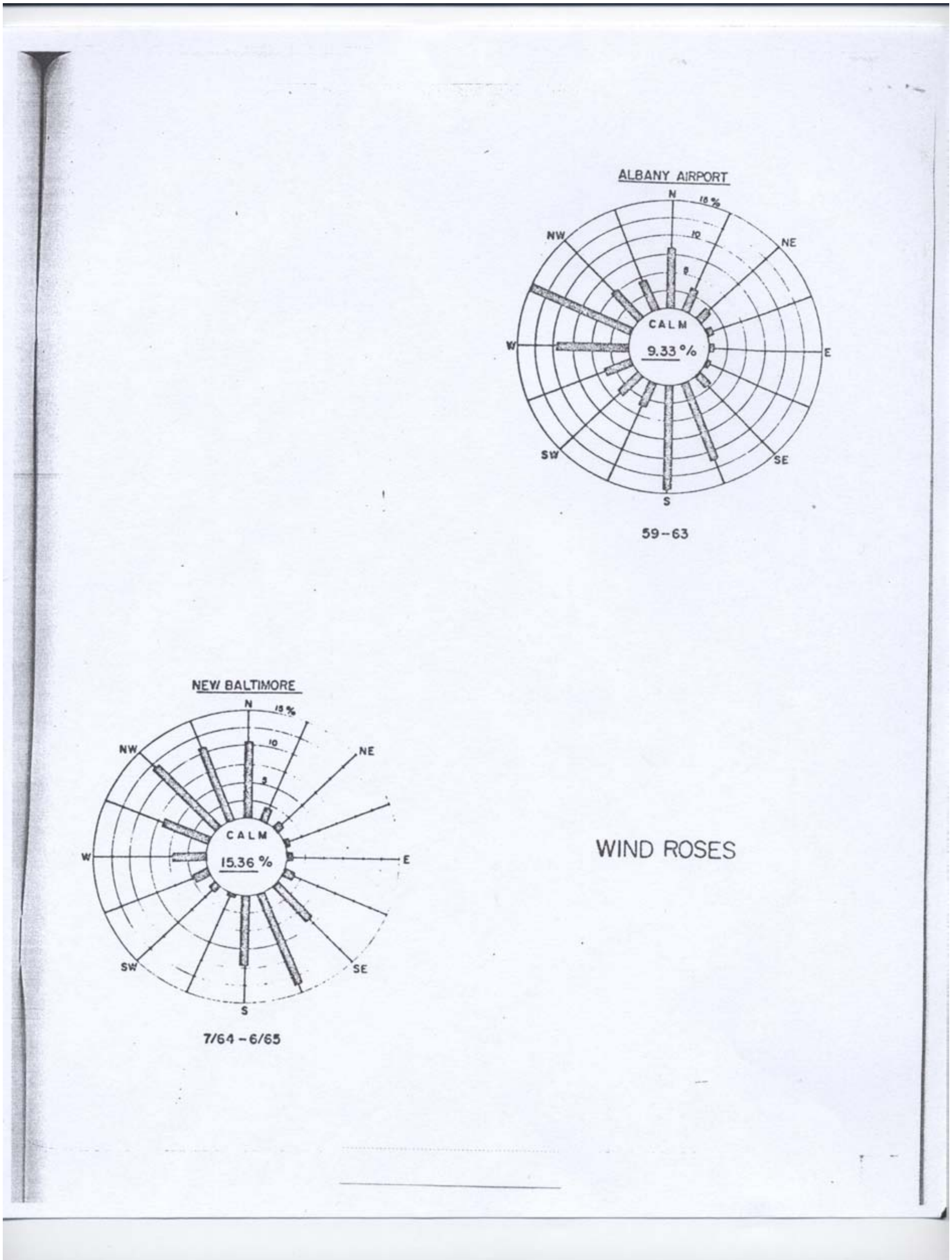
Meteorological (Met) data (i.e., wind data) is available from the Albany International Airport Met station that has operated throughout the years. There are also wind data illustrated with wind roses from two different Hudson Valley locations within several miles of the Ravena cement plant. A full year of wind data (October 1994-September 1995) is available from a Met station that was temporarily located at the Niagara Mohawk (now Bethlehem Energy) facility in Glenmont, which lies north of the Ravena cement plant (Figure B-1. Empire State Newsprint Project). Wind rose data for July 1964 through June 1965 are available for a New Baltimore Met station, south of the facility (Figure B-2. NYS DOH, 1969). Additionally, wind roses showing corresponding five-year average data (1990–1994, 1959–1963) for the continuous Met station located at the Albany International Airport are available (Figures B-3, B-2). The wind roses from New Baltimore and Glenmont show good concordance. Given their locations in the Hudson River valley north and south of the Ravena Cement plant, they can be considered a good estimate of the winds at the plant.

These wind roses are also generally consistent with the five-year wind rose for the Albany International Airport (Figures B-2, B-3). There are slight differences between the airport data and the Hudson River valley locations, but the differences are not very great, with winds at both locations predominately coming from the south and the northwest. However, the river sites do show an apparent shift to a more northwest-north component in comparison to the Albany International Airport, which shows a more west-northwest component. Additionally, research performed in 2003 by David Fitzjarrald, of the Atmospheric Sciences Research Center University at Albany, SUNY, using Met stations in locations further south in the Hudson Valley (Ulster and Dutchess Counties) also reported winds "channeling up (south to north) the valley" (Fitzjarrald, 2006). Given these data, and in the absence of more locally collected data, wind data from the Albany International Airport can be considered a reasonable approximation of the wind conditions for Ravena, NY.

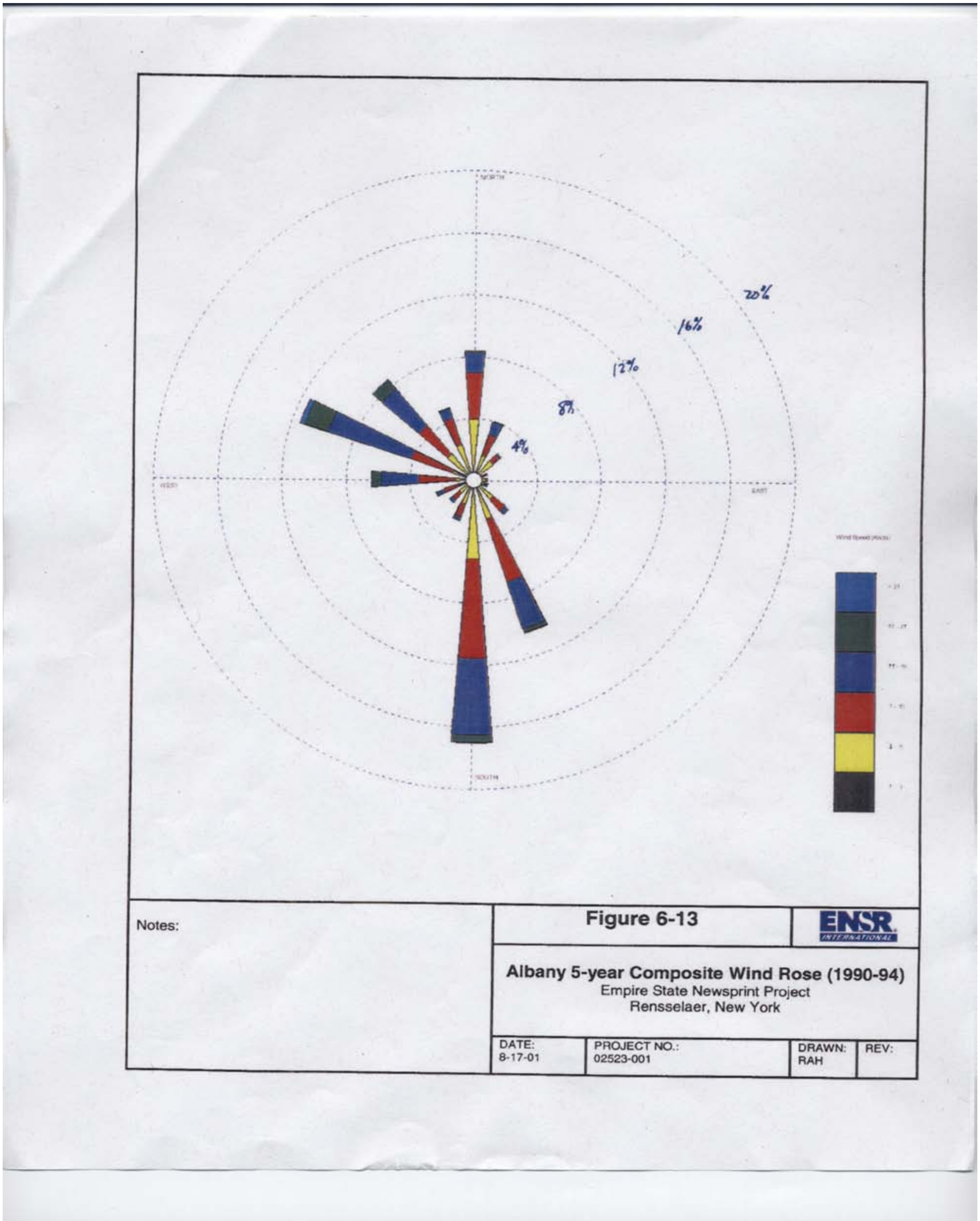
Appendix B, Figure 1. Glenmont, NY Wind Rose.



Appendix B, Figure 2. Albany and New Baltimore Wind Roses Circa 1960.



Appendix B, Figure 3. Albany International Airport Wind Rose 1990-1994.



APPENDIX C. NYS AAQS AND NAAQS PARTICULATES AND SULFUR DIOXIDE

AMBIENT AIR QUALITY STANDARDS FOR PARTICULATES AND SULFUR DIOXIDE

New York State's Air Pollution Control Program, initiated in 1957, has undergone multiple revisions preceding and following the passage of the Federal Clean Air Act in 1970. In general, existing federal and state regulations are identical, but in some cases (e.g., particulates) NYS has retained additional standards (e.g., 30-, 60- and 90-day standards for TSP and monthly standards for settleable dust). Table C-1 provides a chronological history of NYS Ambient Air Quality Standards for suspended and settleable particles. Chronological histories of the NAAQS for particulates and sulfur dioxide are shown in Tables C-2 and C-3, respectively.

Ambient air quality data for particulates, and in a limited fashion for sulfur dioxide, are available for some years during the plant's operation. Particulate samplers are designed to collect and measure particles in different size ranges. In the 1960s, 1970s and 1980s, NYS DOH and NYS DEC collected air samples for settleable particles (particles larger than 10 micrometers in diameter) and TSP (particles generally larger than 1 micrometer up to perhaps 100 micrometers in diameter) in locations adjacent to the facility and several locations across NYS, including locations in and around the Town of Coeymans, for which some data are available. Sulfur dioxide levels were measured in a few locations. We found no additional independent (i.e., collected by non-governmental groups, the cement plant or others) sources of ambient air sampling data or air quality reports for the facility or surrounding area.

Appendix C, Table 1. New York State Ambient Air Quality Standards for Suspended and Settleable Particulates.

Year	Indicator	Averaging Time	Locality [1]	Concentration (µg/m3)	Form
		24 hour	**Anywhere**	**260**	**Not to be exceeded more than once per year**
1971 [2]	Total Suspended Particles (TSP) [3]	Annual	Level I	45/70 [4]	During 12 consecutive months the 50th percentile and 84th percentile values of the 24 hour concentrations are not to be exceeded.
			Level II	55/85 [4]	
			Level III	65/100 [4]	
			Level IV	75/110 [4]	
1977	TSP	30 Day	Level I	80	During 30 consecutive days the arithmetic mean of every day 24 hour value at any location shall not be exceeded.
			Level II	100	
			Level III	115	
			Level IV	135	
		60 Day	Level I	70	During 60 consecutive days, the arithmetic mean of the every other day 24 hour value at any location shall not be exceeded.
			Level II	85	
			Level III	95	
			Level IV	115	
		90 Day	Level I	65	During 90 consecutive days, the arithmetic mean of the every other day 24 hour value at any location shall not be exceeded.
			Level II	80	
			Level III	90	
			Level IV	105	
		Annual	Level I	45	During 12 consecutive months, geometric mean of the every sixth day sample can not exceed value more than once per year.
			Level II	55	
			Level III	65	
			Level IV	75	
				mg/cm^2/month	
1971 [2]	Settleable Particulate (dustfall)	Annual	Level I	0.3	During 12 consecutive months, 50% of the 30-day average values shall not be exceeded.
			Level II	0.3	
			Level III	0.4	
			Level IV	0.6	
		Annual	Level I	0.45	During 12 consecutive months, 84% of the 30-day average values shall not be exceeded.
			Level II	0.45	
			Level III	0.6	
			Level IV	0.9	

[1] Level I predominantly used for timber, agricultural crops, dairy farming or recreation, habitation and industry sparse.
Level II predominantly single and two family residences, small farms and limited commercial services and industrial development.
Level III densely populated, primarily commercial office buildings,department stores and light industries in small and medium metropolitan complexes, or suburban areas of limited commercial and industrial development near large metropolitan complexes.
Level IV densely populated, primarily commercial office buildings,department stores and industries in large metropolitan complexes or areas of heavy industry.
[2] Prior to 1971, NYS AAQS for TSP an settleable particulates varied by region (described based on land use) and subregion (further defined by land use). A good reference describing the system can be found in a 1965 journal article by Alexander Rihm Jr. The complete citation appears in the reference list.
[3] TSP particles includes particles up to 25-45 and perhaps up to 100 micrometers in diameter.
[4] The 50th and 84th percentile values of the 24-hour concentrations are not to exceed the designated values.

Appendix C, Table 2. Timeline of National Ambient Air Quality Standards for Particles.

Year	Indicator	Averaging Time	Concentration (µg/m3)	Form
1971	Total Suspended Particles (TSP)[1]	24-Hour Annual	260 75	Not to be exceeded more than once per year geometric mean.
1987	PM_{10} [2]	24-Hour Annual	150 50	Not to be exceeded more than once per year on average over 3-years arithmetic mean, averaged over 3 years.
1997	$PM_{2.5}$ [3]	24-Hour Annual	65 15	98th percentile, averaged over 3 years arithmetic mean, averaged over 3 years.
	PM_{10}	24-Hour Annual	150 50	Not to be exceeded more than once per year on average over 3-years arithmetic mean, averaged over 3 years.
2006	$PM_{2.5}$	24-Hour Annual	35 15	98th percentile, averaged over 3 years arithmetic mean, averaged over 3 years.
	PM_{10}	24-Hour	150	Not to be exceeded more than once per year on average over 3 years.

[1] TSP particles includes particles up to 25-45 and perhaps up to 100 micrometers in diameter.
[2] PM_{10}, Particulate matter with an aerodynamic diameter less than or equal to 10 micrometers.
[3] $PM_{2.5}$, Particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers.

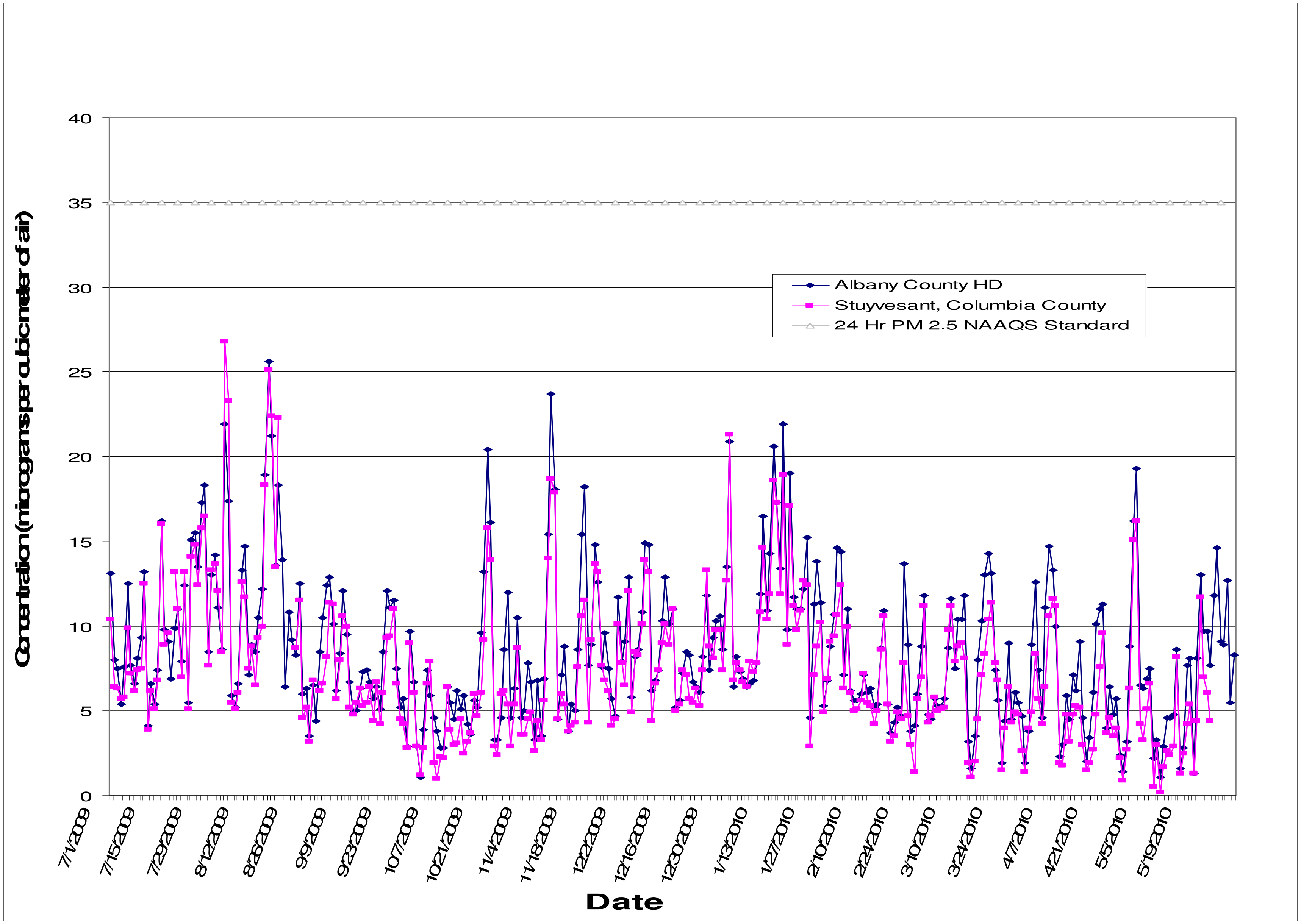
Appendix C, Table 3. Timeline of National Ambient Air Quality Standards for Sulfur Dioxide.

Year	Indicator	Averaging Time	Concentration (ppm) [1]	Form
1971–2010	SO2	24 hour	0.14	Not to be exceeded more than once per year.
		Annual	0.03	Arithmetic average
2010		24 hour	0.14	Not to be exceeded more than once per year.
		1 hour	0.075	3-year average of the 99th percentile of the daily maximum 1-hour average at each monitor must not exceed 0.075 ppm.

[1] ppm - parts per million

APPENDIX D. FINE PARTICULATE MONITORING

Appendix D, Figure 1. Daily $PM_{2.5}$ in Albany and Stuyvesant, NY (as measured by TEOM).



APPENDIX E. AIR MODELING

AIR MODELING

Available data indicate that various types of pollutants (particulates and chemicals) have been released to air from the Ravena cement plant. To estimate the potential geographic extent of any possible impact of air emissions to the surrounding community, contours, estimated using air dispersion modeling, were developed. Contour lines can illustrate where facility impacts are predicted to occur, where contaminant concentrations are expected to be at their highest level and characterize how concentrations change over geographic areas extending outward from the source(s). Contour lines indicate changes in pollutant concentrations across an area in the same way contour lines on a topographic map indicate changes in elevation. Contour lines can illustrate chemical-specific concentrations or concentration relative to some measure (e.g., relative to the concentration at the point of maximum impact as illustrated later). Using the relative impact approach, we can generalize the expected area of impact, regardless of the amount emitted.

Contours of $PM_{2.5}$ impacts from existing sources at the facility were created from results of a modeling analysis prepared by consultants to Lafarge as part of the DEIS, in conjunction with the Air Permit Application for Ravena Modernization Project. The consultants used US EPA's refined dispersion model, AERMOD, to evaluate the $PM_{2.5}$ impacts from the existing Kiln #1 and #2 Stack and from the two clinker coolers. The sources modeled represent the majority of the existing emissions at the facility and these are the only source impacts represented by the contours. Other sources of $PM_{2.5}$ exist at the facility, but were not included in this analysis (e.g., fugitive sources such as the conveyor belts, road dust, barge loading/unloading particulates from car and truck exhaust).

AERMOD is a "preferred" US EPA model in the *Guideline on Air Quality Models.* It is a steady-state plume model which incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts, including treatment of both surface and elevated sources, and both simple and complex terrain. Aside from the source stack information, meteorology, building locations and heights for downwash and terrain data are input into AERMOD to calculate impacts. The Lafarge analysis used standard regulatory default modeling options, as appropriate. The modeling analysis considered stack-tip downwash and rural dispersion coefficients. The modeling did not account for any degradation or deposition mechanisms.

Some emission rates and other stack parameters are listed in Table 3 of the "Air Permit Application for Ravena Modernization Project, Tab G." For the $PM_{2.5}$ plume modeling, emissions rates from clinker coolers 1 and 2 were also used. For the annual average impacts, an average hourly emission rate was entered into the model, and for the 24-hour impacts, maximum hourly emission rates were used. Results of the modeling analysis are conservative, since worst-case emissions (e.g., assumes operation is always at full capacity) were used rather than the actual emissions.

For this application, Met data from Albany International Airport for the years 2003–2007 was used. The Albany International Airport is located approximately 15 miles (24 km) north of the Ravena cement plant. The representativeness of the Albany International Airport data to the Ravena plant site is reasonable, considering the general similar valley orientations for the two areas and the same mesoscale Met conditions affecting each area, as well as earlier data (see Appendix B).

Because the stacks and building dimensions are such that building downwash of released effluent may cause the plumes to be influenced (which will tend to bring the plume closer to the ground), these effects were included in the analysis. Building locations and heights were input to Building Profile Input Program (BPIP) -Prime to develop direction-specific building dimensions to be input to AERMOD in order to calculate effects from downwash.

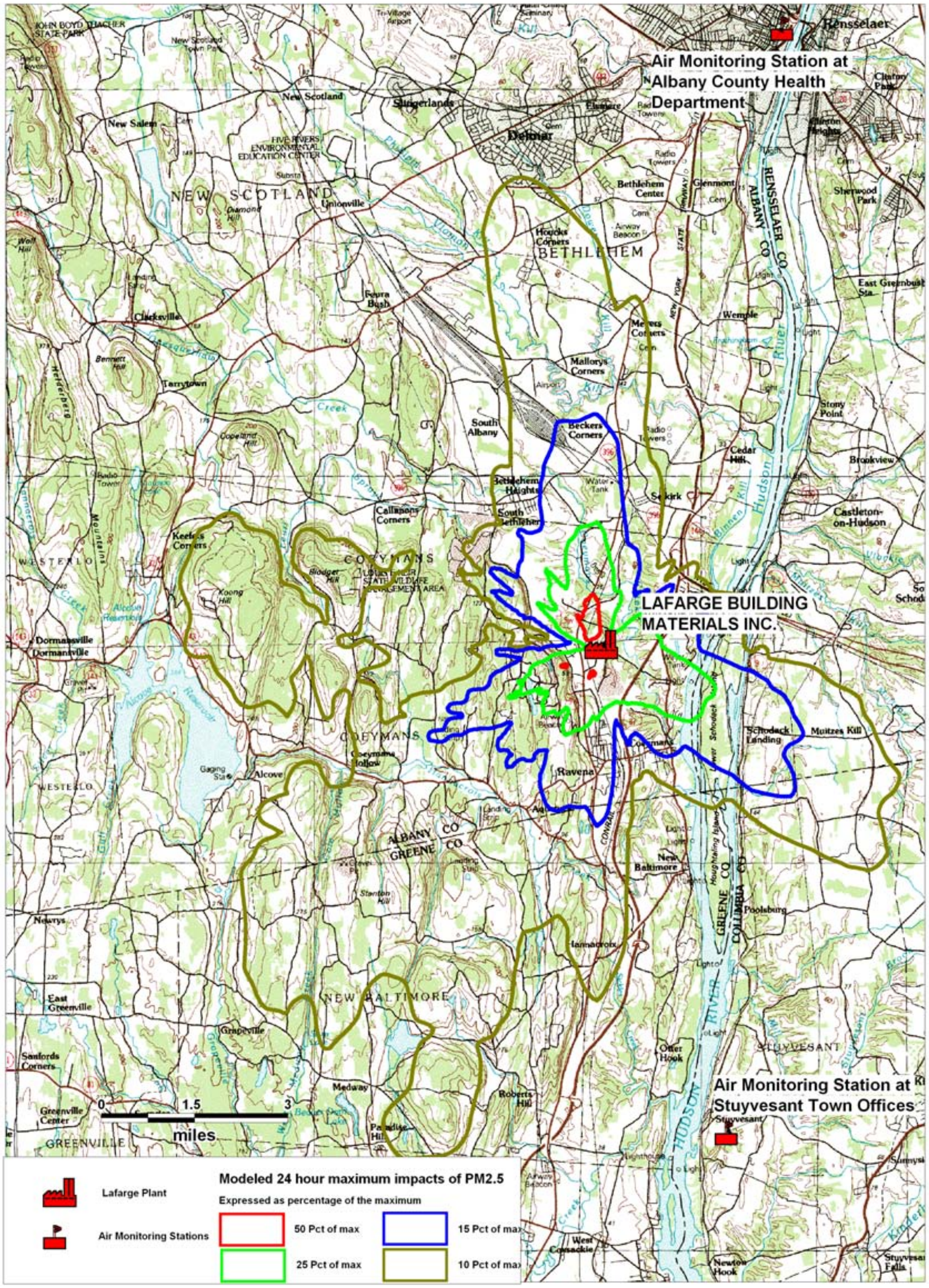
The receptors that were used for the analysis include a fence line (or property line) grid at approximately 50 meter intervals and multiple Cartesian grids from 100 meters near the fence line to 1000 meter intervals at the perimeter of the grid (approximately 15 km from the facility). Intermediate grid spacing of 250 and 500 meters was also utilized out to the limit of the modeling domain which was determined based on expected concentration impact levels. Grid resolutions of 100 meters were implemented in complex terrain settings and areas identified as "hot-spots." This Cartesian grid system is defined in Table 4 of the application and shown in Figures 4 and 5 of the application. The AERMAP program was run with local Digitized Elevation Model (DEM) data to determine the hill height scales and base elevation for each receptor, source and structure used in the analysis.

To identify appropriate ZIP codes on which to focus the health data summary, NYS DEC provided NYS DOH with modeled annual and 24-hour maximum impact contours for $PM_{2.5}$ from major $PM_{2.5}$ sources on-site at the Ravena cement plant, as described above. Only emissions from the kiln and clinker cooler stacks were used in the development of the modeled impacts, although it is recognized that other minor $PM_{2.5}$ sources exist on-site. While $PM_{2.5}$ is not the only pollutant emitted from the stacks, these contours, produced using worst-case modeling conditions for $PM_{2.5,}$ are also useful for characterizing areas that would similarly be impacted by many gaseous pollutants released from the Ravena cement plant stacks.

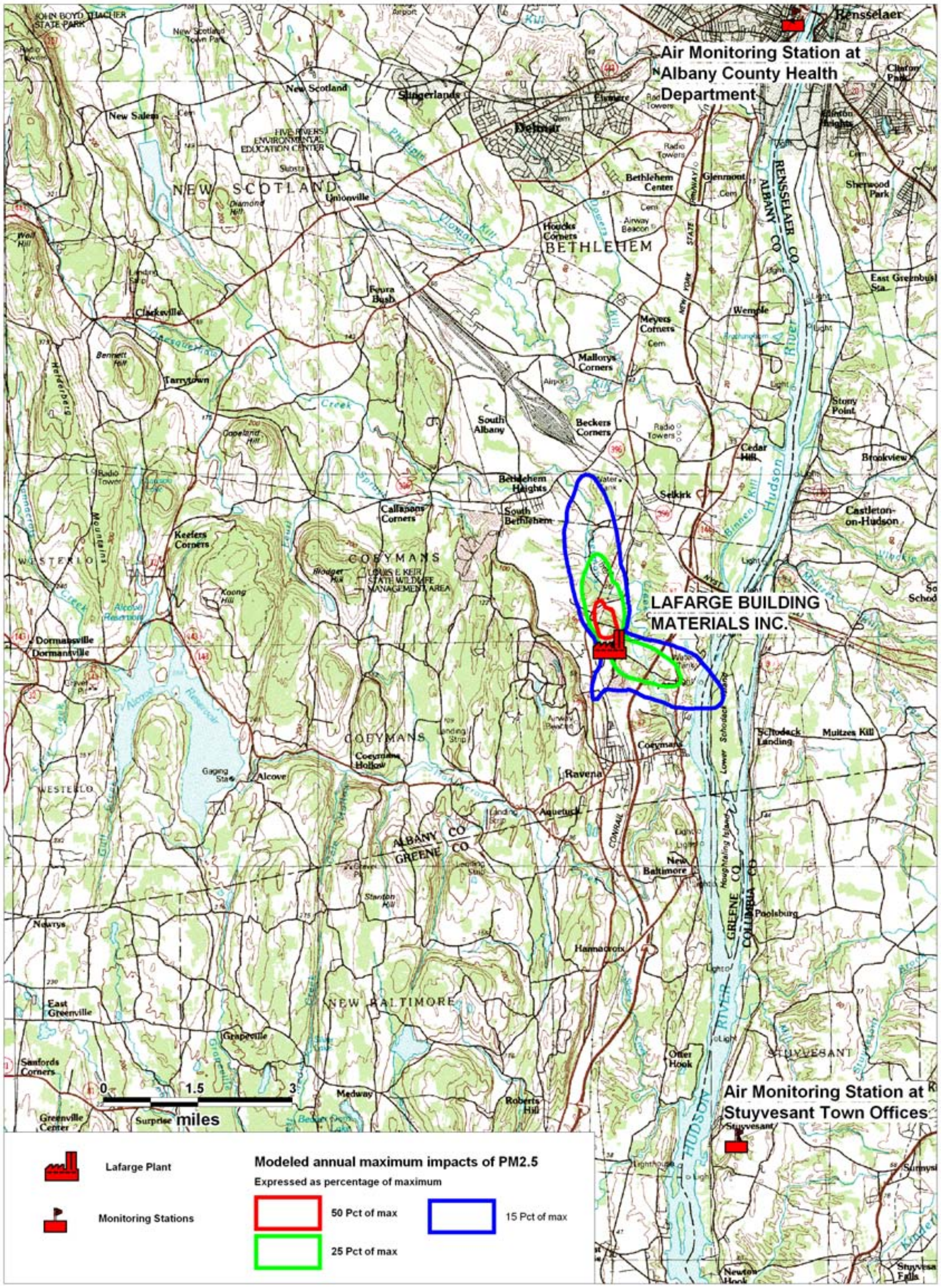
Figures E-1 and E-2 illustrate the results from modeled maximum 24-hour and average annual $PM_{2.5}$ emissions. Although both the annual and 24-hour contours extend to areas of interest in the surrounding community, the 24-hour impact contours cover a relatively larger geographic area than the annual impacts. Thus the 24-hour model results were used to include as many ZIP codes in the health data summary as possible. Areas that were modeled as potentially experiencing at least 10 percent of the modeled 24-hour maximum impact were used to select ZIP codes to include in the health data summary.

Since most health data are available at the ZIP code level, we identified ZIP codes that overlapped those 24-hour modeled impact contours. Finally, we limited the selection of ZIP codes to those five in which at least 40 percent of the population resided within the 10 percent contour of the modeled 24-hour maximum impact (see Figure 5.)

Appendix E, Figure 1. 24-Hour Modeled Impact Contours for $PM_{2.5}$ from Major $PM_{2.5}$ Sources at the Lafarge Cement Plant, Ravena, NY.



Appendix E, Figure 2. Annual Modeled Impact Contours for $PM_{2.5}$ from Major $PM_{2.5}$ Sources at the Lafarge Cement Plant, Ravena, NY.



APPENDIX F. WARD STONE ENVIRONMENTAL SAMPLES

New York State Department of Environmental Conservation
Division of Air Resources
Bureau of Air Quality Analysis and Research, 2nd Floor
625 Broadway, Albany, New York 12233-3259
Phone: (518) 402-8402 • **Fax:** (518) 402-9035
Website: www.dec.ny.gov

Alexander B. Grannis
Commissioner

June 21, 2010

Jan E. Storm, Ph.D.
Bureau of Toxic Substance Assessment
Center for Environmental Health
NYS Department of Health
547 River St.
Troy NY 12180

Dear Dr. Storm,

Per your recent request about the availability of Ward Stone's data, I am enclosing copies of the Freedom of Information Law (FOIL) responses that were recently sent to the Mayor of the Village of Ravena, Honorable John Bruno. The first letter indicated the DEC did not have any information that could be provided to Mayor Bruno. The second letter indicated the DEC discovered records that were responsive to the FOIL request and these records were sent to Mayor Bruno on May 26, 2010. This information request contains laboratory reports from the Utah Veterinary Diagnostic Lab that provided trace metals analyses in biological samples and water, soil and sediment samples that were taken from Mr. Stone's State owned computer. It is assumed that the information contained in these reports reflect the sampling that Mr. Stone undertook in vicinity of the Lafarge Cement Plant in Ravena. It is not known if this is a complete record of Mr. Stone's work in this area. In addition, DEC does not have information on the sampling protocols, sample locations, sample controls and required laboratory certifications for conducting these analyses. In summary, the DEC will not attempt to interpret this data based on the lack of information as briefly described above.

Sincerely,
Thomas Gentile
Thomas Gentile
Chief, Air Toxics Section

40 years of stewardship 1970-2010

Appendix F, Table 1. Environmental and Biota Samples Collected in Ravena, New York (January–March, 2010).

	Environmental Samples					
	Samples Taken from Ravena (ppm)					Sample Taken from Five Rivers, Delmar (ppm)
Analytes	**Sediment n = 2**	**Mineral Material n = 1**	**Water n = 6**	**Conveyor Fallout n = 1**	**Soil n = 6**	**Soil n = 1**
Silver	0.03, 0.05	0.05	<0.001	<0.001	0.02 – 0.10	0.03
Aluminum	6536.85, 7217.63	6368.42	0.009 – 0.772	2434.52	7034.12 – 17480.14	9548.67
Arsenic	5.55, 6.71	4.59	<0.001 – 0.001	3.59	4.14 – 6.37	4.97
Boron	1.22, 2.90	2.77	0.013 – 0.065	2.97	0.36 – 2.51	0.92
Barium	50.90, 53.11	31.05	0.018 – 0.046	91.47	26.79 – 129.24	58.86
Beryllium	0.37, 0.46	0.26	<0.001	0.16	0.43 – 1.07	0.63
Calcium	131501.3, 141227.0	173582.2	25.746 – 204.890	265820.8	5877.03 – 50347.72	12249.94
Cadmium	0.20, 0.25	0.09	<0.001	0.05	0.05 – 0.27	0.10
Cobalt	6.92, 19.64	4.35	<0.001 – 0.002	2.85	5.33 – 12.34	7.55
Chromium	10.32, 10.77	9.20	<0.001 – 0.002	4.08	9.73 – 19.14	11.82
Copper	11.50, 18.78	20.42	<0.001 – 0.006	4.02	9.12 – 24.71	14.11
Iron	21451.26, 22442.44	14233.62	1.235 – 2.920	11305.05	13695.42 – 32380.85	23070.30
Mercury	0.04, 0.08	<0.01	<0.001	0.01	0.03 – 0.13	0.04
Potassium	534.19, 840.23	587.06	2.469 – 4.086	722.29	581.23 – 2320.00	872.37
Lithium	13.27, 14.26	9.96	0.001 – 0.047	5.51	14.24 – 26.68	15.74
Magnesium	7629.79, 11164.97	10518.58	2.844 – 58.983	15744.19	3173.72 – 6975.74	5210.87
Manganese	335.54, 608.49	178.86	0.007 – 0.372	120.75	304.74 – 1098.60	472.91
Molybdenum	0.31, 0.82	0.27	<0.001 – 0.003	0.72	0.22 – 0.46	0.30
Sodium	160.42, 304.424	4624.15	20.212 – 52.429	296.04	40.04 – 817.34	46.97
Nickel	15.86, 52.67	13.01	0.003 – 0.011	7.22	12.43 – 24.65	15.73
Phosphorous	369.64, 523.52	268.29	<0.001 – 0.122	106.13	374.89 – 859.37	516.49
Lead	27.62, 28.49	7.06	<0.001 – 0.009	3.73	9.30 – 181.58	9.60
Antimony	<0.01, 0.04	<0.01	<0.001	0.01	0.01 – 0.09	0.02
Selenium	0.17, 1.28	0.07	<0.001 – 0.004	0.18	0.23 – 0.65	0.32
Silicon	339.56, 401.01	151.38	1.460 – 2.044	1285.26	202.04 – 730.85	389.89
Tin	0.10, 0.11	0.70	<0.001 – 0.007	0.07	0.04 – 0.31	0.07
Strontium	222.80, 277.92	322.74	0.068 – 2.286	482.63	17.11 – 83.80	25.28
Thallium	0.06, 0.14	0.04	<0.001	0.06	0.03 – 0.16	0.07
Vanadium	11.78, 13.08	16.40	<0.001 – 0.002	3.04	11.71 – 24.08	17.06
Zinc	57.83, 101.57	31.54	0.003 – 0.063	20.33	40.83 – 110.94	45.20

Appendix F, Table 1 (Continued).

	Biota (Plant Tissue) Samples			
	Samples Taken from Ravena (ppm)			Sample Taken from Five Rivers, Delmar (ppm)
Analytes	**Bark n = 1**	**Cattail n = 1**	**Pine Cone n = 1**	**Cattail n = 1**
Silver	<0.01	<0.01	<0.01	<0.01
Aluminum	155.88	13.05	7.97	4.36
Arsenic	0.23	0.03	0.12	0.10
Boron	4.20	15.41	7.63	28.04
Barium	8.27	3.89	0.48	3.53
Beryllium	<0.01	<0.01	<0.01	<0.01
Calcium	4839.87	6401.42	421.21	9573.11
Cadmium	0.09	0.06	0.01	0.02
Cobalt	0.19	0.05	0.03	0.06
Chromium	2.56	1.66	2.06	1.63
Copper	3.92	5.00	2.98	4.25
Iron	428.31	106.18	31.01	148.92
Mercury	0.07	0.03	0.09	0.03
Potassium	169.78	13048.75	4333.89	6717.22
Lithium	0.21	0.11	0.03	0.09
Magnesium	193.65	1457.23	405.16	2536.95
Manganese	7.99	73.56	4.59	540.33
Molybdenum	0.13	1.83	0.48	3.99
Sodium	1026.31	1901.25	60.79	139.65
Nickel	0.89	0.32	0.22	0.27
Phosphorous	129.07	2712.64	677.20	1767.25
Lead	2.75	0.10	0.05	0.05
Antimony	0.11	0.02	<0.01	<0.01
Selenium	0.17	0.07	<0.01	0.36
Silicon	163.55	122.41	147.33	115.33
Tin	0.08	0.02	<0.01	<0.01
Strontium	14.09	20.77	1.25	20.80
Thallium	0.03	<0.01	<0.01	<0.01
Vanadium	0.82	0.07	0.03	0.02
Zinc	25.33	19.19	12.74	17.60

Appendix F, Table 1 (Continued).

	Biota (Animal Tissue) Samples							
	Samples Taken from Ravena (ppm)							
Analytes	**Rabbit Liver n = 2**	**Rabbit Kidney n = 2**	**Opossum Liver n = 2**	**Opossum Kidney n = 2**	**Squirrel Brain n = 1**	**Coyote Kidney n = 2**	**Coyote Liver n = 2**	**Raccoon Kidney n = 1**
Silver	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Aluminum	0.989, 175.102	0.483, 1.559	0.684, 0.815	0.344, 0.512	0.334	0.065, 0.094	0.154, 0.180	0.540
Arsenic	<0.001, 0.265	0.018, 0.036	0.120, 0.238	0.085, 0.175	0.008	<0.001, 0.006	0.003, 0.008	0.068
Boron	0.218, 0.547	0.200, 0.471	0.092, 0.174	0.146, 0.261	0.113	0.018, 0.062	0.035, 0.101	0.338
Barium	0.064, 0.947	0.078, 0.094	0.021, 0.035	0.024, 0.038	0.029	0.013, 0.014	0.012, 0.015	0.031
Beryllium	<0.001, 0.010	<0.001	<0.001, 0.002	<0.001	<0.001	<0.001	<0.001, 0.014	<0.001
Calcium	95.370, 1038.680	124.471, 171.624	87.378, 157.196	101.142, 155.814	96.270	55.892, 62.315	36.222, 43.465	71.941
Cadmium	0.151, 0.159	1.341, 1.415	0.128, 0.177	0.522, 0.906	0.001	0.051, 0.066	0.022, 0.041	3.666
Cobalt	0.102, 0.209	0.063, 0.083	0.031, 0.047	0.039, 0.046	0.002	0.012, 0.017	0.014, 0.016	0.060
Chromium	0.430, 1.130	0.355, 0.624	0.498, 0.738	0.360, 0.510	0.264	0.397, 0.454	0.552, 0.662	0.446
Copper	2.706, 3.610	3.057, 3.886	2.843, 11.471	3.541, 5.715	2.252	3.276, 4.378	2.763, 3.410	5.611
Iron	568.619, 675.950	61.052, 69.184	180.039, 201.265	70.201, 79.091	30.038	46.918, 75.556	232.794, 244.138	94.877
Mercury	0.002, 0.018	0.009, 0.021	0.082, 0.088	0.108, 0.128	0.003	0.02	0.008	0.246
Potassium	1961.438, 3299.396	2686.516, 2871.054	2211.907, 2425.756	2052.225, 2197.530	2651.562	2131.292, 2195.876	2247.795, 2376.665	2548.815
Lithium	0.007, 0.263	0.005, 0.022	0.012, 0.025	0.009, 0.073	0.005	0.007, 0.017	0.004, 0.008	0.004
Magnesium	177.838, 310.194	164.750, 201.827	154.212, 188.781	132.828, 145.131	118.239	120.757, 140.585	168.131, 172.027	147.515
Manganese	2.823, 10.407	2.196, 2.422	3.133, 4.023	0.717, 0.889	0.253	0.774, 1.269	3.416, 3.503	1.302
Molybdenum	0.831, 0.882	0.492, 0.990	0.287, 0.319	0.233, 0.249	0.030	0.100, 0.147	0.271, 0.320	0.649
Sodium	1167.089, 1316.409	1464.291, 1523.384	909.605, 1276.672	1894.336, 1281.658	1228.401	1660.440, 1110.421	1003.979, 1110.421	1521.779
Nickel	0.011, 0.327	0.037, 0.040	0.008, 0.013	0.024, 0.029	0.012	0.010, 0.015	0.003, 0.005	0.016
Phosphorous	2948.662, 3327.238	2461.951, 2700.165	2397.716, 3151.324	1878.642, 2460.804	2889.779	2368.697, 2805.161	3295.409, 3360.029	2666.251
Lead	0.085, 0.513	0.017, 0.031	0.073, 0.152	0.042, 0.108	0.008	0.025, 0.030	0.042, 0.063	0.173
Antimony	0.003, 0.008	0.002	0.003, 0.004	0.001, 0.002	<0.001	<0.001	<0.001	0.002
Selenium	0.155, 0.442	0.766, 1.146	0.878, 0.937	1.191, 1.349	0.426	0.383, 0.844	0.295, 0.447	2.302
Silicon	41.045, 61.109	22.935, 32.687	25.427, 37.512	15.469, 21.894	10.439	12.384, 14.950	26.448, 30.468	31.298
Tin	0.004, 0.007	0.002, 0.004	0.006, 0.010	0.001, 0.004	<0.001	<0.001	<0.001	<0.001
Strontium	0.093, 1.721	0.137, 0.174	0.058, 0.154	0.079, 0.144	0.043	0.037, 0.039	0.026, 0.027	0.082
Thallium	0.001, 0.003	0.013, 0.024	0.001, 0.002	0.002, 0.006	<0.001	0.001, 0.002	<0.001	0.003
Vanadium	0.021, 0.323	0.016, 0.021	0.025, 0.028	0.050, 0.061	0.012	0.024	0.018, 0.021	0.066
Zinc	30.253, 34.432	23.882, 33.504	22.843, 35.931	20.694, 35.093	95.66	14.101, 16.441	29.688, 32.389	28.352