

**A. INTRODUCTION**

This chapter examines the potential for air quality impacts from the proposed project. Air quality impacts can be either direct or indirect. Direct impacts could stem from emissions generated by stationary sources at a project site, such as emissions from fuel burned on site for heating, ventilation, and air conditioning (HVAC) systems. Indirect impacts could be caused by emissions from nearby existing stationary sources (impacts on the proposed project) and the emissions due to mobile vehicle trips generated by the proposed project or other changes to future traffic conditions due to the proposed project.

This section also describes the expected use of potentially hazardous materials and the procedures and systems that would be employed in the proposed school facility to ensure the safety of staff, students and the surrounding community in the event of a chemical spill in one of the proposed laboratories.

**B. POLLUTANTS FOR ANALYSIS**

Ambient air quality is affected by air pollutants produced by both motor vehicles and stationary sources. Emissions from motor vehicles are referred to as mobile source emissions, while emissions from fixed facilities are referred to as stationary source emissions. Typically, ambient concentrations of carbon monoxide (CO) are predominantly influenced by mobile source emissions. Volatile organic compounds (VOCs) and nitrogen oxides (NO and NO<sub>2</sub>, collectively referred to as NO<sub>x</sub>) are emitted from both mobile and stationary sources. Emissions of sulfur dioxide (SO<sub>2</sub>) are associated mainly with stationary sources, and sources utilizing non-road diesel such as diesel trains, marine engines and non-road vehicles such as construction engines, but diesel-powered vehicles, primarily heavy duty trucks and buses, also currently contribute somewhat to these emissions; diesel fuel regulations which will begin to take effect in 2006 will reduce SO<sub>2</sub> emissions from mobile sources to extremely low levels. Particulate matter (PM) is emitted from both stationary and mobile sources. Fine particulate matter is also formed when emissions of NO<sub>x</sub>, sulfur oxides (SO<sub>x</sub>), ammonia, organic compounds, and other gases react or condense in the atmosphere. Ozone is formed in the atmosphere by complex photochemical processes that include NO<sub>x</sub> and VOCs, emitted mainly from industrial processes and mobile sources.

**CARBON MONOXIDE**

CO, a colorless and odorless gas, is produced in the urban environment primarily by the incomplete combustion of gasoline and other fossil fuels. In urban areas, approximately 80 to 90 percent of CO emissions are from motor vehicles. Since CO is a reactive gas which does not persist in the atmosphere, CO concentrations can vary greatly over relatively short distances; elevated concentrations are usually limited to locations near crowded intersections, heavily

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traveled and congested roadways, parking lots, and garages. Consequently, CO concentrations must be predicted on a local, or microscale, basis.

The proposed project would result in changes in traffic patterns and an increase in traffic volume in the study area and could potentially result in local increases in CO concentrations. Therefore, a mobile source analysis was conducted at critical intersections in the study area to evaluate future CO concentrations with and without the proposed project.

### **NITROGEN OXIDES, VOCs, AND OZONE**

NO<sub>x</sub> are of principal concern because of their role, together with VOCs, as precursors in the formation of ozone. Ozone is formed through a series of reactions that take place in the atmosphere in the presence of sunlight. Because the reactions are slow, and occur as the pollutants are advected downwind, elevated ozone levels are often found many miles from sources of the precursor pollutants. The effects of NO<sub>x</sub> and VOC emissions from all sources are therefore generally examined on a regional basis. The contribution of any action or project to regional emissions of these pollutants would include any added stationary or mobile source emissions; the change in regional mobile source emissions of these pollutants would be related to the total vehicle miles traveled added or subtracted on various roadway types throughout the New York metropolitan area, which is designated as a moderate non-attainment area for ozone by the U.S. Environmental Protection Agency (EPA).

The proposed project would not have a significant effect on the overall volume of vehicular travel in the metropolitan area; therefore, no measurable impact on regional NO<sub>x</sub> emissions or on ozone levels is predicted. An analysis of project related emissions of these pollutants from mobile sources was therefore not warranted.

In addition, there is a standard for average annual NO<sub>2</sub> concentrations, which is normally examined only for fossil fuel energy sources. Potential impacts from the fuel to be burned for the proposed project's HVAC systems were evaluated.

### **LEAD**

Lead emissions in air are principally associated with industrial sources and motor vehicles that use gasoline containing lead additives. Most U.S. vehicles produced since 1975, and all produced after 1980, are designed to use unleaded fuel. As these newer vehicles have replaced the older ones, motor vehicle related lead emissions have decreased. As a result, ambient concentrations of lead have declined significantly. Nationally, the average measured atmospheric lead level in 1985 was only about one-quarter the level in 1975.

In 1985, EPA announced new rules drastically reducing the amount of lead permitted in leaded gasoline. The maximum allowable lead level in leaded gasoline was reduced from the previous limit of 1.1 to 0.5 grams per gallon effective July 1, 1985, and to 0.1 grams per gallon effective January 1, 1986. Monitoring results indicate that this action has been effective in significantly reducing atmospheric lead concentrations. Effective January 1, 1996, the Clean Air Act banned the sale of the small amount of leaded fuel that was still available in some parts of the country for use in on-road vehicles, concluding the 25-year effort to phase out lead in gasoline. Even at locations in the New York City area where traffic volumes are very high, atmospheric lead concentrations are far below the national standard of 1.5 micrograms per cubic meter (3-month average).

No significant sources of lead are associated with the proposed project, and, therefore, analysis was not warranted.

### **RESPIRABLE PARTICULATE MATTER—PM<sub>10</sub> AND PM<sub>2.5</sub>**

PM is a broad class of air pollutants that includes discrete particles of a wide range of sizes and chemical compositions, as either liquid droplets (aerosols) or solids suspended in the atmosphere. The constituents of PM are both numerous and varied, and they are emitted from a wide variety of sources (both natural and anthropogenic). Natural sources include the condensed and reacted forms of naturally occurring volatile organic compounds, salt particles resulting from the evaporation of sea spray; wind-borne pollen, fungi, molds, algae, yeasts, rusts, bacteria, and material from live and decaying plant and animal life; particles eroded from beaches, soil, and rock; and particles emitted from volcanic and geothermal eruptions and from forest fires; naturally occurring PM is generally greater than 2.5 micrometers in diameter. Major anthropogenic sources include the combustion of fossil fuels (e.g., vehicular exhaust, power generation, boilers, engines and home heating), chemical and manufacturing processes, all types of construction, agricultural activities, as well as wood-burning stoves and fireplaces. Particulate matter also acts as a substrate for the adsorption of other pollutants, often toxic and some likely carcinogenic compounds.

As described below, PM is regulated in two size categories: particles with an aerodynamic diameter of less than or equal to 2.5 micrometers, or PM<sub>2.5</sub>, and particles with an aerodynamic diameter of less than or equal to 10 micrometers, or PM<sub>10</sub>, which includes PM<sub>2.5</sub>. PM<sub>2.5</sub> has the ability to reach the lower regions of the respiratory tract, delivering with it other compounds that adsorbed to the surfaces of the particles, and is also extremely persistent in the atmosphere. PM<sub>2.5</sub> is mainly derived from combustion material that has volatilized and then condensed to form primary particulate matter (often soon after the release from an exhaust pipe or stack) or from precursor gases reacting in the atmosphere to form secondary PM.

Diesel-powered vehicles, especially heavy duty trucks and buses, are a significant source of respirable PM, most of which is PM<sub>2.5</sub>; PM concentrations may, consequently, be locally elevated near roadways with high volumes of heavy diesel-powered vehicles. The proposed project would not result in any significant increases in truck traffic near the project site or in the region, and therefore, an analysis of potential impacts from respirable particulate matter is not warranted.

The proposed project would utilize natural gas in the HVAC systems. Therefore, emissions of PM are considered to be insignificant.

### **SULFUR DIOXIDE**

SO<sub>2</sub> emissions are primarily associated with the combustion of sulfur-containing fuels: oil and coal.

Due to the federal restrictions on the sulfur content in diesel fuel for on-road vehicles, no significant quantities are emitted from vehicular sources. Monitored SO<sub>2</sub> concentrations in New York City are below the national standards. Vehicular sources of SO<sub>2</sub> are not significant and therefore, an analysis of this pollutant from mobile sources was not warranted.

The proposed project would utilize natural gas in the HVAC systems. Therefore, emissions of SO<sub>2</sub> are considered to be insignificant.

## C. AIR QUALITY REGULATIONS, STANDARDS, AND BENCHMARKS

### NATIONAL AND STATE AIR QUALITY STANDARDS

As required by the Clean Air Act, primary and secondary NAAQS have been established for six major air pollutants: CO, NO<sub>2</sub>, ozone, respirable PM (both PM<sub>2.5</sub> and PM<sub>10</sub>), SO<sub>2</sub>, and lead. The primary standards protect public health and represent levels at which there are no known significant effects on human health. The secondary standards are intended to protect the nation's welfare, and account for air pollutant effects on soil, water, visibility, materials, vegetation, and other aspects of the environment. For NO<sub>2</sub>, ozone, lead and PM, the primary and secondary standards are the same; there is no secondary standard for CO. EPA promulgated additional NAAQS which became effective September 16, 1997: a new 8-hour standard for ozone, which replaced the previous 1-hour standard, and in addition to retaining the PM<sub>10</sub> standards, EPA adopted 24-hour and annual standards for PM<sub>2.5</sub>. The standards for these pollutants are presented in Table 8-1. These standards have also been adopted as the ambient air quality standards for New York State and New Jersey.

**Table 8-1  
Ambient Air Quality Standards**

Pollutant	Primary		Secondary	
	ppm	µg/m <sup>3</sup>	ppm	µg/m <sup>3</sup>
<b>Carbon Monoxide (CO)</b>				
Maximum 8-Hour Concentration <sup>(1)</sup>	9	10,000	None	
Maximum 1-Hour Concentration <sup>(1)</sup>	35	40,000		
<b>Lead</b>				
Maximum Arithmetic Mean Averaged Over 3 Consecutive Months	NA	1.5	NA	1.5
<b>Nitrogen Dioxide (NO<sub>2</sub>)</b>				
Annual Arithmetic Average	0.053	100	0.053	100
<b>Ozone (O<sub>3</sub>)</b>				
8-Hour Average <sup>(2)</sup>	0.08	157	0.08	157
<b>Total Suspended Particles (TSP)</b>				
Annual Mean	NA	45	None	
Rural Open Space		55		
Rural Residential		65		
Urban Residential		75		
Maximum 24-Hour Concentration	NA	250		
<b>Respirable Particulate Matter (PM<sub>10</sub>)</b>				
Average of 3 Annual Arithmetic Means	NA	50	NA	50
24-Hour Concentration <sup>(1)</sup>	NA	150	NA	150
<b>Fine Respirable Particulate Matter (PM<sub>2.5</sub>)</b>				
Average of 3 Annual Arithmetic Means	NA	15	NA	15
24-Hour Concentration <sup>(3)</sup>	NA	65	NA	65

**Table 8–1 (cont'd)**  
**Ambient Air Quality Standards**

Pollutant	Primary		Secondary	
	ppm	µg/m <sup>3</sup>	ppm	µg/m <sup>3</sup>
<b>Sulfur Dioxide (SO<sub>2</sub>)</b>				
Annual Arithmetic Mean	0.03	80	NA	NA
Maximum 24–Hour Concentration <sup>(1)</sup>	0.14	365	NA	NA
Maximum 3–Hour Concentration <sup>(1)</sup>	NA	NA	0.50	1,300
<p><b>Notes:</b> ppm – parts per million  µg/m<sup>3</sup> – micrograms per cubic meter  NA – not applicable</p> <p>Particulate matter concentrations are in µg/m<sup>3</sup>. Concentrations of all gaseous pollutants are defined in ppm — approximately equivalent concentrations in µg/m<sup>3</sup> are presented.</p> <p>TSP levels are regulated by a New York State Standard only. All other standards are National Ambient Air Quality Standards (NAAQS).</p> <p><sup>(1)</sup> Not to be exceeded more than once a year.  <sup>(2)</sup> Three–year average of the annual fourth highest daily maximum 8–hr average concentration.  <sup>(3)</sup> Not to be exceeded by the 98th percentile averaged over 3 years.</p> <p><b>Sources:</b> 40 CFR Part 50: National Primary and Secondary Ambient Air Quality Standards;  6 NYCRR Part 257: Air Quality Standards.</p>				

### NAAQS ATTAINMENT STATUS AND STATE IMPLEMENTATION PLANS (SIP)

The Clean Air Act, as amended in 1990 (CAA) defines non–attainment areas (NAA) as geographic regions that have been designated as not meeting one or more of the NAAQS. When an area is designated as non–attainment by EPA, the state is required to develop and implement a State Implementation Plan (SIP), which is a state’s plan on how it will meet the NAAQS under the deadlines established by the CAA.

EPA has re–designated New York City as in attainment for CO. The CAA requires that a maintenance plan ensure continued compliance with the CO NAAQS for former non–attainment areas. New York City is also committed to implementing site–specific control measures throughout the city to reduce CO levels, should unanticipated localized growth result in elevated CO levels during the maintenance period.

Manhattan has been designated as a moderate NAA for PM<sub>10</sub>. On December 17, 2004, EPA took final action designating the five boroughs of New York City as well as Nassau, Suffolk, Rockland, Westchester and Orange counties as PM<sub>2.5</sub> non–attainment areas under the CAA. State and local governments are required, by early 2008, to develop implementation plans designed to meet the standards.

Nassau, Rockland, Suffolk, Westchester and the five counties of New York City had been designated as severe non–attainment for ozone 1–hour standard. In November 1998, New York State submitted its *Phase II Alternative Attainment Demonstration for Ozone*, which was finalized and approved by EPA effective March 6, 2002, addressing attainment of the one–hour ozone NAAQS by 2007. New York State has recently submitted revisions to the SIP; these SIP revisions included additional emission reductions that EPA requested to demonstrate attainment

of the standard, and an update of the SIP estimates using two new EPA models—the mobile source emissions model MOBILE6, and the non-road emissions model NONROAD—which have been updated to reflect current knowledge of engine emissions, and the latest mobile and non-road engine emissions regulations. On April 15, 2004, EPA designated these same counties as moderate non-attainment for the new 8-hour ozone standard which became effective as of June 15, 2004 (the entire Orange county was moved to the Poughkeepsie moderate non-attainment area for 8-hour ozone). EPA revoked the 1-hour standard on June 15, 2005; however, the specific control measures for the 1-hour standard included in the SIP are required to stay in place until the 8-hour standard is attained. The discretionary emissions reductions in the SIP would also remain but could be revised or dropped based on modeling. A new SIP for ozone will be adopted by the state no later than June 15, 2007, with a target attainment deadline of June 15, 2010.

### **DETERMINING THE SIGNIFICANCE OF AIR QUALITY IMPACTS**

Any action predicted to increase the concentration of a criteria air pollutant to a level that would exceed the concentrations defined by the NAAQS (see Table 8-1) would be deemed to have a potential significant adverse impact. In addition, in order to maintain concentrations lower than the NAAQS in attainment areas, or to ensure that concentrations will not be significantly increased in non-attainment areas, threshold levels have been defined for certain pollutants; any action predicted to increase the concentrations of these pollutants above the thresholds would be deemed to have a potential significant adverse impact, even in cases where violations of the NAAQS are not predicted.

#### *DE MINIMIS CRITERIA REGARDING CO IMPACTS*

New York City has developed *de minimis* criteria to assess the significance of the incremental increase in CO concentrations that would result from proposed projects or actions, as set forth in the *City Environmental Quality Review (CEQR) Technical Manual*. These criteria set the minimum change in CO concentration that defines a significant environmental impact. Significant increases of CO concentrations in New York City are defined as: (1) an increase of 0.5 ppm or more in the maximum 8-hour average CO concentration at a location where the predicted No Action 8-hour concentration is equal to or between 8 and 9 ppm; or (2) an increase of more than half the difference between baseline (i.e., No Action) concentrations and the 8-hour standard, when No Action concentrations are below 8.0 ppm.

## **D. METHODOLOGY FOR PREDICTING POLLUTANT CONCENTRATIONS**

### **MOBILE SOURCES**

The prediction of vehicle-generated CO emissions and their dispersion in an urban environment incorporates meteorological phenomena, traffic conditions, and physical configurations. Air pollutant dispersion models mathematically simulate how traffic, meteorology, and geometry combine to affect pollutant concentrations. The mathematical expressions and formulations contained in the various models attempt to describe an extremely complex physical phenomenon as closely as possible. However, because all models contain simplifications and approximations of actual conditions and interactions and it is necessary to predict the reasonable worst case

condition, most of these dispersion models predict conservatively high concentrations of pollutants, particularly under adverse meteorological conditions.

The mobile source analyses for the proposed project employs a model approved by EPA that has been widely used for evaluating air quality impacts of projects in New York City, other parts of New York State, and throughout the country. The modeling approach includes a series of conservative assumptions relating to meteorology, traffic, and background concentration levels resulting in a conservatively high estimate of expected pollutant concentrations that could ensue from the proposed project. The assumptions used in the PM analysis were based on the latest PM<sub>2.5</sub> draft interim guidance developed by the NYCDEP.

#### *DISPERSION MODEL FOR MICROSCALE ANALYSES*

Maximum CO concentrations adjacent to streets near the project site, resulting from vehicle emissions, were predicted using the CAL3QHC model Version 2.0.<sup>1</sup> The CAL3QHC model employs a Gaussian (normal distribution) dispersion assumption and includes an algorithm for estimating vehicular queue lengths at signalized intersections. CAL3QHC predicts emissions and dispersion of CO from idling and moving vehicles. The queuing algorithm includes site-specific traffic parameters, such as signal timing and delay calculations (from the 2000 *Highway Capacity Manual* traffic forecasting model), saturation flow rate, vehicle arrival type, and signal actuation (i.e., pre-timed or actuated signal) characteristics to accurately predict the number of idling vehicles. The CAL3QHC model has been updated with an extended module, CAL3QHCR, which allows for the incorporation of hourly meteorological data into the modeling, instead of worst-case assumptions regarding meteorological parameters. This refined version of the model, CAL3QHCR, is employed if maximum predicted future CO concentrations are greater than the applicable ambient air quality standards or when *de minimis* thresholds are exceeded using the first-level CAL3QHC modeling.

#### *METEOROLOGY*

In general, the transport and concentration of pollutants from vehicular sources are influenced by three principal meteorological factors: wind direction, wind speed, and atmospheric stability. Wind direction influences the accumulation of pollutants at a particular prediction location (receptor), and atmospheric stability accounts for the effects of vertical mixing in the atmosphere.

CO calculations were performed using the CAL3QHC model. In applying the CAL3QHC model, the wind angle was varied to determine the wind direction resulting in the maximum concentrations at each receptor.

Following the EPA guidelines<sup>2</sup>, CO computations were performed using a wind speed of 1 meter per second, and the neutral stability class D. The 8-hour average CO concentrations were estimated by multiplying the predicted 1-hour average CO concentrations by a factor of 0.81 to account for persistence of meteorological conditions and fluctuations in traffic volumes. A

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<sup>1</sup> *User's Guide to CAL3QHC, A Modeling Methodology for Predicted Pollutant Concentrations Near Roadway Intersections*, Office of Air Quality, Planning Standards, EPA, Research Triangle Park, North Carolina, Publication EPA-454/R-92-006.

<sup>2</sup> *Guidelines for Modeling Carbon Monoxide from Roadway Intersections*, EPA Office of Air Quality Planning and Standards, Publication EPA-454/R-92-005.

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surface roughness of 3.21 meters was chosen. At each receptor location, the wind angle that maximized the pollutant concentrations was used in the analysis regardless of frequency of occurrence. These assumptions ensured that worst-case meteorology was used to estimate impacts.

### *ANALYSIS YEAR*

The CO microscale analyses were performed for existing conditions and 2008, the year by which the proposed project is likely to be completed. The future analysis was performed both without the proposed project (the No Build condition) and with the proposed project (the Build condition).

### *VEHICLE EMISSIONS DATA*

Vehicular CO engine emission factors were computed using the EPA mobile source emissions model, MOBILE6.2<sup>1</sup>. This is the most current, recently released emissions model capable of calculating engine emission factors for various vehicle types, based on the fuel type (gasoline, diesel, or natural gas), meteorological conditions, vehicle speeds, vehicle age, roadway types, number of starts per day, and engine soak time, and various other factors that influence emissions, such as inspection maintenance programs. The inputs and use of MOBILE6.2 incorporates the most current guidance available from the NYSDEC and NYCDEP. An ambient temperature of 43° Fahrenheit was used in accordance with *CEQR* guidelines.

Vehicle classification data were based on field studies. Appropriate credits were used to accurately reflect the inspection and maintenance program. The inspection and maintenance programs require inspections of automobiles and light trucks to determine if pollutant emissions from the vehicles' exhaust systems are below emission standards. Vehicles failing the emissions test must undergo maintenance and pass a repeat test to be registered in New York State.

### *TRAFFIC DATA*

Traffic data for the air quality analysis were derived from existing traffic counts, projected future growth in traffic, and other information developed as part of the traffic analysis for the proposed project (see Chapter 6, "Traffic"). Traffic data for the future without and with the proposed project were employed in the respective air quality modeling scenarios. The weekday AM (8:00 to 9:00 AM) and PM (3:00 to 4:00 PM) peak periods were subjected to microscale analysis. These time periods were selected for the mobile source analysis because they produce the maximum anticipated project-generated traffic and therefore have the greatest potential for significant air quality impacts.

### *BACKGROUND CONCENTRATIONS*

Background concentrations are those pollutant concentrations not directly accounted for through the modeling analysis, which directly accounts for vehicle-generated emissions on the streets within 1,000 feet and line-of-sight of the receptor location. Background concentrations must be added to modeling results to obtain total pollutant concentrations at a study site.

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<sup>1</sup> EPA, User's Guide to MOBILE6.1 and MOBILE6.2: Mobile Source Emission Factor Model, EPA420-R-02-028, October 2002.

The 8-hour average background concentration used in this analysis was 2.3 ppm for the 2008 predictions. This value, obtained from NYCDEP, is based on CO concentrations measured at NYSDEC monitoring stations and is adjusted to reflect the reduced vehicular emissions expected in the analysis year. For purposes of this adjustment, based on EPA guidance, it was assumed that 20 percent of the background value is caused by stationary source emissions that have remained relatively unchanged with time and that 80 percent of the background value is caused by mobile sources that decrease with time. This decrease reflects the increasing numbers of federally mandated lower-emission vehicles that are projected to enter the vehicle fleet as older, higher-polluting vehicles are retired (i.e., vehicle turnover), and the continuing benefits of the New York State inspection and maintenance program.

*MOBILE SOURCE ANALYSIS SITES*

A total of two analysis sites were selected for microscale analysis (see Table 8-2). These intersections were selected because they are the locations in the study area where the largest levels of project-generated traffic are expected, and, therefore, where the greatest air quality impacts and maximum changes in the concentrations would be expected. Each of these intersections was analyzed for CO.

**Table 8-2**

**Mobile Source Analysis Intersection Locations**

Analysis Site	Location
1	Tillary Street and Adams Street
2	Tillary Street and Flatbush Avenue

*RECEPTOR LOCATIONS*

Multiple receptors (i.e. precise locations at which concentrations are predicted) were modeled at each of the selected sites; receptors were placed along the approach and departure links at spaced intervals. The receptors were placed at sidewalk or roadside locations near intersections with continuous public access.

**STATIONARY SOURCES**

A screening analysis was performed to assess air quality impacts associated with emissions from the HVAC system of the proposed project. The methodology described in the *CEQR Technical Manual* was used for the analysis and considered impacts on sensitive uses (both existing residential development as well as other residential developments under construction). The *CEQR* methodology determines the threshold of development size below which the action would not have a significant adverse impact. The screening procedures utilize information regarding the type of fuel to be burned, the maximum development size, and the HVAC exhaust stack height to evaluate whether a significant adverse impact is likely. Based on the distance from the development to the nearest building of similar or greater height, if the maximum development size is greater than the threshold size in the *CEQR Technical Manual*, there is the potential for significant air quality impacts, and a refined dispersion modeling analysis would be required. Otherwise, the source passes the screening analysis, and no further analysis is required.

The proposed project site was evaluated and any nearby projected residential development of similar or greater height was analyzed as a potential receptor. The maximum development floor area of the site was used as input for the screening analysis. Based on the proposed building

design, the screening analysis was performed using natural gas in the HVAC systems, and a stack height of approximately 91 feet above grade.

## **CHEMICAL SPILL ANALYSIS**

### *INTRODUCTION*

Emissions from the proposed school facility's fume hood exhaust system, in the event of an accidental chemical spill in one of the laboratories, were evaluated. Impacts were evaluated using information, procedures, and methodologies contained in the *CEQR Technical Manual*. Maximum concentrations were compared to the short-term exposure levels (STELs) or to the ceiling levels recommended by the U.S. Occupational Safety and Health Administration (OSHA) for the chemicals examined. It is assumed that the types and quantities of materials that are to be used in the proposed school are those typically used in high school science laboratories at New York City Department of Education schools.

The following section details the expected usage of potentially hazardous materials, as well as the systems that would be employed at the proposed school to ensure the safety of the students and staff and the surrounding community in the event of an accidental laboratory chemical spill in the science laboratories. A quantitative analysis employing mathematical modeling was performed to determine potential impacts on nearby places of public access and potential impacts due to recirculation into air intake systems.

### *LABORATORY FUME HOOD EXHAUSTS*

All laboratories in which hazardous chemicals are used would be equipped with fume hoods. Fume hoods are enclosures that are maintained under negative pressure and continuously vented to the outside. Their function is to protect teachers, staff, and students from potentially harmful fumes. By providing a continuous exhaust from laboratory rooms, they also prevent any fumes released within the laboratory from escaping into other areas of the building, or through windows to the outside.

Based on the design information for the exhaust system supplied by the engineers, all fume hoods within laboratory units would be manifolded and vented to the building roof through a single plenum. The exhaust fan would maintain an exit velocity of at least 3,026 feet per minute through a 9-inch stack. The plenum exhaust fan would be located on the roof of the building.

### *PLANNED OPERATIONS*

An inventory of chemicals which may be present in a typical laboratory in the proposed school facility was examined. From the chemical inventory, approximately 10 chemicals were selected for further examination, based on their toxicity and potential for air quality impacts. Common buffers, salts, enzymes, nucleotides, peptides, and other bio-chemicals were not considered in the analysis since they are not typically categorized as air pollutants. Nonvolatile chemicals (a vapor pressure of less than 10 mm Hg) were excluded as well. Table 8-3 shows the hazardous chemicals selected. The vapor pressure shown for each chemical is a measure of the material's volatility—its tendency to evaporate, or to form fumes or vapors, which is a critical parameter in determining potential impacts from chemical spills. The exposure standards (OSHA permissible exposure limit [PEL], National Institute for Occupational Safety and Health [NIOSH], immediately dangerous to life or health [IDLH], and OSHA and/or NIOSH short-term exposure

level [STEL] and ceiling values) are measures of the material's toxicity—more toxic substances have lower exposure standards.

**Table 8-3**  
**Expected Hazardous Materials in the Proposed Laboratories**

Chemical	Vapor Pressure (mmHG)	PEL (ppm)	STEL (ppm)	IDLH (ppm)	Ceiling (ppm)
Acetic Acid [64-19-7]	11	10	15	50	10
Acetone [67-64-1]	180	1,000	-	2,500	250
Cyclohexene [110-83-8]	67	300	-	2,000	300
Ether [60-29-7]	440	400	-	1,900	-
Ethyl Alcohol [64-17-5]	44	1,000	-	3,300	1,000
Hydrofluoric Acid [7664-39-3]	25	3	-	30	6
Methyl Alcohol [67-56-1]	96	200	250	6,000	200
Nitric Acid [7697-37-2]	48	2	4	25	2
Petroleum distillates (Naphtha) [80002-05-9]	40	500	-	1,100	1,800
Toluene [108-88-3]	21	200	150	500	300

**Notes:**  
 PEL—Permissible Exposure Limit; Time Weighted Average (TWA) for up to a 10-hour workday during a 40-hour workweek.  
 STEL—Short-Term Exposure Limit is a 15-minute TWA exposure that should not be exceeded at any time during a workday.  
 IDLH—Immediately Dangerous to Life or Health.  
 Ceiling—Level set by NIOSH or OSHA not to be exceeded in any working exposure.  
 ppm = parts per million.  
 Where a hyphen (-) appears there is no recommended corresponding guideline value.

#### ESTIMATES OF WORST-CASE EMISSION RATES

The dispersion of hazardous chemicals from a spill within one of the proposed laboratories was analyzed to assess the potential for exposure of the general public and of students and staff within the school to hazardous fumes in the event of an accident. Evaporation rates for volatile hazardous chemicals expected to be used in the proposed laboratory were estimated using the model developed by the Shell Development Company<sup>1</sup>. The Shell model, which was developed specifically to assess air quality impacts from chemical spills, calculates evaporation rates based on physical properties of the material, temperature and rate of air flow over the spill surface. Room temperature conditions (20° C) and an air-flow rate of 0.5 meters/second were assumed for calculating evaporation rates.

Based on relative STELs and the vapor pressures of the chemicals listed in Table 8-3, a subset of the most potentially hazardous chemicals, shown in Table 8-4, were selected for the “worst-case” spill analysis. Besides the relative toxicities, other factors such as molecular weight, container size, and frequency of use were also considered. Chemicals with high vapor pressures evaporate most rapidly. Among the chemicals with the highest vapor pressures compiled for Table 8-3, the chemical selected also has the lowest STEL. Since the chemical selected for detailed analysis is most likely to have the highest emissions rates and the lowest exposure standards, if the analysis of this chemical resulted in no significant impacts, it would indicate

<sup>1</sup> Fleischer, M.T., *An Evaporation/Air Dispersion Model for Chemical Spills on Land*, Shell Development Company, December 1980.

that the other chemicals listed in Table 8-3 would also not present any significant potential impacts.

**Table 8-4**  
**Chemical Selected for Worst-Case Spill Analysis**

Chemical	Quantity (liters)	Evaporation Rate (gram/meter <sup>2</sup> /sec)	Emission Rate* (gram/sec)
Nitric Acid	—	0.240	0.401
<b>Note:</b> * Average emission rate			

The analysis conservatively assumes that a full container of the chemical would be spilled in a fume hood. For a spill area of approximately 1.7 square meters, the emission rate was determined using the evaporation rates. For modeling purposes, the emission rate shown in Table 8-4 is calculated for a 15-minute time period. The vapor from the spill would be drawn into the fume hood exhaust system and released into the atmosphere via the roof exhaust fans. The high volume of air drawn through this system provides a high degree of dilution for hazardous fumes before they are released above the roof.

#### MODELING

The potential for recirculation of the fume hood emissions back into the building air intakes was assessed using the Wilson method<sup>1</sup>. This empirical procedure, which has been verified by both wind-tunnel and full-scale testing, is a refinement of the 1981 ASHRAE Handbook procedure, and takes into account such factors as plume momentum, stack-tip downwash, and cavity recirculation effects. The procedure determines the worst-case, absolute minimum dilution between exhaust vent and air intake. Three separate effects determine the eventual dilution: internal system dilution, obtained by combining exhaust streams (i.e., mixing in plenum chambers of multiple exhaust streams, introduction of fresh air supplied from roof intakes); wind dilution, dependent on the distance from vent to intake and the exit velocity; and dilution from the stack, caused by stack height and plume rise from vertical exhaust velocity. The critical wind speed for worst-case dilution is dependent on the exit velocity, the distance from vent to intake, and the cross-sectional area of the exhaust stack.

The recirculation analysis indicates that the minimum potential dilution factor between the fan exhausts and the nearest air intake below the rooftop is over 1,335 (i.e., pollutant concentrations at the nearest intake to the exhaust fan would be 1/1,335th the concentration at the fan). Thus, a nitric acid spill in a fume hood as described above would produce a maximum concentration at the nearest intake location of about 0.008 parts per million (ppm).

Therefore, a spill in a fume hood as described above would produce a maximum concentration at the nearest intake location well below the corresponding STELs set by OSHA and/or NIOSH for any of the chemicals in Table 8-3.

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<sup>1</sup> D.J. Wilson, *A Design Procedure for Estimating Air Intake Contamination from Nearby Exhaust Vents*, ASHRAE TRAS 89, Part 2A, pp. 136-152, 1983.

The study performed also considered the impact of an accidental spill on nearby receptors, such as open windows on nearby buildings. As mentioned above, the fume hood ventilation design was found to achieve a minimum dilution ratio criterion of 1,335:1.

Maximum concentrations at elevated receptors downwind of the fume exhausts were estimated using the EPA INPUFF model, version 2.5<sup>1</sup>. This is the only EPA model designed to estimate impacts from short-term releases and was used to develop the EPA guidelines<sup>2</sup>. INPUFF assumes a Gaussian dispersion of a pollutant “puff” (a brief release, as opposed to a continuous one) as it is transported downwind of a release point. Stable atmospheric conditions and a 1-meter/second wind speed were assumed. Receptors (locations at which concentrations are calculated) were modeled at multiple heights at locations closest to the exhaust fans. Since the emissions resulting from chemical spills are short-term releases, a worst-case assumption of the wind blowing the exhaust directly to the window or air intake receptors was made for modeling purposes.

## E. EXISTING CONDITIONS

### EXISTING MONITORED AIR QUALITY CONDITIONS

Monitored background concentrations of SO<sub>2</sub>, NO<sub>2</sub>, CO, O<sub>3</sub>, lead, and PM<sub>10</sub> for the area are shown in Table 8-5. These values are the most recent monitored data that have been made available by NYSDEC. With the exception of ozone, which is a regional pollutant, there were no monitored violations of NAAQS at these monitoring sites.

**Table 8-5**  
**Representative Monitored Ambient Air Quality Data**

Pollutants	Location	Units	Period	Concentrations			Number of Exceedances of Federal Standard	
				Mean	Highest	Second Highest	Primary	Secondary
CO	PS 59	ppm	8-hour	-	2.1	2.0	0	0
			1-hour	-	2.9	2.6	0	0
SO <sub>2</sub>	PS 59	ppm	Annual	0.010	-	-	0	-
			24-hour	-	0.037	0.033	0	-
			3-hour	-	0.087	0.056	-	0
Respirable Particulates (PM <sub>10</sub> )	JHS 126	µg/m <sup>3</sup>	Annual	17	-	-	0	0
			24-hour	-	47	32	0	0
Respirable Particulates (PM <sub>2.5</sub> )	JHS 126	µg/m <sup>3</sup>	Annual	14.0	-	-	0	0
			24-hour	-	48.6	37.8	0	0
NO <sub>2</sub>	PS 59	ppm	Annual	0.035	-	-	0	0
Lead	Susan Wagner	µg/m <sup>3</sup>	3-month	-	0.01	0.01	0	-
O <sub>3</sub>	Susan Wagner	ppm	1-hour	-	0.127	0.108	1	0

**Source:** NYSDEC, 2004 New York State Air Quality Data.

<sup>1</sup> Peterson, W.B., *A Multiple Source Gaussian Puff Dispersion Algorithm—Users Guide*, EPA, 600/8-86-024, August 1986.

<sup>2</sup> EPA, *Chemical Emergency Preparedness Program, Interim Guidance*, November 1985.

**PREDICTED POLLUTANT CONCENTRATIONS IN THE STUDY AREA – MOBILE SOURCES**

As noted previously, receptors were placed at multiple sidewalk locations next to the intersections under analysis. The receptor with the highest predicted CO concentrations was used to represent these intersection sites for the existing conditions. CO concentrations were calculated for each receptor location, at each intersection, for each peak period specified above.

Table 8-6 shows the maximum predicted existing (2005) CO 8-hour average concentrations at the receptor sites. (No 1-hour values are shown since predicted values are much lower than the standard.) At all receptor sites, the maximum predicted 8-hour average concentrations are below the national standard of 9 ppm.

**Table 8-6  
Maximum Predicted Existing 8-Hour Average  
Carbon Monoxide Concentrations for 2005 (parts per million)**

Receptor Site	Location	Time Period	8-Hour Concentration (ppm)
1	Tillary Street and Adams Street	AM	5.7
2	Tillary Street and Flatbush Avenue	AM	6.2
<b>Note:</b> 8-hour standard is 9 ppm.			

**F. THE FUTURE WITHOUT THE PROPOSED PROJECT**

**MOBILE SOURCE ANALYSIS**

CO concentrations without the proposed project were determined for the 2008 analysis year at traffic intersections using the methodology previously described. Table 8-7 shows future maximum predicted 8-hour average CO concentrations at the analysis intersections without the proposed actions (i.e., 2008 No Build values). The values shown are the highest predicted concentrations for the receptor locations for any of the time periods analyzed.

**Table 8-7  
Future (2008) Maximum Predicted 8-Hour  
Average Carbon Monoxide No Build Concentrations  
in the Project Study Area (parts per million)**

Receptor Site	Location	Time Period	8-Hour Concentration (ppm)
1	Tillary Street and Adams Street	AM	4.6
2	Tillary Street and Flatbush Avenue	AM	5.0
<b>Note:</b> 8-hour standard is 9 ppm.			

Compared to Table 8-6, predicted No Build values are lower than Existing Conditions. The decrease in CO concentrations primarily reflects the increasing proportion of newer vehicles with more effective pollution controls, as well as the continuing benefits of the New York State I&M Program.

## G. THE FUTURE WITH THE PROPOSED PROJECT

The proposed project would result in increased mobile source emissions in the immediate vicinity of the project site. The proposed project could also affect the surrounding community through emissions from HVAC and laboratory equipment. The following sections describe the results of the studies performed to analyze the potential impacts on the surrounding community from these sources.

### MOBILE SOURCE ANALYSIS

CO concentrations with the proposed project were determined for the 2008 analysis year at traffic intersections using the methodology previously described. Table 8-8 shows the future maximum predicted 8-hour average CO concentration with the proposed actions at the two intersections studied. (No 1-hour values are shown since no exceedances of the standard would occur and the *de minimis* criteria are only applicable to 8-hour concentrations. Therefore, the 8-hour values are the most critical for impact assessment.) The values shown are the highest predicted concentration for any of the time periods analyzed. The results indicate that the proposed project would not result in any violations of the CO standard or any significant impacts at the receptor locations.

**Table 8-8**  
**Future (2008) Maximum Predicted 8-Hour Average**  
**No Build and Build Carbon Monoxide Concentrations (parts per million)**

Receptor Site	Location	Time Period	8-Hour Concentration (ppm)	
			No Build	Build
1	Tillary Street and Adams Street	AM	4.6	4.7
2	Tillary Street and Flatbush Avenue	AM	5.0	5.0
<b>Note:</b> 8-hour standard is 9 ppm.				

### STATIONARY SOURCE ANALYSIS

The primary stationary source of air pollutants associated with the proposed development would be emissions from the combustion of natural gas by HVAC equipment. The primary pollutant of concern when burning natural gas is NO<sub>x</sub>. The screening methodology in the *CEQR Technical Manual* was utilized for the analysis with the size of the proposed building in square feet (approximately 141,089 square feet). At the distance to the nearest receptors of a similar or greater height (approximately 223 feet), the proposed project is below the maximum permitted levels specified in Figure 3Q-10 of the *CEQR Technical Manual* for natural gas. Therefore, the proposed project would not result in any potential adverse air quality impacts from HVAC emission sources.

### CHEMICAL SPILL ANALYSIS

The results of the analysis of emissions from the proposed school facility's fume hood exhaust system are shown below in Table 8-9. The maximum concentration at elevated receptors downwind of the fume exhausts were estimated using the methodology previously described. The maximum concentration found at the proposed school facility would be below the STEL level.

**Table 8-9**  
**Maximum Predicted Concentrations (ppm)**

<b>Chemical</b>	<b>STEL</b>	<b>15-Minute Average</b>
Nitric Acid	2	1.2

Therefore, the results indicate that there would be no predicted significant health effects from the exhaust system of the laboratories in the proposed school facility and the surrounding community. \*