Chapter 19: Air Quality and Greenhouse Gas Emissions

This chapter examines the potential for air quality impacts due to the proposed project. An analysis of the potential greenhouse gas (GHG) emissions associated with the proposed project is also presented in this chapter, along with specific measures to reduce GHG emissions and improve energy efficiency that are either included as part of the proposed project or are under consideration.

A. AIR QUALITY

INTRODUCTION

Ambient air quality is affected by numerous sources and activities that introduce air pollutants into the atmosphere. A comprehensive assessment of potential air quality impacts from the proposed project was performed. The analyses described in the sections that follow were performed utilizing the general procedures recommended in the *City Environmental Quality Review (CEQR) Technical Manual*. However, in some cases more detailed analyses were undertaken to characterize potential air quality impacts from the proposed project, or because of changes in state or local policies and procedures for conducting and evaluating air quality impacts from a proposed project.

Air quality impacts can be either direct or indirect. Direct impacts stem from emissions generated by stationary sources associated with the proposed project, such as emissions from fuel burned on site for heating, ventilation, and air conditioning (HVAC) systems. Indirect effects include emissions from motor vehicles ("mobile sources") traveling to and from a project.

Fossil fuel-fired HVAC systems would be included to provide heating and cooling to the new buildings. This air quality analysis assesses the impacts of these systems on the environment. Potential effects on the proposed project from the existing New York Power Authority (NYPA) North 1st Street gas turbine power generating facility, which is located near the northern boundary of the project site, are examined. In addition, because the project site is located in an area zoned for industrial use, an analysis of potential air quality impacts from nearby industrial sources of air pollution (e.g., from manufacturing or processing facilities) is required.

PRINCIPAL CONCLUSIONS

The analyses conclude that the proposed project would not result in any significant adverse air quality impacts on sensitive uses in the surrounding community, and the proposed project would not be adversely affected by existing sources of air emissions in the project area. A summary of the general findings is presented below.

Concentrations of carbon monoxide (CO) and particulate matter less than 10 microns in diameter (PM_{10}) due to project-generated traffic at intersections near the proposed project site (the primary study area) and along main corridors outside the primary study area (the secondary study area) would not result in any violations of National Ambient Air Quality Standards (NAAQS). It was

also determined that CO impacts would not exceed CEQR *de minimis* criteria (see Page 19-8), while incremental increases in fine particulate matter less than 2.5 microns in diameter ($PM_{2.5}$) would not contravene the City's current interim guidance criteria. Impacts from the proposed project's parking facilities were found to result in no significant adverse air quality impacts.

Analysis of the emissions and dispersion of nitrogen dioxide (NO_2), CO and PM_{10} from the proposed project's HVAC sources indicate that such emissions would not result in violations of NAAQS. Emissions of $PM_{2.5}$ were analyzed in accordance with the City's current $PM_{2.5}$ interim guidance criteria, which determined that the maximum incremental increases in $PM_{2.5}$ concentrations from stationary sources would be below the significant impact thresholds. To ensure the avoidance of impacts, limitations on annual fuel usage and minimum stack heights would be included in the Restrictive Declaration for the proposed project.

Nearby existing sources from manufacturing or processing facilities were analyzed for their potential impacts on the proposed project. The results of the industrial source analysis demonstrated that there would be no significant adverse air quality impacts on the proposed project.

Analysis of the emissions and dispersion of NO_2, CO and PM_{10} from the NYPA North 1st Street facility's stationary source indicate that such emissions would not result in the violations of NAAQS. Emissions of $PM_{2.5}$ were analyzed in accordance with the City's current $PM_{2.5}$ interim guidance criteria, which determined that the maximum incremental increases in $PM_{2.5}$ concentrations from this source on the proposed project would be below the annual significant impact criterion of micrograms per cubic meter ($\mu g/m^3$), as well as the 24-hour average interim guidance criterion of 5 $\mu g/m^3$. Maximum 24-hour average $PM_{2.5}$ incremental concentrations from the NYPA facility could exceed the City's 24-hour interim guidance criterion of 2 $\mu g/m^3$ at a limited number of locations on elevated receptors on Sites A and B under the modeled conservative operating scenario. Exceedances on Site B were determined not to be significant, consistent with the City's application of this criterion, based on the magnitude, and the limited frequency and extent of these occurrences. To ensure the avoidance of any potential significant adverse impacts on Site A from the NYPA facility, limitations on the placement of operable windows and air intakes would be included in the Restrictive Declaration for the proposed project. With these measures in place, no significant adverse air quality impact is predicted from emissions of $PM_{2.5}$ from the NYPA facility.

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. Ambient concentrations of CO are predominantly influenced by mobile source emissions. Particulate matter (PM), volatile organic compounds (VOCs), and nitrogen oxides (NO and NO_2, collectively referred to as NO_x) are emitted from both mobile and stationary sources. Fine PM is also formed when emissions of NO_x, sulfur oxides (SO_x), ammonia, organic compounds, and other gases react or condense in the atmosphere. Emissions of sulfur dioxide (SO_2) are associated mainly with stationary sources and sources utilizing non-road diesel, such as diesel trains, marine engines, and non-road vehicles (e.g., construction engines). On-road diesel vehicles currently contribute very little to SO_2 emissions, since the sulfur content of on-road diesel fuel, which is federally regulated, is extremely low. Ozone is formed in the atmosphere by complex photochemical processes that include NO_x and VOCs.

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 that does not persist in the atmosphere, concentrations of it can vary greatly over relatively short distances; elevated concentrations are usually limited to locations near crowded intersections, heavily 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. 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.

In addition, the potential effects of vehicle emissions from the elevated Williamsburg Bridge on the project were evaluated. CO emissions were also evaluated as a result of natural gas combustion from the proposed project's HVAC systems.

NITROGEN OXIDES, VOCS, AND OZONE

NO_x 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_x 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 United States 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_x emissions or on ozone levels is predicted. An analysis of project-related emissions of these pollutants from mobile sources was therefore not warranted.

As part of the proposed project, fossil fuels would be burned in the heat and hot water systems. Therefore, potential future levels of NO_x from boilers were examined. In addition, potential PM impacts on the proposed project from the NYPA facility were examined.

LEAD

Airborne lead emissions 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 that drastically reduced 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 (CAA) 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 3-month average national standard of 0.15 $\mu g/m^3$.

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

RESPIRABLE PARTICULATE MATTER—PM_{10} AND $PM_{2.5}$

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 VOC; 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. PM 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 ($PM_{2.5}$) and particles with an aerodynamic diameter of less than or equal to 10 micrometers (PM_{10}, which includes $PM_{2.5}$). $PM_{2.5}$ has the ability to reach the lower regions of the respiratory tract, delivering with it other compounds that adsorb to the surfaces of the particles, and is also extremely persistent in the atmosphere. $PM_{2.5}$ is mainly derived from combustion material that has volatilized and then condensed to form primary PM (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 $PM_{2.5}$; PM concentrations may, consequently, be locally elevated near roadways with high volumes of heavy diesel powered vehicles. The number of project-generated vehicle trips is greater than the New York City Department of Environmental Protection's (DEP's) current threshold of 19 trucks trips for conducting a $PM_{2.5}$ microscale mobile source analysis. Therefore, an analysis of potential impacts from mobile sources of PM was conducted to assess the worst-case PM impacts due to the increased traffic associated with the proposed project.

The proposed HVAC systems would result in emissions of PM_{10} and $PM_{2.5}$; therefore, these sources were evaluated for potential impacts. In addition, potential PM impacts on the proposed project from the NYPA facility were examined.

SULFUR DIOXIDE

SO_2 emissions are primarily associated with the combustion of sulfur-containing fuels (oil and coal). Monitored SO_2 concentrations in New York City are lower than the national standards. Due to federal restrictions on the sulfur content in diesel fuel for on-road vehicles, no significant quantities are emitted from vehicular sources. Vehicular sources of SO_2 are not significant; therefore, an analysis of SO_2 from mobile sources was not warranted.

As part of the proposed project, natural gas would be burned in the proposed HVAC systems. The sulfur content of natural gas is negligible; therefore, no analysis was performed to estimate the future levels of SO_2 with the proposed project.

AIR TOXICS

In addition to the criteria pollutants discussed above, air toxics are of concern. Air toxics are emitted by a wide range of man-made and naturally occurring sources. Emissions of air toxics from industries are regulated by EPA. Federal ambient air quality standards do not exist for non-criteria air toxics; however, the New York State Department of Environmental Conservation (NYSDEC) has issued standards for certain non-criteria compounds including beryllium, gaseous fluorides, and hydrogen sulfide. NYSDEC has also developed guideline concentrations for numerous air toxic compounds. The NYSDEC guidance document DAR-1 (September 2007) contains a compilation of annual and short-term (one-hour) guideline concentrations for these compounds. The NYSDEC guidance thresholds represent ambient levels that are considered safe for public exposure.

The potential impact from adjacent industrial sources on air toxics concentrations within the proposed project area was examined.

AIR QUALITY REGULATIONS, STANDARDS, AND BENCHMARKS

NATIONAL AND STATE AIR QUALITY STANDARDS

As required by the CAA, primary and secondary NAAQS have been established for six major air pollutants: CO, NO_2, ozone, respirable PM (both $PM_{2.5}$ and PM_{10}), SO_2, and lead. The primary standards represent levels that are requisite to protect the public health, allowing an adequate margin of safety. 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. The primary and secondary standards are the same for NO_2, ozone, lead, and PM, and there is no secondary standard for CO. The NAAQS are presented in Table 19a-1. The NAAQS for CO, NO_2, and SO_2 have also been adopted as the ambient air quality standards for New York State, but are defined on a running 12-month basis rather than for calendar years only. New York State also has standards for total suspended particulate matter (TSP), settleable particles, non-methane hydrocarbons (NMHC), and ozone which correspond to federal standards that have since been revoked or replaced; and for beryllium, fluoride, and hydrogen sulfide (H_2S).

EPA has revised the NAAQS for PM, effective December 18, 2006. The revision included lowering the level of the 24-hour $PM_{2.5}$ standard from 65 $\mu g/m^3$ to 35 $\mu g/m^3$ and retaining the level of the annual standard at 15 $\mu g/m^3$. The PM_{10} 24-hour average standard was retained and the annual average PM_{10} standard was revoked. EPA has also revised the eight-hour ozone standard, lowering it from 0.08 to 0.075 parts per million (ppm), effective in May 2008.

Table 19a-1
National Ambient Air Quality Standards (NAAQS)

Pollutant	Primary		Secondary	
	ppm	µg/m^3	ppm	µg/m^3
Carbon Monoxide (CO)				
8-Hour Average [1]	9	10,000	None	
1-Hour Average [1]	35	40,000		
Lead				
Rolling 3-Month Average [5]	NA	0.15	NA	0.15
Nitrogen Dioxide (NO_2)				
Annual Average	0.053	100	0.053	100
Ozone (O_3)				
8-Hour Average [2]	0.075	150	0.075	150
Respirable Particulate Matter (PM_{10})				
24-Hour Average [1]	NA	150	NA	150
Fine Respirable Particulate Matter ($PM_{2.5}$)				
Average of 3 Annual Means	NA	15	NA	15
24-Hour Average [3,4]	NA	35	NA	35
Sulfur Dioxide (SO_2)				
Annual Arithmetic Mean	0.03	80	NA	NA
Maximum 24-Hour Average [1]	0.14	365	NA	NA
Maximum 3-Hour Average [1]	NA	NA	0.50	1,300

Notes: ppm – parts per million
µg/m^3 – micrograms per cubic meter
NA – not applicable
All annual periods refer to calendar year.
PM concentrations (including lead) are in µg/m^3, since ppm is a measure for gas concentrations.
Concentrations of all gaseous pollutants are defined in ppm, and approximately equivalent concentrations in µg/m^3 are presented.
(1) Not to be exceeded more than once a year.
(2) 3-year average of the annual fourth highest daily maximum 8-hour average concentration. EPA has reduced these standards down from 0.08 ppm, effective May 27, 2008.
(3) Not to be exceeded by the annual 98th percentile when averaged over 3 years.
(4) EPA has reduced these standards down from 65 µg/m^3, effective December 18, 2006.
(5) EPA has lowered the NAAQS down from 1.5 µg/m^3, effective January 12, 2009.
Source: 40 CFR Part 50: National Primary and Secondary Ambient Air Quality Standards.

EPA lowered the primary and secondary standards for lead to 0.15 µg/m^3, effective January 12, 2009. EPA revised the averaging time to a rolling 3-month average, and the form of the standard to not-to-exceed across a 3-year span. The current lead NAAQS will remain in place for one year following the effective date of attainment designations for any new or revised NAAQS before being revoked, except in current non-attainment areas, where the existing NAAQS will not be revoked until the affected area submits, and EPA approves, an attainment demonstration for the revised lead NAAQS.

On June 26, 2009, EPA proposed to establish a new one-hour average NO_2 standard at a level between 0.080-0.100 ppm, in addition to the current annual standard. The statistical form proposed is the 3-year average of the 4th highest daily maximum one-hour average

concentration in a year (the 4th highest daily maximum corresponds approximately to 99th percentile for a year).

NAAQS ATTAINMENT STATUS AND STATE IMPLEMENTATION PLANS

The CAA, as amended in 1990, 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 delineates how a state plans to achieve air quality that meets the NAAQS under the deadlines established by the CAA.

In 2002, EPA 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_{10}. On December 17, 2004, EPA took final action designating the five New York City counties, and Nassau, Suffolk, Rockland, Westchester and Orange Counties as a $PM_{2.5}$ non-attainment area under the CAA due to exceedance of the annual average standard. New York State has submitted a draft SIP to EPA, dated April 2008, designed to meet the annual average standard by April 8, 2010, which will be finalized after public review.

As described above, EPA has revised the 24-hour average $PM_{2.5}$ standard. In October 2009, EPA finalized the designation of the New York City Metropolitan Area as non-attainment with the 2006 24-hour $PM_{2.5}$ NAAQS, effective in November 2009. The non-attainment area includes the same 10-county area EPA designated as non-attainment with the 1997 annual $PM_{2.5}$ NAAQS. By November 2012, New York State will be required to submit a SIP demonstrating attainment with the 2006 24-hour standard by November 2014 (EPA may grant attainment date extensions for up to five additional years).

As a result of the Clean Air Act Amendments of 1990, Nassau, Rockland, Suffolk, Westchester, Lower Orange County Metropolitan Area (LOCMA), and the five New York City counties were designated as a severe non-attainment area under the former ozone one-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. These SIP revisions included additional emission reductions that EPA requested to demonstrate attainment of the standard, and an update of the SIP estimates using the latest versions of the mobile source emissions model, MOBILE6.2, 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 eight-hour ozone standard, which became effective as of June 15, 2004 (LOCMA was moved to the Poughkeepsie moderate non-attainment area for eight-hour ozone). EPA revoked the one-hour standard on June 15, 2005; however, the specific control measures for the one-hour standard included in the SIP are required to stay in place until the eight-hour standard is attained. The discretionary emissions reductions in the SIP would also remain but could be revised or dropped based on modeling. On February 8, 2008, NYSDEC submitted final revisions to a new

SIP for ozone to EPA. NYSDEC has determined that achieving attainment for ozone before 2012 is unlikely, and has therefore made a request for a voluntary reclassification of the New York non-attainment area as "serious."

In March 2008, EPA strengthened the eight-hour ozone standards. SIPs will be due three years after the final designations are made. On March 12, 2009, NYSDEC recommended that the counties of Suffolk, Nassau, Bronx, Kings, New York, Queens, Richmond, Rockland, and Westchester be designated as a non-attainment area for the 2008 ozone NAAQS (the NYMA [New York Metropolitan Area] Metropolitan Statistical Area [MSA] non-attainment area). The EPA has proposed to determine that the Poughkeepsie non-attainment area (Dutchess, Orange, Ulster, and Putnam counties) has attained the one- and eight-hour National Ambient Air Quality Standards for ozone.

New York City is currently in attainment of the annual average NO_2 and short-term SO_2 standards. EPA has proposed a new one-hour standard for each of these pollutants, but it is unclear at this time what the City's attainment status will be due to the range of concentrations proposed in the new standards.

DETERMINING THE SIGNIFICANCE OF AIR QUALITY IMPACTS

The State Environmental Quality Review Act (SEQRA) regulations and the *CEQR Technical Manual* state that the significance of a likely consequence (i.e., whether it is material, substantial, large, or important) should be assessed in connection with its setting (e.g., urban or rural), probability of occurrence, duration, irreversibility, geographic scope, magnitude, and the number of people affected.[1] In terms of the magnitude 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 19a-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 increase in CO concentrations that would result from the impact of proposed projects or actions on mobile sources, as set forth in the *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 eight-hour average CO concentration at a location where the predicted No Action 8 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 eight-hour standard, when No Action concentrations are below 8.0 ppm.

[1] *CEQR Technical Manual*, section 222, 2001; and State Environmental Quality Review Act § 617.7.

Interim Guidance Criteria Regarding $PM_{2.5}$ Impacts

NYSDEC has published a policy to provide interim direction for evaluating $PM_{2.5}$ impacts.[1] This policy applies only to facilities applying for permits or major permit modifications under SEQRA that emit 15 tons of PM_{10} or more annually. The policy states that such a project will be deemed to have a potentially significant adverse impact if the project's maximum impacts are predicted to increase $PM_{2.5}$ concentrations by more than 0.3 $\mu g/m^3$ averaged annually or more than 5 $\mu g/m^3$ on a 24-hour basis. Projects that exceed either the annual or 24-hour threshold will be required to prepare an Environmental Impact Statement (EIS) to assess the severity of the impacts, to evaluate alternatives, and to employ reasonable and necessary mitigation measures to minimize the $PM_{2.5}$ impacts of the source to the maximum extent practicable.

In addition, DEP is currently recommending interim guidance criteria for evaluating the potential $PM_{2.5}$ impacts for projects subject to CEQR. The updated interim guidance criteria currently employed by DEP for determination of potential significant adverse $PM_{2.5}$ impacts under CEQR are as follows:

- 24-hour average $PM_{2.5}$ concentration increments, which are predicted to be greater than 5 $\mu g/m^3$ at a discrete receptor location, would be considered a significant adverse impact on air quality under operational conditions (i.e., a permanent condition predicted to exist for many years regardless of the frequency of occurrence);
- 24-hour average $PM_{2.5}$ concentration increments, which are predicted to be greater than 2 $\mu g/m^3$ but no greater than 5 $\mu g/m^3$, could be considered a significant adverse impact on air quality depending on the magnitude, frequency, duration, location, and size of the area of the predicted concentrations;
- Predicted annual average $PM_{2.5}$ concentration increments greater than 0.1 $\mu g/m^3$ at ground level on a neighborhood scale (i.e., the annual increase in concentration representing the average over an area of approximately 1 square kilometer, centered on the location where the maximum ground-level impact is predicted for stationary sources; or at a distance from a roadway corridor similar to the minimum distance defined for locating neighborhood scale monitoring stations); or
- Predicted annual average $PM_{2.5}$ concentration increments greater than 0.3 $\mu g/m^3$ at a discrete or ground-level receptor location.

Actions under CEQR that would increase $PM_{2.5}$ concentrations by more than the DEP or NYSDEC interim guidance criteria above will be considered to have potential significant adverse impacts. DEP recommends that actions subject to CEQR that fail the interim guidance criteria prepare an EIS and examine potential measures to reduce or eliminate such potential significant adverse impacts.

The proposed project's annual emissions of PM_{10} are estimated to be well below the 15-ton per year threshold under NYSDEC's $PM_{2.5}$ policy guidance. The above DEP and NYSDEC interim guidance criteria have been used for the purpose of evaluating the significance of predicted impacts of the proposed project on $PM_{2.5}$ concentrations and determining the need to minimize PM emissions from the proposed project.

[1] CP33/Assessing and Mitigating Impacts of Fine Particulate Emissions, NYSDEC 12/29/2003.

METHODOLOGY FOR PREDICTING POLLUTANT CONCENTRATIONS

INTRODUCTION

This section presents the methodologies, data, and assumptions used to conduct the air quality analyses for the proposed project. The analyses presented below are as follows:

- Mobile Source Analysis
  - Impacts at intersections due to the proposed project; and
  - Impacts due to the proposed project's parking facilities.
- Stationary Source Analysis
  - Impacts due to the proposed project's HVAC systems;
  - Impacts from the NYPA facility on the proposed project; and
  - Impacts on the proposed project from nearby industrial sources.

MOBILE SOURCES

The prediction of vehicle-generated emissions and their dispersion in an urban environment incorporates meteorological phenomena, traffic conditions, and physical configuration. Air pollutant dispersion models mathematically simulate how traffic, meteorology, and physical configuration 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 since it is necessary to predict the reasonable worst-case condition, most dispersion analyses predict conservatively high concentrations of pollutants, particularly under adverse meteorological conditions.

The mobile source analyses for the proposed project employ 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 $PM_{2.5}$ draft interim guidance developed by DEP.

Mobile Sources—Vehicle Emissions

Mobile Sources—Engine Emissions

Vehicular CO and PM engine emission factors were computed using the EPA mobile source emissions model, MOBILE6.2.[1] This emissions model is 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, engine soak time, and various other factors that influence emissions, such as inspection maintenance programs. The inputs and use of MOBILE6.2 incorporate the most current guidance available from NYSDEC and DEP.

[1] EPA, User's Guide to MOBILE6.1 and MOBILE6.2: Mobile Source Emission Factor Model, EPA420-R-03-010, August 2003.

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 each vehicle exhaust system are lower than emission standards. Vehicles failing the emissions test must undergo maintenance and pass a repeat test to be registered in New York State.

All taxis were assumed to be in hot stabilized mode (i.e., excluding any start emissions). The general categories of vehicle types for specific roadways were further categorized into subcategories based on their relative breakdown within the fleet.[1]

An ambient temperature of 43° Fahrenheit (°F) was used. The use of this temperature is recommended in the *CEQR Technical Manual* and is consistent with current DEP guidance.

Mobile Sources—Road Dust

The contribution of re-entrained road dust to PM_{10} concentrations, as presented in the PM_{10} SIP, is considered to be significant; therefore, the PM_{10} estimates include both exhaust and road dust. Road dust emission factors were calculated according to the latest procedure delineated by EPA.[2] Fugitive road dust was not included in the $PM_{2.5}$ microscale analyses based on the current EPA protocol for determining fugitive dust from paved roads.

Mobile Sources—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 17, "Traffic and Parking"). Traffic data for the future without and with the proposed project were employed in the respective air quality modeling scenarios. The weekday morning (8:30 to 9:30 AM) and afternoon (4:30 to 5:30 PM) peak periods were analyzed. 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.

For particulate matter, the peak morning, midday, and evening period traffic volumes were used as a baseline for determining off-peak volumes. Off-peak traffic volumes in the existing condition and in the future without the proposed project (the "No Action" condition), and off-peak increments from the proposed project, were determined by adjusting the peak period volumes by the 24-hour distributions of actual vehicle counts collected at appropriate locations. For annual impacts, average weekday 24-hour distributions were used to more accurately simulate traffic patterns over longer periods.

Mobile Sources—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.[3] The CAL3QHC model employs a Gaussian (normal distribution) dispersion assumption and includes an algorithm for

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[1] The MOBILE6.2 emissions model utilizes 28 vehicle categories by size and fuel. Traffic counts and predictions are based on broader size categories, and then broken down according to the fleet-wide distribution of subcategories and fuel types (diesel, gasoline, or alternative).

[2] EPA, Compilations of Air Pollutant Emission Factors AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources, Ch. 13.2.1, NC, http://www.epa.gov/ttn/chief/ap42, November, 2006.

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

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 of CAL3QHC modeling.

To determine motor-vehicle-generated PM concentrations adjacent to streets near the project area, the CAL3QHCR model was applied. This refined version of the model can utilize hourly traffic and meteorology data, and is therefore more appropriate for calculating 24-hour and annual average concentrations.

Mobile Sources—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 direction in which pollutants are dispersed, and atmospheric stability accounts for the effects of vertical mixing in the atmosphere. These factors, therefore, influence the concentration at a particular prediction location (receptor).

Mobile Sources—Tier I Analyses—CAL3QHC

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,[1] CAL3QHC computations were performed using a wind speed of 1 meter per second, and the neutral stability class D. The eight-hour average CO concentrations were estimated by multiplying the predicted one-hour average CO concentrations by a factor of 0.70 to account for persistence of meteorological conditions and fluctuations in traffic volumes. A surface roughness of 3.21 meters was chosen. At each receptor location, concentrations were calculated for all wind directions, and the highest predicted concentration was reported, regardless of frequency of occurrence. These assumptions ensured that worst-case meteorology was used to estimate impacts.

Mobile Sources—Tier II Analyses—CAL3QHCR

A Tier II analysis performed with the CAL3QHCR model includes the modeling of hourly concentrations based on hourly traffic data and five years of monitored hourly meteorological data. The data consists of surface data collected at LaGuardia Airport and upper air data collected at Brookhaven, New York for the period 2003-2007. All hours were modeled, and the highest resulting concentration for each averaging period is presented.

Mobile Sources—Analysis Year

The microscale analyses were performed for existing conditions and 2020, the year by which the proposed project is expected to be completed. The future analysis was performed for both the No Action and the future with the proposed project conditions.

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[1] *Guidelines for Modeling Carbon Monoxide from Roadway Intersections*, EPA Office of Air Quality Planning and Standards, Publication EPA-454/R-92-005.

Mobile Sources—Background Concentrations

Background concentrations are those pollutant concentrations originating from distant sources that are not directly included in the modeling analysis, which directly accounts for vehicular emissions on the streets within 1,000 feet and in the line of sight of the analysis site. Background concentrations must be added to modeling results to obtain total pollutant concentrations at an analysis site. The highest background concentrations monitored at the nearest NYSDEC background monitoring station in the most recent five-year period were used, and it was conservatively assumed that the maximum background concentrations occur on all days.

The eight-hour average CO background concentration used in this analysis was 2.5 ppm for the 2020 prediction, which is based on the second-highest eight-hour measurements over the most recent five-year period for which complete monitoring data is available (2003–2007), utilizing measurements obtained at the NYSDEC P.S. 59 monitoring station located on East 57th Street in Manhattan. The one-hour CO background employed in the analysis was 4.0 ppm.

The PM_{10} 24-hour background concentration of 60 $\mu g/m^3$ was based on the second-highest concentration, measured over the most recent three-year period for which complete data are available (2005–2007). The nearest NYSDEC monitoring site, at P.S. 59, was used. $PM_{2.5}$ background concentrations are not presented, since impacts are assessed on an incremental basis.

Mobile Sources—Analysis Sites

A total of three intersections were selected for microscale analysis (see Table 19a-2 and Figure 19a-1). The intersections of Kent Avenue and South 3rd Street, and Kent Avenue and South 4th Street were selected because they are the locations in the primary study area where the largest levels of project-generated traffic are expected and, therefore, where the greatest air quality impacts and maximum changes in concentrations would be expected. Each of these intersections was analyzed for CO. Kent Avenue and Williamsburg Street West was selected for analysis of CO due to the high overall build traffic. This intersection included background traffic volumes from the nearby Brooklyn-Queens Expressway. Overall, Kent Avenue and South 4th Street had the highest level of project-generated traffic and was therefore analyzed for impacts of $PM_{2.5}$ and $PM_{10,}$ as well as CO.

Table 19a-2
Mobile Source Analysis Sites

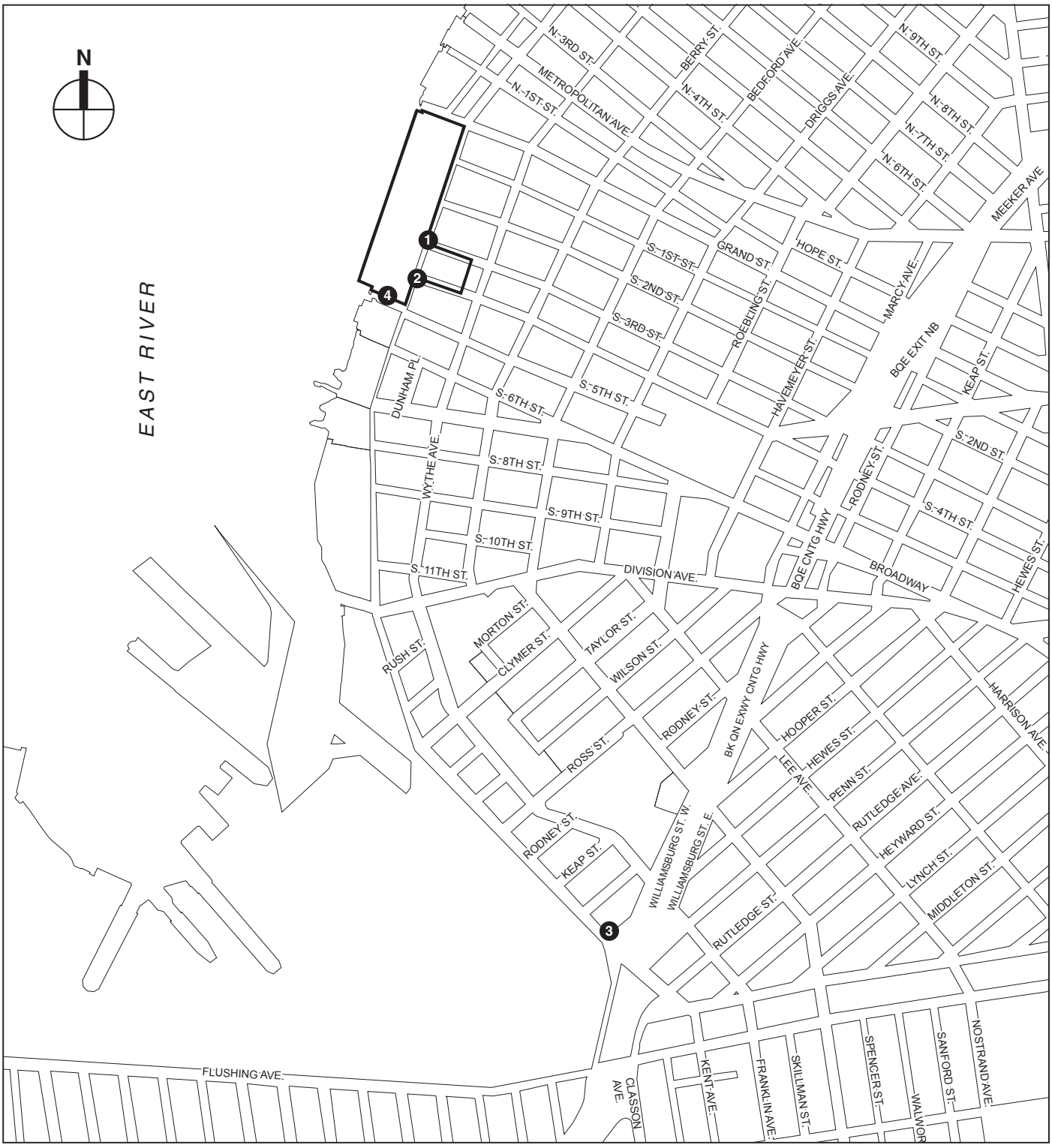
Receptor	Location
1	Kent Avenue & South 3rd Street
2	Kent Avenue & South 4th Street
3	Kent Avenue & Williamsburg Street West
4	Williamsburg Bridge Approach at Site D

The proposed project is bordered to the south by the Williamsburg Bridge. Impacts on the proposed project were analyzed due to its proximity to an atypical (elevated) source of vehicular pollutants, as recommended in the *CEQR Technical Manual*. Receptors were placed at various locations and elevations on proposed adjacent buildings on Site D to predict concentrations from vehicles. Receptors at this location were analyzed due to concerns regarding potential CO, PM_{10}, and $PM_{2.5}$ impacts.

Mobile Sources—Receptor Locations

Multiple receptors (i.e., precise locations at which concentrations are predicted) were modeled at each of the selected intersections. Receptors were placed along the approach and departure links at spaced intervals. Local model receptors were placed at sidewalk or roadside locations near intersections with continuous public access, and at residential locations. Receptors in the annual

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Project Site Boundary

Air Quality Receptor Locations

1. Kent Avenue and South 3rd Street
2. Kent Avenue and South 4th Street
3. Kent Avenue and Williamsburg Street West
4. Williamsburg Bridge Approach at Site D

Air Quality Receptor Locations
Figure 19a-1

$PM_{2.5}$ neighborhood scale models were placed at a distance of 15 meters from the nearest moving lane, based on the DEP procedure for neighborhood scale corridor $PM_{2.5}$ modeling. Receptors were also placed at façades of buildings on Site D that would be adjacent to and facing the elevated Williamsburg Bridge roadways.

Mobile Sources—Parking Facilities

The proposed project would result in the operation of several parking garages—two parking levels under the Site A and B parcels, one level under the Refinery parcel, two levels under the Site C and D parcels, and two levels under the Site E parcel, with a combined total of 1,694 spaces (the illustrative site plan is shown on Figure 1-4a in Chapter 1, "Project Description"). The outlet air from the garages' ventilation systems could contain elevated levels of pollutants from vehicular exhaust emissions in the garages. Emissions from the vents could potentially affect ambient pollutant concentrations at nearby locations. An analysis of the dispersion of emissions from the outlet vents was performed; pollutant levels in the surrounding area, using the methodology set forth in the *CEQR Technical Manual*. The largest parking garage, at Site A, with a total parking capacity of 782 spaces, and the proposed parking garage at Site E, with a total capacity of 374 spaces, were used to assess maximum potential concentrations from parking facilities associated with the proposed project.

Emissions from vehicles entering, parking, and exiting the garages were estimated using the EPA MOBILE6.2 mobile-source emission model, as described above, for mobile sources. For all arriving and departing vehicles, an average speed of five miles per hour was conservatively assumed for travel within the parking garage. In addition, all departing vehicles were assumed to idle for 1 minute before proceeding to the exit because departing drivers often take some time after starting the engine before leaving. The concentrations within the garages were calculated assuming a minimum ventilation rate, based on New York City Building Code requirements, of one cubic foot per minute of fresh air per gross square foot of garage area. To determine compliance with the NAAQS, CO concentrations were predicted for the maximum eight-hour average period. (No exceedances of the one-hour CO standard would occur, and the eight-hour values are the most critical for impact assessment.)

To determine pollutant concentrations, the outlet vents were analyzed as a "virtual point source" using the methodology in EPA's *Workbook of Atmospheric Dispersion Estimates, AP-26*. This methodology estimates concentrations at various distances from an outlet vent by assuming that the concentrations in the garages are equal to the concentration leaving the vent, and determining the appropriate initial horizontal and vertical dispersion coefficients at the vent faces.

The CO concentrations were determined for the time periods when overall garage usage would be the greatest, considering the hours when the greatest number of vehicles would exit the facility. Departing vehicles were assumed to be operating in a "cold-start" mode, emitting higher levels of CO than arriving vehicles. Traffic data for the parking garage analysis were derived from the trip generation analysis described in Chapter 17, "Traffic and Parking."

Since the detailed ventilation plans have not yet been laid out, worst-case assumptions were made regarding the design of the garages' mechanical ventilation systems. It was conservatively assumed that the air from each parking garage would be vented through a single outlet at a height of approximately 10 feet. The vent face was modeled to directly discharge above the sidewalk, and receptors were placed along the sidewalks on both sides of the street (both near the vent and across the street) at a pedestrian height of six feet and at distances of seven feet and 47 feet from the vent on Site A and at distances of seven feet and 52 feet from the vent on Site E to account for receptors near the vent and for receptors on the opposite side of an avenue or a

street, respectively. The vent was also analyzed assuming a residential receptor located at a height of six feet above the vent. A persistence factor of 0.70, supplied by DEP, was used to convert the calculated one-hour average maximum CO concentrations to eight-hour averages, accounting for meteorological variability over the average eight-hour period.

Background and on-street CO concentrations, predicted in the mobile-source analysis at nearby locations, were added to the modeling results to obtain the total ambient levels. The predicted on-street levels are conservatively high for the parking analysis since those represented peak results from intersections that would experience the highest concentrations, whereas the intersections near the parking garage ventilation outlets would have lower background and project-related traffic and the vents may be located mid-block.

Stationary Sources

HVAC Analysis

A stationary source analysis was conducted to evaluate potential impacts from the proposed project's HVAC systems. The boilers would generate hot water for building and domestic hot water heating. The boilers would utilize natural gas exclusively.

The stationary source air quality analysis assumed the maximum allowable building heights under the proposed rezoning and related land use actions. This is conservative when determining impacts on the proposed project (including project-on-project impacts), since maximum impacts from nearby elevated sources tend to occur on the upper floors of a receptor site (e.g., at window locations). In addition, maximizing building heights results in the greatest potential for building downwash conditions, which can result in higher concentrations at ground-level receptors and low-rise buildings.

For sites A, B, C, D and E it was assumed that each would have a boiler installation. For the air quality analysis of the Refinery, it was assumed that there would no HVAC stacks on the roof of this building, and the boiler installation serving the Refinery would be vented to Site C to avoid potential significant impacts with the completion of the proposed project. As a contingency, if the construction of the Refinery were to occur before Site C is completed, boiler exhaust stacks are permitted on the Refinery, until the completion of Site B. The proposed boiler stacks were assumed to exhaust to a single location on the tallest portion of each of the sites.

Limitations on the type of fuel and stack height would be included in the Restrictive Declaration. In addition, the Restrictive Declaration would include limitations on the placement of HVAC exhaust stacks for buildings to ensure that no significant adverse air quality impacts occur.

Stack exhaust parameters and emission estimates for the proposed boiler installations were conservatively estimated. Boiler fuel usage was obtained from conceptual design information, based on the size (in square feet) of the development site and type of fuels used. Fuel usage factors of 40 Btu/sq ft-hr for residential space and 20 Btu/sq ft-hr for commercial/community use space were used.[1] Emissions rates were calculated based on emissions factors obtained from the EPA *Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources*. PM_{10} and $PM_{2.5}$ emissions include both the filterable and condensable fractions. Table 19a-3 presents the stack parameters and emission rates used in the analysis.

[1] Source: Cosentini Associates.

Table 19a-3
Boiler Stack Parameters and Emission Rates

Parameter		Development				
		Site A	Site B	Site C[3]	Site D	Site E
Building Size (gsf)		375,038	772,496	587,668[4] / 394,800[5]	330,592	354,437
Building Height (ft)		300	400	399	297	148
Stack Exhaust Temp. (°F)		300	300	300	300	300
Stack Exhaust Height (ft)		308.7	407	400	330.7	157
Stack Exhaust Flow (ACFM)[1] [2]		7,566	10,603	12,723	6,185	6,185
Stack Exhaust Velocity (ft/s) [2]		20	25	30	21	21
Lb/hr[2]	NO_2	0.243	0.705	0.897	0.302	0.324
	CO	1.158	3.090	3.527	1.322	1.418
	$PM_{2.5}$	0.105	0.280	0.319	0.120	0.128
	PM_{10}	0.105	0.280	0.319	0.120	0.128

Notes:
(1) ACFM = actual cubic feet per minute.
(2) Emission rates and stack parameters are based on 100 percent load operation (per unit). Emissions at other loads were estimated by scaling the emission rates and exhaust flow proportionate to the load.
(3) Site C has combined emissions from Parcel C, as well as from the Refinery.
(4) Parcel C building size.
(5) Refinery building size.
Reference:
Emission factors are based on AP-42, while stack parameters are based on conceptual design data.

Since the proposed project's boilers would operate primarily during colder periods, the annual impact analysis used historical monthly weather data for New York City to adjust the boiler load for each month of the year to approximate the average monthly boiler demand.

Multiple scenarios were modeled to estimate emissions and predict impacts. The boilers would be capable of operating at various loads depending on the heating and hot water demands of the proposed development program's buildings. Therefore, boiler operations were modeled at loads of 25, 50, 75, and 100 percent to calculate impacts over a full range of operating conditions which represents the highest modeled scenario was reported for each pollutant.

HVAC Analysis—Dispersion Modeling

Potential impacts from boiler stack emissions were evaluated using the EPA/AMS AERMOD dispersion model. The AERMOD model was designed as a replacement to the EPA Industrial Source Complex (ISC3) model and was recently approved for use by the EPA. AERMOD is a state-of-the-art dispersion model, applicable to rural and urban areas, flat and complex terrain, surface and elevated releases, and multiple sources (including point, area, and volume sources). AERMOD is a steady-state plume model that incorporates current concepts about flow and dispersion in complex terrain and includes updated treatments of the boundary layer theory, understanding of turbulence and dispersion, and handling of terrain interactions.

The AERMOD model calculates pollutant concentrations from one or more points (e.g., exhaust stacks) based on hourly meteorological data, and has the capability of calculating pollutant concentrations at locations when the plume from the exhaust stack is affected by the aerodynamic wakes and eddies (downwash) produced by nearby structures. The analyses of potential impacts from exhaust stacks were made assuming stack tip downwash, urban dispersion and surface roughness length (with and without building downwash), and elimination of calms.

The AERMOD Model also incorporates the algorithms from the PRIME model, which is designed to predict impacts in the "cavity region" (i.e., the area around a structure which, under certain conditions, may affect an exhaust plume, causing a portion of the plume to become entrained in a

recirculation region). The Building Profile Input Program (BPIP) program for the PRIME model (BPIPRM) was used to determine the projected building dimensions modeling with the building downwash algorithm enabled. The modeling of downwash from sources accounts for all obstructions within a radius equal to five obstruction heights of the stack.

The analysis was performed both with and without downwash in order to assess the worst case at elevated receptors close to the height of the sources, which would occur without downwash, as well as the worst case at lower elevations and ground level, which would occur with downwash.

HVAC Analysis—Meteorological Data

The meteorological data set consisted of five consecutive years of meteorological data: surface data collected at La Guardia Airport (2003–2007), and concurrent upper air data collected at Brookhaven, New York. The meteorological data provide hour-by-hour wind speeds and directions, stability states, and temperature inversion elevation over the five-year period. These data were processed using the EPA AERMET program to develop data in a format which can be readily processed by the AERMOD model. The land uses around the site where meteorological surface data were available were classified using categories defined in digital United States Geological Survey (USGS) maps to determine surface parameters used by the AERMET program.

HVAC Analysis—Receptor Placement

A comprehensive receptor network (i.e., locations with continuous public access) was developed for the modeling analyses. Discrete receptors were analyzed and included locations on the proposed project and other nearby buildings, and at operable windows, air intakes, and publicly accessible ground-level locations. The model also included elevated and ground-level receptor grids in order to address more distant locations and to identify the highest ground-level impact.

HVAC Analysis—Background Concentrations

To estimate the maximum expected total pollutant concentrations, the predicted levels were added to corresponding background concentrations, presented in Table 19a-4. It was conservatively assumed that the maximum background concentrations occur on all days.

Table 19a-4
Maximum Background Pollutant Concentrations

Pollutant	Average Period	Location	Concentration ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)
NO_2	Annual	PS 59 Manhattan	71.5	100
SO_2	3-hour	PS 59, Manhattan	201	1,300
	24-hour		123	365
	Annual		37	80
CO	1-hour	PS 59, Manhattan	4,851	40,000
	8-hour		2,863	10,000
PM_{10}	24-hour	PS 59, Manhattan	60	150

Source: New York State Air Quality Report Ambient Air Monitoring System, NYSDEC, 2003–2007.

Industrial Source Analysis

Potential effects on the project site from existing industrial operations in the surrounding area were analyzed. Industrial air pollutant emission sources within 400 feet of the development project site's boundaries were considered for inclusion in the air quality impact analysis, as recommended in the *CEQR Technical Manual.*

As the first step in this analysis, a request was made to DEP's Bureau of Environmental Compliance (DEP-BEC) and NYSDEC to obtain all the available certificates of operation for

these locations and to determine whether manufacturing or industrial emissions occur. In addition, a search of federally and state-permitted facilities within the study area was conducted using the EPA's Envirofacts database.[1]

Land use and Sanborn maps were reviewed to identify potential sources of emissions from manufacturing/industrial operations. Next, a field survey was conducted to identify buildings within 400 feet of the project site that have the potential for emitting air pollutants.

After compiling the information on facilities with manufacturing or process operations in the study area, maximum potential pollutant concentrations from different sources at various distances from the site were estimated based on the look-up values found in Table 3Q-3 in the *CEQR Technical Manual*. The database provides factors for estimating maximum concentrations based on emissions levels at the source, which were derived from generic ISC3 dispersion modeling for the New York City area. Impact distances selected for each source were the minimum distances between the boundary of the project site and the source site. Predicted worst-case impacts on the project site were compared with the short-term guideline concentrations (SGCs) and annual guideline concentrations (AGCs) recommended in NYSDEC's *DAR-1 AGC/SGC Tables.*[2] These guideline concentrations present the airborne concentrations, which are applied as a screening threshold to determine whether future occupants of the proposed project could be significantly impacted from nearby sources of air pollution.

To assess the effects of multiple sources emitting the same pollutants, cumulative source impacts were estimated. Concentrations of the same pollutant from industrial sources that were within 400 feet of the project site were combined and compared to the NYSDEC AGCs and SGCs. This method is conservative since it combines concentrations from multiple sources and assumes that the location on the project site nearest any source is the same regardless of its distance and orientation.

Additional Sources

The *CEQR Technical Manual* requires an assessment of any actions that could result in the location of sensitive uses within 1,000 feet of a large emission source (e.g., a power plant), or within 400 feet of commercial, institutional, or large-scale residential developments where the proposed structure would be of a height similar to or greater than the height of an existing emission stack. To assess the potential effects of these existing sources on the proposed project, a review of existing permitted facilities was conducted. Within the 1,000-foot area around the project site, "large" sources, including major combustion-related facilities, were considered. This included all existing facilities subject to federal Prevention of Significant Deterioration (PSD) regulations, existing electrical generating facilities, and proposed major electrical generating facilities and peaking facilities. Other potential sources listed in the *CEQR Technical Manual* were surveyed, including cogeneration plants, concrete batching, plants, wastewater treatment plants, etc. Within the study area boundaries, other sources, such as those permitted under NYSDEC's Title V program, were considered. Sources of information reviewed included the EPA's Envirofacts database and the NYSDEC Title V and state facility permit Web site.

The only existing combustion sources with a potential to impact air quality within the 400-foot and 1,000-foot study areas are the North 1st Street facility, operated by NYPA, and the Con Edison North 1st Street Oil Terminal. The NYPA facility consists of a gas-fired turbine with a

[1] http://oaspub.epa.gov/enviro/ef_home2.air

[2] NYSDEC Division of Air Resources, Bureau of Stationary Sources, September 10, 2007.

maximum electrical generating potential of 47 megawatts. The Con Edison facility contains boilers which are designed to heat residual fuel oil stored in large tanks to facilitate oil transfer operations to Con Edison facilities on the East River. However, the North 1st Street Oil Terminal is not currently storing any oil, and has been shutdown for over 10 years. According to records submitted to NYSDEC by Con Edison, the facility did not operated its boilers for the most recent five years for which data were obtained (2002 to 2006) and Con Edison confirmed that the boilers have not been used subsequent to 2006. Therefore, it was not analyzed and only the NYPA facility was analyzed, since it is within both the 1,000-foot and 400-foot study areas.

Two separate studies of the NYPA facility's potential air quality impact on the proposed project were conducted. First, pollutant concentrations of NO_2, CO, and PM_{10} were determined using computer dispersion modeling to evaluate whether concentrations of these pollutants could exceed the NAAQS on the proposed project. Second, a more detailed and rigorous study using a wind tunnel was conducted to determine the incremental concentrations of $PM_{2.5}$ from the NYPA facility on the proposed project. This latter study was conducted due to the close proximity of the NYPA facility to the project site, and the stringent impact thresholds associated with $PM_{2.5}$, which are a very small percentage of the NAAQS. A description of the analysis performed for each of these studies follows.

Additional Sources—Potential Impacts of NO_2, CO, and PM_{10}

An analysis of NO_2, CO, and PM_{10} was conducted using computer dispersion modeling. VOCs and THC (total hydrocarbons) are primarily a concern due to their contribution as precursors to regional levels of ozone, and are therefore not a local source of concern with respect to the proposed project. The analysis was conducted using the AERMOD dispersion model, which was previously described (see "HVAC Analysis," above).

Stack parameters and emissions data for the facility were obtained from the *In-City Generation Project Draft Environmental Impact Statement, New York Power Authority, November 2001*. Table 19a-5 shows the stack parameters and maximum emission quantities for the pollutants of concern for the NYPA facility. Based on the emission quantities listed in Table 19a-5, annual emissions of the pollutants are shown in Table 19a-6.

Table 19a-5
NYPA North 1st Street Facility
Stack Parameters and Emission Quantities

Parameter	Value
Stack Height	106.5 feet
Inside Diameter	12 feet
Exhaust Velocity	77 feet/sec
Exhaust Temperature	719°F
NO_2	4.5 lbs/hr
CO	5.2 lbs/hr
PM_{10}	3.0 lbs/hr
SO_2	negligible
THC	10 ppm
VOC	1.2 lbs/hr
Lead	negligible

Notes:
All NO_x is assumed to be NO_2.
THC=total hydrocarbons.

Table 19a-6
NYPA North 1st Street Facility
Estimated Annual Emissions

Pollutant	Annual Emissions (tons per year [tpy])
NO_2	19.7
CO	22.8
PM_{10}	13.7
SO_2	negligible
Lead	negligible
VOC	5.3

The same general assumptions were utilized, with receptors placed at various locations on the project site, at ground level and on buildings. The maximum predicted concentrations from the modeling were added to the background concentrations to estimate the ambient air quality at the locations on the proposed project.

Additional Sources—Potential Impacts of $PM_{2.5}$

A wind tunnel study was conducted to assess the potential $PM_{2.5}$ impacts from the NYPA facility on the proposed project.

$PM_{2.5}$ concentrations emitted from the NYPA facility were estimated through wind tunnel tests on a scale model of the proposed project, the NYPA facility, and their surroundings. The wind tunnel data were analyzed in combination with historical hour-by-hour wind conditions and pollutant background levels. A further discussion of the wind tunnel analysis procedures and assumptions is presented in Appendix E of this DEIS.

The $PM_{2.5}$ emission rate used in the wind tunnel study was derived from stack tests performed at facilities operating the same gas turbine used at the NYPA facility. (PM emission data is not available from the North 1st facility, nor from any of the other identical gas turbine facilities operated by NYPA, because the NYSDEC Title V permits for those facilities do not require periodic testing of PM, including $PM_{2.5}$.)

The $PM_{2.5}$ emission rate is based on the statistical average of the emission test data, consistent with the procedure outlined in the *EPA Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources* for deriving the emission factor for combustion turbines. Applying this procedure and based on the stack test data, the $PM_{2.5}$ emission rate is estimated to be 1.48 lb/hr, which is equivalent to an emission factor of 0.00355 lb/MMBtu. This emission factor includes both the filterable and condensable fractions. The filterable and condensable fractions were both assumed to be 100 percent $PM_{2.5}$.

A reasonable worst-case operating scenario was developed in consultation with DEP to estimate maximum 24-hour and annual $PM_{2.5}$ concentrations from the existing NYPA facility. Over the five-year NYPA operating period studied (2002-2006), the NYPA facility operated at an annual average capacity of approximately 20 to 30 percent and operated more often in the summer months and less often at other times of the year. The reasonable worst-case operating scenario assumes the NYPA facility operates at approximately 72 percent on an annual basis, which is approximately three times the average annual operation during the study period.

To capture the general impacts over a broad area, receptors were placed on the proposed project's building façades. The NYPA facility stack height is approximately 110 feet and is located to the north of the project site, therefore, maximum potential impacts would occur on

buildings closest to the plant, and at locations above this height since the stack exhaust plume rises. On Site A, the highest residential floors would be at an elevation of approximately 110 feet. Floors above this height would be programmed for commercial or community facility use and would have inoperable windows and no air intakes. Accordingly, a higher density of receptors was placed on the highest residential floor locations of buildings on Site A and B. A number of receptors were also placed at ground-level locations, near the base of proposed buildings and in Grand Ferry Park. A total of 106 receptors were modeled in the wind tunnel analysis, including 22 receptors on Site A and 66 receptors on Site B. Figure 19a-2 shows the location of receptors modeled in the wind tunnel study.

EXISTING CONDITIONS

EXISTING MONITORED AIR QUALITY CONDITIONS

The most recent concentrations of all criteria pollutants at NYSDEC air quality monitoring stations nearest the study area are presented in Table 19a-7. It should be noted that these values are somewhat different than the background concentrations presented in Table 19a-4. These existing concentrations presented in Table 19a-7 are the latest (2007) measured values that have been made available by NYSDEC. Concentrations are averaged according to the NAAQS (e.g., $PM_{2.5}$ concentrations are averaged over three years). The background concentrations presented earlier in Table 19a-4 are the highest values based on several past years of measurements, and are used as a conservative estimate of the highest background concentrations for future conditions.

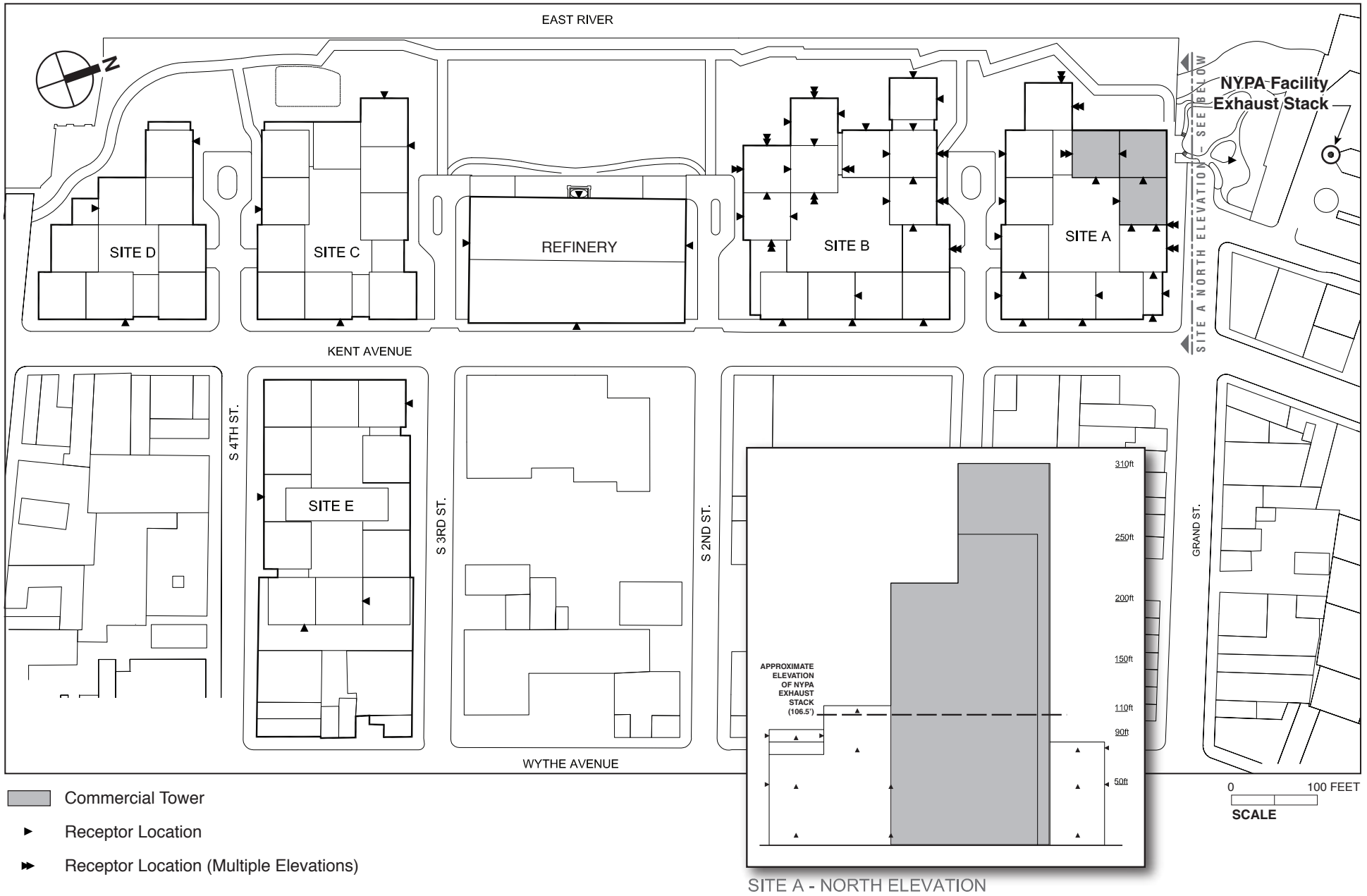
Table 19a-7
Representative Monitored Ambient Air Quality Data

Pollutants	Location	Units	Period	Concentration	Exceeds Federal Standard?	
					Primary	Secondary
CO	PS 59, Manhattan	ppm	8-hour	1.4	N	N
			1-hour	2.3	N	N
SO_2	PS 59, Manhattan	µg/m^3	Annual	26	N	-
			24-hour	76	N	-
			3-hour	133	-	N
Respirable particulates (PM_{10})	JHS 126, Brooklyn	µg/m^3	24-hour	57	N	N
Respirable particulates ($PM_{2.5}$)	JHS 126, Brooklyn	µg/m^3	Annual	13.9	N	N
			24-hour	33.6	Y(2)	Y(2)
NO_2	PS 59, Manhattan	µg/m^3	Annual	64	N	N
Lead	JHS 126, Brooklyn	µg/m^3	3-month	0.02	N	-
Ozone (O_3)	IS 52, Bronx	ppm	1-hour	0.103 (1)	N	N
		ppm	8-hour	0.076	N	N

Notes:
[1] The 1-hour ozone NAAQS has been replaced with the 8-hour standard; however, the maximum monitored concentration is provided for informational purposes.
[2] The maximum concentration exceeds the recently revised NAAQS based on the 98th percentile measurement over the most recent three-year period (2005-2007).
Source: NYSDEC, New York State Ambient Air Quality Data.

In the case of the 8-hour ozone and 24-hour $PM_{2.5}$, concentrations reflect the most recent three years of data, consistent with the basis for these standards. There were no monitored violations of NAAQS at these monitoring sites, with the exception of the maximum 24-hour $PM_{2.5}$ concentration, which is above the recently revised NAAQS. For modeling purposes, the analysis utilized the maximum values over the most recent three-year period (see Table 19a-4).

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NYPA Facility $PM_{2.5}$ Analysis
Receptor Locations
Figure 19a-2

EXISTING SIMULATED POLLUTANT CONCENTRATIONS IN THE STUDY AREA

The monitored concentrations (presented above) represent general air quality in the study area. However, the concentrations adjacent to the mobile-source analysis sites in the existing condition may be higher than at the monitoring stations, due to the adjacent vehicular emissions. Existing concentrations were calculated using the CAL3QHC dispersion model. The highest simulated existing eight-hour average CO concentrations at the mobile-source analysis sites are presented in Table 19a-8. (One-hour average values are not shown since predicted values are much lower than the one-hour standard of 35 ppm.)

Table 19a-8
Maximum Predicted Existing
Eight-Hour Average CO Concentrations for 2007

Receptor Site	Location	Time Period	8-Hour Concentration (ppm)
1	Kent Avenue & South 3rd Street	AM/PM	3.1
2	Kent Avenue & South 4th Street	AM/PM	3.1
3	Kent Avenue & Williamsburg Street West	AM	5.2
Note:	8-hour standard is 9 ppm.		

THE FUTURE WITHOUT THE PROPOSED PROJECT

MOBILE SOURCES ANALYSIS

Traffic Intersections

CO

CO concentrations in the No Action condition were determined for the Build year using the methodology previously described. Table 19a-9 shows future maximum predicted eight-hour average CO concentrations at the analysis intersections in the No Action condition (i.e., No Action values). The values shown are the highest predicted concentrations for the receptor locations for any of the time periods analyzed. As shown in Table 19a-9, No Action values are predicted to be well below the eight-hour CO standard of 9 ppm.

Table 19a-9
Future Maximum Predicted Eight-Hour
Average Carbon Monoxide No Action Concentrations

Receptor Site	Location	Time Period	8-Hour Concentration (ppm)
1	Kent Avenue & South 3rd Street	PM	3.2
2	Kent Avenue & South 4th Street	PM	3.3
3	Kent Avenue & Williamsburg Street West	AM	4.7
Note:	8-hour standard is 9 ppm.		

PM

PM concentrations in the No Action condition were determined for the Build year using the methodology previously described. Table 19a-10 presents the future maximum predicted 24-hour and annual average PM_{10} concentrations at the analysis intersections in the No Action condition (i.e., No Action values). The values shown are the highest predicted concentrations for the receptor locations for any of the time periods analyzed. Note that $PM_{2.5}$ concentrations in the No Action condition are not presented, since impacts are assessed on an incremental basis.

Table 19a-10
Future Maximum Predicted
No Action 24-Hour PM_{10} Concentrations

Receptor Site	Location	Concentration ($\mu g/m^3$)
1	Kent Avenue & South 4th Street	63.47
Note: NAAQS—24-hour, 150 $\mu g/m^3$.		

STATIONARY SOURCE ANALYSIS

As described in Chapter 2, "Analytical Framework," additional growth and development would occur within the project site and in the study area in the No Action condition by 2020. Overall, industrial source emissions would be lower than existing conditions due to the redevelopment of current manufacturing businesses to primarily residential uses, while HVAC emissions in the No Action condition would likely be somewhat greater than existing conditions.

THE FUTURE WITH THE PROPOSED PROJECT

The proposed project would result in increased mobile source emissions in the immediate vicinity of the project area and could also affect the surrounding community with emissions from HVAC equipment. The following sections describe the results of the studies performed to analyze the potential impacts on the surrounding community from these sources for the Build year. In addition, existing industrial facilities, including the NYPA facility, were assessed for potential significant adverse impacts on the proposed project's buildings.

MOBILE SOURCES

Traffic Intersections

CO

CO concentrations with the proposed project were determined for the Build year at traffic intersections using the methodology previously described. Table 19a-11 shows the future maximum predicted eight-hour average CO concentration with the proposed project at the three intersections studied. (No one-hour values are shown, since no exceedances of the NAAQS would occur and the *de minimis* criteria are only applicable to eight-hour concentrations; therefore, the eight-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 eight-hour CO standard. In addition, the incremental increases in eight-hour average CO concentrations are very small, and consequently would not result in a violation of the CEQR *de minimis* CO criteria. (The *de minimis* criteria were previously described.) Consequently, the proposed project would not result in any significant CO air quality impacts in the future with the proposed project condition.

Table 19a-11
Future Maximum Predicted Eight-Hour Average No Action and Future With the Proposed Project Build Carbon Monoxide Concentrations

Receptor Site	Location	Time Period	8-Hour Concentration (ppm)	
			No Action	Future with the Proposed Project
1	Kent Avenue & South 3rd Street	PM	3.2	3.6
2	Kent Avenue & South 4th Street	PM	3.3	3.6
3	Kent Avenue & Williamsburg Street West	AM	4.7	4.7
Note: 8-hour standard is 9 ppm.				

PM

PM concentrations with the proposed project were determined for the Build year using the methodology previously described. Table 19a-12 shows the future maximum predicted 24-hour average PM_{10} concentrations with the proposed project.

Table 19a-12
Future Maximum Predicted
24-Hour Average PM_{10} Concentrations

Receptor Site	Location	24-Hour Concentration ($\mu g/m^3$)	
		No Action	Future with the Proposed Project
1	Kent Avenue & South 4th Street	63.47	66.59
Note: NAAQS—24-hour, 150 $\mu g/m^3$.			

The values shown are the highest predicted concentrations for any of the time periods analyzed. The results indicate that the proposed project would not result in any violations of the PM_{10} standard at any of the receptor locations analyzed.

Future maximum predicted 24-hour and annual average $PM_{2.5}$ concentration increments with the proposed project were determined so that they could be compared with the interim guidance criteria that would determine the potential significance of the proposed project's impacts. Based on this analysis, the maximum predicted localized 24-hour average and neighborhood-scale annual average incremental $PM_{2.5}$ concentrations are presented in Tables 19a-13 and 19a-14, respectively. The results show that the annual and daily (24-hour) $PM_{2.5}$ increments are predicted to be well below the updated DEP interim guidance criteria and, therefore, the proposed project would not result in significant $PM_{2.5}$ impacts at the analyzed receptor locations.

Table 19a-13
Future Maximum Predicted
24-Hour Average $PM_{2.5}$ Increment

Receptor Site	Location	Increment
1	Kent Avenue & South 4th Street	0.18
Note: $PM_{2.5}$ interim guidance criteria—24-hour average, > 2 $\mu g/m^3$ (5 $\mu g/m^3$ not-to-exceed value), depending on the magnitude, frequency, duration, location, and size of the area of the predicted concentrations.		

Table 19a-14
Future Maximum Predicted
Annual Average $PM_{2.5}$ Increment

Receptor Site	Location	Increment
1	Kent Avenue & South 4th Street	0.03
Note: $PM_{2.5}$ interim guidance criteria—annual (neighborhood scale), 0.1 µg/m^3.		

Additional Receptor Sites

As described in "Methodology for Predicting Pollutant Concentrations," CO analyses were also undertaken at elevated receptors to determine if there would be any CO impacts at these locations (e.g., the upper floors of project buildings on Site D that would be located near traffic lanes on the Williamsburg Bridge). The maximum predicted one- and eight-hour average CO concentrations on "worst-case" development sites at elevated receptors are presented in Table 19a-15. The results show that future CO concentrations at the project sites situated near elevated roadways are well below the standards.

Table 19a-15
Future Maximum Predicted One- and Eight-Hour
Carbon Monoxide on the Proposed Project (parts per million)

Receptor Site	Location	Time Period	1-Hour	8-Hour
4	Williamsburg Bridge Approach at Site D	AM	4.6	2.9
		PM	4.7	3.0
Notes: NAAQS: 1-hour: 35 ppm. 8-hour: 9 ppm.				

Parking Facilities

A screening analysis was performed to assess potential impacts from the proposed project's parking facilities based on the methodology previously discussed. For the proposed parking facility at Site A, the maximum overall predicted future CO concentrations (including ambient background levels) at any receptor location would be 9.4 ppm and 4.4 ppm for the one- and eight-hour periods, respectively. The maximum one- and eight-hour contributions from the parking garage alone would be 5.4 ppm and 1.9 ppm, respectively. For the proposed parking facility at Site E, the maximum overall predicted future CO concentrations (including ambient background levels and potential contributions from nearby on-street traffic) at sidewalk receptor locations would be 10.6 ppm and 6.1 ppm for the one- and eight-hour periods, respectively. The maximum one- and eight-hour contributions from the parking garage alone would be 5.0 ppm and 2.5 ppm, respectively. The values are the highest predicted concentrations for any time period analyzed.

These maximum predicted CO levels are below the applicable CO standards and CEQR CO *de minimis* criteria. Therefore, no significant adverse impacts from the proposed project's parking garages are expected.

STATIONARY SOURCES

HVAC Systems

Table 19a-16 shows maximum predicted concentrations for NO_2, CO, and PM_{10} from the proposed project's HVAC systems. As shown in the table, the maximum concentrations from stack emissions, when added to ambient background levels, would be well below the NAAQS.

Table 19a-16
Future Maximum Modeled Pollutant Concentrations from the Proposed Project (μg /m^3)

Pollutant	Averaging Period	Concentration Due to Stack Emission	Maximum Background Concentration	Modeled Load Condition	Total Concentration	Standard
NO_2 (1)	Annual	0.86	71.5	25%	72.4	100
CO	1-Hour	369.1	4,851	50%	5,220	40,000
	8-Hour	78.8	2,863	100%	2,942	10,000
PM_{10} (2)	24-hour	3.7	60	100%	63.7	150

Notes:
[1] NO_2 impacts were estimated using a NO_2/NO_x ratio of 0.55.
[2] EPA revoked the annual NAAQS for PM_{10}, effective December 18, 2006.

The air quality modeling analysis also determined the highest predicted increase in 24-hour and annual average $PM_{2.5}$ concentrations from the proposed project's HVAC systems. As shown in Table 19a-17, the maximum 24-hour incremental impacts at any discrete receptor location would be less than the applicable interim guidance criterion of 2 μg/m^3. On an annual basis, the projected $PM_{2.5}$ impacts would be less than the applicable interim guidance criterion of 0.3 μg/m^3 for local impacts, and the DEP interim guidance criterion of 0.1 μg/m^3 for neighborhood scale impacts. Therefore, no potential significant stationary source air quality impacts related to $PM_{2.5}$ are expected to occur with the proposed project.

Table 19a-17
Future Maximum Predicted $PM_{2.5}$ Concentrations

Pollutant	Averaging Period	Maximum Concentration	Modeled Load Condition	Threshold Concentration (μg/m^3)
$PM_{2.5}$	24-hour	1.9	100%	5/2
	Annual (discrete)	0.12	25%	0.3
	Annual (neighborhood scale)	0.01	25%	0.1

To preclude the potential for significant adverse air quality impacts from the proposed project's HVAC emissions, the Restrictive Declaration would have the following requirements for the proposed developments:

Block 2414, Lot 1 (Sites A, B, C, D). Any new development on this property must ensure that the heating, ventilating, and air conditioning stack(s) utilize natural gas, to avoid any potential significant air quality impacts.

Site A. Boiler exhaust stacks on this property must have a minimum exhaust height of 309 feet above Brooklyn Datum, and must be located no greater than 66 feet from the lot line facing Grand Street to avoid any potential significant air quality impacts.

Site B. Boiler exhaust stacks on this property must have a minimum exhaust height of 407 feet above Brooklyn Datum, and must be located no greater than 417 feet from the lot line facing Grand Street to avoid any potential significant air quality impacts.

Site C. Boiler exhaust stacks on this property must have a minimum exhaust height of 400 feet above Brooklyn Datum, and must be located no greater than 383 feet from the lot line facing South 5th Street to avoid any potential significant air quality impacts.

Site D. Boiler exhaust stacks on this property must have a minimum exhaust height of 331 feet above Brooklyn Datum, and must be located no greater than 130 feet from the lot line facing South 5th Street to avoid any potential significant air quality impacts.

Block 2428 Lot 1 (Site E) Any new development on this property must ensure that the heating, ventilating, and air conditioning stack(s) utilize natural gas, to avoid any potential significant air quality impacts. Boiler exhaust stacks on this property must have a minimum exhaust height of 157 feet above Brooklyn Datum, and must be located at least 228 feet from the lot line facing Kent Avenue, to avoid any potential significant air quality impacts.

In the event that the construction of the Refinery were to occur before the completion of Site C, the following restrictions would apply.

Block 2414, Lot 1 (Refinery). Heating, ventilating, and air conditioning stack(s) must utilize natural gas, to avoid any potential significant air quality impacts. Boiler exhaust stacks on this property must have a minimum exhaust height of 220 feet above Brooklyn Datum and be located at least 743 feet from the lot line facing South 5th Street to avoid any potential significant air quality impacts. Upon completion of Site B, no boiler exhausts stacks are permitted on this property.

Figure 19a-3 shows the areas on each site where boiler stacks are to be restricted. With these restrictions, emissions from the boiler exhaust stacks would not result in any significant adverse air quality impacts.

Industrial Source Analysis

As discussed above, a study was conducted to identify manufacturing and industrial uses within the 400-foot study area. DEP-BEC and EPA permit databases were used to identify existing sources of industrial emissions. Three permitted facilities were identified within 400 feet of the project site in the future with the proposed project condition.

The screening procedure used to estimate the pollutant concentrations from these businesses is based on information contained in the certificates to operate obtained from DEP-BEC and NYSDEC. The information describes potential contaminants emitted by the permitted processes, hours per day, and days per year in which there may be emissions (which is related to the hours of business operation), and the characteristics of the emission exhaust systems (temperature, exhaust velocity, height, and dimensions of exhaust).

Table 19a-18 presents the maximum impacts at the proposed project. The table also lists the Short-Term Guideline Concentrations (SGC) and Annual Guideline Concentrations (AGC) for each toxic air pollutant. The results of the industrial source analysis demonstrate that there would be no predicted significant adverse impacts on the proposed project from existing industries in the area.

Additional Sources

Additional Sources - NO_2, CO, and PM_{10}

Potential stationary source impacts on the project from the NYPA facility were determined using the methodology previously described. The estimated concentrations from the modeling were added to the background concentrations to estimate total air quality concentrations at the proposed development sites. The results of this analysis are presented in Table 19a-19 for NO_2, CO and PM_{10}.

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Restricted Area for Placement of Boiler Exhaust Stack

Modeled Stack Location

DOMINO SUGAR REZONING

Modeled Boiler Stack Locations
Figure 19a-3

Table 19a-18
Maximum Predicted Impacts from Industrial Sources

Potential Contaminants	Estimated Short-term Impact (ug/m^3)	SGC[a] (ug/m^3)	Estimated Long-term Impact (ug/m^3)	AGC[a] (ug/m^3)
Acetone	395.4	180,000	0.54	28,000
Carbon Monoxide	1476.6	14,000	10.93	--
Hexane	143.7	--	1.08	700
Isopropyl Alcohol	253.6	98,000	0.97	7,000
Nitrogen Dioxide	177.4	--	0.53	100
Nitrogen Oxides	935.6	--	7.04	74
Particulates	156.8	380	0.26	45
Stoddard Solvent	779.7	--	3.11	1,300
Sulfur Dioxide	0.9	910	0.003	80

Notes:
[a]NYSDEC DAR-1 (Air Guide-1) AGC/SGC Tables, September, 2007.
AGC-Annual Guideline Concentrations.
SGC-Short-term Guideline Concentrations.

Table 19a-19
Maximum Modeled Pollutant Concentrations from the NYPA North 1st Street Facility on the Proposed Project ($\mu g/m^3$)

Pollutant	Averaging Period	Concentration Due to Stack Emission	Maximum Background Concentration	Total Concentration	Standard
NO_2 (1)	Annual	0.44	71.5	71.9	100
CO	1-Hour	42.3	4,851	4,893.3	40,000
	8-Hour	26.3	2,863	2,889.3	10,000
PM_{10} (2)	24-hour	9.9	60	69.9	150

Notes:
[1] NO_2 impacts were estimated using a NO_2/NO_x ratio of 0.55.
[2] EPA revoked the annual NAAQS for PM_{10}, effective December 18, 2006.

As shown in the table, the predicted pollutant concentrations for all of the pollutant time averaging periods shown are well below their respective standards. Therefore, no significant air quality impacts would occur on the proposed project's buildings from these pollutants.

Additional Sources - $PM_{2.5}$

Potential stationary source impacts of $PM_{2.5}$ on the project from the NYPA facility were determined using wind tunnel modeling, as previously described.

The air quality modeling analysis determined the maximum predicted increase in 24-hour and annual average $PM_{2.5}$ increments from the NYPA facility on the proposed project. As shown in Table 19a-20, the maximum 24-hour incremental impacts at any discrete receptor location would be less than the applicable interim guidance criterion of 5 $\mu g/m^3$. On an annual basis, the maximum projected $PM_{2.5}$ increments would be less than the applicable interim guidance criterion of 0.3 $\mu g/m^3$ for local impacts.

The air quality analysis also evaluated impacts with the 24-hour average interim guidance criterion of 2 $\mu g/m^3$ for discrete receptor locations. The assessment examined the magnitude, duration, frequency, and extent of the increments at locations where exposure above the 2 $\mu g/m^3$ threshold averaged over a 24-hour period could occur.

Table 19a-20
Future Maximum Predicted $PM_{2.5}$ Increments

Averaging Period	Maximum Increment (µg/m^3)	Incremental Threshold (µg/m^3)
24-Hour	2.74	5/2
Annual	0.19	0.30
Note:	24-hour $PM_{2.5}$ interim guidance criterion, > 2 µg/m^3 (5 µg/m^3 not-to-exceed value), depending on the magnitude, frequency, duration, location, and size of the area of the predicted concentrations.	

Site A. The receptor location with the maximum continual 24-hour exposure would be on the north façade of Site A, in the residential northeastern portion of the site, at an elevation of 90 feet. At this location, the maximum 24-hour average $PM_{2.5}$ incremental concentration from the NYPA facility is predicted to be 2.36 µg/m^3. $PM_{2.5}$ incremental concentrations exceeding 2 µg/m^{3}on this site were predicted on the north façade at one other residential location, at the maximum residential elevation of 110 feet. On this site, floors above this height would be for commercial or community facility use with inoperable windows and no air intakes. 24-Hour incremental concentrations from the NYPA facility were predicted to exceed 2 µg/m^3 at a maximum frequency of twice per year, and with an annual average frequency of less than once per year. At other locations on this site, maximum 24-hour average $PM_{2.5}$ incremental concentration from the NYPA facility are predicted to be less than 2.0 µg/m^3.

Site B. On Site B, the receptor location with the maximum continual 24-hour exposure from the NYPA facility would be on the north façade, at an elevation of 410 feet. At this location, maximum 24-hour $PM_{2.5}$ incremental concentration would be 2.74 µg/m^3. $PM_{2.5}$ incremental concentrations exceeding 2 µg/m^{3}on this site were predicted on the north façade at two other locations, at elevations of 300 feet and 360 feet; on the west façade at one discrete location at an elevation of 230 feet; and on the east façade at five locations at elevations of 230 to 410 feet. At each of these receptors, 24-hour average incremental concentrations were predicted to exceed 2 µg/m^3 at a maximum frequency of from one to three times per year, and with an annual average frequency of once per year or less. At other locations on this site, maximum 24-hour average $PM_{2.5}$ incremental concentration from the NYPA facility is predicted to be less than 2.0 µg/m^3.

Sites C, D, and E, and the Refinery. At each of these locations, maximum predicted $PM_{2.5}$ incremental concentrations from the NYPA facility were predicted to be below the interim guidance criterion of 2 µg/m^3.

Ground Level Receptor Locations. At a number of receptor locations, at the ground level of proposed buildings and in Grand Ferry Park, potential maximum $PM_{2.5}$ concentrations were estimated. The maximum predicted 24-hour and annual $PM_{2.5}$ concentrations are 0.73 µg/m^3 and 0.034 µg/m^3, respectively, on the project site, and 0.51 µg/m^3 and 0.023 µg/m^3, respectively, in Grand Ferry Park. These concentrations are extremely low and do not exceed any interim guidance thresholds for $PM_{2.5}$; therefore, they are not considered significant.

Furthermore, future air quality in New York City is expected to improve, as presented in the NYSDEC draft $PM_{2.5}$ State Implementation (SIP). Well before the projected completion of the proposed project in 2020, the annual $PM_{2.5}$ NAAQS is projected to be attained at all locations in the New York City Metropolitan Area, with reductions in annual average $PM_{2.5}$ concentrations exceeding any predicted localized increment from the NYPA facility. This will also result in lower 24-hour average $PM_{2.5}$ concentrations. NYSDEC will also be addressing the attainment of the 24-hour NAAQS in the area, which will require further reductions in emissions of $PM_{2.5}$ and its precursors. Taken together, these reductions are anticipated to result in a substantial

improvement in air quality at the project site, further reducing the 24-hour average $PM_{2.5}$ concentrations from the NYPA facility, as well as from other sources in the ambient air.

To ensure that there are no significant adverse impacts of $PM_{2.5}$ on Site A from the NYPA facility, any locations above an elevation of 110 feet, the approximate stack height of the NYPA facility, would have inoperable windows and no air intakes. With these restrictions in place, there would be no significant adverse air quality impacts from the NYPA facility on the proposed project.

Overall, the magnitude, extent, and frequency of concentrations above 2.0 $\mu g/m^3$ are very low. Consequently, no potential significant air quality impacts related to $PM_{2.5}$ are expected to occur from the NYPA facility on the proposed project.

B. GREENHOUSE GAS EMISSIONS

INTRODUCTION

There is general consensus in the scientific community that the global climate is changing as a result of increased concentrations of greenhouse gases (GHG) in the atmosphere. As a consequence, government policies have begun to address GHG emissions at global, national, and local levels, including New York City's long-term sustainability program, PlaNYC 2030.

An analysis of the potential GHG emissions associated with the proposed project is presented in this section. Specific measures to reduce GHG emissions and improve energy efficiency that are either included as part of the proposed project or are under consideration are discussed as well, and quantified to the extent possible.

The proximity of the proposed development to public transportation, its mixed-use program, and dense design are all factors that contribute to the energy efficiency of the proposed project, resulting in lower GHG emissions.

PRINCIPAL CONCLUSIONS

Overall, the site selection, the reuse of the existing Refinery complex, the dense and mixed-use design, the commitment to achieve a significant reduction in energy use, and other measures incorporated in the proposed project would result in lower GHG emissions than would otherwise be achieved by similar residential and commercial uses, and, thus, would advance New York City's GHG reduction goals as stated in PlaNYC.

The annual GHG emissions from the proposed project are predicted to be approximately 39,699 metric tons of carbon dioxide equivalent (defined below). This does not represent a net increment in GHG emissions, since similar GHG emissions would occur if residential units and associated uses were to be constructed elsewhere, and could be higher if constructed with less energy efficiency, as lower density residential, further from employment and commercial uses, and/or with less access to transit service.

ANALYSIS APPROACH

Although the contribution of any single project to climate change is infinitesimal, the combined GHG emissions from all human activity have a severe adverse impact on global climate. While the emission of criteria pollutant and toxic air emissions are assessed in the context of health-based standards and local impacts, there are no established thresholds for assessing the

significance of a project's contribution to climate change. Nonetheless, the nature of the climate change impact dictates that all sectors address GHG emissions by identifying GHG sources and practicable means to reduce them.

Therefore, this section does not identify the relative increment in GHG emissions due to the proposed project as compared with the No Action condition, but rather presents the total GHG emissions associated with the proposed project (on-site fuel use, electricity use, vehicle use, waste generation, and construction) and identifies the measures incorporated in the proposed project to limit those emissions. Note that much of these emissions would be associated with similar activity regardless of the proposed project. For example, if the proposed buildings were to be constructed elsewhere to accommodate the same number of people as the proposed project, the electricity use, fuel consumption, vehicle use, and construction materials used associated with those buildings could, depending on their location, access to transit, building type, construction materials, and energy efficiency measures, equal or exceed those of the proposed project.

POLLUTANTS OF CONCERN

GHGs are those gaseous constituents of the atmosphere, from both natural and anthropogenic (i.e., resulting from the influence of human beings) emission sources, that absorb infrared radiation (heat) emitted from the earth's surface, the atmosphere, and clouds. This property causes the general warming of the earth's atmosphere, or the "greenhouse effect." Water vapor, carbon dioxide (CO_2), nitrous oxide, methane, and ozone are the primary greenhouse gases in the earth's atmosphere.

CO_2 is the primary pollutant of concern from anthropogenic emission sources. CO_2 is by far the most abundant and has the greatest overall impact on global average atmospheric temperature. CO_2 is emitted as a product of combustion (both natural and anthropogenic) from some industrial processes such as the manufacture of cement, mineral production, metal production, and the use of petroleum-based products, from volcanic eruptions, and from the decay of organic matter. CO_2 is removed ("sequestered") from the lower atmosphere by natural processes such as photosynthesis and uptake[1] by the oceans. CO_2 is included in any analysis of GHG emissions.

Methane and nitrous oxide also play an important role in global climate change, since they have longer atmospheric lifetimes and a greater ability to absorb infrared radiation than an equal quantity of CO_2. Methane is emitted from agriculture, natural gas distribution, and decomposition of organic materials in landfills and wastewater treatment plants. Methane is also released from natural processes that include the decay of organic matter lacking sufficient oxygen, for example, in wetlands. Nitrous oxide is emitted from fertilizer use and fossil fuel burning. Natural processes in soils and the oceans also release nitrous oxide. Therefore, emissions of these compounds are included in GHG emissions analyses as appropriate.

Other GHGs—including certain hydrofluorocarbons (HFCs), used as refrigerants and foam blowers and released as byproducts from the production of other HFCs; some perfluorocarbons (PFCs), produced as byproducts of traditional aluminum production, among other activities; and sulfur hexafluoride (SF_6), used as an electrical insulating fluid in power distribution equipment—are sometimes included in GHG emissions analyses where relevant (e.g., analysis of manufacturing facilities), but are not included in the analysis of the proposed project, since the proposed project would not result in significant emissions of these GHGs.

[1] Biological and chemical processes by which CO_2 is removed from the atmosphere and stored in the oceans.

There are also a number of entirely human-made GHGs in the atmosphere, such as halocarbons and other chlorine- and bromine-containing substances, which are also responsible for damaging the stratospheric ozone layer (creating the "ozone hole"). Since these compounds are being replaced and phased out from use due to the 1987 Montreal Protocol, there is generally no need to address these chemicals in GHG assessments of residential and commercial uses, which are not sources of those gases. Ozone itself is also a substantial GHG; however, long-term project-level impacts on ozone emissions as a GHG do not need to be analyzed, since ozone is a rapidly reacting chemical, and since efforts are ongoing to reduce the production of ozone as a criteria pollutant.

Although water vapor is of great importance to global climate change, it is not directly of concern as an emitted pollutant, since the miniscule quantities of anthropogenic emissions are of no consequence. However, an increase in global temperature can increase evaporation and thereby, indirectly, cause further atmospheric warming.

POLICY, REGULATIONS, STANDARDS, AND BENCHMARKS

As a result of the growing consensus that human activity resulting in GHG emissions has the potential to profoundly impact the earth's climate, countries around the world have undertaken efforts to reduce emissions by implementing both global and local measures addressing energy consumption and production, land use, and other sectors. Although the U.S. has not ratified the international agreements which set emissions targets for GHGs, in a step toward the development of national climate change regulation, in June 2009 the U.S. House of Representatives passed the American Clean Energy and Security Act (ACES, "cap and trade bill"). The proposed legislation would place a national cap on GHG emissions, resulting in the gradual reduction of emission from large sources (accounting for approximately 85 percent of the U.S. GHG emissions) to 17 percent lower than 2005 levels by 2020 and to 83 percent lower than 2005 levels by 2050. ACES calls for the long-term investment of billions of dollars in energy efficiency and renewable energy, carbon capture and storage, electric and other advanced technology vehicles, and basic scientific research and development in related fields. Although this legislation activity is still in progress, without such legislation EPA would be obliged to act as a regulator, under a U.S. Supreme Court ruling which affirmed GHG's as pollutants under the Clean Air Act.

EPA has established various voluntary programs to reduce emissions and increase energy efficiency and has recently embarked on a few regulatory initiatives related to GHG emissions, including regulation of geological sequestration of CO_2, and a GHG reporting rule to collect information on GHG emissions as pollutants.

The Energy Independence and Security Act of 2007 includes provisions for increasing the production of clean renewable fuels, increasing the efficiency of products, buildings, and vehicles, and for promoting research on greenhouse gas capture and storage options. The American Recovery and Reinvestment Act of 2009 (ARRA, "economic stimulus package") funds actions and research that can lead to reduced GHG emissions. The wind, biomass, geothermal, and landfill tax credits have also been extended. Funds from ARRA are currently being disbursed.

In March 2009, the U.S. Department of Transportation (USDOT) set combined corporate average fuel economy (CAFE) standards for light-duty vehicles for the 2011 model year (MY). In June 2009, EPA granted California a previously denied waiver to regulate vehicular GHG emissions, allowing 19 other states (representing 40 percent of the light-duty vehicle market, including New York) to adopt the California mobile source GHG emissions standards. EPA and USDOT have recently proposed legislation to establish the first GHG emission standards and more stringent

CAFE standards for MY2012 through 2016 light-duty vehicles. These regulations will all serve to reduce vehicular GHG emissions over time.

There are also regional, state, and local efforts to reduce GHG emissions. In 2009, Governor Paterson issued Executive Order No. 24, establishing a goal of reducing GHG emissions in New York by 80 percent, compared to 1990 levels, by 2050. The 2009 New York State Energy Plan,[1] outlines the state's energy goals and provides strategies and recommendations for meeting those goals. The state's goals include:

- Implementing programs to reduce electricity use by 15 percent below 2015 forecasts;
- Updating the energy code;
- Reducing vehicle miles traveled by expanding alternative transportation options;
- Implementing programs to increase the proportion of electricity generated from renewable resources to 30 percent of electricity demand by 2015; and
- Developing a Climate Action Plan in accordance with Executive Order No. 24 to identify strategies, actions, and infrastructure needs to reduce GHG emissions by 80 percent by 2050.

New York State has also developed regulations to cap and reduce CO_2 emissions from power plants to meet its commitment to the Regional Greenhouse Gas Initiative (RGGI). Under the RGGI agreement, the governors of 10 northeastern and mid-Atlantic states have committed to regulate the amount of CO_2 that power plants are allowed to emit. The regional emissions from power plants will be held constant through 2014, and then gradually reduced to 10 percent below the initial cap through 2018. Each power source with a generating capacity of 25 megawatts or more would need to purchase a tradable CO_2 emission allowance for each ton of CO_2 it emits. The 10 RGGI states and Pennsylvania have also announced plans to reduce GHG emissions from transportation, through the use of biofuel, alternative fuel, and efficient vehicles.

Many local governments worldwide, including New York City, are participating in the Cities for Climate Protection™ (CCP) campaign and have committed to adopting policies and implementing quantifiable measures to reduce local GHG emissions, improve air quality, and enhance urban livability and sustainability.

New York City has a long-term sustainability program, PlaNYC 2030, which sets a citywide GHG emissions reduction goal of 30 percent below 2005 levels by 2030. PlaNYC includes specific initiatives that can result in emission reductions and initiatives targeted at adaptation to climate change impacts. The New York City Climate Protection Act (enacted in 2007) codified PlaNYC's GHG reduction goal in the Administrative Code of the City of New York. The law also requires the City to reduce GHG emissions from municipal operations by 2017 to 30 percent less than fiscal year 2006 emissions. Of particular relevance to GHGs from development projects are PlaNYC initiatives to encourage higher density where appropriate, mixed use, infill, and transit-oriented development, promote cycling, expand clean distributed generation, foster a market for renewable energy, and improve private vehicle fuel efficiency. In December 2009, the New York City Council enacted a suite of four laws aimed at achieving higher energy efficiency in new and existing buildings, in accordance with PlaNYC. The laws will require owners of existing buildings larger than 50,000 square feet to conduct energy efficiency audits every 10 years, to optimize building energy efficiency, and to "benchmark" the building energy and water consumption annually, using an EPA online tool. By 2025, commercial buildings over

[1] New York State, *2009 New York State Energy Plan*, December 2009.

50,000 square feet would also require lighting upgrades, including the installation of sensors and controls, more efficient light fixtures, and the installation of submeters, so that tenants could be provided with information on their electricity consumption. The legislation would also create a local New York City Energy Code, which would require equipment installed during a renovation to meet current efficiency standards.

A number of benchmarks for energy efficiency and green building design have also been developed. For example, the United States Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED) system is a benchmark for the design, construction, and operation of high performance green buildings that includes energy efficiency components. EPA's Energy Star is a voluntary labeling program designed to identify and promote energy efficient appliances, office equipment, lighting, home electronics, and building envelopes.

There is an emerging consensus that GHGs need to be considered in the environmental review of major projects. NYSDEC has published guidance on the analysis of GHG emissions for projects where GHG emissions or energy use have been identified as significant and where NYSDEC is the lead agency,[1] and the City of New York is currently formulating guidance for analysis under CEQR. However, there are currently no specific benchmarks or regulations applicable to GHG emission levels or impacts from actions subject to environmental review in New York State or New York City. Accordingly, the potential effects of the proposed project have been evaluated in the context of the objectives stated in PlaNYC. Potential GHG emissions from the proposed project are assessed and disclosed, and the feasibility and practicability of various measures available for reducing GHG emissions are discussed. Commitments to implement such measures are noted.

METHODOLOGY

Emissions of GHG that would be associated with the proposed project have been quantified, including GHG emissions from HVAC systems, off-site emissions associated with the production of electricity used on-site, emissions from vehicle use attributable to the proposed project, and emissions indirectly produced as a result of solid waste that would be generated by the development and disposed of in landfills. Average annual and total GHG emissions that would result from construction of the development, including on-site construction equipment, delivery trucks, and upstream emissions from the production of steel, rebar, aluminum, and cement used for construction, were calculated as well.

GHG emissions for gases other than CO_2 are included where practicable or in cases where they comprise a substantial portion of overall emissions. The various GHG emissions are added together and presented as CO_2 equivalent (CO_2e) emissions—a sum which includes the quantity of each GHG weighted by a factor of its effectiveness as a GHG using CO_2 as a reference. This is achieved by multiplying the quantity of each GHG emitted by a factor called global warming potential (GWP). The GWP accounts for the lifetime and the radiative forcing of each gas over a period of 100 years (e.g., CO_2 has a much shorter atmospheric lifetime than SF_6, and therefore has a much lower GWP). The GWPs for the main GHGs discussed are presented in Table 19b-1.[2]

[1] NYSDEC, Guide for Assessing Energy Use and Greenhouse Gas Emissions in an Environmental Impact Statement, July 15, 2009.

[2] Following standard protocol for greenhouse gas inventories, and consistent with New York City's GHG inventory, the GWP factors from IPCC's Second Assessment Report (1996) are used. These GWP factors are specified for use for national GHG inventories under the Kyoto Protocol.

Table 19b-1
Global Warming Potential (GWP) for Major GHGs

Compound	100-year Horizon GWP
Carbon Dioxide (CO_2)	1
Methane (CH_4)	21
Nitrous Oxide (N_2O)	310
Hydrofluorocarbons (HFCs)	140 to 11,700
Perfluorocarbons (PFCs)	6,500 to 9,200
Sulfur Hexafluoride (SF_6)	23,900

Sources: IPCC, Climate Change 1995—The Science of Climate Change: Contribution of Working Group I to the Second Assessment of the Intergovernmental Panel on Climate Change, 1996.

EPA estimates that the well-to-pump GHG emissions of gasoline and diesel are approximately 20 and 22 percent of the tailpipe emissions, respectively.[1] Although upstream emissions (emissions associated with production, processing, and transportation) of all fuels can be substantial and are important to consider when comparing the emissions associated with the consumption of different fuels, they are not considered in the analysis for the proposed project, in accordance with the methodology used in developing the New York City GHG inventory. The GHG emissions are presented as metric tons of CO_2e per year, consistent with the New York City annual inventory.[2]

The project is committed to achieving energy efficiency resulting in 10 percent less energy consumed than would be achieved solely based on the existing building energy code requirements, and is exploring options to achieve greater energy efficiency. The analysis below assumes only a 10 percent energy efficiency will be achieved.

ON-SITE GHG EMISSIONS FROM HEAT AND HOT WATER SYSTEMS

The proposed project would allow for the development of residential, commercial office, retail, and community space. It is expected that natural gas would be used as the primary fuel for heat and hot water systems for the proposed project. An emission factor of 117 pounds of CO_2 per MMBtu of natural gas was used to calculate GHG emissions.[3] The amount of fuel required for building heat and hot water systems was calculated to assess the energy needs of the proposed project (see Appendix E: Air Quality), and is estimated at approximately 70,000 MMBtu per year of natural gas, assuming no energy efficiency beyond that required by code. Based on the commitment to implement energy efficiency measures that would reduce building energy use by at least 10 percent as compared with code, it was assumed that fuel use in heat and hot water systems for the proposed buildings would be 10 percent lower than the baseline consumption described above. The commitment to energy efficiency would apply to total energy consumption, from electricity use and on-site fuel use in heat and hot water systems. For the purposes of this assessment, it was assumed that the 10 percent overall energy efficiency would result in a 10 percent reduction from each of the energy use components (electricity and on-site fuel use).

[1] EPA, Renewable Fuel Standard Program—Lifecycle Analysis of Renewable Fuels, May 2009, http://www.epa.gov/otaq/renewablefuels/index.htm.

[2] *Inventory of New York City Greenhouse Gas Emissions 2008*, Mayor's Office of Long-Term Planning and Sustainability, September 2009.

[3] Energy Information Administration. Voluntary Reporting of Greenhouse Gases Program, Fuel and Energy Source Codes and Emission Coefficients. http://www.eia.doe.gov/oiaf/1605/coefficients.html

OFF-SITE GHG EMISSIONS FROM ELECTRICITY USE

The demand for electricity for the proposed development was calculated using building energy modeling to assess the energy needs of the proposed project (see Appendix E), and is estimated at approximately 42,682 Megawatt hours (MWh) per year, assuming no energy efficiency beyond that required by code. Based on the energy efficiency commitment, a 10 percent reduction in the above quoted electricity consumption was assumed in estimating the GHG emissions. A GHG emission factor of 775 lbs/MWh was applied based on the coefficient for electricity consumed in New York City in 2008.[1] The coefficient included the consumption of both in-city-generated and imported electricity, and accounted for transmission and distribution losses. Emissions of CO_2, methane, and nitrous oxide were accounted for. Although the electricity emission factor would likely decrease by 2020 due to an expected increase in the amount of electricity produced from renewable sources, the 2008 emissions factor was conservatively used without an adjustment for future emissions.

GHG EMISSIONS FROM VEHICLE USE

The vehicle trips generated by the proposed project are discussed in Chapter 17, "Traffic and Parking." The annual number of car and truck trips that could be attributed to the proposed project was calculated from average daily weekday, Saturday, and Sunday person trips for each use group, percentage of trips by car and taxi, and average vehicle occupancy, as described in Chapter 17, "Traffic and Parking." An average trip distance for personal vehicles was developed using weekday and weekend data from the 2001 National Household Travel Survey.[2] The average weekday and weekend trip distances used in the analysis for each type of use are presented in Table 19b-2.

Table 19b-2
Average Vehicle Trip Distances

Use Type	Trip Distance Weekday (miles)	Trip Distance Weekend (miles)
Residential	7.52	8.78
Office	11.19	8.17
Other Commercial	4.57	7.75
Community Uses	8.91	6.13
Recreational Open Space	9.65	11.55

Notes: The distances presented are one-way average trip distances.
Sources: Center for Transportation Analysis, Oak Ridge National Laboratories, Add-on for New York State, National Household Travel Survey (NHTS), 2001.

Delivery truck distances were calculated based on data from the Freight Analysis Framework (FAF2, FHWA) for the New York Metropolitan Area.[3] The average one-way truck trip distance

[1] *Inventory of New York City Greenhouse Gas Emissions 2008*, Appendix: Electricity Coefficients, Mayor's Office of Long-Term Planning and Sustainability, PlaNYC2030, September 2009.

[2] Center for Transportation Analysis, Oak Ridge National Laboratories, Add-on for New York State, National Household Travel Survey (NHTS), 2001.

[3] AKRF, 2009. This estimate is based on the freight tonnage by mode, origin, and destination for the New York City Combined Statistical Area, obtained from FHWA's Freight Analysis Framework FAF2 Provisional Commodity Origin-Destination Database (2008 data). Driving distances for each origin/destination were estimated and multiplied by the tonnage, resulting in ton-miles for each origin/destination. Average distance was calculated by dividing the total ton-miles by the total tons delivered.

used in the analysis was 112 miles. This distance is likely a conservatively high estimate, since it does not account for linked trips on multi destination deliveries.

The average car and truck fuel efficiencies of 24.6 miles per gallon (mpg) and 6.5 mpg, respectively, projected for the 2020 analysis year, were employed in estimating the annual fuel consumed by vehicle use connected with the proposed project.[1] It was assumed that all trucks would be diesel-fueled and that all cars would be gasoline-fueled. The GHG emission factors were based on the gasoline and diesel fuel carbon content,[2] assuming that all carbon is transformed to CO_2, resulting in emission factors of 8,877 grams (g) CO_2 per gallon of gasoline and 10,186 g CO_2 per gallon of diesel.

GHG EMISSIONS FROM WASTE GENERATION

The quantity of waste that would be generated annually by the proposed project is described in Chapter 15, "Solid Waste and Sanitation Services." Since information about the type of waste that would be generated by each of the proposed uses is not available, the waste stream composition was estimated based on data from the New York City Waste Composition Survey[3] (for residential uses), and from the Commercial Waste Study[4] (for all other uses). Annual GHG emissions associated with each waste type were estimated using EPA's Waste Reduction Model (WARM)[5]. WARM calculates GHG emissions for a variety of waste management practices—source reduction, recycling, combustion, composting, and landfilling—for 34 types of waste materials.

CONSTRUCTION GHG EMISSIONS

Construction activities for the proposed project would result in GHG emissions from on-site engines, truck travel, and water vessel trips associated with construction material deliveries and disposal, construction worker trips, and the use of steel, rebar, aluminum, and concrete.

Construction Activity

GHG emissions from construction material delivery and disposal by trucks barges, and rail, construction worker trips, as well as construction equipment, were quantified using the construction activity estimates developed as part of Chapter 21, "Construction Impacts." The emission factors for construction equipment were obtained from the EPA's NONROAD2008 Emission Model (NONROAD). The model is based on source inventory data accumulated for specific categories of nonroad equipment.

For construction material deliveries by truck, barge, and rail a GHG emission factor of 10,186 g CO_2e per gallon of diesel was used, based on the carbon content of diesel (see "GHG Emissions from Vehicle Use," above). The fuel efficiency of construction trucks was assumed to be 6.3

[1] Energy Information Administration, An Updated Annual Energy Outlook 2009 Reference Case Reflecting Provisions of the American Recovery and Reinvestment Act and Recent Changes in the Economic Outlook, 2009. Table 7 Transportation Sector Key Indicators and Delivered Energy Consumption.

[2] The Code of Federal Regulations (40 CFR 600.113).

[3] *The New York City 2004-05 Residential and Street Basket Waste Characterization Study (WCS)*, prepared for New York City Department of Sanitation, Bureau of Waste Prevention, Refuse and Recycling, March 2007.

[4] *Commercial Waste Management Study*, prepared for New York City Department of Sanitation, March 2004.

[5] Environmental Protection Agency WARM, updated August 2008. Available from: http://www.epa.gov/climatechange/wycd/waste/calculators/Warm_home.html

mpg—the EIA projected average fuel economy for trucks (2012 to 2020). For most truck deliveries, the average one-way trip distance was assumed to be 112 miles (see "GHG Emissions from Vehicle Use," above). For concrete deliveries by truck, the one-way distance was assumed to be 25 miles, based on the short time during which concrete must be poured before it hardens. The fuel delivery trucks and waste hauling trucks were also assumed to be traveling for 25 miles one way, based on the conservative estimate that there are fuel stations and construction waste processing facilities within 25 miles of the proposed site. Emissions from the use of tugboats for transporting materials and for maneuvering barges on-site were calculated based on an emission factor of 0.26 metric tons CO_2 per mile for transfer and 0.58 metric tons CO_2 per hour for maneuvering. This assumes an average speed of 6.4 knots at a load factor of 0.6 for transfer, and a load factor of 0.2 for on-site maneuvering.[1,2] Precast concrete piles for the construction of the waterfront platform would likely be transported by barge for approximately 100 miles.

Steel and rebar for the construction of the waterfront platform would likely be transported by rail into the New York metropolitan area, and then by barge to the site. The rail trip distance of 968 miles was assumed based on the analysis of the FAF2 data (see "GHG Emissions from Vehicle Use," above), specific to rail deliveries of base metal to the area. The remaining distance to transport steel by barge was assumed to be approximately 20 miles. Emissions from rail were based on the diesel carbon content, as discussed previously, and an energy consumption of 320 BTU/ton-mile.[3]

Emissions associated with construction worker vehicle trips were calculated using the gasoline carbon content, a vehicle fuel efficiency of 22.7 mpg (the EIA projected average for the construction period)[4], and a one-way trip distance of 11.19, based on the references cited in "GHG Emissions from Vehicle Use," above.

Construction Materials

Upstream emissions associated with the use of steel, aluminum, and cement are included in this assessment because their production would comprise a large component of overall emissions from construction. GHG emissions from the chemical process and fossil fuel energy use in cement manufacturing account for more than 60 percent of industrial source GHG emissions in the United States. According to a report from Energy Information Administration (EIA), producing iron and steel ranks as one of the top sources of manufacturing GHG emissions, largely because of use of coal-based resources to reduce iron ores in blast furnaces or heat metal in electric arc furnaces.[5] The production of steel also generates process-related emissions of CO_2 and methane. Aluminum production is an energy-intensive process, which also results in

[1] Upland tugs are estimated to be an average of 1,970 horsepower (hp), based on The Port of New York and New Jersey Emissions Inventory for Container Terminal Cargo Handling Equipment, Automarine Terminal Vehicles, and Associated Locomotives, PANYNJ, 2003.

[2] Emission factors were calculated assuming 500 hp tug boats, based on the procedure outlined in Analysis of Commercial Marine Vessels Emissions and Fuel Consumption Data, EPA, 2000.

[3] US Department of Energy, Transportation Energy Data Book, Edition 28, 2009.

[4] The worker vehicle and truck fuel efficiencies used to estimate emissions from construction activity were based on the average projected fuel efficiencies for the construction period (2012-2020). They therefore differ from the fuel efficiencies used in estimating emissions from project generated vehicle trips, which were based on the fuel efficiencies projected for the project build year.

[5] Energy-Related Carbon Dioxide Emissions in U.S. Manufacturing Mark Schipper, Energy Information Administration (EIA) Report #: DOE/EIA-0573(2005) Release Date: November 2006.

perfluoromethane, perfluoroethane, and CO_2 process emissions. The official U.S. National GHG inventory accounted for process and energy use emissions from GHG-intensive industrial activity, including emissions from the production of cement, steel, and aluminum, following the IPCC guidelines.[1] Emissions associated with the production of construction materials other than steel, aluminum, and concrete are assumed to be negligible in comparison with the emissions from the production of the materials that were included.

The project sponsor has committed to using fly ash (a byproduct of coal-fired power generation) as a replacement for ordinary portland cement (OPC) in the concrete used for the proposed buildings. The production of OPC cement results in substantial GHG emissions, which can be reduced by approximately 8 to 11 percent through substitution of 15 to 20 percent fly ash. However, the fraction of cement to be replaced is unknown at this time, since it will depend on the varying properties required for concrete for the different portions of the project. Therefore, for the purposes of this analysis, it was conservatively assumed that the concrete used for the development of the proposed project would be produced using 100 percent ordinary portland cement (OPC). A lifecycle emission factor for OPC was based on Building for Environmental and Economic Sustainability (BEES) software data.

A range of values for the steel production GHG emission factor can be found in research literature (0.44 to 1.95 metric tons of CO_2 per metric ton of steel produced). A factor of 1.83 metric tons of CO_2 per metric ton of steel was used in the present analysis.[2] For aluminum, a life-cycle emission factor of approximately 9.7 metric tons CO_2e per metric tons ingot was used.[3]

Building Lifetime

Construction-related emissions are also presented as annualized emissions over the lifetime of the buildings. The REGNER project[4] estimated the lifetime of buildings in Europe to be 80 to 120 years, and recommended that lifecycle analyses should cover up to 100 years. The median age of office buildings in midtown Manhattan is estimated at 37 years for Class A buildings and 80 years for Class B buildings.[5] Since more modern buildings have been constructed in past years, it can be assumed that the oldest Class A buildings are older than twice that age, 74 years, and if all of those buildings are still standing, the actual lifetime—which is unknown at this time—will be much longer. Lifetimes for new tall residential buildings are expected to be similar. Therefore, for the purpose of this analysis, building lifetimes were estimated at 80 years.

Note that these lifetimes may result in a somewhat conservatively high annualized emission level, since the actual lifetimes could be much longer. However, since all of the emissions would actually

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[1] IPCC, 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 3, Industrial Processes and Product Use.

[2] Worrell, Martin, and Price, Energy Efficiency and Carbon Dioxide Emissions Reduction Opportunities in the U.S. Iron and Steel Sector, Ernest Orlando Lawrence Berkeley National Laboratory, 1999.

[3] European Aluminum Industry, Life Cycle Inventory Data for Aluminum Production and Transformation Processes in Europe, 2008.

[4] REGENER Project, European methodology for the evaluation of environmental impact of buildings, Regener Project final report, 1997, http://www.cenerg.ensmp.fr/francais/themes/cycle/html/11.html (accessed April 2009).

[5] Median age is measured from renovation, so this number is conservatively low for overall building materials lifecycle.

Leon Glicksman, "Energy Efficient Buildings: Issues, Research Opportunities," presentation, Building Technology Program, MIT, January 27, 2005, http://web.mit.edu/ese/ (accessed April 17, 2009). Based on Costar database, September 2003.

occur in the early years (during construction), they would have a higher long-term impact than if they were actually emitted over the entire building lifetime (CO_2 has a lifetime on the order of 100 years; therefore, the impact of the concentrated emissions during a few years early on would result in more warming by the end of the century than the cumulative effect of a slow release of the same quantity over 80 years.) In addition, as opposed to electricity and fuels, which may be replaced by renewable alternatives in the future, construction emissions would all occur in the near future, at the rates estimated here. Therefore, it is also important to consider the total construction emissions, and not only their relative annualized contribution.

PROBABLE EMISSIONS FROM THE PROPOSED PROJECT

The estimated fuel and materials that would be used throughout the duration of the construction period and the ensuing GHG emissions are presented in Table 19b-3. Total construction activity emissions, as well as annualized emissions over 80 years, are presented. A summary of GHG emissions by emission source type, along with total annual emissions from the proposed project, is presented in Table 19b-4.

Table 19b-3
GHG Emissions from Construction Activity and Material Use
2012 to 2020

Construction Activity	Fuel / Material Use	GHG Emissions (metric tons CO_2e)
Construction Materials:		
Concrete	221,567 cubic yards	110,441
Steel and Rebar	7,916 tons	13,142
Aluminum	1,408 tons	12,356
Construction Equipment	various	11,866
Deliveries:		
Construction Trucks	1.2 million gallons diesel	11,945
Barges	89 thousand gallons diesel	906
Rail	12 thousand gallons diesel	122
Worker Trips	287 thousand gallons gasoline	2,523
TOTAL (9 years)		163,301
Annualized, Per Year[2]		2,041

Notes:
1. Construction equipment GHG emissions include emissions from use of diesel, natural gas, electricity, and other fuels.
2. Annualized emissions are the average over the lifetime of the project, assumed to be 80 years.

Table 19b-4
Summary of Annual GHG Emissions

Sector	Fuel Consumption	GHG Emissions (metric tons CO_2e)	Fraction of Total Emissions
Heat and Hot Water[1]	61.1 million ft^3 natural gas	3,343	8.4%
Electricity[1]	38,413 MWh (mixed source)	13,499	34.0%
Vehicle Use[2]	1.3 Mgal diesel and 0.8 Mgal gasoline	20,474	51.6%
Solid Waste	various	342	0.9%
Construction (Annualized)[3]	various	2,041	5.1%
TOTAL		39,699	*100.0%*

Notes: All emissions are expressed in metric tons CO_2e/year.
Mgal=million gallons
1. Estimates include the commitment to reducing energy use by 10 percent, as compared with energy use in buildings designed to meet building code requirements.
2. Vehicle Use includes truck deliveries, representing the majority of emissions in this category.
3. Total construction emissions of 163,301 metric tons CO_2e were annualized over 80 years.

According to EIA data, consumption of electricity and heating fuels for residential use in U.S. cities is approximately 20 percent lower than the equivalent use per household in suburban areas. Moreover, the per capita annual electricity consumed in New York City is almost 50 percent lower than the per capita annual electricity consumed nationwide.[1]

Note that most of the emissions in the vehicle use category are associated with truck deliveries. The truck emissions are likely a conservatively high estimate, since they do not account for linked trips on multi-destination deliveries. Linked truck delivery trips in the City and the adjacency to regional distribution centers reduce emissions associated with deliveries in the City. Emissions from private vehicles would be much higher for a similar project that was not close to transit, such as a suburban development.

Emissions associated with construction represent 5.1 percent of the annual emissions as annualized, and are equivalent to the total emissions from the operation of the project over approximately four years.

Overall, per capita GHG emissions in New York City are less than one third of the nationwide average.[2] This is largely due to reduced vehicle use, denser development, and cleaner energy sources. Beyond that, the proposed project would reduce emissions associated with transportation because of the access to transit (nearby subway and bus service).

PROJECT ELEMENTS THAT WOULD REDUCE GHG EMISSIONS

The proposed project would include a number of measures aimed at reducing energy consumption and GHG emissions. The measures include:

- **Energy Efficiency:** Energy efficient systems and design measures (e.g., building envelope, daylighting 75 percent of inhabited spaces, energy efficient systems) and efficient practices are under consideration. The proposed project is committed to energy efficient design, and would exceed the building energy performance required by the current building code by at least 10 percent.
- **Site Selection:** The proposed project's mixed-use development would be situated at a Brownfield site, and would therefore not result in GHG emissions associated with loss of undeveloped land. The project site is located within ½ mile of two subway stations and is served by local buses. The project site is also within walking distance of shopping, restaurants, and parks. Therefore, the proposed project would be consistent with the goals of reducing the dependence on personal vehicles discussed in PlaNYC.
- **Design and Uses:** The proposed project's mixed-use development, which includes retail and dense design, would result in a community that would be less automobile-dependent. The project site is located in an area that is already developed and serviced by transit and existing infrastructure and would therefore not result in GHG emissions associated with urban sprawl.
- **Construction Materials:** Much of the existing site materials would be reused on site. The façade of the Refinery will be entirely preserved, while other debris would be used for site fill and recycled. Up to 75 percent of construction waste would be recycled. The project sponsor would strive to use recycled materials, especially recycled steel and the use of fly

[1] *Inventory of New York City Greenhouse Gas Emission*, Mayor's Office of Long-Term Planning and Sustainability, PlaNYC2030, September 2009.

[2] PlaNYC: A Greener, Greater New York, pp 135, The City of New York, 2007.

ash in concrete. Locally purchased materials would be used to the extent practicable, reducing GHG emissions associated with transport.

- **Efficient Lighting Systems:** Individual controls would be provided for 90 percent of the building's occupants, with lighting and site lighting linked to building management systems to minimize energy consumption when not in use.
- **Commissioning:** An independent commissioning agent would review the design team's work from the earliest stages of design. As part of the building commissioning process, quality assurance and control procedures would be implemented at every stage of the design and construction cycle to ensure that environmentally responsible practices are being followed by the owner and design team and that when installed, the buildings systems are operating as designed.

Energy Initiative #9 in PlaNYC calls for expanding clean distributed generation and combined heat and power (CHP), including the goal to require an analysis of the technical and economic feasibility of installing CHP for all projects larger than 350,000 square feet. The inclusion of a distributed generation system, combining heat and power ("cogeneration"), was considered and analyzed (see Chapter 24, "Alternatives"). Although the inclusion of such systems could reduce GHG emissions and energy use, it was determined to be impracticable for this project due to the high investment and long payback period.

In addition, the following measures, which could result in further reduction in GHG emissions, are currently under consideration by the project sponsor:

- **Water Consumption:** A number of sustainable, green components for the proposed site that could reduce water and energy consumption are being considered. Reducing water demand reduces GHG emissions associated with treatment and delivery of potable water. It also reduces the amount of wastewater requiring treatment, and thereby reduces the emissions from wastewater treatment.
- **Green Roofs:** Installation of green roofs could help mitigate storm water runoff, reduce the heat-island effect, and contribute increased insulation to the building envelope to improve the building energy efficiency.
- **Preferred Alternative Vehicle Parking:** At least 5 percent of parking (or more in future years) could be dedicated as preferred parking for alternative vehicles and may include charging stations for electric vehicles. This measure would be consistent with the Air Quality Initiative #11 in PlaNYC, which calls for promoting wider use of clean vehicles, and is also consistent with PlaNYC's climate change goals.
- **Car Sharing:** Some of the proposed parking spaces may be reserved for vehicles belonging to a car sharing service.
- **Renewable Energy Purchase:** Energy Initiative #11 in PlaNYC calls for fostering the market for renewable energy. The project sponsor is exploring options to buy energy exclusively from renewable sources reducing GHG emissions.
- **Education in Sustainable Practice and Green Buildings:** As part of the proposed development, the project would incorporate elements designed to educate inhabitants and the community of sustainable living.

Implementing these measures would reduce the GHG emissions from the proposed project and would be consistent with the PlaNYC goal to reduce GHG emissions citywide by 30 percent.

In addition, the development associated with the proposed project could be subject to changes in the New York City Building Code that are currently being considered to require greater energy efficiency and to further the goals of PlaNYC. These could include energy efficiency requirements, specifications regarding cement, and other issues influencing GHG emissions.

CONCLUSION

Overall, the site selection, the reuse of existing buildings, the dense and mixed-use design, the commitment to achieve a significant reduction in energy use, and other measures incorporated in the proposed project would result in lower GHG emissions than would otherwise be achieved by similar residential and commercial uses, and, thus, would advance New York City's GHG reduction goals as stated in PlaNYC.

The annual GHG emissions from the proposed project are predicted to be approximately 39,699 metric tons of CO_2e. This does not represent a net increment in GHG emissions, since similar GHG emissions would occur if residential units and associated uses were to be constructed elsewhere, and could be higher if constructed with less energy efficiency, as lower-density residential, further from employment and commercial uses, and/or with less access to transit services. ✷