Chapter 19: Air Quality and Greenhouse Gas Emissions

A. AIR QUALITY

INTRODUCTION

Air quality is a general term used to describe pollutant levels in the atmosphere that occur from numerous sources and activities that produce air contaminants. The following two broad classifications are often used to describe these sources: "mobile source" emissions from motor vehicles, and "stationary source" emissions from fixed-location facilities.

This chapter documents the assessment of the following emission sources:

- Increased traffic or changes in traffic patterns on congested intersections of the local street network;
- Proposed parking facilities;
- Emissions from the heating, ventilation, and air conditioning (HVAC) systems of the proposed buildings; and
- Toxic air emissions generated by existing industrial sources that would affect the proposed buildings.

This chapter also estimates the effects of the Proposed Actions on greenhouse gas emissions (GHG) and discusses the Proposed Actions' conformity to PlaNYC. Potential air quality impacts associated with the construction phase of the Proposed Actions are analyzed in Chapter 21, "Construction Impacts."

PRINCIPAL CONCLUSIONS

MOBILE SOURCE ANALYSIS

Emissions from increased traffic or changed traffic patterns as a result of the Proposed Actions would not cause or exacerbate a violation of the National Ambient Air Quality Standards (NAAQS) or cause an exceedance of DEC/ DEP significant threshold values (STVs) for $PM_{2.5}$ or of the DEP *de minimis* criteria for CO, and thus will not have a significant adverse air quality impact.

The parking facilities included as part of the Proposed Actions would not cause a violation of the NAAQS or an exceedance of the STVs, and thus would not have a significant adverse air quality impact.

STATIONARY SOURCE ANALYSIS

HVAC Analysis

Based on evaluation of emissions from the HVAC systems of the proposed buildings and assuming specified numbers, heights and locations of exhaust stacks, and air intake duct restrictions (which would be included in the Restrictive Declaration for the Development Site), the Proposed Actions would not cause a violation of the NAAQS or an exceedance of the STVs—either from the impacts of the HVAC emissions of the buildings to be constructed as part of the Proposed Actions on other Proposed Actions buildings (building-on-building impacts) or on existing and future No Build developments. In addition, the HVAC emissions of existing and future No Build developments, as well as “major” existing emission sources, will not significantly affect the Proposed Actions’ buildings. Therefore, the proposed HVAC systems would not result in a significant adverse air quality impact.

Air Toxics Analysis

The analysis of the potential impacts of the air toxic emissions from existing nearby industrial facilities indicates that the proposed sensitive land uses associated with the Proposed Actions would not experience a significant adverse air quality impact.

APPLICABLE POLLUTANTS

CRITERIA POLLUTANTS

The following criteria air pollutants have been identified by the U.S. Environmental Protection Agency (EPA) as being of concern nationwide: CO, hydrocarbons (HC), nitrogen dioxide (NO_2), photochemical oxidants, lead, sulfur dioxide (SO_2), and particulate matter (PM). In New York City, ambient concentrations of CO, HC, and photochemical oxidants are predominantly influenced by motor vehicle activity. NO_2 is emitted from both mobile and stationary sources. Emissions of sulfur dioxide (SO_2) are associated mainly with stationary sources, and emissions of PM are associated with stationary sources and, to a lesser extent, mobile sources and fugitive dust. Lead emissions, which historically were principally influenced by motor vehicle activity, have been substantially reduced due to the elimination of lead from gasoline.

Carbon Monoxide

CO is a colorless and odorless gas that is generated in the urban environment primarily by the incomplete combustion of fossil fuels in motor vehicles. In New York City, more than 80 percent of CO emissions are from motor vehicles. Prolonged exposure to high levels of CO can cause headaches, drowsiness, loss of equilibrium, or heart disease. CO concentrations can vary greatly over relatively short distances. Relatively high concentrations of CO are typically found near congested intersections, along heavily used roadways carrying slow-moving traffic, and in areas where atmospheric dispersion is inhibited by urban “street canyon” conditions. Consequently, CO concentrations are predicted on a localized, or microscale, basis.

Hydrocarbons, Nitrogen Oxides, and Photochemical Oxidants

HCs include a wide variety of volatile organic compounds, emitted principally from the storage, handling, and use of fossil fuels. Nitrogen oxides (NO_x) constitute a class of compounds that include NO_2 and nitric oxide (NO), both of which are emitted by motor vehicles and stationary sources. Both HCs and NO_x are of concern primarily because most of those compounds react in sunlight to form photochemical oxidants, including ozone. This reaction occurs comparatively slowly and ordinarily takes place far downwind from the site of actual pollutant emission. The effects of these pollutants are normally examined on an areawide, or mesoscale, basis.

Lead

Lead emissions are principally associated with industrial sources and motor vehicles using gasoline containing lead additives. As the availability of leaded gasoline has decreased, motor vehicle-related lead emissions have decreased, resulting in a significant decline of lead concentrations. Atmospheric lead concentrations in New York City are well below national standards. Lead concentrations are expected to continue decreasing; therefore, an analysis of lead from mobile sources is not warranted.

Sulfur Dioxide

High concentrations of SO_2 affect breathing and may aggravate existing respiratory and cardiovascular disease. SO_2 emissions are generated from the combustion of sulfur-containing fuels—oil and coal—largely from stationary sources such as coal- and oil-fired power plants, steel mills, refineries, pulp and paper mills, and nonferrous smelters. In urban areas, especially in the winter, smaller stationary sources, such as space heaters, contribute to elevated SO_2 levels.

Although diesel-fueled heavy-duty vehicles also emit SO_2, transportation sources are not considered by EPA (and other regulatory agencies) to be significant sources of this pollutant that should be quantitatively evaluated in a mobile source impact analysis. Therefore, SO_2 is analyzed for stationary sources only.

Particulate Matter

PMs are liquid droplets or solids, with a wide range of sizes and chemical composition, suspended in the atmosphere. Both natural and man-made sources contribute to the formation of this broad class of air pollutants. Natural sources of PM include the condensed and reacted forms of natural organic vapors, salt particles resulting from the evaporation of sea spray, wind-borne pollen, fungi, molds, algae, yeasts, rusts, bacteria, and debris from live and decaying plant and animal life, particles eroded from beaches, desert, soil and rock, and particles from volcanic and geothermal eruptions and forest fires. Major man-made sources of PM include: the combustion of fossil fuels from vehicles, power generation and home heating, chemical and other manufacturing processes; various types of construction (including that from equipment exhaust and re-entrained dust); agricultural activities; and wood-burning fireplaces. Fine PM is also derived from combustion material that has volatilized and then condensed to form primary PM (often after release from a stack or exhaust pipes) or from precursor gases reacting in the atmosphere to form secondary PM. It is also derived from mechanical breakdown of coarse PM, e.g., from building demolition or roadway surface wear.

Of particular health concern are those breathable particles that are smaller than or equal to 10 microns in size (PM_{10}) or 2.5 microns in size ($PM_{2.5}$). The principal health effects of airborne PM are on the respiratory system. PM_{10} and $PM_{2.5}$ concentrations are predicted on a localized basis.

NON-CRITERIA POLLUTANTS

Air Toxics

Toxic air pollutants can be grouped into the following two categories: carcinogenic air pollutants and non-carcinogenic air pollutants, which include hundreds of pollutants, ranging from high to low toxicity. While no federal standards have been promulgated for ambient levels of toxic air pollutants, EPA and DEC have issued guidelines that establish acceptable ambient levels for these pollutants based on human exposure criteria.

Examples of toxic air pollutants include benzene, which is found in gasoline; perchloroethlyene, which is emitted from dry cleaning facilities; and methylene chloride, which is used as a solvent and paint stripper by a number of industries.

POLLUTANTS FOR ANALYSIS

The air pollutants that are considered in this air quality analysis include:

- CO, PM_{10}, and $PM_{2.5}$ for the analysis of emissions from motor vehicles;
- PM_{10}, $PM_{2.5}$, NO_2, and SO_2 for the analysis of emissions from the HVAC systems of project-related, existing, and future No Build developments; and
- Air toxic emissions from nearby industrial sources.

AIR QUALITY STANDARDS AND REGULATIONS

STANDARDS (NATIONAL AND NEW YORK STATE)

National Ambient Air Quality Standards (NAAQS), developed to protect human health and welfare, set maximum allowable concentrations for each of the criteria pollutants specified by EPA (49 CFR 50). New York has adopted NAAQS as state ambient air quality standards. Primary standards target the health of sensitive populations such as asthmatics, children, and the elderly. Secondary standards protect public welfare, including visibility, and damage to animals, crops, vegetation, and buildings. DEC and DEP also provide further guidance for evaluating potentially significant project-related air quality impacts from CO and $PM_{2.5}$. The current standards that were applied to the analysis for the Proposed Actions, together with their health-related averaging periods, are presented in Table 19-1.

IMPACT CRITERIA (NEW YORK STATE AND NEW YORK CITY)

State Environmental Quality Review Act (SEQRA) regulations and the *City Environmental Quality Review (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), its probability of occurrence, its duration, its irreversibility, its geographic scope, its magnitude, and the number of people affected. 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 NAAQS (see Table 19-1) would be deemed to have a potential significant adverse air quality impact. Threshold levels have also been defined for certain pollutants to determine whether a proposed action has the potential to result in significant adverse air quality impacts.

Table 19-1
Applicable National and State Ambient Air Quality Standards and State and Local Significant Threshold Values (STVs)

Pollutant	Average Period	National and New York State Standards	
		Primary	Secondary
Ozone	8-Hour	0.075 ppm ($147\ \mu g/m^3$)	Same as Primary
Carbon Monoxide	8-Hour	9 ppm ($10\ mg/m^3$)	None
	8-Hour *de minimis* (New York City Only)	0.5 ppm Increase*	
	1-Hour	35 ppm ($40\ mg/m^3$)	Same as Primary
Nitrogen Dioxide	Annual Average	0.053 ppm ($100\ \mu g/m^3$)	Same as Primary
Sulfur Dioxide	Annual Average	$80\ \mu g/m^3$ (0.03 ppm)	
	24-Hour	$365\ \mu g/m^3$ (0.14 ppm)	
	3-Hour		$1{,}300\ \mu g/m^3$ (0.5 ppm)
Coarse Particulate Matter (PM_{10})	24-Hour	$150\ \mu g/m^3$	Same as Primary
Fine Particulate Matter ($PM_{2.5}$)	24-Hour	$35\ \mu g/m^3$	Same as Primary
	Annual Neighborhood	$15\ \mu g/m^3$	Same as Primary
	24 Hour STV (DEC)	$5\ \mu g/m^3$	
	24 Hour STV (DEP)	2 to $5\ \mu g/m^3$	
	Annual Neighborhood STV (DEP)	$0.1\ \mu g/m^3$	
	Annual Maximum STV (DEC and DEP)	$0.3\ \mu g/m^3$	
Lead	Rolling 3-Month Average	$0.15\ \mu g/m^3$	Same as Primary
	Quarterly Average	$1.5\ \mu g/m^3$	Same as Primary

Notes: EPA, DEC, and DEP
ppm = parts per million
$\mu g/m^3$ = micrograms per cubic meter
STV = significant threshold value
Source: * When the predicted No Build 8-hour concentration is equal to or between 8 and 9 ppm.

De Minimis Criteria for CO Impacts

DEP has developed *de minimis* criteria to assess the significance of the increase in CO concentrations that would result from proposed projects or actions, 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 parts per million (ppm) or more in the maximum 8-hour average CO concentration at a location where the predicted No Build 8-hour concentration is equal to or between 8.0 and 9.0 ppm; or (2) an increase of more than half the difference between baseline (i.e., No Action) concentrations and the 8-hour standard of 9.0 ppm, when No Build concentrations are below 8.0 ppm.

Interim Guidance Criteria Regarding $PM_{2.5}$ Impacts

Because New York City's existing concentrations of $PM_{2.5}$ currently exceed the annual and 24-hour NAAQS, DEP and DEC have developed interim criteria for assessing the potential impacts of individual projects under CEQR and SEQRA. DEP is currently recommending the following interim guidance criteria for determining the potential for significant adverse $PM_{2.5}$ impacts for projects subject to CEQR:

- 24-hour (daily) 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 between 2 and 5 $\mu g/m^3$, could be considered a significant adverse impact on air quality based on the magnitude, frequency, and duration of the predicted concentrations as well as the sensitivity and size of the affected area(s);
- 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 increment is predicted for stationary sources; or fifteen meters from roadways for the mobile sources); or
- For stationary sources, predicted annual average $PM_{2.5}$ concentration increments greater than 0.3 $\mu g/m^3$ at discrete receptor locations.

Similar interim guidance for evaluating $PM_{2.5}$ impacts has been adopted by DEC. The DEC policy, however, applies only to facilities applying for permits or major permit modification under SEQRA that emit 15 tons of PM_{10} or more annually. The interim guidance policy states that such a project will be deemed to have a potentially significant adverse impact if the project's maximum increments 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.

An action under CEQR that would increase $PM_{2.5}$ concentrations in excess of DEP or DEC interim guidance criteria (summarized in Table 19-1) is considered to have a significant adverse impact. DEC recommends that for actions subject to CEQR that fail the interim guidance criteria, an Environmental Impact Statement (EIS) must be prepared and potential measures to reduce or eliminate a significant adverse impact examined.

The DEC/DEP guidance criteria have been used to evaluate the significance of the predicted impacts of the Proposed Actions on $PM_{2.5}$ concentrations and determine the need to mitigate the potential impacts of these emissions. While some of the DEC criteria do not directly apply to the Proposed Actions (or are less restrictive than the DEP criteria), they are considered in this analysis, as they are generally consistent with DEP guidelines.

Non-Criteria Toxic Air Pollutant Thresholds

Non-criteria or toxic air pollutants include hundreds of chemical compounds, ranging from high to low toxicity. No federal standards have been promulgated for toxic air pollutants. However, EPA and DEC have issued guidelines that establish acceptable ambient levels for these pollutants based on human exposure criteria.

To evaluate short-term (1-hour) and annual impacts of non-carcinogenic toxic air emissions, DEC's short-term guideline concentrations (SGCs) and annual guideline concentrations (AGCs) for exposure limits were used. These guidelines are 1-hour and annual guideline concentrations, respectively, which are considered acceptable concentrations below which no adverse effect on health of the general public would occur. In addition, EPA's "Hazard Index Approach" was applied to estimate the potential cumulative increments of these pollutants.

For carcinogenic pollutants, EPA's carcinogenic unit risk factors, which are based on toxicities, were used to determine whether the incremental risk associated with the release of these pollutants is significant.

EXISTING CONDITIONS AND REGULATORY SETTING

STUDY AREA DESIGNATION

The federal Clean Air Act (CAA) defines non-attainment areas as geographic regions that have been designated as not meeting one or more of the NAAQS. Air quality maintenance areas are regions that have recently attained compliance with the NAAQS. New York City is currently designated as a moderate non-attainment area for the 8-hour ozone standard[1] and a non-attainment area for $PM_{2.5}$, and Manhattan is designated as a moderate non-attainment area for PM_{10}. New York City has been re-designated from a non-attainment area to a maintenance area for CO, after demonstrating compliance with the CO standards. The study area is in attainment for the other pollutants.

The 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 µg/m^3 to 35 µg/m^3, and retaining the level of the annual $PM_{2.5}$ standard at 15 µg/m^3. DEC is currently preparing and will implement measures designed to reduce $PM_{2.5}$ levels in the region as part of its $PM_{2.5}$ State Implementation Plan (SIP). These measures are projected by DEC to reduce annual levels below the $PM_{2.5}$ standard by 2010. In addition, compliance with the revised 24-hour standard is required by 2014. Although the effects of the Proposed Actions would not occur until 2017 or 2019, existing (i.e., higher) background levels have been utilized in the following conservative analyses of $PM_{2.5}$.

MONITORED AMBIENT AIR QUALITY LEVELS

Ambient air quality monitoring data that have been collected at stations located near the study area are shown in Table 19-2. These data, which are presented to provide an indication of the pollutant levels in the area, were collected by DEC and compiled in EPA Airdata Database for 2007 and DEC Annual Monitoring Report for the latest calendar year for which data are available. Monitored levels are representative of existing conditions in the study area and include both background and local influences.

The monitored levels do not exceed national and state ambient air quality standards except for the annual and 24-hour $PM_{2.5}$ concentrations. As noted above, DEC is preparing and implementing measures designed to reduce $PM_{2.5}$ levels in the region as part of the $PM_{2.5}$ SIP for the $PM_{2.5}$ annual standard, which was submitted to EPA on April 5, 2008. With these emission reduction measures (e.g., diesel retrofit programs, improved fuel efficiency programs, industrial

[1] The metropolitan area is also designated as a severe ozone non-attainment area for the 1-hour ozone standard. Even though the 1-hour standard was revoked (and replaced by an 8-hour standard), New York must maintain a SIP to achieve compliance with this standard under the CAA anti-backsliding provisions.

emission reduction programs), DEC is currently projecting to reduce annual background levels below the $PM_{2.5}$ standard of 15 µg/m^3 by 2010.

Table 19-2
Representative Ambient Air Quality Data (2007)

Pollutant	Monitor	Averaging Time	Value	NAAQS
CO	PS 59	8-hour	1.4 ppm	9.0 ppm
		1-hour	2.3 ppm	35.0 ppm
NO_2	PS 59	Annual	64 µg/m^3	100 µg/m^3
PM_{10}	1 Pace Plaza	Annual	25 µg/m^3	50 µg/m^3
		24-hour	53 µg/m^3	150 µg/m^3
$PM_{2.5}$	PS 59	Annual	16.1 µg/m^3*	15 µg/m^3
		24-hour	37 µg/m^3*	35 µg/m^3
	Post Office, Canal Street	Annual	15.8 µg/m^3*	15 µg/m^3
		24-hour	35 µg/m^3*	35 µg/m^3
SO_2	PS 59	3-hour	0.051 ppm	0.50 ppm
		24-hour	0.029 ppm	0.14 ppm
		Annual	0.010 ppm	0.03 ppm

Notes: Values are the highest pollutant levels recorded during the 2007 calendar year.
* Exceeds the applicable NAAQS
Source: EPA Airdata Database 2007/DEC Data.

BACKGROUND VALUES

In estimating the total impact of the Proposed Actions, it is necessary to include consideration of the background pollutant levels for the study area. Background levels, which are the components of total concentrations not accounted for through microscale modeling analysis, are generally based on monitored values, but do not include the effects of local emission sources and are often estimated for future analysis years by factoring in projected changes in area-wide pollutant emission rates. Following these procedures, background values applicable to the Proposed Actions were developed.

CO background values were provided from Table 9 of the New York State Department of Transportation (NYSDOT) Environmental Procedures Manual for Midtown Manhattan and by DEP. PM_{10}, NO_2 and SO_2 background values, which were developed by DEP based on monitored values, were used in this analysis.

Background values were added to the modeling results to obtain total pollutant concentrations at each receptor site for each analysis year. The background values used in the mobile and stationary source analyses are provided in Table 19-3.

Table 19-3
Background Concentrations

Pollutant	Average Time	Value
CO	8-hour	2.9 ppm
NO2	Annual	71 µg/m^3
PM10	24-hour	60 µg/m^3
PM2.5	24-hour	39.2* µg/m
	Annual	15.8* µg/m
SO2	3-hour	202 µg/m^3
	24-hour	123 µg/m^3
	Annual	37 µg/m^3

Note: $PM_{2.5}$ values, which exceed the NAAQS, are representative concentrations based on the latest three years of data collected at the DEC's PS 59 monitor.
Source: DEC, DEP and NYSDOT data and guidelines

MOBILE SOURCE INTERSECTION ANALYSIS

METHODOLOGY

Analysis Years

A microscale modeling analysis was conducted to estimate CO and PM_{10} levels near the heavily congested intersections in the study area that are anticipated to be most affected by the Proposed Actions. The following analysis year and scenarios were analyzed:

- 2008 for existing conditions, and
- 2019 for the Future with and without the Proposed Actions.

Modeling analyses were also conducted to estimate $PM_{2.5}$ increments generated by the Proposed Actions at affected intersections.

Site Selection

To select analysis sites, traffic volumes, traffic levels of service, and travel speeds at the major signalized intersections were evaluated with and without the Proposed Actions. Site selection was conducted using *CEQR Technical Manual* screening threshold criteria to determine where the air quality levels would be most greatly be affected by the Proposed Actions. The screening analysis considered total traffic volumes at intersections, operational changes associated with speeds, and project-generated trips from the traffic analysis to determine the analysis sites for all pollutants of concern in the microscale intersection analysis. The intersections selected for CO analysis are shown in Figure 19-1 and in Table 19-4. Four of these intersections, with the highest projected increase in truck and bus volumes, were selected for PM_{10} and $PM_{2.5}$ analyses.

Table 19-4
Carbon Monoxide Analysis Sites

Site Number	Location
1	Tenth Avenue @ West 30th Street
2	Tenth Avenue @ West 33rd Street
3	Tenth Avenue @ West 34th Street
4	Eleventh Avenue @ West 29th Street
5*	Eleventh Avenue @ West 30th Street
6*	Eleventh Avenue @ West 33rd Street
7*	Eleventh Avenue @ West 34th Street
8	Twelfth Avenue @ West 30th Street
9	Twelfth Avenue @ West 33rd Street
10*	Twelfth Avenue @ West 34th Street

* Also selected as a PM_{10}/$PM_{2.5}$ analysis site.

Receptors

The locations at which pollutant concentrations are estimated are known as “receptors.” Following guidelines established by EPA, receptors were located where the maximum concentration is likely to occur and where the general public is likely to have access. For this analysis, receptors were located along sidewalks near the intersections selected for analysis.

Traffic Data

Traffic data for the air quality analysis were derived from traffic counts and other information developed as part of the traffic analysis, using CEQR guidelines. Due to the traffic patterns associated with the various components of the Proposed Actions, the following analysis periods were considered: the weekday AM, midday, and PM peak periods, and a Saturday peak period. These are the periods during which the maximum changes in pollutant concentrations are expected, based on overall traffic volumes and anticipated changes in traffic patterns. These same periods were selected for the traffic analysis.

The *2000 Highway Capacity Manual* and HCS 2000+ software were used to develop the traffic data necessary for the air quality analysis. Vehicle classifications were determined through field data collection. Existing vehicle speeds were obtained from field measurements for the area, and adjusted to estimate future free-flow speeds. Traffic data used in the intersection modeling are summarized in Chapter 17, "Traffic and Parking."

Vehicle Classification Data

Vehicle classification data required to determine composite emission factors were based on traffic survey data for the following categories: light-duty gasoline vehicles (LDGVs); sport utility vehicles (SUVs); medallion taxis; light-duty trucks; heavy-duty trucks; and buses. Light-duty gasoline trucks were divided into four groups (LDGT1, LDGT2, LDGT3, and LDGT4) based on local registration data. Based on current CEQR guidelines, SUVs were classified as light-duty gasoline trucks with 75 percent of emissions considered as LDGT1 and LDGT2, and the remaining 25 percent as LDGT3 and LDGT4. The split between LDGT1 and 2 and LDGT3 and 4 and heavy-duty gasoline vehicles (HDGVs) and heavy-duty diesel vehicles (HDDVs) was based on DEC's 2008 registration data. Buses were analyzed using urban transit bus emission factors.

Vehicular Emissions

CO, PM_{10}, and $PM_{2.5}$ emission factors were estimated using EPA's MOBILE 6.2.03 (EPA420-R-03-010), the most current updated version of the mobile emission factor algorithm model. This version includes the effects of new vehicle standards, vehicle turnover, and emission factors for PM. The following model inputs and assumptions were applied in using MOBILE 6.2.03:

- DEC input files with engine operating start and distribution parameters for New York County were used to estimate baseline conditions.
- 2008 New York State registration and diesel sales data.
- 100 percent hot-stabilized LDGV emission factors were used for medallion taxis, with taxi registration and mileage data.
- SUVs were assumed to be LDGTs that have the same engine operating parameters as automobiles.
- An average winter temperature of 50.0 degrees Fahrenheit was used to estimate CO, PM_{10} and $PM_{2.5}$ emission factors.
- In estimating PM emissions from diesel engines, the following sulfur contents were used: 400 ppm for existing conditions, and 15 ppm for the future conditions (to account for the future required use of ultra-low sulfur diesel [ULSD]).
- Project-specific CO emission factors used in the mobile source analysis, which are provided in the technical backup documentation.
- Total PM_{10} and $PM_{2.5}$ emissions consist of vehicle exhaust emissions, brake and tire wear and fugitive (re-entrained) road dust. 24-hour particulate exhaust emission factors were estimated using EPA's MOBILE 6.2.03 emission model and included brake, and tire-wear

emissions from moving vehicles for each vehicle type, with the regional factors outlined above. 24-hour particulate idle emissions were estimated only for heavy-duty diesel trucks and buses, because idle emissions from other vehicle types are considered negligible).

- PM_{10}/$PM_{2.5}$ emissions from fugitive (re-entrained) dust are dependent on average vehicle weight and the roadway surface silt loading factor. These emissions were estimated based on the equation from the August 2008 version of EPA's *Compilation of Air Pollutant Emission Factors* (AP-42) for paved roads. This formula uses empirical data for fugitive dust, and has recently been adjusted by EPA to discount the contribution from exhaust and brake and tire wear emissions. Applying the latest DEP guidelines, an average vehicle fleet weight of 6,000 pounds was used for the analyses. The following silt loading factors were used: 0.015 for freeways; 0.1 for principal and minor arterials with more than 5,000 vehicles per day; and 0.4 for local roadways with fewer than 5,000 vehicles per day.

The MOBILE 6.2.03 model provides urban bus emission factors based on DEC's vehicle age distribution, various engine technologies, and national default-mileage accumulation data. As part of its 2000-2004 Capital Program, the Metropolitan Transportation Authority (MTA) has installed Continuously Regenerating Technology (CRT) particulate filters as an exhaust after-treatment device on more than 3,000 older diesel buses. MTA has demonstrated that adding CRT along with using ULSF can reduce particulate emissions by more than 90 percent. MOBILE 6.2.03 bus emission factors were used to determine future particulate increments. Since MTA will have fully implemented CRT technology on all buses by the Proposed Actions' first year of operation, the emissions analyses reflect this program for future conditions.

Dispersion Analysis

Mobile source dispersion models are the basic analytical tools used to estimate pollutant concentrations from emissions generated by motor vehicles expected under given conditions of traffic, roadway geometry, and meteorology. CAL3QHC Version 2 is a line-source dispersion model that predicts pollutant concentrations near congested intersections and heavily traveled roadways. CAL3QHC input variables include free-flow and calculated idle emission factors, roadway geometries, traffic volumes, site characteristics, background pollutant concentrations, signal timing, and meteorological conditions. CAL3QHC predicts inert pollutant concentrations, averaged over a 1-hour period near roadways. This model was used to predict concentrations at affected study area intersections. Receptors were located in accordance with *CEQR Technical Manual* guidelines.

CAL3QHC predicts peak 1-hour pollutant concentrations using assumed meteorology and peak-period traffic conditions. Different emission rates occur when vehicles are stopped (idling), accelerating, decelerating, and moving at different average speeds. CAL3QHC simplifies these different emission rates into the following two components:

- Emissions when vehicles stop (idle) during the red phase of a signalized intersection.
- Emissions when vehicles are in motion during the green phase of a signalized intersection.

CAL3QHCR is a refinement to CAL3QHC that uses actual meteorological data as opposed to an assumed worst-case set of meteorological conditions. CAL3QHCR was used in the PM2.5 analyses. Five years of actual meteorological data from LaGuardia Airport (2002–2006) were used to estimate peak 24-hour and annual average $PM_{2.5}$ concentrations.

The analyses followed EPA Intersection Modeling Guidelines (EPA-454/R-92-005) for CO modeling methodology and receptor placement. Each major roadway segment (link) within approximately 1,000 feet from each analysis site (i.e., congested intersection) was considered. A mixing height of 1,000 meters and a surface roughness factor of 321 centimeters were included in each calculation.

Peak 8-hour mobile source CO concentrations were obtained by assuming a conservative persistence factor of 0.77 to the maximum predicted one-hour values. This persistence factor takes account of the fact that over eight hours (as distinct from a single hour) vehicle volumes will fluctuate downward from the peak, vehicle speeds may vary, and meteorological conditions including wind speeds and wind direction will change to some degree as compared to the conservative assumptions used for the single maximizing hour.

Peak 24-hour PM_{10} concentrations were estimated directly from the modeling analysis using five years of actual meteorological data. The analysis is conservative in that it assumes that peak-period traffic conditions would occur every hour of every 24-hour period, every day of the year for the full five-year analysis period. This approach is particularly conservative for estimating project impacts because it assumes that peak period traffic conditions would occur for every hour of the day, 365 days per year.

Estimated Pollutant Levels Under Existing Conditions

The results of the mobile source analysis under the 2008 existing conditions are provided in Table 19-5. The values shown are the maximum estimated 8-hour CO and 24-hour PM_{10} concentrations estimated near each analysis site.

Table 19-5
2008 Existing Conditions
Maximum Estimated Pollutant Levels

Site No.	Analysis Site	Max 8-Hour CO (ppm)	Max 24-Hour PM_{10} ($\mu g/m^3$)
1	Tenth Avenue @ West 30th Street	3.7	--
2	Tenth Avenue @ West 33rd Street	3.8	--
3	Tenth Avenue @ West 34th Street	4.2	--
4	Eleventh Avenue @ West 29th Street	3.8	--
5	Eleventh Avenue @ West 30th Street	3.6	83.2
6	Eleventh Avenue @ West 33rd Street	3.7	84.5
7	Eleventh Avenue @ West 34th Street	4.1	91.5
8	Twelfth Avenue @ West 30th Street	4.7	--
9	Twelfth Avenue @ West 33rd Street	4.7	--
10	Twelfth Avenue @ West 34th Street	4.7	128.3

Notes:
NAAQS = 9 ppm for CO, 150 $\mu g/m^3$ for PM_{10}.
All values are the maximum estimated concentrations under all time periods considered and include background concentrations.
Concentrations were estimated for the following time periods:
AM – AM peak period (8:00–9:00 AM) PM – PM peak period (5:00–6:00 PM)
MD – Midday peak period (12:00–1:00 PM) SAT – Saturday peak period (1:00–2:00 PM)

The results of this analysis are summarized as follows:

- CO levels would not exceed the 8-hour standard. The highest estimated concentration (4.7 ppm) would occur near Sites 8, 9, and 10.
- PM_{10} levels would not exceed the 24-hour standard. The highest estimated concentration (128.3 $\mu g/m^3$) would occur near Site 10.

Estimated Pollutant Levels in the Future without the Proposed Actions

The results of the mobile source air quality modeling analysis in the 2019 Future without the Proposed Actions are provided in Table 19-6. The values shown are the maximum CO, PM_{10}, and $PM_{2.5}$ concentrations estimated near each analysis site under the time frames that correspond to the NAAQS.

Table 19-6
2019 Future Without the Proposed Actions
Maximum Estimated Pollutant Levels

Site No.	Analysis Site	CO Max 8-Hour (ppm)	PM_{10} Max 24-Hour ($\mu g/m^3$)	$PM_{2.5}$ Max 24-Hour ($\mu g/m^3$)	$PM_{2.5}$ Max Annual ($\mu g/m^3$)
1	Tenth Avenue @ West 30th Street	4.3	--	--	--
2	Tenth Avenue @ West 33rd St.	4.6	--	--	--
3	Tenth Avenue @ West 34th St.	4.9	--	--	--
4	Eleventh Avenue @ West 29th St.	3.8	--	--	--
5	Eleventh Avenue @ West 30th St.	4.1	101.4	48.5	16.7
6	Eleventh Avenue @ West 33rd St.	4.1	94.6	48.6	16.6
7	Eleventh Avenue @ West 34th St.	3.9	100.1	50.5	16.7
8	Twelfth Avenue @ West 30th St.	4.4	--	--	--
9	Twelfth Avenue @ West 33rd St.	4.5	--	--	--
10	Twelfth Avenue @ West 34th St.	4.5	144.2	54.1	17.1

Notes: NAAQS = 9 ppm for CO, 150 $\mu g/m^3$ for PM_{10} , 35 $\mu g/m^3$ for 24-hour $PM_{2.5}$ and 15 $\mu g/m^3$ for annual $PM_{2.5}$.
All values are the maximum estimated concentrations under all time periods considered and include background concentrations.
Concentrations were estimated for the following time periods:
AM – AM peak period (8:00–9:00 AM) PM – PM peak period (5:00–6:00 PM)

The results of this analysis are summarized as follows:

- CO levels would not exceed the 8-hour standard. The highest estimated concentration (4.9 ppm) would occur near Site 3.
- PM_{10} levels would not exceed the 24-hour standard. The highest estimated concentration (144.2 $\mu g/m^3$) would occur near Site 10.

Estimated Pollutant Levels Under Future with the Proposed Actions Condition

Summaries of the results of the mobile source air quality modeling analysis for the 2019 Future with the Proposed Actions without the implementation of traffic mitigation measures are provided in Tables 19-7 and 19-8. The values shown are the maximum CO and PM_{10} concentrations and $PM_{2.5}$ incremental impacts (i.e., differences between estimated Future with and without the Proposed Actions conditions) estimated for each analysis site.

The $PM_{2.5}$ results are conservatively based on existing monitored data and do not reflect any future reductions pursuant to attainment measures required by law.

Table 19-7
2019 Future With and Without the Proposed Actions
Maximum Estimated Pollutant Levels

Site No.	Analysis Site	Maximum 8-Hour CO Concentrations (ppm)				Max 24-Hour PM_{10}
		No Build	Build	Max Increment	Peak Time Period	($\mu g/m^3$)
1	Tenth Ave @ West 30th St	4.2	4.3	0.1	PM	--
2	Tenth Ave @ West 33rd St	4.6	4.8	0.2	PM	--
3	Tenth Ave @ West 34th St	4.9	5.0	0.1	PM	--
4	Eleventh Ave @ West 29th St	3.8	4.1	0.3	PM	--
5	Eleventh Ave @ West 30th St	4.1	4.4	0.3	PM	105.5
6	Eleventh Ave @ West 33rd St	3.7	3.9	0.2	AM	101.4
7	Eleventh Ave @ West 34th St	3.9	4.1	0.2	PM	104.3
8	Twelfth Ave @ West 30th St	4.4	4.4	0.0	AM	--
9	Twelfth Ave @ West 33rd St	4.5	4.7	0.2	PM	--
10	Twelfth Ave @ West 34th St	4.5	4.8	0.3	PM	147.4

Notes:
NAAQS = 9 ppm for CO, 150 $\mu g/m^3$ for PM_{10}
All values are the maximum estimated concentrations under all time periods considered and include background concentrations.
Concentrations were estimated for the following time periods:
AM – AM peak period (8:00–9:00 AM) PM – PM peak period (5:00–6:00 PM)
MD – Midday peak period (12:00–1:00 PM) SAT – Saturday peak period (1:00–2:00 PM)

Table 19-8
2019 Future With the Proposed Actions
Maximum Estimated $PM_{2.5}$ Increments ($\mu g/m^3$)

Site No.	Analysis Site	24-Hour		Annual	
		No Build*	Increment	No Build*	Increment
5	Eleventh Avenue @ West 30th St.	46.07	1.98	16.67	0.018
6	Eleventh Avenue @ West 33rd St.	45.81	1.90	16.42	0.022
7	Eleventh Avenue @ West 34th St.	45.78	1.96	16.58	0.026
10	Twelfth Avenue @ West 34th St.	49.76	0.52	16.90	0.016

Notes:
Significant STVs:
24-hour = 2 to 5 $\mu g/m^3$ increment
Annual (neighborhood) = 0.1 $\mu g/m^3$ increment
* Includes the following P.S. 59 monitored values: 39.2 $\mu g/m^3$ for 24-hour $PM_{2.5}$ and 15.8 $\mu g/m^3$ for annual $PM_{2.5}$.

The results of this analysis are summarized as follows:

- CO levels would not exceed the 8-hour standard. The highest estimated increments would occur near Sites 4, 5, and 10.
- The DEP CO *de minimis* criteria would not be exceeded at any of the analysis sites, indicating that the CO impacts of the Proposed Actions would not be significant.
- PM_{10} levels would not exceed the 24-hour standard. The highest estimated concentration (147.4 $\mu g/m^3$) would occur near Site 10.
- The Proposed Actions would not cause increases greater than the 24-hour or annual $PM_{2.5}$ STVs, and therefore, would not result in a significant adverse air quality impact. The highest estimated 24-hour increment (1.98 $\mu g/m^3$) would occur at Site 5; the highest estimated annual increment (0.026 $\mu g/m^3$) would occur near Site 7.

ANALYSIS OF PARKING FACILITIES

The proposed parking facilities on the Development Site could increase certain air pollutant concentrations. Detailed analyses were conducted for the proposed 1,600-space parking garage located at West 30th Street and Eleventh Avenue. No analyses were conducted for the much smaller (i.e., approximately 15-space) facilities that would be included as part of the Proposed Actions, as these facilities are considered to be too small to significantly impact localized air quality levels. Because the proposed garage would be used almost exclusively by gasoline-powered automobiles and not diesel-fueled trucks, CO was the only pollutant considered for this analysis. PM_{10} and $PM_{2.5}$ concentrations would not be materially affected by the proposed facilities. In addition, the locations of the release PM_{10} /and $PM_{2.5}$ emissions from the garage would not be close enough to the affected mobile source intersections to cause cumulative impacts that would exceed the STVs.

CO concentrations near the 1,600-space facility were estimated following the CEQR guidelines for the mechanically ventilated, enclosed garage. CO concentrations were estimated at five feet and 50 feet from the exhaust vents—at receptor points located a minimum of six feet above street level—and at nearby operable windows. Contributions from emissions generated by street traffic were added to these estimated concentrations to estimate total concentrations.

This analysis was conducted for the 2019 analysis year—when these facilities are anticipated to be in operation—for the peak periods, when estimated garage emissions would be greatest.

The maximum total 8-hour CO concentration (including background levels and street traffic contributions) estimated for any of the receptor sites considered is 5.0 ppm. Therefore, the impacts of garage emissions are not expected to result in or exceed the NAAQS of 9.0 ppm.

The garage associated with the Ninth Avenue Additional Housing Site is smaller than the parking facilities that require a traffic analysis (as per Table 30-1 of the *CEQR Technical Manual*). Therefore, no analysis is required for this facility, and no significant adverse impact from the emissions of this facility is expected.

BUILDING HVAC ANALYSIS

HVAC ANALYSIS OF DEVELOPMENT SITE

The primary issues regarding emissions associated with the HVAC systems of the proposed buildings include: (1) the impact of the HVAC emissions of the proposed buildings on other proposed buildings (project-on-project impacts); (2) the impact of HVAC emissions of the proposed buildings on nearby existing (and future No Build) sensitive land uses; and (3) the impact of existing and future “major” emission sources (i.e., heating units with 20 MMBtu/hour or greater heat input) on the proposed buildings. Analyses were conducted for both Development Site and Additional Housing Site buildings.

The *CEQR Technical Manual* generally recommends a two-step approach to estimating potential impacts of action-induced development HVAC systems: a screening-level analysis followed by a detailed dispersion analysis, if necessary. This two-step approach, however, is not applicable to the Development Site, which would have multiple large-scale development buildings that are located near one other; the combined impacts of the HVAC emissions of all of these buildings would have to be considered. Therefore, a cumulative analysis of all of the HVAC emission sources combined was conducted for each pollutant to estimate project-on-project impacts as well as the impacts on existing and future No Build land uses. Modeling analyses were conducted by including the emissions from all sources in one modeling run for each pollutant. Operable windows and air intake ducts of the development buildings and potentially affected existing and future No Build buildings were considered as sensitive receptor sites. The same type of analysis was conducted to estimate the impacts of existing major HVAC emission sources on the proposed developments, with receptors placed on each development building.

To estimate maximum concentrations, receptors were located on all façades of each affected building, at heights and locations that would be impacted by the HVAC emissions released through the exhaust stacks of the other Proposed Actions buildings.

Dispersion analyses were conducted using the EPA AERMOD dispersion model. AERMOD is a steady-state plume model that incorporates new concepts regarding flow and dispersion in complex terrain, treatments of the boundary layers, turbulence and dispersion, and handling of terrain interactions. The model is applicable in rural and urban areas, flat and complex terrain, surface and elevated releases, and multiple sources (including point, area, and volume sources). It 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 in a cavity region and at locations when the plume from the exhaust stack is affected by the aerodynamic wakes and eddies (downwash) produced by nearby structures. Analyses of the proposed development buildings' HVAC emissions were conducted assuming the use of fuel oil during the four winter months (December, January, February, and March) and natural gas for the remainder of the year. This is a conservative approach because natural gas is proposed to be the primary fuel for the HVAC systems, with higher polluting fuel oil used solely as backup.

Stack parameters (diameters, exit velocities, and temperatures) for Proposed Actions and Eastern Rail Yard buildings were provided by JB&B Consulting Engineers; stack parameters for the Hudson Yards No Build buildings were approximated based on the size of the buildings and estimated HVAC system heat requirements.

Analyses were conducted as follows:

- Pollutant emission factors were obtained from EPA's *Compilation of Air Pollutant Emission Factors* (AP-42) for the appropriate fuel types and boiler sizes.
- Fuel consumption rates for No. 2 fuel oil and natural gas were estimated using factors presented in Appendix 7 of the *CEQR Technical Manual* and proposed building sizes.
- Analyses were conducted using the latest five consecutive years of meteorological data from LaGuardia Airport (2002-2006). While pollutant concentrations were estimated at each receptor site, only the highest concentrations estimated for any of these years are reported.
- Estimated maximum SO_2, NO_2, and PM_{10} concentrations were compared with the NAAQS to determine whether the Proposed Actions would cause a significant impact.
- Estimated $PM_{2.5}$ increments were compared with the STVs established by DEC and DEP to determine whether the Proposed Actions would cause a significant impact.
- $PM_{10}/PM_{2.5}$ emissions included both filterable and condensable particulate matter.
- It was conservatively assumed that all emissions would be uncontrolled.
- Although only a fraction of the NO_x emissions released from boilers are in the form of NO_2, which is the pollutant of concern, and not all of these emissions would be converted to NO_2 when the exhaust plumes reach the nearby buildings, it was conservatively assumed that all of the NO_2 emissions released from the stacks would be in the form of NO_2 at all of the receptor sites.

Building-On-Building Impacts

Under the Proposed Actions, HVAC system boilers at the Development Site would generate hot water for building and domestic hot water heating. The potential impacts of the emissions from the boilers of each proposed building on the other proposed buildings (as well on surrounding land uses) would be a function of the size of each building, the fuel used (fuel oil or natural gas), stack heights, and the location of each emission sources relative to the nearby buildings. Emission rates of the HVAC system for each building were estimated based on size (total gross square footage) and fuel type (fuel oil and natural gas).

The following building design scenarios were evaluated for the Development Site:

- Maximum Commercial Scenario;
- Maximum Residential Scenario-Office Option; and
- Maximum Residential Scenario-Hotel Option.

Building heights and sizes would vary under the proposed scenarios, with the commercial building ranging from 1,128,000 to 2,315,000 square feet (with a maximum height of 860 feet) and the residential buildings ranging from 375,000 to 885,000 square feet (with heights from 500 feet to 810 feet). Building sizes and heights, and stack heights considered in the analyses under each scenario, are provided in Table 19-9. These building sizes and heights are conservative, since some of the Development Site buildings are expected to be lower than the values considered.

Table 19-9
Buildings Heights and Sizes Under Each Development Scenario

Building No.	Building Height (feet)	Gross Floor Area (square feet)
SCENARIO 1 – MAXIMUM COMMERCIAL SCENARIO		
WR-1	720	730,000
WR-2	660	710,000
WR-3	560	585,000
WR-4	500	375,000
WR-5	510	535,000
WR-6	660	550,000
WR-7	560	675,000
WC-1	860	2,315,000
SCENARIO 2 – MAXIMUM RESIDENTIAL-OFFICE OPTION		
WR-1	780	805,000
WR-2	750	822,500
WR-3	650	697,500
WR-4	500	375,000
WR-5	610	660,000
WR-6	750	662,500
WR-7	650	775,000
WC-1	860	1,625,000
SCENARIO 3 – MAXIMUM RESIDENTIAL-HOTEL OPTION		
WR-1	770	792,500
WR-2	810	885,000
WR-3	710	772,500
WR-4	500	375,000
WR-5	680	747,500
WR-6	810	737,500
WR-7	710	850,000
WC-1	860	1,128,000

Note: Although the maximum height of WR-4 must be no greater than 350 feet to maintain a 10 FAR for the Development Site, the analysis conservatively assumed (because the height of this building was not set at the time of the analysis) that the height of this building would be 500 feet.

Methodology

The methodologies and procedures utilized in the dispersion analyses are described below.

Data Sources

Building locations, configurations, sizes (total gross square footage), and heights under each scenario were provided by Hudson Yards Development Corporation (HYDC) and New York Department of City Planning (DCP).

Stack Parameters

Stack parameters (diameters, exit velocities, and temperatures) were provided by JB&B Consulting Engineers.

Pollutant Emission Rates

It was conservatively assumed for all analyses that the boilers in all buildings would be operating simultaneously. For each development scenario, short-term (24-hour) and annual emission rates were estimated.

Fuel consumption rates were estimated using fuel factors presented in Appendix 7 of the *CEQR Technical Manual* for residential buildings. These fuel factors, which are 0.38 gallon per square feet per year for fuel Number 2 and 52.8 cubic feet per square feet per year for natural gas, were multiplied by the square footage of each building to estimate the total number of gallons (or cubic feet) of fuel consumed by that building annually.

To estimate winter (December, January, February, and March) emission rates, it was assumed that all of the annual fuel oil required for each building would be consumed in a 100-day (2,400-hour) heating season; emission rates for the rest of the year were developed assuming the use of natural gas. The estimated fuel oil and natural gas emission rates under each development scenario are provided in Table 19-10**.**

Dispersion Model and Model Approach

The dispersion modeling analysis was conducted using the EPA AERMOD model to estimate impacts of the HVAC systems of the existing and proposed buildings. Following CEQR guidelines, analyses were conducted assuming stack tip downwash, urban dispersion and surface roughness length, and elimination of calms. The AERMOD downwash BPIP algorithm was utilized to estimate the potential affects of the multiple building structures on the plume dispersion. Analyses were conducted both with the consideration of these downwash effects on plume dispersion (effects caused by wind flow obstructions around buildings) and without these effects (to estimate direct plume impacts).

Meteorological Data

Analyses were conducted using five consecutive years of meteorological data (2002-2006). Surface data were obtained from La Guardia Airport and upper air data were obtained from Brookhaven Station, New York. These meteorological data provide hour-by-hour wind speeds and directions, stability states, and temperature inversion elevations over the five-year period. Data were processed using EPA AERMET processor to develop data in a format that can be readily processed by the AERMOD model. The land use of the study area was classified as urban.

Table 19-10
Pollutant Emission Rates (grams/sec) with Fuel Oil and Natural Gas

Site No.	Pollutant	DEVELOPMENT SCENARIO					
		Max Commercial		Max Residential/Office		Max Residential/Hotel	
		Fuel Oil	Natural Gas	Fuel Oil	Natural Gas	Fuel Oil	Natural Gas
WR-1	NO_x	0.291	0.055	0.321	0.061	0.316	0.060
	SO_2	0.414	0.0003	0.456	0.0004	0.449	0.0004
	$PM_{2.5}$	0.031	0.004	0.034	0.005	0.034	0.005
	PM_{10}	0.035	0.004	0.038	0.005	0.038	0.005
WR-2	NO_x	0.283	0.054	0.328	0.062	0.353	0.067
	SO_2	0.402	0.0003	0.466	0.0004	0.501	0.0004
	$PM_{2.5}$	0.030	0.004	0.035	0.005	0.038	0.005
	PM_{10}	0.034	0.004	0.039	0.005	0.042	0.005
WR-3	NO_x	0.233	0.044	0.278	0.053	0.308	0.059
	SO_2	0.331	0.000	0.395	0.0003	0.437	0.0004
	$PM_{2.5}$	0.025	0.003	0.030	0.004	0.033	0.004
	PM_{10}	0.028	0.003	0.033	0.004	0.037	0.004
WR-4	NO_x	0.150	0.028	0.150	0.028	0.150	0.028
	SO_2	0.212	0.0002	0.212	0.0002	0.212	0.0002
	$PM_{2.5}$	0.016	0.002	0.016	0.002	0.016	0.002
	PM_{10}	0.018	0.002	0.018	0.002	0.018	0.002
WR-5	NO_x	0.213	0.041	0.263	0.050	0.298	0.057
	SO_2	0.303	0.000	0.374	0.0003	0.424	0.0003
	$PM_{2.5}$	0.023	0.003	0.028	0.004	0.032	0.004
	PM_{10}	0.025	0.003	0.031	0.004	0.035	0.004
WR-6	NO_x	0.219	0.042	0.264	0.050	0.294	0.056
	SO_2	0.312	0.0003	0.375	0.0003	0.418	0.0003
	$PM_{2.5}$	0.023	0.003	0.028	0.004	0.031	0.004
	PM_{10}	0.026	0.003	0.031	0.004	0.035	0.004
WR-7	NO_x	0.269	0.051	0.309	0.059	0.339	0.065
	SO_2	0.382	0.0003	0.439	0.0004	0.482	0.0004
	$PM_{2.5}$	0.029	0.004	0.033	0.004	0.036	0.005
	PM_{10}	0.032	0.004	0.037	0.004	0.040	0.005
WC-1	NO_x	0.924	0.176	0.648	0.123	0.450	0.086
	SO_2	1.312	0.001	0.921	0.001	0.639	0.001
	$PM_{2.5}$	0.098	0.013	0.069	0.009	0.048	0.007
	PM_{10}	0.110	0.013	0.077	0.009	0.054	0.007

Notes:
Emission factors for fuel oil and natural gas combustion were obtained from EPA AP-42 Table 1.3-1 "Criteria Pollutant Emission Factors for Fuel Oil Combustion" for Boilers with less then 100 MMBtu/hr, Table 1.4-1 "Emission Factors for Nitrogen Oxides (NO_2) and Carbon Monoxide (CO) for Natural Gas Combustion, and Table 1.4-2 "Emission Factors for Criteria Pollutants and Greenhouse Gases From Natural Gas Combustion."
SO_2 emission factors from fuel oil combustion are estimated using the following equation: SO2=142S, where S= sulfur content (0.2 percent) in No. 2 fuel oil
PM_{10} and $PM_{2.5}$ emission factors include both filterable and condensable PM emissions (AP-42, Table 1.3-2 Condensable Particulate Matter Emission Factors for Oil Combustion) and were estimated using cumulative particle size distribution and size-specific emission factors for uncontrolled commercial boilers from AP-42 Table 1.3.7

Receptor Locations

Pollutant concentrations were estimated at multiple locations and elevations on each building. With regard to emissions from building HVAC systems, maximum impacts generally occur at the approximate level of the plume centerline, and receptor sites can be selected accordingly. However, because plumes are dispersed from multiple stacks at different heights for buildings under each development scenario, it is not possible to identify worst-case receptor heights or locations. Therefore, to estimate maximum concentrations under the each of the design scenarios, a comprehensive set of elevated receptors (e.g., operable windows for the residential buildings and air intake ducts of the mechanical ventilation system for the commercial building/hotel) were developed for each building. The receptors were placed on the façades of each building at locations and elevations from the roof downward. All analyses were conducted to estimate potential worst-case impacts at any of these receptors.

For the proposed commercial building/hotel, which would not have operable windows, certain locations of the air intake ducts on the upper stories of several façades were restricted to avoid being adversely impacted by the exhaust plumes of the other project buildings.

Stack Heights

Initial analyses were conducted to estimate the minimum height of the exhaust stack on the roof of each building. Based on the dispersion modeling analyses, it was determined that if each stack were at least 20 feet tall, plume downwash effects would not cause an exceedance of the NAAQS at the upper floor receptors of that building. Therefore, a minimum of 20-foot-tall stacks were initially used for all eight development buildings, and detailed dispersion analyses were conducted using 20-foot tall stacks on the roof of each building. For some buildings, however, 40-foot-tall stacks were required to reduce the impacts on nearby taller buildings.

Stack Locations

Initial analyses were also conducted to determine stack location requirements on the roof of each building. Detailed trial-and-error modeling analyses were conducted (with and without the effects of downwash) to determine the number and location of stacks that would be required so that the potential air quality impacts of the HVAC emissions would not cause exceedance of the NAAQS or STVs. The number of stacks that are required and the general location of these stacks on the buildings' roofs are provided in Table 19-11. The exact locations and height requirements of these stacks are provided in Appendix F, "Air Quality."

Results

The results of the dispersion analyses conducted for the scenarios identified in Table 19-9 are summarized in Table 19-12 and 19-13. Table 19-12 presents the projected maximum increments and concentration for SO_2, NO_2 , and PM_{10}. The maximum 24-hour SO_2 concentration would be 181.8 $\mu g/m^3$, the maximum 24-hour PM_{10} concentration would be 64.9 $\mu g/m^3$, and maximum annual NO_2 concentration would be 73.9 $\mu g/m^3$. The analysis also considered $PM_{2.5}$ emissions as shown in Table 19-13. The maximum 24-hour incremental impact would be 1.99 $\mu g/m^3$ and the maximum annual incremental impact would be 0.29 $\mu g/m^3$. Therefore, the potential building-on-building increments from HVAC emissions from the proposed buildings would not result in an exceedance of either the NAAQS or STV, and no significant adverse air quality impact would occur. Detailed results of this analysis are provided in Appendix F, "Air Quality."

The results of the building-on-building dispersion analyses specify the number, height and location of stacks at proposed buildings as well as air intake locations for the proposed commercial building (WC-1). These restrictions on the location of air intake ducts for the mechanical ventilation system of WC-1 as well as the number, location, and heights of the HVAC stacks on the roof of each proposed building, would be included in the Restrictive Declaration for the Development Site.

Table 19-11
Stack Locations and Restrictions

Building ID	Stack Requirements: Number	Stack Requirements: Height Above the Roof, feet	Stack Requirements: Location on Roof	Air Intake Location Restrictions
SCENARIO 1 – MAXIMUM COMMERCIAL SCENARIO				
WC-1	1	20	Center	North façades: None South and West façades: Above 400 feet East façade: Above 650 feet
WR-1	1	20	Center	None
WR-2	1	20	South	None
WR-3	1	20	Center	None
WR-4	1	20	Center	None
WR-5	1	20	Center	None
WR-6	1	20	Center	None
WR-7	2	20	Center	None
SCENARIO 2 – MAXIMUM RESIDENTIAL SCENARIO-OFFICE OPTION				
WC-1	1	20	Center	North façade – None South and West façades: Above 400 feet East façade: Above 650 feet
WR-1	1	20	North	None
WR-2	1	20	South	None
WR-3	1	20	South-West	None
WR-4	1	40	Center	None
WR-5	1	40	South-West	None
WR-6	1	20	Center	None
WR-7	2	20	West	None
SCENARIO 3 – MAXIMUM RESIDENTIAL SCENARIO-HOTEL OPTION				
WC-1	1	20	Center	North façade – None South and West façades: Above 400 feet East façade: Above 650 feet
WR-1	1	20	North-West	None
WR-2	1	20	South	None
WR-3	1	20	South-West	None
WR-4	1	40	Center	None
WR-5	1	40	South-East	None
WR-6	1	20	Center	None
WR-7	2	20	West	None

Table 19-12
Maximum Estimated Building-On-Building HVAC Increments and Concentrations (μg/m^3)

Pollutant	Averaging Time Period	Maximum Increments[1] Scenario 1	Maximum Increments[1] Scenario 2	Maximum Increments[1] Scenario 3	Background Conc.[2]	Maximum Concentrations Scenario 1	Maximum Concentrations Scenario 2	Maximum Concentrations Scenario 3	Applicable NAAQS[3]
SO_2	24-hr	58.8	46.0	48.3	123	181.8	169.0	171.3	365
	Annual	2.8	2.6	3.1	37	39.8	39.6	40.1	80
NO_2	Annual	2.5	2.7	2.9	71	73.5	73.7	73.9	100
PM_{10}	24-hr	4.9	3.9	4.1	60	64.9	63.9	64.1	150

Notes:
1. Results were estimated assuming the use of fuel oil for the four winter months and natural gas for the rest of the year.
2. Background concentrations are provided in Table 19-3.
3. NAAQS = National Ambient Air Quality Standards.

Table 19-13
Maximum Estimated Building-On-Building HVAC Increments for $PM_{2.5}$ ($\mu g/m^3$)

Pollutant	Averaging Time Period	Background Conc.(1)	Maximum Increments			Significant Threshold Value(2) (STVs)
			Scenario 1	Scenario 2	Scenario3	
$PM_{2.5}$	24-hr	39.2	1.84	1.99	1.84	2–5
	Max Annual	15.8	0.25	0.26	0.29	0.3(2)

Notes:
1. Background concentrations are provided in Table 19-3.
2. STVs established by DEP and DEC.
3. Maximum annual "neighborhood" increments were not considered because the maximum annual discrete increment did not exceed 0.3 $\mu g/m^3$.

Impacts on Existing Land and Future No Build Land Uses

Because emissions from the HVAC systems of the proposed buildings could affect air quality levels at nearby existing and future No Build land uses, air quality analyses were conducted to determine whether the HVAC emissions from the proposed buildings would result in violations of ambient air quality standards or STV exceedances at nearby sensitive land uses.

The HVAC emissions of the proposed buildings would be released through rooftop stacks that would generally be between 500 and 900 feet tall, and the maximum increments of these emissions would occur at elevated receptors in this height range. Therefore, elevated receptors were considered on all existing and future No Build tall buildings (greater than 100 feet in height) that are or would likely be located within a 400-foot radius of the Development Site.

A survey of existing land uses within 400 feet of the Development Site and a review the New York City OASIS mapping network system determined that there are no existing tall buildings in this area. However, there are proposed high-rise buildings nearby that include development proposed to be built in the future as part of the Hudson Yards rezoning and development project, including those proposed for the Eastern Rail Yard site, which were considered for this analysis. These buildings are:

- Hudson Yards Building—Site 2 (676 feet tall)
- Hudson Yards Building—Site 3 (355 feet tall)
- Hudson Yards Building—Site 4 (940 feet tall)
- Eastern Rail Yard Building—Site EH-1/ER-3 (819 feet tall)
- Eastern Rail Yard Building—Site ER-2 (563 feet tall)
- Eastern Rail Yard Building—Site ECF-1 (107 feet tall)
- Avalon Bay Properties (279 feet tall)

Analyses were conducted to determine whether the HVAC emissions from the proposed Development Site buildings would have the potential to significantly impact elevated receptors on these future No Build buildings. These analyses used the same dispersion modeling methodology and procedures described used in the building-on-building analysis. Emissions from the HVAC systems of all eight Development Site buildings were included in one modeling run, and pollutant concentrations were estimated at elevated receptors located on the future No Build buildings. Receptors were located at levels where the highest increments are likely to occur. For buildings that are shorter than the Development Site buildings (ECF-1, the Avalon Bay Properties building, and HY 3), receptors were placed at rooftop levels.

Table 19-14 summarizes the analysis for 24-hour SO_2, 24-hour PM_{10}, and annual NO_2. Maximum total estimated concentrations are provided above in Table 19-14. The maximum 24-hour SO_2 concentration would be 160.9 μg/m^3, the maximum 24-hour PM_{10} concentration would be 69.5 μg/m^3, and maximum annual NO_2 concentration would 72.6 μg/m^3. The analysis also considered $PM_{2.5}$ emissions as shown in Table 19-15. The maximum 24-hour incremental impact would be 1.69 μg/m^3 and the maximum annual incremental impact would be 0.16 μg/m^3. Therefore, as indicated in Tables 19-14 and 19-15, impacts of the HVAC emissions from the proposed buildings would not result in an exceedance of either the NAAQS or STV at existing or future land uses, and no significant adverse air quality impact would occur.

Table 19-14
Maximum Estimated HVAC Increments (μg/m^3) on Existing and Future No Build Land Uses

Pollutant	Averaging Time Period	Maximum Increments[1]			Background Conc.[2]	Maximum Concentrations			Applicable NAAQS[3]
		Scenario 1	Scenario 2	Scenario 3		Scenario 1	Scenario 2	Scenario 3	
SO_2	24-hr	22.3	37.9	26.7	123	145.3	160.9	149.7	365
	Annual	1.1	1.8	1.4	37	38.1	38.8	38.4	80
NO_2	Annual	1.0	1.6	1.3	71	72.0	72.6	72.3	100
PM_{10}	24-hr	1.9	3.2	2.2	60	69.1	63.2	62.2	150

Notes:
1. Results were estimated assuming the use of fuel oil for the four winter months and natural gas for the rest of the year.
2. Background concentrations are provided in Table 19-3.
3. NAAQS = National Ambient Air Quality Standards.

Table 19-15
Maximum Estimated HVAC Increments for $PM_{2.5}$ (μg/m^3) on Existing and Future No Build Land Uses

Pollutant	Averaging Time Period	Background Conc.[1]	Maximum Increments			Significant Threshold Value[2] (STVs)
			Scenario 1	Scenario 2	Scenario 3	
$PM_{2.5}$	24-hr	39.2	1.69	1.19	0.87	2–5
	Max Annual	15.8	0.10	0.16	0.13	0.3[5]

Note:
1. Background concentrations are provided in Table 19-3.
2. STVs established by DEP and DEC.

Impacts of Existing and Future No Build Building Emissions on the Proposed Buildings

Following *CEQR Technical Manual* guidelines, an analysis was conducted to determine whether the HVAC emissions associated with the existing and future major emission sources in the study area have the potential to significantly impact the proposed Development Site buildings. HVAC emissions from all existing and future No Build buildings located within 1,000 feet of the Development Site were considered for this analysis, including those with heat inputs that are less than and greater than 20 million BTUs per hour (i.e., “major” HVAC emission sources). For the conservative purpose of this analysis, the emissions from all of the buildings to be built as part of the Hudson Yards project (15 buildings, six of which would be built on the Eastern Rail Yard site) were included in this analysis. No "major" existing significant emission sources were identified in the study area.

Analyses were conducted assuming that No. 2 fuel oil would be used in the future HVAC systems. Emission rates were estimated using the same procedures and assumptions as those used in the building-on-building analysis. For the conservative purpose of this analysis, it was assumed that emissions from each building would be released through a single stack located at the nearest edge of the roof of each building facing the Development Site. Analyses were conducted with and without the building downwash option.

Building IDs and locations, stack parameters, and pollutant emissions rates used in the analysis are provided in Table 19-16. The results, which are provided in Table 19-17, show that the maximum total estimated 24-hour SO_2 and PM_{10} concentrations would be below the NAAQS standards of 365 $\mu g/m^3$ and 150 $\mu g/m^3$, respectively. Table 19-18 shows that the maximum 24-hour and annual $PM_{2.5}$ increments would be less than the STVs.

An additional examination was conducted to determine if there are any "large" combustion emission source (e.g., power plant, co-generation facility, etc) located within 1,000 feet of the Development Site that might impact the proposed development. No large boiler emission sources were identified within 1,000 feet of the proposed developments. The only identified large emission source (Con Edison Power Plant at West 59th Street) is located far from the Development Site (approximately 4,000 feet), and the impacts of the power plant on the Development Site receptor sites are likely to be negligible at this distance.

HVAC ANALYSIS OF ADDITIONAL HOUSING SITE BUILDINGS

The Proposed Actions also include two Additional Housing Sites that are located between West 48th and West 49th Streets (Tenth Avenue Site), and West 53rd and West 54th Streets (Ninth Avenue Site), where residential units for low- to moderate-income households are proposed. The sites and the proposed developments are as follows:

- Site 1—a 99-foot-tall building (133,500 square feet) located near the west side of Tenth Avenue between West 48th and West 49th Streets; and
- Site 2—a 115-foot-tall building (133,050 square feet) located on the east side of Ninth Avenue and between West 53rd and West 54th Streets.

The potential impacts of the two Additional Housing Sites on all nearby existing buildings of similar or greater height were evaluated. The maximum floor area of each building was used as input for the screening analysis. It was assumed that HVAC system of each building would utilize a single stack with the height three feet above roof height (as per *CEQR Technical Manual* guidance).

A survey of existing land uses within 400 feet of the rezoning area was conducted using the New York City OASIS mapping network system and GIS shape files to identify residential land uses and other sensitive receptor sites. The survey identified two existing residential buildings that are taller than the proposed buildings:

- A 12-story building on Block 1078, Lot 12 (near the Site 1); and
- A 10-story building on Block 1063, Lot 35 (near the Site 2).

Table 19-16
Stack, Building Parameters, and Pollutant Emission Rates of Future No Build Developments

Pollutant	Proposed Development Size (ft^2)	Stack Height (meters)	Pollutant Emission Rates (g/sec)
Eastern Rail Yard EC-1 Building			
SO_2	2,405,000	250.2	1.363
$PM_{2.5}$			0.102
PM_{10}			0.114
Eastern Rail Yard EC-2 Building			
SO_2	2,440,000	275.2	1.382
$PM_{2.5}$			0.104
PM_{10}			0.116
Eastern Rail Yard EH-1/ER-3 Building			
SO_2	1,117,500	250.6	0.633
$PM_{2.5}$			0.047
PM_{10}			0.053
Eastern Rail Yard ER-1 Building			
SO_2	690,000	260.0	0.391
$PM_{2.5}$			0.029
PM_{10}			0.033
Eastern Rail Yard ER-2 Building			
SO_2	528,000	172.5	0.299
$PM_{2.5}$			0.022
PM_{10}			0.025
Eastern Rail Yard ECF-1 Building			
SO_2	230,000	33.5	0.130
$PM_{2.5}$			0.010
PM_{10}			0.011
Hudson Yards Site 2, Eleventh Avenue, Block 705A (Extell)			
SO_2	1,574,930	207.0	0.892
$PM_{2.5}$			0.067
PM_{10}			0.075
Hudson Yards Site 3, 316 Eleventh Avenue, Block 701, Lots 62, 68, 70			
SO_2	315,070	109.1	0.179
$PM_{2.5}$			0.013
PM_{10}			0.015
Hudson Yards Site 4, Eleventh Avenue, Moinian, Block 706A			
SO_2	1,811,080	287.4	1.026
$PM_{2.5}$			0.077
PM_{10}			0.086
Related Site 7, Tenth Avenue , Block 701, Lots 30, 33, 36, 37, 42, and 44			
SO_2	354,700	101.5	0.201
$PM_{2.5}$			0.015
PM_{10}			0.017
Avalon Bay Properties & W. Chelsea Site 3, Eleventh Avenue, Block 700, Lots 1, 49-61			
SO_2	510,000	86.0	0.289
$PM_{2.5}$			0.022
PM_{10}			0.024
Related Site 6, West 30th Street, Midblock 701			
24-hr SO_2	337,800	101.5	0.191
$PM_{2.5}$			0.014
PM_{10}			0.016
W. Chelsea Site 9, Tenth Avenue, Block 700, Lots 27, 32, 34, 38, 42, 44, and 45			
SO_2	77,950	89.3	0.044
$PM_{2.5}$			0.003
PM_{10}			0.004
W. Chelsea Site 52, 547 West 27th Street, Block 699, Lot 5			
SO_2	115,848	24.1	0.066
$PM_{2.5}$			0.005
PM_{10}			0.006
W. Chelsea Site 53, 507 West 27th Street, Block 699, Lots 22-27, and 44			
SO_2	280,526	42.1	0.159
$PM_{2.5}$			0.012
PM_{10}			0.013

Table 19- 17
Maximum Estimated Increments (μg/m^3) of Existing and Future No Build Buildings on the Proposed Development Site Buildings

Pollutant	Average Time Period	Maximum Increments(1)	Background Conc. (2)	Maximum Concentrations	Applicable NAAQS(3)
SO_2	24-hr	73.8	123	196.8	365
PM_{10}	24-hr	6.2	60	66.2	150

Notes:
1. Results were estimated assuming the use of fuel oil for the four winter months and natural gas for the rest of the year.
2. Background concentrations are provided in Table 19-3.
3. NAAQS = National Ambient Air Quality Standards.

Table 19-18
Maximum Estimated Increments for $PM_{2.5}$ (μg/m^3) of Existing and Future No Build Land Uses on the Proposed Development Site Buildings

Pollutant	Averaging Time Period	Background Conc.(1)	Maximum Increments	Significant Threshold Value(2) (STVs)
$PM_{2.5}$	24-hr	39.2	1.37	2–5
	Max Annual	15.8	.28	0.3(5)

Note:
1. Background concentrations are provided in Table 19-3.
2. STVs established by DEP and DEC.

Following *CEQR Technical Manual* guidance, the following analysis was conducted to determine whether the potential impacts of the HVAC emissions of the Additional Housing developments on these buildings would be significant:

- Figures 3Q-5, 3Q-7 and 3Q-9 of the *CEQR Technical Appendix* were used to determine potential for significant SO_2 (i.e., the critical pollutant for fuel oil) and NO_2 (i.e., the critical pollutant for natural gas) impacts.
- The estimated maximum size of each building (133,500 square feet for Site 1 and 133,050 square foot for Site 2) was plotted on the nomograph against the distance to a potentially affected nearby taller building.
- The threshold distance at which a potentially significant impact is likely to occur was estimated and compared with the actual distance between the shorter buildings and the nearest taller building.
- If the distance between buildings is greater than the threshold distance indicated on the nomograph, no potentially significant adverse air quality impact is expected, and no detailed analysis is conducted.
- If the distance is less than the threshold distance indicated on the nomograph, a potentially significant adverse air quality impact is possible, and a detailed dispersion modeling analysis is required.

The following are the results of the screening level analyses:

- The estimated distance between Site 1 and the building on Block 1078, Lot 12 (83 feet) exceeds the estimated screening threshold distance for the Site 1 (65 feet); therefore, Site 1 passes the screening analysis, and no further analysis is required.
- The estimated distance between Site 2 and building on Block 1063, Lot 35 (206 feet) exceeds the estimated screening threshold distance for the Site 2 (65 feet); therefore, Site 2 passes the screening analysis, and no further analysis is required.

The result of the screening-level analysis is that no significant adverse air quality impact from the emissions of the HVAC systems of the Additional Housing Sites on the surrounding existing land uses is expected to occur.

Impacts from Existing and No Build Building Emissions on Additional Housing Sites

Following *CEQR Technical Manual* guidelines, a survey was conducted to determine whether there are any future No Build or existing “major” sources of boiler emissions (i.e., emissions from boiler facilities with heat inputs approximately 20 million Btu per hour) that could significantly impact the Additional Housing Sites. Two major sources were identified within 1,000 feet of the rezoning area: a 450-foot-tall building located at 592–608 Eleventh Avenue (on Block 1073, Lots 1, 28), and a 615-foot-tall building located at 250 West 55th Street (on Block 1026, Lots 1, 3, 4, 8, 9, 55, 59, 60, 61, 64, 101-103).

The first building, which is closer to Site 1, is located approximately 840 feet from the site, and the second building, which is closer to Site 2, is located approximately 930 feet from the site. Because both buildings are taller than the proposed buildings and located far away from Sites 1 and 2, no significant adverse air quality impact from HVAC emissions of these additional housing sites is expected to occur.

An additional examination was conducted to determine if there is any “large” combustion emission source (e.g., power plant, co-generation facility, etc) located within 1,000 feet of additional housing site buildings. No large boiler emission sources were identified within 1,000 feet of the proposed developments and, therefore, no further analysis is required.

ANALYSIS OF DIESEL EMISSIONS

IMPACTS OF DIESEL EMISSIONS AT DEVELOPMENT SITE

The dual-mode (diesel-electric) locomotives entering and leaving Penn Station currently operate in diesel mode under the Development Site, and this would continue with the Proposed Actions. Diesel-fueled delivery, maintenance, and garbage trucks would also continue to operate in the yard. The proposed mechanical ventilation system, under the Proposed Actions, would exhaust these emissions through stacks located on the roofs of the low-rise sections of two of the proposed development buildings.

An analysis was conducted to determine whether the potential impacts of these emissions would significantly impact air quality levels at the operable windows and balconies of the proposed high-rise buildings. Emission rates were estimated based on the types and sizes of engines operating in the future as well as anticipated daily train schedules. The EPA AERMOD model was used to estimate pollutant concentrations.

The result of this analysis is that the emission increments would not be significant, and the air quality impacts of these emissions would not result in a violation of the NAAQS or an exceedance of the STVs. In addition, the low elevation of these releases would preclude cumulative impacts with the HVAC emissions (which would be released above the roof-tops of the proposed tall buildings). Therefore, there would be no significant adverse air quality impact as a result of these emissions.

IMPACTS OF DIESEL LOCOMOTIVE AND HVAC EMISSIONS AT TENTH AVENUE SITE

The locomotives traveling under the Tenth Avenue Site operate in diesel mode. Under the Proposed Actions, these emissions would be released to the atmosphere through exhaust stacks located on the roof of the proposed building. Emissions from the HVAC system of the proposed building would also be released from rooftop stacks.

An analysis was conducted to estimate whether emissions from the diesel-fueled locomotives, together with the HVAC emissions, would significantly impact air quality levels at nearby sensitive receptor sites (i.e., operable windows, open space, etc.).

Locomotive emission rates were estimated based on the types and sizes of engines that would be operating in the future as well as the anticipated daily schedule of trains entering and leaving Penn Station. HVAC emission rates were estimated based on the size of the proposed development building and the methodology used in the building-on-building impact analysis of the Development Site. The EPA AERMOD model was used to estimate pollutant concentrations.

The result of this analysis is that the emission increments would not be significant, and the air quality impacts of these emissions would not result in a violation of the NAAQS or an exceedance of the STVs. Therefore, there would not be a significant adverse air quality impact as a result of these emissions.

AIR TOXICS ANALYSIS

METHODOLOGY

Overview

The primary issue with air toxic contaminants is the potential impact of nearby industrial sources on the project sites. The potential air quality impacts associated with industrial sources were addressed using the procedures discussed below to determine the increment of each air toxic contaminant and the cumulative increment of multiple air toxic contaminants combined.

Analyses were conducted to determine whether the increment of toxic air pollutant emissions would result in a significant adverse air quality impact. Information was collected regarding the types of toxic air pollutants that are being emitted from existing emission sources that could potentially affect sensitive receptors in the study area, and all industrial toxic emission sources within 400 feet of the project sites were considered. These boundaries were used to identify the extent of the study areas for determining air quality impacts associated with the Proposed Actions.

Data Sources

Information regarding emissions of toxic air pollutants from existing industrial sources was obtained from the New York State and New York City Clean Air Tracking System database as follows:

- Boundaries of study areas within a 400-foot radius of each of the three project sites were developed using GIS shapefiles.
- A search was performed to identify DEC Title V permits and New York State air permits listed in the EPA Envirofacts database for the industrial emission sources within the three study areas.
- Air permits for active (currently permitted) industrial facilities within the study areas that are contained in DEP's Clean Air Tracking System database were acquired and reviewed.
- A field survey was conducted to verify the existence of the identified permitted facilities.
- Industrial sources within a 400-foot radius of each site were located using GIS shapefiles and the Universal Transverse Mercator (UTM) coordinate system.

The data on current permits, which include source code ID, facility type, location and process description, stack parameters and pollutant hourly and annual emission rates, were considered to be the most current and served as the primary basis of data for this analysis. This information was compiled into DAR-1 format for use in the dispersion analyses with DAR-1 software.

Health Risk Assessment Methodology

To evaluate short-term and annual impacts of non-carcinogenic toxic air pollutants, DEC's short-term guideline concentrations (SGCs) and annual average-based guideline concentrations (AGCs) were used.

EPA's Hazard Index Approach was then used to estimate the potential impacts of non-carcinogenic pollutants. If the sum of the combined ratios of estimated pollutant concentrations, divided by the respective SGCs or AGCs value for each of the toxic pollutants, is found to be less than 1, no significant adverse air quality impacts are expected to occur due to these pollutant releases.

For carcinogenic pollutants, unit risk factors based on the toxicity of each pollutant were used. The EPA does not consider an overall incremental cancer risk from a proposed action of less than one-in-a-million to be significant. Using these factors, the potential cancer risk associated with each carcinogenic pollutant, as well as the total cancer risk of the releases of the carcinogenic toxic pollutants combined, can be estimated. If the total incremental cancer risk of the carcinogenic toxic pollutants combined is less than one-in-a-million, no significant adverse air quality impacts are predicted to occur due to these pollutant releases.

These methods are based on equations that use EPA health risk information (established for individual compounds with known health effects) to determine the level of health risk posed by an increased ambient concentration of that compound at a potentially sensitive receptor. The derived health risk values are additive, and can be used to determine the total risk posed by the release of multiple air contaminants.

Non-Carcinogens

Public health risk estimates for inhalation of non-carcinogenic compounds are based on the following calculation:

Hazard Index = C/AGCs

Where:

C = annual average ambient air concentration of compound in $\mu g/m^3$

AGCs = DEC annual ambient guideline concentration equivalent to reference dose concentrations RfC, established by EPA, in $\mu g/m^3$.

Once the hazard index of each compound is established, they are added together. If the total hazard index is less than or equal to one, then the non-carcinogenic risk is considered to be insignificant.

Carcinogens

Public health risk estimates for inhalation of carcinogenic compounds are based on the following calculation:

Incremental Risk = C x URF

Where:

C = annual average ambient air concentration of the compound in $\mu g/m^3$

URF = compound-specific inhalation unit risk factor in $(\mu g/m^3)$-1

Once the incremental risk of each compound is established, they are added together. If the total risk is less than or equal to one-in-a million (1.0 E-06), the carcinogenic risk is considered to be insignificant.

Dispersion Analyses

Dispersion analyses were conducted using EPA Hazard Index Approach for non-carcinogenic pollutants and EPA Unit Risk Factors for carcinogenic pollutants to determine the potential of the toxic emissions released from the permitted emission sources to adversely affect the new residential areas. DEC DAR-1 database and modeling software was employed to estimate maximum cumulative short-term (1-hour) and annual impacts for each air toxic pollutant, and determine whether facilities have the potential to exceed short-term or annual guidelines values (i.e., SGCs or AGCs).

When AGCs in the DAR-1 database are based on potential carcinogenic risks, they represent estimates of air concentrations associated with an excess cancer risk of one-in-a-million from lifetime inhalation exposures. If the AGC is based on a one-in-a-million risk level, as calculated with an inhalation cancer risk value, the AGC is set in the DAR-1 database at the 10-6 risk level (e.g., includes cancer risk factor for that pollutant). If the AGC is based on non-carcinogenic effects, it is lower than those associated with carcinogenic end-points.

The refined analysis with the DAR-1 software was used to estimate the maximum concentrations of each pollutant, the ratio of concentration to that pollutant's AGC, the total hazard index, the top contributors to the maximum hazard index, and the incremental cancer risk associated with the carcinogenic pollutants combined.

The dispersion analysis was performed by modeling the emissions of identified toxic air pollutants from the existing industrial facilities in one modeling run. The estimated ambient concentrations of each air toxic pollutant were then compared with the guideline concentrations established by DEC and EPA and contained in the DAR-1 database.

Two types of analyses were conducted: an analysis of non-carcinogenic pollutants (where the results were compared with the total Hazard Index of 1.0), and an analysis of the carcinogenic pollutants (where the results were compared with the EPA threshold level of one per million).

INDUSTRIAL SOURCE EMISSIONS

Development Site

Three active facilities with DEP permits were identified within the Development Site study area. The permits for these facilities identified three active emission sources of non-carcinogenic pollutants. No carcinogenic pollutants are associated with these facilities. According to these permits, six toxic non-carcinogenic air pollutants are being released from these emission sources.

In Permit PA044092, some of the air toxic contaminants were identified as compound groups (e.g., hydrocarbons). Because no guideline concentrations are available for these compound groups, it was necessary to use a substitute contaminant that was representative of the compound group, to enable a comparison to risk assessment guidelines. In this case, toluene was considered to be a substitute contaminant.

Additional Housing Sites

Air toxic analyses were also conducted for the two Additional Housing Sites where affordable housing would be constructed under the Proposed Actions.

Tenth Avenue Site

Two active industrial facilities with DEP permits were identified within a 400-foot radius of the Tenth Avenue Site. The permits for these facilities identify one active emission source of non-carcinogenic pollutants (Permit PA046188) and one source of carcinogenic pollutants (Permit PA019999). According to these permits, three toxic non-carcinogenic and one carcinogenic pollutant are released from identified emission sources. Toluene was again used as a substitute contaminant for the hydrocarbons compound groups in Permit PA046188.

The carcinogenic pollutant emitted from sources under Permit PA019999 is tetrachlorethylene (PERC). This facility, the West Side Cleaners, located at 734 Tenth Avenue, is a dry-cleaning facility that is equipped, as required by the New York State Perchloroethylene (PERC) Dry Cleaning Facilities Regulation (Part 232), with a fourth-generation emission control system, with a built-in carbon adsorber and refrigeration units. Because it is a totally enclosed system, it is considered to be a non-vented outside system with, presumably, no emissions. However, according to the permit, the efficiency of this control system is listed as 98 percent, which means that 2 percent of the PERC may still be released into the atmosphere, partially as fugitive emissions. Based on this condition, and for conservative purposes, 98 percent control efficiency was applied for this analysis to estimate PERC emissions released into the atmosphere.

Ninth Avenue Site

Four active industrial facilities with DEP permits were identified within a 400-foot radius of the Ninth Avenue Site. The permits for these facilities identify two active emission sources of non-carcinogenic pollutants (Permit PA035996 and PA027886) and two emission sources of the carcinogenic pollutants (Permit PA011995 and PB024901). According to these permits, two non-carcinogenic toxic air pollutants and two carcinogenic pollutants (both of them are PERC from dry-cleaning operations) are released from the identified emission sources. To estimate PERC emission rates from these facilities, the procedure described above was applied.

RESULTS

Non-Carcinogens

Table 19-17 lists the identified facilities located near the Development Site and the Additional Housing Sites that emit non-carcinogenic pollutants together with the type and location of each facility and its permit number, emission point(s), contaminant name, and CAS registry number. Also provided are the respective pollutant guidelines values, estimated pollutant concentrations (short-term and long-term), and hazard indexes. As shown in Table 19-17, the maximum estimated concentrations for each non-carcinogenic toxic contaminant are below DEC's SGCs and AGCs. The total hazard index caused by the non-carcinogenic pollutants emitted from sources combined at the Development Site was estimated to be 0.254 x 10-2, at the Tenth Avenue Site = 0.234 x 10-2, and at the Ninth Avenue Site = 0.99 x 10-4.

These values are below the level (1.0) considered by EPA to be significant.

Carcinogens

Table 19-19 provides the identified facilities that emit carcinogenic pollutants together with the type and location of each facility and its permit number, emission point(s), contaminant name, and CAS registry number. Also included in Table 19-18 are the estimated maximum annual concentrations and maximum incremental cancer risks. As shown, the maximum total estimated incremental cancer risk caused by carcinogenic pollutants emitted from sources combined at the Additional Housing Sites is as follows:

- At the Tenth Avenue Site = 0.287 x 10-3 per million; and
- At the Ninth Avenue Site = 0.199 x 10-1 per million.

These values are below the level of one per million considered by EPA to be significant.

SUMMARY OF RESULTS

This analysis demonstrates that no exceedances of either DEC SGC or AGC acceptable limits or the EPA incremental risk threshold limit are expected to occur with the Proposed Actions.

Table 19-19
Analysis of the Non-Carcinogenic Toxic Pollutants at Development Site and Additional Housing Sites

Facility Name	Facility Address	Type of Business	DEP Permit No.	Emission Point	CAS Registry No.	Compound	Permitted Emission Rates		Est. Short-Term Conc. µg/m³	DEC SGC µg/m³	Est. Short-Term Conc. % of SGC	Est. Annual Av. Conc. µg/m³	DEC AGC µg/m³	Hazard Index
							lb/hr	lb/year						
Development Site														
Midtown Neon Sign Corp	550 West 30th Street, Manhattan	Spray Booth	PA089687	XONH0001	NY075-00-0	PM_{10}	0.020	24.0	14.0507	380	3.6975	0.874E-02	50	1.75E-04
					00108-88-3	Toluene	2.160	2,593	1517.478	37,000	4.1013	0.94E+00	400	2.36E-02
Federal Express Corp	528 West 34th Street, Manhattan	Vehicular Exhaust Removal System	PA044092	XMQ80001	00108-88-3	Toluene	1.180	613.0	610.013	37,000	1.6486	0.200E-02	400	0.500E-05
					00630-08-0	Carbon Monoxide	22.46	11,679	11610.9	14,000	82.936	0.28E+01	-	0.277E-06
					00124-38-9	Carbon Dioxide	176.5	9.180	9.1243	5,400,000	0.0002	0.218E-02	21,000	0.143E-08
Noan Block	314 11 Avenue, Manhattan	Spray Booth	PA040386	XK580001	NY075-00-0	PM_{10}	0.028	14	29.623	380	7.7955	0.358E-10	50	7.15E-12
					00108-88-3	Toluene	0.990	495.0	1047.392	37,000	2.8308	0.126E-08	400	0.316E-11
					00067-63-0	Isopropyl Alcohol	0.480	240	507.826	98,000	0.5182	0.6132E-05	7,000	0.876E-13
					00067-64-1	Acetone	0.490	245.0	518.406	180,000	0.2880	0.558E-05	28,000	0.224E-13
					00123-86-4	Butyl Acetate	0.490	245.0	518.406	95,000	0.5457	0.570E-05	17,000	0.368E-13
Tenth Avenue Site: West 48th Street														
BMW of Manhattan	547 West 47th Street, Manhattan	Auto Tailpipe Exhaust System	PA046188	XQ3J0001	00108-88-3	Toluene	0.4	1,000	423.1886	37,000	1.1438	0.93E+00	400	2.32E-03
					00630-08-0	Carbon Monoxide	1.0	2,500	1057.972	14,000	7.5569	0.23E+01	-	-
					10102-44-0	Nitrogen Dioxide	0.001	2.5	1.0579	-	-	0. 23E-02	100	2.32E-05
Ninth Avenue Site: West 54th Street														
A & C Piano Craft, Inc	333 West 52nd Street, Manhattan	Piano Woodwork Machines	PA035996	XFGB0001	NY075-00-0	PM_{10}	0.001	1.6	1.0579	380	0.2784	0.144E-02	50	0.941E-05
Louis Feron, Inc	333 West 52nd Street, Manhattan	Pickling & Melting	PA027886	X3XQ0001	07664-93-9	Sulfuric Acid Mist	0.001	1.5	0.1522	120	0.1268	0.896E-04	1.0	0.896E-04

Table 19-20
Analysis of the Carcinogenic Toxic Pollutants at Additional Housing Sites

Facility Name	DEP Permit No.	Emission Point	CAS Registry No.	Compound	Permitted Emission Rates		DEC AGC (µg/m³)	Estimated Annual Conc. (µg/m³)	Incremental Cancer Risk (per million)
					lb/hr	lb/year			
West Side Cleaners	PA019999	XGRW0001	00127-18-4	Tetrachloethylene (PERC)	0.00018	0.276	1.0	0.287E-03	0.287E-03
Kims Cleaners	PA011995	X77U0001	00127-18-4	Tetrachloethylene (PERC)	0.015	22.5	1.0	0.414E-02	0.414E-02
Neat Cleaners	PB024901	X9XX0001	00127-18-4	Tetrachloethylene (PERC)	0.009	15.22	1.0	0.158E-01	0.158E-01

B. GREENHOUSE GAS ANALYSIS

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.

This section presents an analysis of the potential GHG emissions associated with the Proposed Actions. The proximity of the proposed development to public transportation, its mixed-use and dense design, and efficient use of the land over the rail yard are all factors that contribute to the sustainability of the Proposed Actions. In addition, the Developer is committed to implementing a number of voluntary sustainability measures that would improve the energy efficiency of the Proposed Actions and result in reduced GHG emissions. Specific measures to reduce GHG emissions that are either included in the Proposed Actions or are under consideration are discussed below, and quantified to the extent possible.

The Maximum Commercial Scenario, as described in Chapter 2, "Framework for Analysis," has the greatest potential to generate GHG emissions in the 2019 analysis year, due to the relatively high electricity demand associated with office uses. Therefore, the Maximum Commercial Scenario for the Development Site is the only scenario examined for this analysis. The potential GHG emissions from the Additional Housing Sites are also quantified. The GHG emissions generated by various activities (on-site fuel use, electricity use, vehicles use, and waste generation) are presented separately for the Development Site and for the Additional Housing Sites because the sites would apply different measures that would affect GHG emissions. A summary of annual operational GHG emissions and total emissions associated with the construction period are presented for a reasonable worst-case scenario, which includes both the Additional Housing Sites and the Maximum Commercial Scenario for the Development Site.

PRINCIPAL CONCLUSIONS

Overall, the site selection, the dense and mixed-use design, the commitment to seek LEED Silver certification for all buildings and achieve a significant reduction in energy use, and other measures incorporated in the Proposed Actions, 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 uses at the Development Site are predicted to be approximately 102,026 metric tons of carbon dioxide equivalent (MT CO_2e, defined below), while the GHG emissions from the uses at the Additional Housing Sites are predicted to be approximately 4,364 MT CO_2e. The total GHG emissions associated with the Proposed Actions would be approximately 106,390 metric tons of CO_2e per year. This would not necessarily represent a net increment in GHG emissions, since similar GHG emissions would occur elsewhere if residents and associated uses were to be constructed elsewhere, and could be higher if constructed as lower density residential, further from employment and commercial uses, with less immediate access to transit service.

BACKGROUND

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 increments 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 Actions as compared with a No Build scenario, but rather presents the total GHG emissions associated with the Proposed Actions and identifies the measures incorporated in the Proposed Actions to limit those emissions. Note that much of these emissions would be associated with similar activity regardless of the Proposed Actions. For example, if residences and office buildings were to be constructed elsewhere to accommodate the same number of people as the Proposed Actions, 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 Actions. On the other hand, construction of the platform over the Long Island Rail Road (LIRR) rail yard is not typical of residential or commercial developments, and the GHG emissions associated with the ventilation and lighting of that portion of the Proposed Actions could be treated as incremental emissions. The construction of the platform would also have GHG emissions associated with the additional concrete needed for construction, which would be partly offset by the reduced need for excavation and foundations.

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.

Moreover, there are 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 office 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.

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 Actions, since the Proposed Actions would not result in significant emissions of these GHGs.

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 measures. Although the U.S. has not ratified international agreements setting emissions targets for GHGs, in 2002 the federal government announced its goal to reduce the national GHG emissions per unit of economic output by 18 percent over the 10-year period from 2002 to 2012. Achieving this goal would result in a smaller increase in GHG emissions in the U.S. than would otherwise occur by 2012. More ambitious GHG emission reduction goals and participation in international agreements have been discussed by the new administration; however, no legislation or executive orders have been adopted yet. The President's outline for the U.S. Government Budget for Fiscal Year 2010, as presented to Congress in February 2009, calls for an economy-wide emissions reduction program to reduce total GHG emissions approximately 14 percent below 2005 levels by 2020, and approximately 83 percent below 2005 levels by 2050. The Energy and Commerce Committee released a draft of clean energy legislation, currently aimed at achieving these goals. If approved, the program would be implemented through a cap-and-trade system, in which some or all of the emission allowances would be auctioned, enabling the program to provide funding for clean energy over a 10-year period.

EPA has established various voluntary programs to reduce emissions and increase energy efficiency, by financial incentives for the development and deployment of innovative technologies that would result in reduced GHG emissions, and by investing in scientific and

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

technological research. EPA has recently embarked on a few regulatory initiatives related to GHG emissions, including regulation of geological sequestration of CO_2 to ensure protection of water sources and the long-term integrity of CO_2 sequestration, and a GHG reporting rule to collect information on GHG emissions as pollutants under the Clean Air Act. The National Highway Traffic Safety Administration (NHTSA) has adopted fuel economy standards for newly manufactured vehicles for MY2011 and is in the process of establishing standards for future years.

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 ("the economic stimulus package") includes provisions that can reduce GHG emissions, including funding low-income weatherization programs, state and local government energy efficiency projects, "smart grid" investments, carbon capture and sequestration demonstration projects, electric car battery research, training for "green jobs," capital assistance for high speed rail corridors and intercity passenger rail service and funding for public transportation agencies. The wind, biomass, geothermal, and landfill tax credits have also been extended.

The U.S. Department of Transportation has recently set fuel economy standards for cars and light trucks for the 2011 model year. The new standards will raise the industry-wide combined average to 27.3 miles per gallon (mpg)—a 2.0 mpg increase over the 2010 model year average, as estimated by NHTSA. EPA is also reconsidering granting California a waiver to regulate vehicle CO_2 emissions. If the waiver is granted, 19 other states, including New York, would adopt the California mobile source air emissions standards.

There are also regional, State, and local efforts to reduce GHG emissions. In 2001, New York State Governor George Pataki issued Executive Order 111, Green and Clean State Buildings and Vehicles, a directive that set goals for energy-efficient State buildings, the use of energy from renewable sources, and the procurement of energy-efficient products and alternative fuel vehicles. The 2002 New York State Energy Plan included goals to increase the State's use of renewable energy and called for increased energy efficiency with the aim of cutting the State's GHG emissions. The Energy Plan was designed to provide statewide policy guidance for energy-related decisions by government and private market participants. In 2004, the New York State Public Service Commission voted to adopt a Renewable Portfolio Standard with a goal of increasing the proportion of renewable electricity used by New York consumers from the 2004 baseline of 19.3 percent to at least 25 percent by 2013. In 2005, Executive Order 142 directed State agencies and authorities to diversify transportation fuel and heating oil supplies through the use of bio-fuels in State vehicles and buildings.

Recently, New York State announced that it would update the State Energy Plan with goals to reduce electricity use by 15 percent from forecasted levels by the year 2015 through new energy efficiency programs in industry and government, create new appliance efficiency standards and set more rigorous energy building codes, invest in renewable energy projects throughout the state, and propose power plant siting legislation that creates an expedited review process for wind and other energy projects that result in fewer GHG emissions. The Draft 2009 State Energy Plan is scheduled to be released on July 15, 2009.

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 by 2019. 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 use of biofuel and 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. The program is run by ICLEI—Local Governments for Sustainability, an international association of local governments and national and regional local government organizations that have made a commitment to sustainable development.

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 (Local Law 55 of 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 the GHG emissions from municipal operations by 30 percent as compared with fiscal year 2006 emissions by 2017. Of particular relevance to development projects are PlaNYC initiatives to encourage transit-oriented development, decking over rail yards to create new land, greening parking lots, installing green roofs, promoting cycling, expanding clean distributed generation, fostering a market for renewable energy, and improving private vehicle fuel efficiency.

A number of benchmarks for energy efficiency and green building design have also been developed. 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 can include energy efficiency components. EPA's Energy Star is a voluntary labeling program for major appliances, office equipment, lighting, home electronics, homes, and commercial and industrial buildings designed to identify and promote energy-efficiency and reduce GHG emissions.

MTA has released "Greening Mass Transit & Metro Regions" in February 2009 by the Blue Ribbon Commission on Sustainability and the MTA that contains sustainability-related recommendations for the MTA and its operating agencies, including recommendations encouraging smart growth and transit-oriented development.

There is an emerging consensus that GHGs need to be considered in the environmental review of major projects. DEC has published draft guidance on the analysis of GHG emissions for projects where GHG emissions or energy use have been identified as significant and where DEC is the lead agency.[1] However, there are 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 Actions are evaluated in the context of their consistency with the objectives stated in PlaNYC. Potential GHG emissions

[1] NYSDEC, Draft Guide for Assessing Energy Use and Greenhouse Gas Emissions in an Environmental Impact Statement, March 11, 2009.

from the Proposed Actions are assessed and disclosed, and various options available for reducing such emissions are discussed and implemented to the extent practicable.

METHODOLOGY

Emissions of GHG that would be associated with the Proposed Actions have been quantified, including GHG emissions from HVAC systems, off-site emissions associated with electricity used on-site, emissions from vehicle use attributable to the Proposed Actions, and emissions indirectly produced as a result of solid waste that would be generated by the development. As specified above, the Maximum Commercial Scenario is considered to be the scenario with the greatest potential GHG emissions in the 2019 analysis year. 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 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_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). GWPs account for the lifetime and the radiative forcing of each chemical 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.[1]

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

	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 of Climate Change 1996.

Based on the EPA MOVES model, the well-to-pump GHG emissions of gasoline and diesel are approximately 22 percent of the tailpipe emissions.[2] Although upstream emissions (emissions associated with production, processing, and transportation) of all fuels can be substantial and are important to consider when comparing the use of different fuels, when making wider policy-level decisions, and for large energy supply projects they are not considered in the analysis for the Proposed Actions, in accordance with the methodology used in developing the New York

[1] Following standard protocol for greenhouse gas inventories and consistent with New York City's GHG inventory, the global warming potential from IPCC's Second Assessment Report (1996) are used. These GWPs are used in national governments' GHG emissions calculations under the Kyoto Protocol.

[2] Environmental Protection Agency, *MOVES2004 Energy and Emission Inputs*, Draft Report, EPA420-P-05-003, March 2005.

City GHG inventory. The GHG emission units used are metric tons of CO_2e per year, consistent with the New York City annual inventory.[1]

The Developer is committed to seeking LEED rating for the proposed buildings, at the LEED Silver certification level. The Developer has committed to achieving higher energy efficiency for the proposed buildings, resulting in 14 percent less energy use than would be achieved by complying with the current building code. The analysis includes an estimate of the GHG benefit associated with the above energy efficiency commitment. The Developer has also committed to using fly ash, a byproduct of coal-fired power generation, or slag, a byproduct of iron production, in concrete used for the proposed buildings. These recycled products can be used in concrete as inexpensive replacements for Portland cement—the production of which results in substantial GHG emissions.

At the Additional Housing Sites, the proposed buildings would be 20 percent more energy efficient than buildings constructed to current code. Efficient indoor and outdoor lighting would be implemented, and Energy Star appliances installed where applicable. These and other sustainability measures would be required by the New York City Department of Housing Preservation and Development (HPD) New Construction Program.[2]

ON-SITE GHG EMISSIONS FROM HVAC SYSTEMS

The Proposed Actions would allow for the development of residential, commercial, and public school space. GHG emissions that would result from on-site fuel use for HVAC systems were calculated using emission factors recommended by the Energy Information Administration (EIA).[3] The emission factors used were 116 pounds of CO_2 per 1,000 cubic feet of natural gas, and 22.3 lbs of CO_2 per gallon of fuel oil. The amount of fuel use expected was calculated based on the gross floor area for each use type, and the most recent statistics on energy use from the EIA.[4] For residential units, the annual demand for natural gas was assumed to be 71,000 cubic feet per household, while the demand for oil was assumed to be 803 gallons per household, based on data for New York State. For office, retail, and school uses, the natural gas demand factors used were 38.2 cubic feet per square foot (ft^3/ft^2), 48.2 ft^3/ft^2, and 39.5 ft^3/ft^2, respectively. The annual fuel oil demand was assumed to be 0.08 gallons per square foot (gal/ft^2) for office uses and 0.23 gal/ft^2 for retail uses, based on the data for the Northeast region.

As it is expected that the boilers under the Proposed Actions and the supplemental boilers under the Tri-Generation Alternative would primarily use natural gas, that scenario was presented in the feasibility study and assumed for the GHG estimates of the Proposed Actions. This provides a common basis for the comparison of GHG emissions of the Proposed Actions with the Tri-Generation Alternative (see Chapter 25, "Alternatives"). For the Additional Housing Sites, the analysis assumes the use No. 2 fuel oil in HVAC systems, since this would result in higher GHG emissions which would not be reduced by any additional measures or alternatives.

---

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

[2] Green Communities Criteria v.3.0 Revised May 2008 HPD New Construction Overlay.

[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

[4] *Residential Energy Consumption Survey (RECS)*, Energy Information Administration, revised 2009. Table US8. *Commercial Buildings Energy Consumption Survey (CBECS)*, Energy Information Administration, released 2006. Table C27A.

As per the energy efficiency commitments described above, it was assumed that fuel use and CO_2 emissions from HVAC systems at the Development Site would be 14 percent less than the typical rates described above. For Additional Housing Sites, fuel use and CO_2 emissions were assumed to be 20 percent less than typical, as it is anticipated that the energy efficiency measures described in the HPD Green Communities Criteria would be implemented.

OFF-SITE GHG EMISSIONS FROM ELECTRICITY USE

The demand for electricity for commercial, retail, and school uses was projected using the latest available official statistics from EIA.[1] The annual consumption factor for residential units of 4,232 kilowatt-hours (kWh) per household was applied based on data from the Con Edison 2008 Annual Report. For office, retail, and school uses, the annual electricity demand factors used were 16.6 kWh per square foot (kWh/ft^2), 10.9 kWh/ft^2, and 8.4 kWh/ft^2, respectively, based in data for the Mid-Atlantic region. In addition, it is estimated that 30,744 megawatt-hours (MWh) per year would be required for ventilation and lighting of LIRR facilities and railroad track areas below the platform (see Chapter 16, "Energy").

The GHG emission factor of 985 lbs/MWh was based on the coefficient for electricity consumed in New York City in 2007, developed for the *Inventory of New York City Greenhouse Gas Emissions 2008*.[2] The coefficient included the consumption of both in-city-generated and imported electricity, and accounted for transmission and distribution losses. Emissions of CO_2, CH_4, and N_2O were accounted for. Although the electricity emission factor would likely decrease by 2019 due to an expected increase in the amount of electricity produced from renewable sources, the 2007 emissions factor was conservatively used without an adjustment for future emissions.

As per the energy efficiency commitments described above, it was assumed that CO_2 emissions from electricity use would be 14 percent less than the typical rates described above. For Additional Housing Sites, electricity demand was assumed to be 20 percent less than typical, as it is anticipated that the Energy Star appliances, efficient lighting, and other energy efficiency measures described in the HPD Green Communities Criteria would be implemented.

GHG EMISSIONS FROM VEHICLE USE

The vehicle trips generated by the Proposed Actions are discussed in Chapter 17, "Traffic and Parking." The number of annual car trips that could be attributed to the Proposed Actions 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. The annual number of truck trips that would be generated by the development was also calculated from daily trip generation numbers. The average daily trips were calculated using the assumptions developed for the purposes of 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

---

[1] *Residential Energy Consumption Survey (RECS)*, Table US8. Energy Information Administration, revised 2009. Table US8; *Commercial Buildings Energy Consumption Survey (CBECS)*, Energy Information Administration, released 2006. Table C17 and Table C35A.

[2] *Inventory of New York City Greenhouse Gas Emissions 2008*, Mayor's Office of Long-Term Planning and Sustainability, PlaNYC2030, September 2008. Appendix: Electricity Coefficients—985.020 lbs/MWh in 2007.

Survey.[1] The distances used were 7.5, 11.2, and 4.6 miles per trip on weekdays, and 8.8, 8.2, and 7.8 miles per trip on weekends, for residential, office, and retail trips, respectively. Delivery truck distances were calculated based on data from the Commodity Flow Survey for the New York Metropolitan Area.[2] The average one-way truck trip distance used in the analysis was 139 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 24.3 miles per gallon and 6.5 miles per gallon, respectively projected for the 2019 analysis year, were employed in estimating the annual fuel consumed by vehicle use connected with the Proposed Actions.[3] 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.[4] To calculate CO_2 emissions per gallon of fuel, carbon emissions were multiplied by the ratio of the molecular weight of CO_2 to the molecular weight of carbon (44/12), resulting in emission factors of 8,877 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 Actions 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 uses that would be developed is not available, the waste stream composition was estimated based on data from the New York City Waste Composition Survey[5] (for the residential and school use), and from the Commercial Waste Study[6] (for the retail and office use). Annual GHG emissions associated with each waste type were estimated using EPA’s Waste Reduction Model (WARM)[7]. 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 Actions would result in GHG emissions from on-site engines, truck travel associated with construction material deliveries, and the use of steel and concrete. The construction emissions from the Additional Housing Sites would be negligible compared with the construction emissions from the development over the rail yard. Therefore, a quantified analysis of construction emissions was performed for the project site over the rail yard only.

---

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

[2] Bureau of Transportation Statistics and the U.S. Census Bureau, *Commodity Flow Survey*, 2002

[3] Energy Information Administration, *Annual Energy Outlook, 2009*. Table A7 Transportation Sector Key Indicators and Delivered Energy Consumption.

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

[5] *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

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

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

Construction Activity

GHG emissions from construction delivery trucks and other construction traffic, 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 NONROAD2005 Emission Model (NONROAD). The model is based on source inventory data accumulated for specific categories of nonroad equipment. The GHG emissions factor for diesel fuel used by trucks and worker vehicles was based on diesel fuel and gasoline carbon content, respectively. The amount of fuel that would be used by construction trucks was estimated from the projected average fuel economy for trucks (2011-2019) and distances developed using the Commodity Flow Survey. For most truck deliveries, the average one-way trip distance was assumed to be 139 miles. For concrete deliveries, 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. All construction delivery trucks were assumed to have a fuel efficiency of 6.3 miles per gallon, the average fuel efficiency projected by EIA for the proposed construction period. All delivery trucks were assumed to be diesel fueled, and a GHG emission factor of 10,186 g CO_2e per gallon of diesel was used.

Construction Materials

Upstream steel and concrete emissions are included in this assessment because their production would comprise a major component of overall emissions from material use. GHG emissions associated with the cement manufacturing chemical process and fossil fuel energy use account for more than 60 percent of industrial source GHG emissions in the U.S. According to a report from 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.[1] The production of steel also generates process-related emissions of CO_2 and CH_4. 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 (a component of concrete) and steel, following the IPCC guidelines.[2] Emissions associated with the production of construction materials other than steel and concrete are assumed to be negligible in comparison with the emissions from steel and concrete production.

For the purposes of the analysis, it was conservatively assumed that the concrete used for the development of the Proposed Site would be 100 percent Portland cement. Although the Developer has committed to using recycled cement replacements, resulting in lower GHG emissions associated with the use of cement, 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. A lifecycle emission factor was based on Building for Environmental and Economic Sustainability (BEES) software results. The Developer has committed to using concrete that contains fly ash or slag. Depending on the fly ash or slag content, the GHG emissions associated with the use of concrete could be reduced by approximately 8 to 17 percent.

---

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

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

A range of values for the steel GHG emission factor was found in 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.[1]

Building Lifetime

Construction-related emissions are also presented as annualized emissions over the lifetime of the buildings. The REGNER project[2] 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[3] (the Proposed Sites would be considered Class A). 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. 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 higher. However, since all the emissions would actually 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. Therefore, it is also important to consider the total construction emissions, and not only their relative annualized contribution.

PROBABLE EMISSIONS FROM THE PROPOSED ACTIONS

ON-SITE GHG EMISSIONS FROM HVAC SYSTEMS

The projected fuel use and associated GHG emissions from the Development Site and from the Additional Housing Sites are presented in Table 19b-2 and Table 19b-3, respectively.

Table 19b-2
GHG Emissions from HVAC Systems
Development Site Maximum Commercial Scenario: 2019

Development Program	Floor Area (GSF)	Natural Gas Use (million cubic feet / year)	GHG Emissions[1] (metric tons CO_2e / year)
Residential	3,837,225 (4,624 households)	282.3	15,503
Office	2,185,000	71.8	3,941
Retail	220,500	9.1	502
Public School	120,000	4.1	224
TOTAL	**6,362,725**	**367.3**	**20,170**

Note: The GHG emissions presented in the table include the emissions associated with No. 2 fuel oil that would be used in emergency generators. Fuel use and emission results include a 14 percent reduction from energy efficiency measures.

---

[1] 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.

[2] 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).

[3] 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.

Table 19b-3
GHG Emissions from HVAC Systems
Additional Housing Sites: 2019

Development Program	Floor Area (GSF)	Fuel Oil Use (1000 gallons / year)	GHG Emissions (metric tons CO_2e / year)
Residential	272,600 (312 households)	200	2,367
Office	30,000	1.9	23
Retail	17,550	3.2	38
TOTAL	**320,150**	**206**	**2,428**
Note: Fuel use and emission results include a 20 percent reduction from energy efficiency measures.			

OFF-SITE GHG EMISSIONS FROM ELECTRICITY USE

The projected electricity use and GHG emissions for the Development Site and for the Additional Housing Sites are presented in Table 19b-4 and Table 19b-5, respectively.

Table 19b-4
Off-Site GHG Emissions from Electricity
Development Site Maximum Commercial Scenario: 2019

Development Program	Floor Area (GSF)	Electricity Use (MWh / year)	GHG Emissions (metric tons CO_2e/ year)
Residential	3,837,225 (4,624 households)	16,829	7,519
Office	2,185,000	31,193	13,937
Retail	220,500	2,067	924
Public School	120,000	867	387
Sub-Platform Ventilation and Lighting		30,744	13,736
TOTAL	**6,362,725**	**81,700**	**36,503**
Note: Building electricity use and emission results include a 14 percent reduction from energy efficiency measures.			

Table 19b-5
GHG Emissions from Electricity
Additional Housing Sites: 2019

Development Program	Floor Area (GSF)	Electricity Use (MWh / year)	GHG Emissions (metric tons CO_2e / year)
Residential	272,600 (312 households)	1,056	472
Office	30,000	398	178
Retail	17,550	153	68
TOTAL	**320,150**	**1,608**	**718**
Note: Electricity use and emission results include a 20 percent reduction from energy efficiency measures.			

GHG EMISSIONS FROM VEHICLE USE

The projected vehicle miles traveled (VMT) annually as a result of the Proposed Actions, and the associated GHG emissions for the Development Site and for the Additional Housing Sites, are shown in Table 19b-6 and Table 19b-7, respectively. Note that the majority of the emissions in this category are associated with truck deliveries, and not with private vehicle use. The truck emissions are likely a conservatively high estimate, since they do not account for linked trips on multidestination deliveries.

Table 19b-6
Off-Site GHG Emissions from Vehicle Use
Development Site Maximum Commercial Scenario: 2019

Development Program	Annual Car Vehicle Miles Generated (million VMT / year)	Annual Truck Vehicle Miles Generated (million VMT / year)	GHG Emissions (metric tons CO_2e/ year)
Residential	9.36	5.37	11,830
Office	9.03	12.84	23,422
Retail	2.54	2.83	5,366
Public School	0.10	0.09	542
TOTAL	**21.04**	**21.13**	**41,160**

Note: The annual school GHG emissions from vehicle use include emissions from school buses. School bus emissions were based on PlaNYC inventory and related information.

Table 19b-7
GHG Emissions from Vehicle Use
Additional Housing Sites: 2019

Development Program	Annual Car Vehicle Miles Generated (million VMT / year)	Annual Truck Vehicle Miles Generated (million VMT / year)	GHG Emissions (metric tons CO_2e / year)
Residential	0.63	0.36	567
Office	0.12	0.18	276
Retail	0.19	0.23	353
TOTAL	**0.94**	**0.76**	**1,197**

GHG EMISSIONS FROM WASTE GENERATION

The amount of solid waste and the associated GHG emissions that would be generated annually at the Development Site and at the Additional Housing Sites are shown in 19b-8 and Table 19b-9, respectively.

Table 19b-8
Off-Site GHG Emissions from Solid Waste
Development Site Maximum Commercial Scenario: 2019

Development Program	Solid Waste Generated Annually (short tons / year)	GHG Emissions (metric tons CO_2e/ year)
Residential	3,434	349
Office	2,954	2
Retail	887	244
Public School	78	85
TOTAL	**7,352**	**680**

Table 19b-9
Off-Site GHG Emissions from Solid Waste
Additional Housing Sites: 2019

Development Program	Solid Waste Generated Annually (short tons / year)	GHG Emissions (metric tons CO_2e/ year)
Residential	345	10
Office	41	3
Retail	108	8
TOTAL	**494**	**21**

CONSTRUCTION GHG EMISSIONS

Table 19b-10 summarizes the direct fuel use and GHG emissions from the expected construction activity. Total construction activity emissions as well as annualized emissions over 80 years are presented. Table 19b-11 shows the projected amounts of steel and concrete that would be used for construction, along with the GHG emitted upstream during the material manufacturing.

Table 19b-10
GHG Emissions from Construction Activity
Development Site Maximum Commercial Scenario: 2011-2019

Development Program Construction Activity	Fuel Use (gallons)	GHG Emissions (metric tons CO_2e)
Construction Equipment (mixed)		7,584
Construction Trucks (diesel)	2,550,662	25,981
Worker Trips (gasoline)	328,306	2,914
TOTAL (9 years)		**36,479**
Annualized Per Year[2]		**456**

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

Table 19b-11
GHG Emissions from the Manufacture of Steel and Concrete

Development Program Construction Material	Material Use	GHG Emissions (metric tons CO_2e)
Steel (short tons)	62,673	104,046
Concrete (cubic yards)	281,884	140,506
TOTAL		**244,552**
Annualized Per Year[2]		**3,057**

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

SUMMARY OF EMISSIONS

A summary of GHG emissions by use and by emission source, along with total annual emissions from the overall development, is presented in Table 19b-12.

Table 19b-12
Summary of Annual GHG Emissions
(metric tons CO_2e per year)

Sector	Maximum Commercial Scenario	Additional Housing Sites	Total	Fraction of All Sectors (%)
On-Site Fuel Use	20,170	2,428	**22,598**	21
Electricity	36,503	718	**37,222**	35
Vehicle Use[1]	41,160	1,197	**42,357**	40
Solid Waste	680	21	**701**	1
Construction (Annualized)[2]	3,513	N/A	**3,513**	3
Total	102,026	4,364	**106,390**	100

Notes: All emissions are expressed in metric tons of carbon dioxide equivalent (metric tons CO_2e/ year).
1. Vehicle Use includes truck deliveries, representing the majority of emissions in this category.
2. Total construction emissions of 281,040 metric tons CO_2e were annualized over 80 years.

GHG emissions associated with on-site fuel use for heat and hot water were calculated based on data regarding State and City energy consumption, which were the most reliable data available at this time. It is likely that average energy consumption for heating in the City is lower due to climate differences between the City and upstate New York, and to more compact development in the City. Emissions per MWh of electricity used in New York City are similar to the State average.[1] The New York City-Westchester grid sub-region emissions are 13 percent higher than the Upstate sub-region (mainly due to availability of hydropower upstate), and 47 percent and 39 percent lower than the Long Island sub-region and the U.S. average emissions, respectively. According to the EIA tables cited above, consumption of electricity (including for air conditioning) and heating fuels for residential use in U.S. cities is approximately 20 percent lower than the equivalent use per household in suburban areas. The emissions associated with electricity and heat associated with the Proposed Actions would be at least 14 percent lower than that level because of the energy-efficient design incorporated in the project and included in the above calculations.

The electricity consumption for sub-platform ventilation and lighting needs is estimated to be 38 percent of the total estimated electricity consumption at the Development Site under the Proposed Actions, and would represent 13 percent of total annual GHG emissions associated with the Proposed Actions.

Note that the majority of the emissions in the vehicle use category are associated with truck deliveries, and not with private vehicle use. The truck emissions are likely a conservatively high estimate, since they do not account for linked trips on multidestination deliveries. Linked truck delivery trips in the City and adjacency to regional distribution centers reduces emissions associated with deliveries in the City. Private vehicle related emissions would be much higher for a similar project which was not transit oriented, such as suburban development.

[1] EPA, eGRID2006 Version 2.1, Year 2005 Summary Tables, April 2009, http://www.epa.gov/cleanenergy/energy-resources/egrid/, accessed April 2009.

Overall, per capita GHG emissions in New York City are less than one-third of the nationwide average. This is largely due to reduced vehicle usage, denser development, and cleaner energy sources. Beyond that, the Proposed Actions would reduce the emissions associated with electricity consumption and heating through energy-efficient design, and reduce emissions associated with transportation because of the transit-oriented location within the City.

PROJECT ELEMENTS THAT WOULD REDUCE GHG EMISSIONS

The Proposed Actions would include a number of measures aimed at reducing energy consumption and GHG emissions. To the extent practicable, these measures were included in the quantified estimates presented above and are consistent with PlaNYC's goal of reducing energy consumption and GHG emissions. The measures include:

- **LEED Silver Certification:** The proposed mixed-use buildings at the Development Site would be built to LEED for New Construction standards, and would achieve LEED Silver certification. Almost every LEED credit directly or indirectly reduces GHG emissions. For example, if the Developer obtains LEED credits aimed at optimizing building energy efficiency and use of renewable energy, use of local, recycled and renewable materials, and/or water conservation, then GHG emission reductions exceeding those outlined in the analysis above would be achieved.
- **Site Selection:** The Proposed Actions' mixed-use development at the Development Site would be situated near major public transportation hubs at Penn Station, Times Square, and the Port Authority bus terminal, and within walking distance of the New York Waterway ferry, the M34 and M42 buses, and the proposed No. 7 subway line extension. The Development Site is also within walking distance of shopping, restaurants, and parks. Therefore, the Proposed Actions represent urban transit-oriented development, which is a distinctly beneficial aspect of the Development Site. The presence of dense development at this location would take advantage of the excellent mass transit services provided by the nearby transportation hubs and decrease the need for personal vehicle ownership. Therefore, the Proposed Actions would be consistent with the goals of transit-oriented development specified in PlaNYC.
- **Design and Uses:** The Proposed Actions' mixed-use development at the Development Site and dense design would result in a community that would be less automobile dependent. The Development 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.
- **Energy Efficiency:** As described above, the proposed mixed-use development at the Development Site would exceed the building energy performance required by code by at least 14 percent. At the Additional Housing Sites, the building performance would exceed code requirements by 20 percent.
- **Construction Materials:** To reduce GHG emissions from the manufacture and transport of building materials, especially concrete and steel, locally purchased materials would be used to the extent practicable. Recycled materials, including the use of fly ash or slag in concrete, would be used.

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

- **Water Consumption:** A number of sustainable, green components for the Development Site that would 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.
- **Distributed Generation and Combined Heat and Power:** Energy Initiative #9 in PlaNYC calls for expanding clean distributed generation and combined heat and power, 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 practicability of providing combined heating, cooling, and power ("tri-generation") at the Development Site is being evaluated. See Chapter 25, "Alternatives," for details.
- **Bicycle Paths:** In addition to providing bicycle storage, as required by zoning, the proposed Development Site could include bicycle paths that would be integrated with the existing bicycle routes along the West Side Highway. In addition to reducing GHG emissions, this measure would also be consistent with Transportation Initiative #9 in PlaNYC, which calls for promoting cycling, and with the PlaNYC 1,800-mile bike master plan.
- **Preferred Alternative Vehicle Parking:** At least 5 percent of parking (or more in future years) could be dedicated as preferred parking for alternative 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.
- **Renewable Energy:** Energy Initiative #11 in PlaNYC calls for fostering the market for renewable energy. Electricity produced from renewable resources could be purchased to meet the electricity demand for electricity produced off-site over a two year period.

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

In addition, the development associated with the Proposed Actions 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

The potential GHG emissions associated with the Proposed Actions have been calculated and are presented above. Measures for reducing GHG emissions included in the Proposed Actions and additional relevant measures under consideration have been identified. Overall, the site location, the dense, mixed-use, the commitment to seek LEED Silver certification for all buildings and achieve a significant reduction in energy use, and other measures incorporated in the Proposed Actions 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.

C. CONSISTENCY WITH PLANYC

PlaNYC, the City's long-term sustainability plan, identified two major goals relevant to air quality:

- Achieve the cleanest air quality of any big city in America; and
- Reduce global warming emissions by more than 30 percent.

To achieve these goals and meet federal air quality standards, PlaNYC sets forth several initiatives associated with air quality, including: reduce road vehicle emissions, reduce other transportation emissions, reduce emissions from buildings, pursue natural solutions to improve air quality (e.g., capture benefits of open space, reforest parklands, and plant trees), and better understand the scope of the issue (through collaborative local air quality studies).

The proposed development associated with the Proposed Actions would be built and operated in a manner consistent with these goals and initiatives, as follows:

- The Proposed Actions would not result in exceedances of NAAQS or STVs established by DEP and DEC;
- The heating systems of the proposed buildings would burn clean fuels—natural gas as the primary fuel, with low-sulfur No. 2 fuel oil as an emergency backup;
- The proposed developments are located close to public transportation, with low anticipated car ownership rates and automobile trips;
- With the Developer committed to seeking LEED Silver certification for buildings on the Development Site, these buildings would be energy efficient;
- Construction of approximately five acres of open space, with trees and other green space, are included as part of the Development Site; and
- The construction of the proposed buildings and platform on the Development Site would utilize the most effective technologies to minimize construction-related emissions, including the use of ULSD, diesel particulate filters, diesel oxygen catalysts, and/or other filtration systems on construction vehicles. ✷