A. INTRODUCTION

Ambient air quality, or the quality of the surrounding air, may be affected by air pollutants produced by motor vehicles, referred to as “mobile sources”; by fixed facilities, usually referenced as “stationary sources”; or by a combination of both. Under City Environmental Quality Review (CEQR), an air quality assessment is to be carried out for actions that can result in significant adverse air quality impacts. In accordance with the procedures and methodology outlined in Chapter 17, “Air Quality,” of the *CEQR Technical Manual*, an air quality assessment for the Proposed Development has been performed to determine both the Proposed Development’s effects on ambient air quality and the effects of ambient air quality on the Proposed Development. This analysis considers potential impacts of emissions from mobile sources, including a parking garage analysis, and the heating, ventilation, and air condition (HVAC) systems of the Proposed Development.

B. PRINCIPAL CONCLUSIONS

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

There are no existing buildings of a similar height in the immediate vicinity of the Development Site, therefore an analysis of potential HVAC emission impacts on existing receptors was not required. Because the two Proposed Development buildings are of similar height (421 to 424 feet), a detailed HVAC analysis was conducted to evaluate potential project-on-project impacts. The analysis results showed both buildings had the potential to impact each other; however, this impact would be avoided through (E) designations for both buildings specifying fuel type, stack height and location restrictions that would be placed as part of the Proposed Actions to ensure the Proposed Development would not result in any significant air quality impacts from fossil fuel-fired heat and hot water systems emissions.

There are no industrial land uses or the New York City Department of Environmental Protection (NYCDEP) industrial source permits within 400-ft of the Proposed Development. Therefore, an industrial source analysis is not required. Similarly, there are no sources with a State Facility or Title V permit from the New York State Department of Environmental Conservation (NYSDEC) within 1,000 feet of the Proposed Development. Therefore, an analysis of other large/major sources is not required.

With respect to mobile source impacts at intersections, the Proposed Development would not exceed CEQR screening criteria for carbon monoxide (CO) or particulate matter less than 2.5 microns in diameter ($PM_{2.5}$). The Proposed Development would include two below-grade parking garages with parking for 16 percent of market rate DUS (128 spaces). A parking garage analysis was undertaken and the results show that the garage emissions would not result in significant adverse air quality impacts.

C. POLLUTANTS FOR ANALYSIS

Ambient air quality is affected by air pollutants produced by both motor vehicles and stationary sources. Emissions from motor vehicles are referred to as mobile source emissions, while emissions from fixed facilities are referred to as stationary source emissions. Ambient concentrations of CO are predominantly influenced by mobile source emissions. PM, volatile organic compounds (VOCs), and nitrogen oxides (nitric oxide (NO) and nitrogen dioxide (NO_2), collectively referred to as NO_x) are emitted from both mobile and stationary sources. Fine PM is also formed when emissions of NO_x, sulfur oxides (SO_x), ammonia, organic compounds, and other gases react or condense in the atmosphere. Emissions of sulfur dioxide (SO_2) are associated mainly with stationary sources, and some sources utilizing non-road diesel such as large international marine engines. On-road diesel vehicles currently contribute very little to SO_2 emissions since the sulfur content of on-road diesel fuel, which is federally regulated, is extremely low. Ozone is formed in the atmosphere by complex photochemical processes that include NO_x and VOCs. Ambient concentrations of CO, PM, NO_2, SO_2, ozone, and lead are regulated by the U.S. Environmental Protection Agency (EPA) under the Clean Air Act (CAA), and are referred to as 'criteria pollutants'; emissions of VOCs, NO_x, and other precursors to criteria pollutants are also regulated by EPA.

Carbon Monoxide

CO, a colorless and odorless gas, is produced in the urban environment primarily by the incomplete combustion of gasoline and other fossil fuels. CO concentrations can diminish rapidly over relatively short distances; elevated concentrations are usually limited to locations near crowded intersections, heavily traveled and congested roadways, parking lots, and garages. Consequently, CO concentrations must be analyzed on a local (microscale) basis.

The Proposed Development would increase traffic volumes on streets surrounding the Development Site. Therefore, a CEQR mobile source screening analysis was conducted. An analysis was also conducted to evaluate future CO concentrations with the operation of the parking garages included in the Proposed Development.

Ozone Precursors (Nitrogen Oxides and VOCs)

NO_x are of principal concern because of their role, together with VOCs, as precursors in the formation of ozone. Ozone is formed through a series of reactions that take place in the atmosphere in the presence of sunlight. Because the reactions are slow and occur as the pollutants are transported downwind, elevated ozone levels are often found many miles from the sources of the precursor pollutants. Therefore, ozone precursors are examined at the regional level, as opposed to the localized level considered for other criteria pollutants such as CO and PM. The Proposed Development would not substantially increase vehicle miles traveled or stationary source emissions at a regional scale (such as within Brooklyn or New York City as a whole). Therefore, a detailed regional (mesoscale) analysis of ozone precursor emissions is not required.

Nitrogen Dioxide

In addition to being a precursor to the formation of ozone, NO_2 (one component of NO_x) is also a CAA criteria pollutant. NO_2 is mostly formed from the transformation of NO in the atmosphere and is of concern downwind from large stationary sources. Potential impacts on local NO_2 concentrations from the fuel combustion for the Proposed Development heat and hot water systems were evaluated (assuming the use of natural gas).

Lead

Airborne lead emissions are currently associated principally with industrial sources. Lead in gasoline has been banned under the CAA and would not be emitted from any other component of Proposed Development. There are no industrial sources in the study area involving lead emissions. Therefore, an analysis of this pollutant was not warranted.

Respirable Particulate Matter —PM_{10} and $PM_{2.5}$

PM is emitted into the atmosphere from a variety of sources: industrial facilities, power plants, construction activity, concrete batching plants, waste transfer stations, etc. The primary respirable particulates of concern are: (i) particles with an aerodynamic diameter of less than or equal to 2.5 micrometers (µm) (referred to as $PM_{2.5}$); and (ii) particles with an aerodynamic diameter of less than or equal to ten µm (referred to as PM_{10}, which includes $PM_{2.5}$). $PM_{2.5}$ is extremely persistent in the atmosphere and has the ability to reach the lower regions of the respiratory tract, delivering with it other compounds that adsorb to the surfaces of the particles.

All gasoline-powered and diesel-powered mobile source vehicles, especially heavy trucks and buses operating on diesel fuel, emit respirable particulates, most of which is $PM_{2.5}$. Consequently, levels of respirable particulates may be locally elevated near roadways with high volumes of gasoline and diesel-powered vehicles. Vehicular traffic may also contribute to PM emissions through brake and tire wear and by disturbing dust on roadways. The traffic generated by the Proposed Development was assessed as part of a CEQR $PM_{2.5}$ screening analysis. An analysis was also conducted to evaluate future $PM_{2.5}$ concentrations with the operation of the parking garages included in the Proposed Development.

Stationary sources that burn large volumes of fuel oil may also elevate PM_{10} and $PM_{2.5}$ in the surrounding area. Therefore, an assessment of $PM_{2.5}$ and PM_{10} emissions from heat and hot water systems of the Proposed Development was conducted (assuming the use of No.2 fuel oil), following the *CEQR Technical Manual* and EPA guidance.

Sulfur Dioxide

Sulfur dioxide (SO_2) emissions are associated primarily with the combustion of oil and coal, both sulfur-containing fuels. Due to federal rules on the sulfur content in fuel for on-road vehicles, no significant quantities are emitted from vehicular sources. As part of the Proposed Development, No. 2 fuel oil could be burned in heat and hot water systems. Therefore, potential future levels of SO_2 from these sources were examined. Natural gas or No. 2 fuel oil (which produce minimal SO_2emissions) containing 15 parts per million (ppm) of sulfur or less is required for all new boilers in New York City.[1]

Non-Criteria Pollutants

In addition to the criteria pollutants discussed above, non-criteria pollutants may be of concern. Non-criteria pollutants are emitted by a wide range of man-made and naturally occurring sources. These pollutants are sometimes referred to as hazardous air pollutants (HAP) and when emitted from mobile sources, as Mobile Source Air Toxics (MSATs). Emissions of non-criteria pollutants from industries are regulated by EPA.

[1] http://www.nyc.gov/html/dep/pdf/air/heating_oil_rule.pdf

Federal ambient air quality standards do not exist for non-criteria pollutants; however, NYSDEC has issued standards for certain non-criteria compounds, including beryllium, gaseous fluorides, and hydrogen sulfide. NYSDEC has also developed guideline concentrations for numerous non-criteria pollutants. The NYSDEC guidance document DAR-1 (August 2016)[2] contains a compilation of annual and short term (one-hour) guideline concentrations for these compounds. The NYSDEC guidance thresholds represent ambient levels that are considered safe for public exposure. EPA has also developed guidelines for assessing exposure to non-criteria pollutants. These exposure guidelines are used in health risk assessments to determine the potential effects to the public.

The study area for the Proposed Development does not contain existing industrial sources and therefore an analysis of non-criteria pollutant emission impacts on the Proposed Development was not warranted.

D. AIR QUALITY REGULATIONS, STANDARDS, AND BENCHMARKS

National and State Air Quality Standards

The Clean Air Act (CAA) requires the U.S. Environmental Protection Agency (EPA) to set National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and the environment. The NAAQS establish primary and secondary maximum allowable concentrations of six "criteria" pollutants in outdoor air. The six pollutants are CO, lead, ground-level ozone (O_3), nitrogen dioxide (NO_2), respirable PM, and sulfur dioxide (SO_2). The primary standards represent levels that are required to protect the public health, allowing an adequate margin of safety. The secondary standards are intended to protect the nation's welfare and account for air pollutant effects on soil, water, visibility, materials, vegetation, and other aspects of the environment. The primary standards are generally either the same as the secondary standards or more restrictive. The NAAQS are presented in **Table 15-1**. NAAQS have been adopted as the ambient air quality standards for the State of New York. New York State also has standards for total suspended PM, settleable particles, non-methane hydrocarbons, 24-hour and annual SO_2, and ozone, which correspond to federal standards that have since been revoked or replaced, and for the non-criteria pollutants beryllium, fluoride, and hydrogen sulfide.

Determining the Significance of Air Quality Impacts

The State Environmental Quality Review Act (SEQRA) regulations and *CEQR Technical Manual* indicate that the significance of a predicted consequence of a project (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.[3] In terms of the magnitude of air quality impacts, any project predicted to increase the concentration of a criteria air pollutant to a level that would exceed the concentrations defined by the NAAQS would be deemed to have a potential significant adverse impact. In addition, threshold levels have been defined for certain pollutants to ensure that concentrations will not be significantly increased and/or to maintain concentrations lower than the NAAQS. Any project predicted to increase the concentrations of these pollutants above the thresholds would be deemed to have a potential significant adverse impact, even in cases where violations of the NAAQS are not predicted.

[2] NYSDEC DAR-1 (Air Guide-1) AGC/SGC Tables, August 2016. http://www.dec.ny.gov/docs/air_pdf/dar1.pdf

[3] *CEQR Technical Manual*, Chapter 1, section 222, March 2014; and State Environmental Quality Review Regulations, 6 NYCRR § 617.7

TABLE 15-1:
National and New York State Ambient Air Quality Standards

Pollutant	Primary		Secondary		New York State	
	ppm	$\mu g/m^3$	ppm	$\mu g/m^3$	ppm	$\mu g/m^3$
Carbon Monoxide (CO)						
8-Hour Average	9	10,000	None		9	10,000
1-Hour Average	35	40,000			35	40,000
Lead (Pb)						
Rolling 3-Month Average	NA	0.15	NA	0.15	None	
Nitrogen Dioxide (NO_2)						
Maximum 1-Hour Concentration	0.100	188	None		None	
Annual Average	0.053	100	0.053	100	0.04	100
Ozone (O_3)						
8-Hour Average	0.070	N/A	0.070	N/A	None	
Respirable Particulate Matter (PM_{10})						
24-Hour Average	NA	150	NA	150	None	
Fine Respirable Particulate Matter ($PM_{2.5}$)						
Annual Mean	NA	12	NA	15	None	
24-Hour Average	NA	35	NA	35		
Sulfur Dioxide (SO_2)[8]						
Maximum 1-Hour Concentration	0.075	196	NA	NA	None	
Maximum 3-Hour Concentration	NA	NA	0.50	1,300	0.50	1,300

Notes:
ppm – parts per million (unit of measure for gases only)
$\mu g/m^3$ – micrograms per cubic meter (unit of measure for gases and particles, including lead)
NA – not applicable
All annual periods refer to calendar year.
Sources: 40 CFR Part 50: National Primary and Secondary Ambient Air Quality Standards. https://www.epa.gov/criteria-air-pollutants/naaqs-table; CEQR Technical Manual, Chapter 17 Air Quality. http://www.nyc.gov/html/oec/downloads/pdf/2014_ceqr_tm/17_Air_Quality_2014.pdf

CO de minimis Criteria

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

$PM_{2.5}$ de minimis Criteria

NYSDEC has published a policy to provide interim direction for evaluating $PM_{2.5}$ impacts.[4] This policy applies only to facilities applying for permits or major permit modifications under SEQRA that emit 15 tons or more annually of PM with a diameter less than ten microns (PM_{10}). The policy states that such a project will be

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

deemed to have a potentially significant adverse impact if the project's maximum impacts are predicted to increase $PM_{2.5}$ concentrations by more than 0.3 µg/m^3 averaged annually or by more than five µg/m^3 on a 24-hour basis. Projects that exceed either the annual or the 24-hour threshold must assess the severity of the impacts, evaluate alternatives, and employ reasonable and necessary mitigation measures to minimize the $PM_{2.5}$ impacts of the source to the maximum extent practicable.

In addition, New York City uses *de minimis* criteria to determine the potential for significant adverse $PM_{2.5}$ impacts under CEQR as follows:

- Predicted increase of more than half the difference between the background concentration and the 24-hour standard;
- Annual average $PM_{2.5}$ concentration increments that are predicted to be greater than 0.1 µg/m^3 at ground level on a neighborhood scale (i.e., the annual increase in concentration representing the average over an area of approximately one square kilometer, centered on the location where the maximum ground-level impact is predicted for stationary sources; or at a distance from a roadway corridor similar to the minimum distance defined for locating neighborhood scale monitoring stations); or,
- Annual average $PM_{2.5}$ concentration increments from stationary sources that are predicted to be greater than 0.3 µg/m^3 at a discrete receptor location (elevated or ground level).[5]

Actions under CEQR predicted to increase $PM_{2.5}$ concentrations by more than the above *de minimis* criteria are considered to have a potential significant adverse impact.

E. METHODOLOGY FOR ASSESSING AIR QUALITY IMPACTS

Mobile Sources

Parking Facilities

The Proposed Development will include three mechanically-ventilated parking garages, each with separate entrances. Building 1 would contain two garages, one on the ground floor and one below grade The Building 2 garage would be located at the cellar level only. The parking facilities analysis focuses on the two Building 1 garages and conservatively assumes both garages would exhaust through a single vent. If the combined impact of the two Building 1 garages is shown to not have significant adverse impacts, the smaller Building 2 garage (with less than half the total number of parking spaces) would not have significant adverse impacts.

The air exhausted from the garage ventilation systems would contain elevated levels of pollutants due to emissions from vehicles using the garage. Since the parking facilities would be used by automobiles, the primary pollutants of concern are CO and PM2.5. An analysis was performed of the emissions from the outlet vent and their dispersion in the environment to calculate pollutant levels in the surrounding area, using the methodology set forth in the *CEQR Technical Manual*. Emissions from vehicles entering, parking, and exiting the garages were estimated using the EPA MOVES mobile source emission model as referenced in the *CEQR Technical Manual*. For all arriving and departing vehicles, an average speed of 5 miles per hour was conservatively assumed for travel within the parking garages. In addition, all departing vehicles were

[5]The *CEQR Technical Manual* does not provide an annual average $PM_{2.5}$ *de minimis* criterion for discrete receptors that is specific to mobile source analysis.

assumed to idle for one minute before proceeding to the exit. The concentration of CO and PM within the garages was calculated assuming a minimum ventilation rate, based on New York City Building Code requirements, of 1 cubic foot per minute of fresh air per gross square foot of garage area. To determine compliance with the NAAQS, CO concentrations were determined for the maximum eight-hour average period, and PM2.5 concentrations were determined for the maximum 24-hour and annual average period.

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

The 8-hr CO analysis focused on the eight consecutive hours with the highest number of vehicle exits from the garage. For the 24-hour and annual average PM2.5 analysis, the 24-hr average entrances and exits were assessed. Traffic data for the parking garage analysis were derived from the trip generation analysis, described in **Chapter 14, "Transportation."**

Since design information regarding the garage's mechanical ventilation system is not available, the worst-case assumption that the air from the two Building 1 garages would be vented through a single outlet was utilized for conservative analysis purposes. The vent face was modeled to directly discharge at a height of approximately 12 feet above grade along the Franklin Avenue façade of the Development Site, and "near" and "far" receptors were placed along the sidewalks at a pedestrian height of six feet at a distance of 5 feet and 50 feet, respectively, from the vent. The near receptor was placed at the sidewalk on the same side as the parking garages, while the far receptor was placed at the sidewalk across the street from the parking garages. The receptors were placed on the sidewalk since people are likely to be there for more than a few minutes, as referenced in the *CEQR Technical Manual*. A persistence factor of 0.7 was used to obtain eight-hour averages; a factor of 0.6 was used to obtain 24-hour average concentrations; and a factor of 0.1 was used to obtain annual average concentrations from the peak one-hour concentrations to account for meteorological variability over the respective periods, as referenced in the *CEQR Technical Manual*.

Background and on-street concentrations were added to the modeling results to obtain the total ambient levels. The on-street CO and PM2.5 concentrations were determined using the methodology in Air Quality Appendix 1 of the *CEQR Technical Manual*, utilizing the weekday peak hour traffic volumes from the analyses presented in **Chapter 14, "Transportation."** The on-street CO and PM2.5 emissions were also calculated using EPA MOVES2014b. County-specific hourly temperature and relative humidity data obtained from DEC were used.

For annual average PM2.5, additional analysis was performed using AERMOD and five years of meteorological data (2014-2018). The exhaust vent was modeled as a point source with a one-meter stack diameter and the grams/second emission rate was determined based on the CEQR Technical Manual procedure. The exit velocity was calculated based on the minimum required flow rate and the assumed stack diameter. The exhaust temperature was assumed to equal the ambient air temperature for each hour of meteorological data, which is reasonable given that the garage air would not be heated. The vent was placed with a release height of 12 feet and two receptors were modeled, one 5 feet from the vent (near receptor) and one 50 feet from the vent (far receptor).

Background Concentrations

Background concentrations are those pollutant concentrations originating from distant sources that are not directly included in the modeling analysis, which directly accounts for vehicular emissions on the streets within 1,000 feet and in the line of sight of the analysis site. Background concentrations for CO are added to modeling results to obtain total pollutant concentrations at an analysis site; while for 24-hour $PM_{2.5}$ the background concentration determines the CEQR *de minimis* criteria.

The CO and $PM_{2.5}$ background concentrations are presented below in **Table 15- 2** and are based on three years of monitored data (2016-2018).[6] For CO, the highest background concentration from the three years of data was used. $PM_{2.5}$ impacts are assessed on an incremental basis and compared with the $PM_{2.5}$ *de* minimis criteria. $PM_{2.5}$ 24-hour average background concentration of 17.2 µg/m3 (based on the 2016 to 2018 average of 98th percentile concentrations) was used to establish the *de minimis* value.

TABLE 15-2
Background Pollutant Concentrations for Mobile Source Analysis

Pollutant	Average Period	Location	Concentration	NAAQS
CO(1)	One-hour	Queens College 2	1.7 ppm	35 ppm
	Eight-hour		1.2 ppm	9 ppm
$PM_{2.5}$	24-hour	JHS 126	17.2 µg/m^3	35 µg/m^3
	Annual		7.7 µg/m^3	12 µg/m^3

Source: https://www.dec.ny.gov/docs/air_pdf/2018airqualreport.pdf

Stationary Sources

There are no existing buildings of a similar height in the immediate vicinity of the Development Site, therefore only Project-on-Project analysis was performed. An HVAC detailed analysis was performed for the Proposed Development following procedures outlined in the *CEQR Technical Manual*. Both Building 1 and Building 2 were analyzed as separate sources, with receptors placed on the opposite building. It was assumed that exhaust stacks of the proposed buildings would be located three feet above roof height (as per the *CEQR Technical Manual*).

Emission Rates

Conservative emission rates were determined by initially assuming the use of No. 2 fuel oil for each analyzed pollutant (e.g. NO2, PM10, PM2.5 and SO2). Emissions rates were estimated based on the floor area of each of the proposed buildings, the typical building energy intensities, and emissions factors published by EPA in their *Compilation of Air Pollutant Emission Factors (AP-42).* First, the annual energy consumption was calculated by multiplying the gross building floor area by energy intensity factors appropriate to each type of floor area use (commercial/non-residential and residential). Conservative short-term fuel consumption rates were derived from the annual rates based on assuming all annual fuel consumption occurs over 100 heating days. Next, appropriate emissions factors for each pollutant were selected from the EPA's *Compilation of Air Pollutant Emission Factors (AP-42).*

Since potentially significant impacts were identified in the initial fuel oil No. 2 assessment, additional analysis restricting the buildings to natural gas was performed. For building 1 only, a further restriction to natural gas

[6]http://www.dec.ny.gov/chemical/8536.html

with low-NOx burners was assessed for purposes of the 1-hr NO2 standard. The natural gas emission rates for Building 1 and Building 2 are also provided in Table 15-3.

The HVAC detailed analysis stack exhaust temperature and exit velocity were determined based on typical values from the NYCDEP boiler database. **Table 15-3** provides the stack parameters and pollutant emission rates that were used in the dispersion analysis for both buildings.

TABLE 15-3
Heating and Hot Water Systems Stack Parameters and Emission Rates

Parameter	Building 1	Building 2
Building Size (gsf)	658,161	635,739
Building Height (ft)[a]	421	424
Boiler Capacity (MMBTU/hr)	16.4	15.7
Stack Exhaust Temp. (F)	254	254
Stack Exhaust Height (ft)	424	427
Height Above Roof (ft)	3	3
Stack Exhaust Diameter (ft)	3	3
Stack Exhaust Velocity (ft/s)	21.03	21.03
Fuel Oil No. 2 Short-Term Emission Rates		
NOx (g/s)	0.26169	0.25023
SO2 (g/s)	0.00279	0.00266
PM10 (g/s)	0.03114	0.02978
PM2.5 (g/s)	0.02787	0.02665
Fuel Oil No. 2 Annual Emission Rates		
NOx (g/s)	0.07170	0.06856
PM2.5 (g/s)	0.00764	0.00730
Natural Gas Short-Term Emission Rates		
NOx (g/s)	0.06481[b]	0.19386
SO2 (g/s)	0.00122	0.00116
PM10 (g/s)	0.01539	0.01473
PM2.5 (g/s)	0.01539	0.01473
Natural Gas Annual Emission Rates		
NOx (g/s)	0.01776[b]	0.05311
PM2.5 (g/s)	0.00422	0.00404

a. Height excludes 40’ mechanical bulkhead.

b. Natural gas with low-NOx burners emission rate required by e-designation

Detailed Dispersion Analysis Methodology

The HVAC detailed analyses were performed using the EPA/AMS AERMOD dispersion model (version 19191). AERMOD is a state-of-the-art dispersion model, applicable to rural and urban areas, flat and complex terrain, surface and elevated releases, and multiple sources (including point, area, and volume sources). AERMOD is a steady-state plume model that incorporates current concepts about flow and dispersion in complex terrain, including updated treatments of the boundary layer theory, understanding of turbulence and dispersion, and includes handling of terrain interactions.[7]

The AERMOD model calculates pollutant concentrations from one or more points (e.g., exhaust stacks) based on hourly meteorological data, and has the capability to calculate pollutant concentrations at locations where the plume from the exhaust stack is affected by the aerodynamic wakes and eddies (downwash) produced by nearby structures. AERMOD can be run with and without building downwash (the downwash option accounts for the effects on plume dispersion created by the structure the stack is located on, and other nearby structures). Typically, modeling "without" building downwash produces higher estimates of pollutant concentrations when assessing the impact of elevated sources on elevated receptor locations. However, depending on the source-receptor relationship, the "with downwash" result can sometimes be higher. Therefore, both "with downwash" and "without downwash" analyses were run and the highest result was used to ensure a conservative assessment.

Pollutants for Analysis

The following pollutants were analyzed: NO_2 (1-hr and annual average), PM2.5 (24-hr and annual average), PM10 (24-hr average) and SO2 (1-hr average).

Annual NO2 concentrations were estimated using EPA approved Tier 2 Ambient Ratio Method 2 (ARM2).

One-hour average NO_2 concentrations were estimated using AERMOD model's Tier 3 Plume Volume Molar Ratio Method (PVMRM) module to analyze chemical transformation within the model. The PVMRM module incorporates hourly background ozone concentrations to estimate NO_x transformation within the source plume. Ozone concentrations were taken from the NYSDEC Queens College monitoring station, which had five years of hourly data available (2014-2018). Missing hours in the hourly ozone data were filled through interpolation from the hours before and after the gap for small gaps, data from a prior or subsequent day was used to fill a longer data gap of several days.

Meteorological Data

All analyses were conducted using five consecutive years of meteorological data (2014-2018). Surface data was obtained from La Guardia Airport National Weather Service station and upper air data was 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.

Receptor Locations

Receptors were located where people are likely to have continuous access and where the maximum total pollutant concentrations or incremental pollutant concentrations resulting from the Proposed Development are likely to occur. For the analysis of the Building 1 stack, receptors were placed at multiple elevations along the façade of Building 2. For the analysis of the Building 2 stack, receptors were placed at multiple elevations along the façade of Building 1. Receptors were placed from pedestrian height up to the maximum height of each building, with particular focus on receptor locations at or above the stack height of the other building.

[7] EPA, AERMOD: Description Of Model Formulation, 454/R-03-004, September 2004; and EPA, User's Guide for the AMS/EPA Regulatory Model AERMOD, 454/B-03-001, September 2004 and Addendum December 2006.

Background Concentrations

To estimate the maximum expected pollutant concentration at a given location (receptor), the predicted impacts must be added to a background value that accounts for existing pollutant concentrations from other sources that are not directly accounted for in the model. Background concentrations at the nearest NYSDEC air quality monitoring stations for all criteria pollutants included in the detailed HVAC analysis are presented in **Table 15-4**. This data was obtained from 2016-2018 reported in NYSDEC's 2018 Ambient Air Quality Report. All data statistical forms and averaging periods are consistent with the definitions of the NAAQS. The data demonstrates that there were no monitored violations of NAAQS at these monitoring sites.

TABLE 15-4:
Representative Monitored Ambient Air Quality Data (2016-2018)

Pollutant	Site Name	Site Address	Units	Averaging Period	Concentration
SO_2	Queens College 2	65-30 Kissena Blvd. Flushing	ppb	1-hour	6
PM_{10}	Division St.	40 Division Street, PS 124	µg/m^3	24-hour	40
$PM_{2.5}$	JHS 126	JHS 126 424 Leonard Street	µg/m^3	Annual	7.7
				24-hour	17.2
NO_2	Queens College 2	Queens College 65-30 Kissena Blvd Parking Lot#6	ppb	Annual	15.8
				1-hour	56

Source: https://www.dec.ny.gov/docs/air_pdf/2018airqualreport.pdf

For SO_2 and PM_{10}, modeled concentrations were added directly to the monitored background concentrations for comparison to the NAAQS. A background concentration is not used for the annual $PM_{2.5}$ analysis, which is based on comparison to the CEQR *de minimis* incremental criteria. For 24-hour $PM_{2.5}$, the background concentration was used to determine the 24-hour $PM_{2.5}$ *de minimis* criterion in accordance with the *CEQR Technical Manual*.

For NO_2, hourly background concentrations varying by season were entered into AERMOD such that the resulting AERMOD output provides a total concentration that includes the background concentration. The third-highest seasonal hourly NO_2 concentration across three years of monitoring data (2016-2018) was used to develop the NO_2 background concentrations in accordance with EPA guidance.[8] The methodology used to determine the compliance of total one-hour NO_2 concentrations from the proposed sources with the one-hour NO_2 NAAQS was based on adding the monitored background to modeled concentrations, as follows: hourly modeled concentrations from proposed sources were first added to the seasonal hourly background monitored concentrations; then the highest combined daily one-hour NO_2 concentration was determined at each receptor location and the 98th percentile daily one-hour maximum concentration for each modeled year was calculated within the AERMOD model; finally the 98th percentile concentrations were averaged over the latest five years. This methodology is recognized by EPA and the City and is referenced in EPA modeling guidance.[9]

8 https://www.epa.gov/sites/production/files/2015-07/documents/appwno2_2.pdf
See page 19 "we recommend that background values by season and hour-of-day used in this context should be based on the third-highest value for each season and hour-of-day combination"
9 http://www.epa.gov/ttn/scram/guidance/clarification/NO2_Clarification_Memo-20140930.pdf

F. EXISTING CONDITIONS

Existing concentrations of criteria pollutants at the nearest NYSDEC air quality monitoring station are presented in **Table 15-5**. These data were obtained from the period extending from 2016-2018 as reported in NYSDEC's 2018 Ambient Air Quality Report and design value reports by EPA. All data statistical forms and averaging periods are consistent with the definitions of the NAAQS. The data demonstrates that there were no monitored violations of NAAQS.

TABLE 15-5:
Representative Monitored Ambient Air Quality Data (2016-2018)

Pollutant	Site Name	Site Address	Units	Averaging Period	Concentration
CO	Queens College 2	65-30 Kissena Blvd. Flushing	ppm	1-hour	1.7
				8-hour	1.2
Ozone	Queens College 2	65-30 Kissena Blvd. Flushing	ppm	8-hour	0.074
SO_2	Queens College 2	65-30 Kissena Blvd. Flushing	ppb	1-hour	6
PM_{10}	Division St.	40 Division Street, PS 124	µg/m^3	24-hour	40
$PM_{2.5}$	JHS 126	JHS 126 424 Leonard Street	µg/m^3	Annual	7.7
				24-hour	17.2
NO_2	Queens College 2	Queens College 65-30 Kissena Blvd Parking Lot#6	ppb	Annual	15.8
				1-hour	56

Source: https://www.dec.ny.gov/docs/air_pdf/2018airqualreport.pdf

The CAA, as amended in 1990, defines non-attainment areas (NAA) as geographic regions that have been designated as not meeting one or more of the NAAQS. When an area is designated as nonattainment by the EPA, the state is required to develop and implement a State Implementation Plan (SIP), which delineates how a state plans to achieve air quality that meets the NAAQS under the deadlines established by the CAA, followed by a plan for maintaining attainment status once the area is in attainment. **Table 15-6** summarizes the attainment status of Kings County for each of the criteria pollutants. As presented in the table, Brooklyn is currently an NAA for the eight-hour ozone standard and maintenance area for CO and $PM_{2.5}$. For the remaining pollutants, the county is considered to be in attainment or insufficient data is available to make a designation of attainment or nonattainment "unclassifiable."

TABLE 15-6:
NAAQS Attainment Status of Kings County

Pollutant	Current Status	Date Redesignated to Maintenance
Carbon Monoxide (CO)	Maintenance Area	05/20/2002
Lead	Attainment/Unclassifiable	NA
Nitrogen Dioxide (NO_2)	Attainment/Unclassifiable	NA
Eight-hour Ozone (O_3) Standard (2008 and 2015)	Nonattainment Area	NA
Respirable Particulate Matter (PM_{10})	Attainment/Unclassifiable	NA
Fine Respirable Particulate Matter ($PM_{2.5}$)	Maintenance Area	04/18/2014
Sulfur Dioxide (SO_2)	Attainment/Unclassifiable	NA

Source: EPA Greenbook. https://www3.epa.gov/airquality/greenbook/anayo_ny.html

G. THE FUTURE WITHOUT THE PROPOSED ACTIONS

A smaller as-of-right development on the project site would not be expected to have significant impacts related to heating and hot water systems assuming appropriate design of the stack location. Parking garage-related impacts would potentially be greater than those of the Proposed Action because the No-Action scenario accommodates a greater number of parking spaces (259 spaces vs. 180 spaces). Overall trip generation of the No-Action scenario would be less than the with-action scenario and thus impacts related to incremental traffic at intersections would not exceed CEQR screening thresholds.

H. THE FUTURE WITH THE PROPOSED ACTIONS

Mobile Sources

Mobile Source Screening

Based on the trip generation and traffic assignment provided in **Chapter 14 "Transportation,"** the Proposed Development would not exceed the *CEQR Technical Manual* screening criteria for CO or $PM_{2.5}$ analyses at any affected intersections. Therefore, detailed mobile source air quality analysis at intersections is not required and no significant adverse impacts would occur.

Parking Facilities

Based on the methodology previously described, the maximum predicted CO and PM concentrations from the two Building 1 garages were analyzed, assuming a near side sidewalk receptor on the same side of the street (five feet) as the parking facility and a far side sidewalk receptor on the opposite side of the street (50 feet) from the parking facilities.

The maximum predicted eight-hour average CO concentration of both of the receptors modeled is 4.9 ppm. This value includes a predicted concentration of 3.52 ppm from emissions within the parking garage, on-street contribution of this 0.15 ppm, and an 8-hr background level of 1.2 ppm. The maximum predicted concentration is below the applicable standard of nine ppm. The maximum increment (3.52 ppm) is below the *de minimis* CO criterion (3.9 ppm).

The maximum predicted 24-hour $PM_{2.5}$ increment is 5.7 µg/m3 . The maximum predicted $PM_{2.5}$ increment is below the $PM_{2.5}$ *de minimis* criteria of 7.7 µg/m^3 for the 24-hour average concentration.

The initial annual PM2.5 analysis using the CEQR procedure identified a potential exceedance of the 0.3 µg/m3 annual average de minimis criterion. Therefore, further detailed analysis was undertaken with AERMOD that demonstrates the concentration increment from the garage at a distance of 5 feet from the vent would be only 0.05 µg/m^3 . The CEQR garage analysis procedure is conservative and is not able to account for variations in meteorological conditions over the year that would serve to reduce concentrations at receptors near the vent. Including an on-street increment of 0.01 µg/$m^{3,}$ the total incremental impact of 0.06 µg/m^3 would be less than the annual average PM2.5 de minimis criterion of 0.3 µg/m3. Therefore, the proposed parking garages would not result in any significant adverse mobile source air quality impacts.

Stationary Sources

The results of the detailed stationary source (HVAC) air quality assessment are summarized in **Table 15-7**. The initial fuel oil No. 2 analysis of Building 1 impact on Building 2 (which is slightly taller than Building 1) showed an exceedance of the 1-hr NO2, 24-hr PM2.5 and annual average PM2.5 standards at a worst-case potential stack location. Therefore, additional analysis was undertaken to evaluate if restricting the boiler system to natural gas with low-NOx burners would eliminate the impact. Low-NOx burners alone were not sufficient to eliminate the impact with respect to the 1-hr NO2 standard, therefore, an iterative stack location analysis was undertaken to identify stack location restrictions. Restricting the Building 1 stack to Lot 66 and at least 12 feet from the northern lot line (facing Montgomery Street) would avoid any exceedance of the 1-hr NO2 NAAQS at Building 2 receptors.

With respect to impacts of Building 2 on Building 1, the initial fuel oil No. 2 analysis showed the potential for exceedance of the CEQR *de minimis* criterion for annual average PM2.5. Therefore, additional analysis was performed restricting Building 2 to the use of natural gas and this was sufficient to eliminate the impact without restricting the stack location (however an E-designation stack height and location restriction is still included below in case Building 2 was constructed to a lower height than currently proposed).

In conclusion, the results show that HVAC emissions from Building 1 (with stack location restriction and natural gas low-NOx burners) and from Building 2 (with restriction to natural gas) would not exceed the significant impact criteria (NAAQS and/or *de minimis* criteria, if applicable). Therefore, no significant adverse project-on-project air quality impacts would occur.

TABLE 15-7:
HVAC Detailed Analysis Results Project-on-Project Impact

Pollutant	Averaging Period	Units	Maximum Increment		Background Concentration	Maximum Predicted Total Concentration		De Minimis Criteria[3]	NAAQS
			Building One[1]	Building Two[2]		Building One[1]	Building Two[2]		
SO_2	1-hour	μg/m^3	1.227	0.55	15.7	16.9	16.3	-	196
PM_{10}	24-hour	μg/m^3	7.639	4.94	40	47.6	44.9	-	150
$PM_{2.5}$	Annual	μg/m^3	0.242	0.18	7.7	-	-	0.3	12
	24-hr	μg/m^3	6.465	4.50	17.2	-	-	8.9	35
NO_2	Annual	μg/m^3	0.915	2.07	29.7	30.7	31.8	-	100
	1-hr		-	-	105.37	141.1	164.5	-	188

Notes: PM2.5 concentration increments are compared to the de minimis criteria. Increments of all other pollutants are compared with the NAAQS to evaluate the magnitude of the increments. Comparison to the NAAQS is based on total concentrations.

1 Impact of Building 1 on Building 2, results based on natural gas and including stack location restriction (and low-NOx burners requirement for NO2 1-hr and NO2 annual average)

2 Impact of Building 2 on Building 1, results based on natural gas for all pollutants (restriction to low-NOx burners not required for Building 2)

3 PM2.5 de minimis criteria are defined as: (a) 24-hour average not to exceed more than half the difference between the background concentration and the 24-hour NAAQS; and (b) annual average not to exceed more than 0.3 µg/m3 at discrete receptor locations.

Proposed E-Designation Requirements

Any future construction of Building 1 on Lots 41, 46, 63 and 66 would be required to comply with the following (E) designation (E-586):

Block 1192, Lots 63 and 66 (Building 1): Any new residential and/or commercial development on the above-referenced properties must utilize only natural gas in the heating, ventilating, and conditioning (HVAC) systems and hot water equipment, must be fitted with low NOx (30 ppm) burners, and ensure the HVAC and hot water equipment stack is located on Lot 66 at least 424 feet above grade and at least 12 feet away from the lot line facing Montgomery Street, to avoid any potential significant adverse air quality impacts.

Block 1192, Lots 41 and 46 (Building 2): Any new residential and/or commercial development on the above referenced properties must utilize only natural gas in the heating, ventilating, and conditioning (HVAC) systems and hot water equipment, and ensure the HVAC and hot water equipment stack is located at least 427 feet above grade and at least 69 feet away from the lot line facing Sullivan Place, to avoid any potential significant adverse air quality impacts.

Industrial Sources

Land uses within 400 feet of the Proposed Development were reviewed and no industrial land uses were identified. In addition, NYCDEP's permit database (CATS) was reviewed and no potential industrial sources requiring further evaluation were identified. Therefore, an industrial source analysis is not required.

Other Large or Major Sources

NYSDEC's listing of State Facility Permits (large sources) and Title V Permits (major sources) were reviewed for a 1,000-foot radius surrounding the Proposed Development. No Large or major sources were identified, therefore no further analysis is required.