A. INTRODUCTION

The Applicant is proposing to facilitate the development of a 23-story, 352-foot-tall commercial (predominantly office) building in the South Williamsburg neighborhood of Brooklyn at 500 Kent Avenue (Block 2023, Lot 10). The proposed building would be located on a 115,244-square foot (gsf) irregular-shaped corner lot located on at the southwest corner of the Kent and Division Avenue intersection, would front the waterfront along the Wallabout Channel. The development would contain 684,242 gross square feet (gsf) of floor area -- with 598,442 gsf of office space and 21,233 gsf of retail space. It would also include approximately 49,453 sf of waterfront public open space. There would also be a 234-space garage occupying approximately 64,567 gsf.

Consistent with the guidance of the 2021 *City Environmental Quality Review (CEQR) Technical Manual*, this chapter provides detailed analysis of the effects of the Proposed Action related to mobile and stationary sources of emissions on air quality.

B. PRINCIPAL CONCLUSIONS

Mobile Sources

The maximum pollutant concentrations and concentration increments from mobile sources with the Proposed Action are projected to be lower than the corresponding NAAQS and CEQR *de minimis* criteria. The public parking garage to be developed as a result of the Proposed Action was analyzed for potential air quality effects, which found that where would be no significant adverse air quality impacts.

Stationary Sources

The Proposed Action would not result in any significant adverse air quality impacts. This includes the results of detailed analysis of the effects of the nearby Kent Village housing facility's boiler emissions (firing either natural gas or fuel oil) on the Proposed Project, which would not significantly impact the proposed development. Additionally, no potential significant adverse air quality impacts would result from the Proposed Project's heating and hot water systems.

An (E) Designation (E-738) would be applied to the Project Site (Block 2023, Lot 10) to ensure that the Proposed Project would not result in any significant adverse air quality impacts from the nearby Kent Village housing facility's boiler emissions.

C. MOBILE SOURCES

The maximum projected hourly incremental traffic volumes generated by the Proposed Action would not exceed the *CEQR Technical Manual* carbon monoxide (CO) screening threshold of 170 peak-hour vehicle trips at intersections in the study area. However, the incremental traffic volumes

would exceed the particulate matter (PM) emission screening threshold discussed in Chapter 17, Sections 210 and 311 of the *CEQR Technical Manual*. Therefore, a quantified assessment of emissions from traffic generated by the Proposed Action was performed for PM.

The Proposed Project would include a below-grade public parking garage. Therefore, an analysis was conducted to evaluate potential future pollutant concentrations in the vicinity of the ventilation outlets with the proposed public parking garage.

Methodology for Predicting Pollutant Concentrations

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

The mobile source analyses for the Proposed Project employ models approved by EPA that have been used for evaluating air quality impacts of projects in New York City, other parts of New York State, and throughout the country. The modeling approach includes a series of conservative assumptions relating to meteorology, traffic, and background concentration levels resulting in a conservatively high estimate of expected pollutant concentrations that could ensue from the Proposed Project.

Intersection Analysis

Vehicle Emissions

Engine Emissions

Vehicular PM engine emission factors were computed using the EPA mobile source emissions model, Motor Vehicle Emission Simulator (MOVES3).[1] This emissions model is capable of calculating engine, break wear, and tire wear emission factors for various vehicle types, based on the fuel type (e.g., gasoline, diesel, or natural gas), meteorological conditions, vehicle speeds, vehicle age, roadway type and grade, number of starts per day, engine soak time, and various other factors that influence emissions, such as inspection maintenance programs. The inputs and use of MOVES incorporate the most current guidance available from the New York State Department of Environmental Conservation (NYSDEC).

[1] EPA. *Motor Vehicle Emission Simulator (MOVES): User Guide for MOVES2014a*. EPA420B15095. November 2015. Motor Vehicle Emission Simulator (MOVES3). EPA-420-R-21-004. March 2021. There is no stand-alone user's guide for MOVES3 as information is incorporated into the interface.

Vehicle classification data were based on field data. Appropriate credits were used to accurately reflect the inspection and maintenance program.[2] County-specific hourly temperature and relative humidity data obtained from NYSDEC were used.

Road Dust

The contribution of re-entrained road dust to PM_{10} concentrations, as presented in the PM_{10} SIP, is considered to be significant; therefore, the PM_{10} estimates include both exhaust and road dust. $PM_{2.5}$ emission rates were determined with fugitive road dust to account for their impacts in local microscale analyses. However, fugitive road dust was not included in the neighborhood scale $PM_{2.5}$ microscale analyses, since the New York City Department of Environmental Protection (DEP) considers it to have an insignificant contribution on that scale. Road dust emission factors were calculated according to the latest procedure delineated by EPA[3] and the *CEQR Technical Manual*.

Traffic Data

Traffic data for the intersection analysis were derived from existing traffic counts, projected future growth in traffic, and other information developed as part of the traffic analysis for the Proposed Project (refer to **Chapter 12, "Transportation"**). Traffic data for the future without the Proposed Project (the No-Action condition) and the With-Action condition were employed in the respective air quality modeling condition. The weekday morning (8:00 to 9:00 AM), midday (12:15 to 1:15 PM), and evening (5:00 to 6:00 PM) peak periods were analyzed.

The peak morning, midday, and evening period traffic volumes were used as a baseline for determining off-peak volumes. Off-peak traffic volumes in the No-Action condition were determined by adjusting the peak period volumes by the 24-hour distributions of actual vehicle counts collected at appropriate locations, and off-peak increments from the Proposed Project site were estimated based on the parking demand as a result of the Proposed Project.

Dispersion Model for Microscale Analyses

The PM concentrations due to vehicular emissions adjacent to the analysis site were predicted using the American Meteorological Society/Environmental Protection Agency Regulated Model (AERMOD) Version 22112.[4] 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. AERMOD has been a recommended model for transportation air quality analyses for several years and EPA mandated its use for transportation conformity purposes after a three-year transition period.[5] Following EPA guidelines, the analysis was performed using

[2] The inspection and maintenance programs require inspections of automobiles and light trucks to determine if pollutant emissions from each vehicle exhaust system are lower than emission standards. Vehicles failing the emissions test must undergo maintenance and pass a repeat test to be registered in New York State.

[3] EPA. *Compilations of Air Pollutant Emission Factors AP-42*. Fifth Edition, Volume I: Stationary Point and Area Sources, Ch. 13.2.1. NC. http://www.epa.gov/ttn/chief/ap42. January 2011.

[4] EPA. *User's Guide for the AMS/EPA Regulatory Model (AERMOD)*. Office of Air Quality Planning and Standards. EPA-454/B-22-007. Research Triangle Park, North Carolina. June 2022.

[5] EPA. Revisions to the Guideline on Air Quality Models: Final rule. Federal Register, Vol. 82, No. 10, January 2017.

an area source representation of emission sources in order to simulate traffic-related air pollutant dispersion.[6] In addition, the weighted average release height and initial vertical source parameters were calculated for each modeled roadway. Hourly traffic volumes and associated emission factors were used to estimate hourly emission rates from each modeled roadway segment and predict traffic-related air pollutant concentrations at receptor locations.

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

The AERMOD model includes the modeling of hourly concentrations based on hourly traffic data and five years of monitored hourly meteorological data. The data consists of surface data collected at LaGuardia Airport and upper air data collected at Brookhaven, New York for the period 2017–2021. The meteorological data provide hour-by-hour wind speeds and directions, stability states, and temperature inversion elevation over the five-year period. These data are processed using the EPA AERMET program to develop data in a format which can be readily processed by the AERMOD model. The land uses around the site where meteorological surface data were available were classified using categories defined in digital United States Geological Survey (USGS) maps. The meteorological dataset processed with the AERMET Version 21112 processor, provided by NYSDEC, was used for the analysis.[7]

Analysis Year

The microscale analyses were performed for 2026, the year by which the Proposed Project is anticipated to be completed. The future analysis was performed for both the No-Action condition and the With-Action condition.

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 an analysis site. Background concentrations must be added to modeling results to obtain total pollutant concentrations at an analysis site.

The background concentrations for the nearest monitored location are presented in **Table 13-1**. PM concentrations are based on recent three years of monitored data (2017-2019)[8] consistent with the

[6] EPA. *Project-Level Conformity and Hot-Spot Analyses*, available at: https://www.epa.gov/state-and-local-transportation/project-level-conformity-and-hot-spot-analyses#pmguidance
[7] NYSDEC staff communicated in an email to AKRF that the met data provided by NYSDEC and processed with earlier versions is acceptable for use with AERMOD version 22112. NYSDEC does not have immediate plans to update the met data using the new version of AERMET (Version 22112).
[8] The 2020 and 2021 background data were not used because of uncertainties in the representativeness of background concentrations for these years due to effects of COVID-19.

statistical format of the NAAQS. These values were used as the background concentrations for the mobile source analysis.

TABLE 13-1: Maximum Background Pollutant Concentrations for Mobile Source Analysis

Pollutant	Average Period	Location	Concentration	NAAQS
PM_{10}	24-hour	Division Street	39.3 µg/m^3	150 µg/m^3
$PM_{2.5}$	24-hour	JHS 126	17.8 µg/m^3	35 µg/m^3

Notes:
[1] PM_{10} concentration represents the average of the highest value from the most-recent three years of data.
[2] $PM_{2.5}$ concentration represents the average of the 98th percentile day from the most recent three years of data.
Source: New York State Air Quality Report Ambient Air Monitoring System, NYSDEC, 2017-2019.

Analysis Site

Intersections in the study area were reviewed for microscale analysis based on the *CEQR Technical Manual* guidance. Several intersections were determined to exceed the PM screening thresholds reference in the *CEQR Technical Manual*. Of those intersections, one was selected for microscale analysis: Kent Avenue and Division Avenue. This intersection was selected because it is projected to have the largest incremental traffic volume. The potential impact from vehicle emissions of PM_{10} and $PM_{2.5}$ was analyzed at this site.

Receptor Placement

Multiple receptors (i.e., precise locations at which concentrations are evaluated) were modeled at the selected site; receptors were placed along the approach and departure links at a 25-foot interval out to 125 feet in each direction. Ground-level receptors were placed at sidewalk or roadside locations near locations with continuous public access, at a pedestrian height of 1.8 meters. Receptors in the analysis models for predicting annual average neighborhood-scale $PM_{2.5}$ concentrations were placed at a distance of 15 meters, from the nearest moving lane at each analysis location, based on the *CEQR Technical Manual* procedure for neighborhood-scale corridor $PM_{2.5}$ modeling.

Parking Analysis

The Proposed Project would result in the development of a 234-space below-grade public parking garage located along Division Avenue. Emissions from vehicles using the mechanically-ventilated parking garage could potentially affect pollutant concentrations in the immediate vicinity of the ventilation outlets. Since the parking lot would be used by automobiles, the primary pollutant of concern is CO, but PM was evaluated as well.

The emissions from the outlet vent and their dispersion were analyzed using the methodology defined in the *CEQR Technical Manual*. Maximum CO concentrations were determined for the time periods when overall garage usage would be the greatest, considering the hours when the greatest number of vehicles would exit the facility. PM increments were determined for peak daily (24-hour) use. The number of vehicles entering and exiting the garage were derived from the trip generation analysis described in **Chapter 12**.

Emissions from vehicles entering, parking, and exiting the garage were determined using the EPA MOVES mobile source emission model as described in detail above for the analysis of emissions at intersections. For all arriving and departing vehicles, an average speed of 5.0 miles per hour was conservatively assumed for travel within the parking garages. In addition, all departing vehicles were assumed to idle for 60 seconds before proceeding to the exit. The concentrations within the system were calculated assuming a minimum ventilation rate, based on New York City Building Code requirements of one cubic foot per minute of fresh air per gross square foot of garage area.

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

The air from the proposed parking garage was conservatively assumed to be vented through a single outlet at a height of approximately 10 feet. The closest receptors to the potential vent location were assumed to be on the sidewalk receptors along Division Avenue Street; therefore, "near" and "far" receptors were placed along adjacent sidewalks at a pedestrian height of 6 feet and at distances of 4.4 feet and 50 feet, respectively, from the vent. A receptor was also modeled at the vent elevation, at a distance of 10 feet from the vent, to conservatively assess the potential air quality impacts on windows or other receptors on the With-Action building. A persistence factor of 0.70 was used to convert the maximum 1-hour average CO concentrations to 8–hour averages, per *CEQR Technical Manual* guidance, and factors of 0.6 and 0.1 to convert maximum 1-hour $PM_{2.5}$ concentrations to 24-hour and annual averages, respectively, per EPA guidance,[9] accounting for meteorological variability over the longer averaging periods.

Background and on-street concentrations were added to the modeling results to obtain the total ambient levels. The on-street pollutant concentrations were determined using the methodology in the Air Quality Appendix of the *CEQR Technical Manual*. On-street build traffic volumes were used for the CO analysis; while the increment was used for the $PM_{2.5}$ analysis.

Future Without the Proposed Action (No-Action Condition)

Intersection Analysis

PM_{10} concentrations in the No-Action condition were determined by using the methodology previously described. The maximum predicted future PM_{10} 24-hour concentration, including background concentrations, at the analyzed intersection in the No-Action condition are presented in **Table 13-2**. The values shown are the highest predicted concentrations for the receptor locations. As shown in the table, No-Action condition concentrations are predicted to be well below the PM_{10} NAAQS.

[9] EPA. *AERSCREEN User's Guide*. EPA-454/B-21-005. April 2021.

TABLE 13-2: Maximum Predicted 24-Hour Average PM_{10} No-Action Concentrations ($\mu g/m^3$)

Location	Concentration
Kent Avenue and Division Avenue	48.1

Notes:
NAAQS—24-hour average 150 $\mu g/m^3$.
Concentration includes a background concentration of 39.3 $\mu g/m^3$.

$PM_{2.5}$ concentrations for the No-Action condition are not presented since impacts are assessed on an incremental basis.

Future With the Proposed Action (With-Action Conditions)

Intersection Analysis

PM_{10} concentrations with the Proposed Project were determined using the methodology previously described and used in the No-Action condition. **Table 13-3** presents the predicted PM_{10} 24-hour concentration at the analyzed intersection in the With-Action condition. The value shown is the highest predicted concentration for the modeled receptor locations and includes the background concentration. The results are well below the NAAQS, which demonstrate that mobile source emissions of PM_{10} from the Proposed Project would not result in a significant adverse air quality impact.

TABLE 13-3: Maximum Predicted 24-Hour Average PM_{10} With-Action Concentration ($\mu g/m^3$)

Location	No-Action	With-Action
Kent Avenue and Division Avenue	48.1	49.3

Notes:
NAAQS—24-hour average 150 $\mu g/m^3$.
Concentrations presented include a background concentration of 39.3 $\mu g/m^3$.

Using the methodology previously described, maximum predicted 24-hour and annual average $PM_{2.5}$ concentration were calculated so that they could be compared with the NAAQS and the *de minimis* criteria. Based on this analysis, the maximum predicted localized 24-hour average and neighborhood-scale annual average incremental $PM_{2.5}$ concentrations are presented in **Tables 13-4 and 13-5**, respectively. **Tables 13-4 and 13-5** also present the maximum total predicted concentrations in the No-Action and With-Action condition. The No-Action and With-Action concentrations shown are the highest predicted concentrations for the modeled receptor locations and include background concentrations.

The results In **Tables 13-4 and 13-5** show that the 24-hour and annual $PM_{2.5}$ incremental concentrations are predicted to be below the *de minimis* criterion and total concentrations are below the NAAQS at the analysis site. Therefore, Proposed Project would not result in a significant adverse air quality impact due to mobile source emissions of $PM_{2.5}$.

Parking Analysis

Based on the methodology previously described the maximum predicted CO and PM concentrations from the proposed parking facility were analyzed assuming a near side sidewalk receptor on the same side of the street (4 feet) as the parking facility, and a far side sidewalk receptor on the opposite side of the street from the parking facility.

TABLE 13-4: Maximum Predicted 24-Hour Average $PM_{2.5}$ With-Action and Incremental Concentration ($\mu g/m^3$)

Location	No-Action	With-Action	Maximum Increment	Criterion
Kent Avenue and Division Avenue	-	-	0.40	8.6 [(1)]
	[(2)] 19.4	[(2)] 19.6	-	35[(3)]

Notes:
[(1)] $PM_{2.5}$ *de minimis* criterion—24-hour average, not to exceed more than half the difference between the background concentration (17.8 $\mu g/m^3$) and the 24-hour standard of 35 $\mu g/m^3$.
[(2)] The 24-hour $PM_{2.5}$ concentration presented represents the maximum of the total 98th percentile. Concentrations presented include a background concentration of 17.8 $\mu g/m^3$.
[(3)] NAAQS.

TABLE 13-5: Maximum Predicted Annual Average $PM_{2.5}$ With-Action Incremental Concentration ($\mu g/m^3$)

Location	No-Action	With-Action	Maximum Increment	Criterion
Kent Avenue and Division Avenue	-	-	0.027	0.1[(1)]
	7.76 [(2)]	7.74 [(2)]	-	12[(3)]

Notes:
[(1)] $PM_{2.5}$ *de minimis* criterion—annual (neighborhood scale), 0.1 $\mu g/m^3$.
[(2)] Concentrations presented include a background concentration of 7.6 $\mu g/m^3$.
[(3)] NAAQS.

The maximum predicted 1-hour average CO concentration is 2.27 ppm, at a receptor on the building facade. This value includes a maximum predicted concentration of 0.55 ppm from emissions within the parking garage, and a background level of 1.72 ppm. The maximum predicted 8-hour average CO concentration is 1.40 ppm, at a receptor on the building facade. This value includes a predicted concentration of 0.20 ppm from emissions within the parking garage, and a background level of 1.2 ppm. The maximum predicted concentrations are substantially below the 1-hour and 8-hour standards of 35 ppm and 9 ppm, respectively, and the maximum predicted 8-hour concentration is below the *de minimis* CO criteria.

The maximum predicted 24-hour and annual average $PM_{2.5}$ increments are 1.00 $\mu g/m^3$ and 0.17 $\mu g/m^3$, respectively, which were modeled at a receptor on the building facade. The maximum predicted $PM_{2.5}$ increments are well below the respective $PM_{2.5}$ *de minimis* criteria of 8.6 $\mu g/m^3$ for the 24-hour average concentration and 0.3 $\mu g/m^3$ for the annual average concentration. Therefore, the proposed parking facility would not result in any significant adverse air quality impacts.

F. STATOINARY SOURCES

Introduction

In accordance with the *CEQR Technical Manual* guidance, stationary source analyses are required to estimate the potential impacts of the following emission sources associated with the Proposed Project: the heating, ventilation, and air conditioning (HVAC) emissions from a nearby large emission source (i.e., the Kent Village housing complex) on the Proposed Project, the emissions

from nearby industrial facilities on the Proposed Project, and the emissions from vehicles using the proposed parking garage.

Project-on-project and project-on-existing HVAC analyses are not warranted as only one building is proposed and it would be taller than all existing or future buildings within 400 feet of the project area (including a proposed 225-foot-tall building at 470 Kent Avenue. As such, there is no need to restrict type of fuel that can be used in the HVAC system.

Large Emission Source Analysis

A review of the NYSDEC permit database and Google aerial images identified one Large Combustion Emission Source having an Air State Facility permit within 1,000 feet of the proposed development. Following *CEQR* guidance "All Major or Large emission sources within the 1000-foot study area that may not be properly accounted for in the background concentrations should be identified along with their stack parameters and emission calculations." As such, a large emission source analysis was conducted.

Industrial Source Analysis

A review of land use within 400 feet of the development identified potential industrial sources that could impact the proposed development. Actual permits were requested from the New York City Department of Environmental Protection (NYCDEP) and reviewed. Although four permits were identified, these were all for combustion installations (or for registration of internal combustion fuel burning equipment) with three of them (for emergency use only) located within the Brooklyn Navy Yard that are owned by Brooklyn Fire Department (Permits PB010914, PB011014, and PB 011114) and fourth permit (CB0488-12P) is for a facility located at 541 Wythe Avenue. These facilities are not considered industrial sources with industrial operations and therefore, were omitted from an industrial analysis.

Large Emission Source

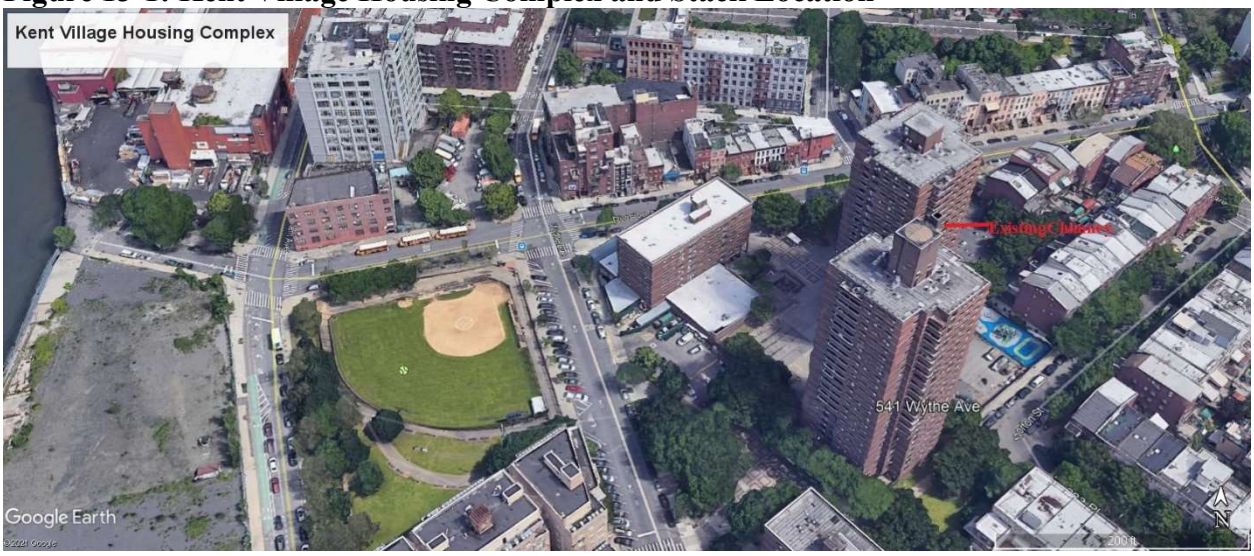
The emission source identified for analysis is the Kent Village housing complex located at 541 Wythe Avenue Brooklyn (Block 2166 Lot 1). The heating system for this complex has a State Air Facility Permit (NYSDEC ID:2610100458) that defines the facility as a large (by *CEQR* definition) emission source.

This apartment building complex operates three (3) identical boilers with a heat capacity of 17.7 MMBtu/hr each that can burn either natural gas or #2 fuel oil. According to the permit for this facility, which was issued in 2005, the upper limit for sulfur content in fuel oil #2 is 0.2 percent. However, since 2010, all power plants and boilers in NYC are required to use fuel oil with a maximum of 0.0015 percent of sulfur (15 ppm). As such, a sulfur content of 0.0015 percent was used in this analysis to estimate the SO_2 emission rate from burning fuel oil.

According to the facility's permit, combustion emissions are released through one common stack listed under emission the unit located on the building's roof. The Kent Village Housing complex includes seven buildings of various heights ranging from 75 feet to 225 feet. Based on visual

observation of a Google map of this area, the stack was assumed to be located on a 25-story building (**Figure 13-1**) even though the UTM coordinates listed in the permit ([587.233 km (E) and 4506.723 km (N)] do not exactly correspond to this stack location.

Figure 13-1: Kent Village Housing Complex and Stack Location



Kent Village Stack Parameters

According to the State air permit, the height of the boiler's common stack is 298 feet and the diameter is 72 inches. The permit, however, does not provide the stack's exit temperature or velocity. As such, an exit temperature of 307.8 deg-F (426 deg-K) was obtained from the NYCDEP permit database, which is applicable for boilers with 15 and greater MMBtu capacity.

For the exit velocity determination, an approach recommended by the NYCDCP was utilized. This approach uses an EPA equation for estimating boiler flow rates at standard conditions via fuel factors and boiler heat inputs, and then adjusts flow rates for actual stack temperatures. Estimated boiler flow rates are then divided by stack diameters to produce stack exit velocities. With the given stack diameter of 72 inches (6 feet), the exit velocity are estimated to be 8.3 ft/sec and 8.7 ft/sec for natural gas and fuel oil, respectively.

Relevant Air Pollutants

The State's facility permit regulates only one pollutant – oxides of nitrogen (NOx.) The annual NOx emissions are capped at 45,000 lb/year (22.5 tons/year).

In addition to the one regulated pollutant (NOx), three other criteria pollutants – $PM_{2.5}$, PM_{10}, and sulfur dioxide (SO_2) were considered for this analysis because they are relevant to natural gas or fuel oil combustion and to ensure that all potential impacts are estimated. $PM_{2.5}$ and PM_{10} are fractions of total particulate matter. These four pollutants were considered in the analysis.

Applicable Air Quality Standards and Significant Impact Criteria

As required by the Clean Air Act, National Ambient Air Quality Standards (NAAQS) have been established for the criteria pollutants by EPA. The NAAQS are concentrations set for each of the criteria pollutants to protect public health and the nation's welfare, and New York has adopted the NAAQS as the State ambient air quality standards.

In addition to the NAAQS, the *CEQR TM* requires that projects subject to CEQR apply $PM_{2.5}$ significant impact criteria (based on concentration increments) developed by the New York City Department of Environmental Protection (NYCDEP) to determine whether potential adverse $PM_{2.5}$ impacts would be significant. If the estimated impacts of a Proposed Project are less than these increments, the impacts are not considered to be significant. This analysis addressed compliance of the potential impacts with the 24-hour and annual $PM_{2.5}$ CEQR significant incremental impact criteria as well as with its respective NAAQS. Compliance with 1-hour/annual NO_2, 24-hour PM_{10}, and 1-hour SO_2 NAAQS is also demonstrated.

The current standards and CEQR significant impact criteria that were applied to this analysis, together with their health-related averaging periods, are provided in **Table 13-6**.

TABLE 13-6:
Applicable National Ambient Air Quality Standards and CEQR Significant Impacts Criteria

Pollutant	Averaging Time	NAAQS	Form	CEQR Significant Impact Criteria
NO_2	1 Hour	0.10 ppm (188 µg/m^3)	98th percentile of 1-hour daily maximum concentrations averaged	
	Annual	.053 ppm (100 µg/m^3)	Annual Mean	
$PM_{2.5}$	24 Hour	35 µg/m^3	98th percentile averaged over 3 years	8.6 µg/m^3
	Annual	12 µg/m^3	Annual mean averaged over 3 years	0.3 µg/m^3
PM_{10}	24 Hour	150 µg/m^3	Not to be exceeded more than once per year on average over 3 years	
SO_2	1-hour	196 µg/m^3	99th percentile of 1-hour daily maximum concentrations averaged over 3 years	

Source: US Environmental Protection Agency, "National Primary and Secondary Ambient Air Quality Standards." (49 CFR 50) (www.epa.gov/air/criteria.html) and New York State Department of Environmental Conservation (http://www.dec.ny.gov/chemical/8542.html.
µg/m^3 = micrograms per cubic meter

NO_2 NAAQS

Nitrogen oxide (NOx) emissions from gas combustion consist predominantly of nitric oxide (NO) at the source. The NOx in these emissions is then gradually converted to NO_2, which is the pollutant of concern, in the atmosphere (in the presence of ozone and sunlight as these emissions travel downwind of a source).

The 1-hour NO_2 NAAQS standard of 0.100 ppm (188 µg/m^3) is the 3-year average of the 98th percentile of daily maximum 1-hour average concentrations in a year. The EPA guidance and memorandums recommend a three-tiered modeling approach for 1-hour NO_2 modeling. Each approach accounts for increasingly complex considerations of NO2/NOx. Tier 1, the most conservative approach, assumes a full (100%) conversion of NOx to NO_2; Tier 2 Ambient Ratio Method (ARM2) applies a conservative ambient NOx/NO_2 ratio to the NOx estimated concentrations; Tier 3 employs AERMOD's Plume Volume Molar Ratio Method (PVMRM) module to accounts for the chemical transformation of NO emitted from the stack to NO_2 within the source plume using hourly ozone background concentrations. The 1-hour NO_2 procedure consists of the following 3-step methodology:

1. At each receptor, the model selects the highest-concentration hour from each day;
2. From this pool of 365 one-hour values (one from each day), the eighth highest NO_2 value from each year is selected, leaving one value per year; and
3. These five values, one from each year of five years, are averaged together to produce the final number.

Tier 1, as the most conservative approach, is recommended initially to apply as a preliminary screening tool to determine whether violations of the NAAQS are likely to occur. If exceedances of the 1-hour NO_2 NAAQS are estimated, the more accurate, less conservative, Tier 2 or Tier 3 methods should be followed.

The annual NO_2 standard is 0.053 ppm (100 µg/m^3). A NO_2/NOx ratio of 0.75 percent recommended by DEP for an annual NO_2 analysis, will apply.

As a Tier 1 NO_2 analysis was not sufficient to demonstrate compliance with the 1-hour NO_2 NAAQS for either natural gas or fuel oil combustion, a Tier 3 analysis (with the PVMRM module) was conducted following NYSDEC DAR-10 guidance. The procedure included the steps necessary to estimate 1-hour NO_2 design concentrations for compliance determination with the 1-hour NO_2 standard design value, as follows:

1. The highest ozone concentration of 212 µg/m^3 from the 5-year NYSDEC datasets was used.
2. The uniform monitored NO_2 background concentration from the Queens College monitoring station, which represents the 3-years average of the 98th-percentiles of the annual distribution of the daily maximum 1-hour concentrations, was applied.
3. The default in-stack and ambient NO_2/NOx equilibrium ratios were set as 0.5 and 0.9, respectively.
4. The maximum estimated 8th-highest (98th percentile) maximum daily 1-hour concentration averaged over 5-years with added background concentration was compared to the 1-hour NO_2 NAAQS to determine compliance with the standard.

$PM_{2.5}$ CEQR De Minimis Criteria

CEQR TM guidance includes the following *de minimis* criteria for evaluating significant adverse $PM_{2.5}$ incremental impacts:

> *Predicted 24-hour maximum $PM_{2.5}$ concentration increase of more than half the difference between the 24-hour $PM_{2.5}$ background concentration and the 24-hour standard.*

The 3-year (2017-2019) average of the 98th percentile 24-hour $PM_{2.5}$ background concentration for Brooklyn JHS 126 monitoring station from the NYSDEC 2019 monitoring Report is 17.8 $\mu g/m^3$ (2017= 17.2 $\mu g/m^3$, 2018=17.9 $\mu g/m^3$, and 2019=18.4 $\mu g/m^3$). Half the difference between the 24-hour $PM_{2.5}$ NAAQS of 35 $\mu g/m^3$ and the background value of 17.8 $\mu g/m^3$ is 8.6 $\mu g/m^3$. As such, a *de minimis* criteria of 8.6 $\mu g/m^3$ was used for determining whether a potential 24-hour $PM_{2.5}$ impact for the 500 Kent Ave development is significant.

* NEW YORK STATE AMBIENT AIR QUALITY REPORT FOR 2019 (ny.gov)

For an annual average adverse $PM_{2.5}$ incremental impact, according to *CEQR* guidance:

> *Predicted annual average $PM_{2.5}$ concentration increments greater than 0.3 $\mu g/m^3$ at any receptor location for stationary sources.*

The above 24-hour and annual *de minimis* criteria were used to evaluate the significance of predicted $PM_{2.5}$ impacts from Kent Village Air State facility boilers. The annual $PM_{2.5}$ background concentration averaged over 3-years (2017-2019) from JHS-126 is 7.6 $\mu g/m^3$.

Dispersion Analysis

A dispersion modeling analysis to estimate impacts from the Kent Village boiler emissions was conducted using the latest version (22112) of EPA's AERMOD dispersion model. AERMOD is a steady-state plume model that 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 can be used to calculate pollutant concentrations from one or more points (e.g., exhaust stacks) based on hourly meteorological data, and has the capability of calculating pollutant concentrations at locations when the plume from the exhaust stack is affected by the aerodynamic wakes and eddies (downwash) produced by nearby structures.

Following CEQR guidance, this analysis was conducted assuming stack tip downwash, urban dispersion surface roughness length, and elimination of calms. AERMOD's Plume Volume Molar Ratio Method (PVMRM) module was utilized for 1-hour NO_2 analysis -- to account for NOx to NO_2 conversion. Analyses were conducted with and without the effects of wind flow around the proposed building (i.e., with and without downwash) utilizing the AERMOD Building Profile Input Program (BPIP) algorithm, and both sets of results are reported.

Site Geometry

A digital base map for the AERMOD modeling was developed using the NYCDCP PLUTO shapefile for the project site area, the proposed building footprints, and Kent Village Housing

Complex footprints and heights from the New York City Open Data shape files database. These footprints were used to delineate the shape of the Kent Village Housing buildings including the 25-story building where the emission stack is located.

Meteorological Data

All analyses were conducted using the latest five consecutive years of meteorological data for 2015-2019 provided by the New York State Department of Environmental Conservation (NYSDEC). Surface data was obtained from La Guardia Airport and upper air data was obtained from Brookhaven station, New York.

Five years of meteorological data were combined into a single multiyear file to conduct 24-hour/annual $PM_{2.5}$ and 1-hour NO_2 as well as other pollutants modeling. The $PM_{2.5}$ special procedure, which is incorporated into AERMOD, calculates concentrations at each receptor for each year modeled, averages those concentrations across the number of years of data, and then selects the highest values across all receptors of the 5-year averaged highest values.

Background Concentrations

Average background concentrations for all pollutants, except $PM_{2.5}$, were obtained from the Queens College monitoring station for the 2017-2019 period, as follows:

- The 3-year average of the 98th percentile of the annual distribution of the daily maximum 1-hour NO_2 concentration is 55.1 ppb (104 $\mu g/m^3$);
- The highest annual NO_2 concentration over the 3 years is 14.62 ppb (27.6 $\mu g/m^3$);
- The 3-year average of the 99th percentile of the annual distribution of the daily maximum 1-hour SO_2 concentration is 5.17 ppb (13.4 $\mu g/m^3$);
- The average of the highest 24-hour PM_{10} concentrations over the 3-years is 28 $\mu g/m^3$, and NEW YORK STATE AMBIENT AIR QUALITY REPORT FOR 2019 (ny.gov)

Receptor Locations

The proposed commercial building (predominantly office building) will ventilated mechanically. The sensitive receptors potentially exposed to the emissions from the nearby heating plant will be the building's fresh air intake ducts. As confirmed by the architect, the proposed building design will include louver openings to maintain the ventilation requirements for the building occupants. As such, the dispersion analysis was conducted to determine the maximum height at which air intakes could be located that will comply with all applicable air quality standards and guidelines. Even though the final design of the building's ventilation system has not been finalized, there will be no restriction to preclude the use of operable windows below determined maximum height.

To determine suitable air intake locations, receptors were placed around all faces of the proposed building in ten-foot increments horizontally and vertically, starting above the ground and extending up to the level where no significant air quality impacts are estimated.

Emission Rates

Emission rates for all pollutants were estimated using EPA AP-42 emission factors for natural gas and fuel oil combustion in uncontrolled small boilers with less than 100 MMBtu/hour and total heat input of Kent Village Air State facility three identical boilers (53.1 MMBtu/hour). The pollutant emission factors, which are in units lb/MM scf (pounds of pollutant per million standard cubic feet of natural gas-fired), were converted to lb/MMBtu. Emission factors for $PM_{2.5}$ and PM_{10} included both condensable and filterable particles. For fuel oil burning in the same units as natural gas, emission factors in units $lb/10^3$ gallons of oil (pounds of pollutant per 1,000 gallons of oil-fired) were also converted to lb/MMBtu.

Natural Gas (for Boilers Firing Natural Gas)

- NOx –100 lb/MMscf (9.8E-02 lb/MMBtu), AP-42, Table 1.4-1;
- $PM_{2.5}$ --7.6 lb/MMscf (7.45E-03 lb/MMBtu), which includes condensable and filterable particles (AP-42, Table 1.4-2);
- PM_{10} --7.6 lb/MMscf (7.45E-03 lb/MMBtu), which includes condensable and filterable particles (AP-42, Table 1.4-2);
- SO_2 -- 0.6 lb/MMscf (5.88E-04 lb/MMBtu); and

Fuel Oil #2 (for Boilers Firing Fuel Oil with 0.2% sulfur)

- NOx -- 20 $lb/10^3$ gal (1.43 E-01 lb/MMBtu), see AP-42, Table 1.3-1;
- $PM_{2.5}$ -- 2.13 $lb/10^3$ gal (1.52E-02 lb/MMBtu), which includes a 1.3 $lb/10^3$ gal emission factor for condensable particles less than 1 micron in diameter (Condensable Particulate Matter for Fuel Oil Combustion, AP-42, Table 1.3-2) and 0.83 $lb/10^3$ gal for particles with a size of 2.5 microns from "Cumulative Particle Size Distribution and Size-Specific Emission Factors for Uncontrolled Commercial Boilers Burning Residual or Distillate Oil", AP-42, Table 1.3-7;
- PM_{10} -- 2.38 $lb/10^3$ gal (1.7E-02 lb/MMBtu) which include condensable particles (AP-42, Table 1.3-2); and 1.08 $lb/10^3$ gal for particles with size of 10 microns from Table 1.3-7; and;
- SO_2 -- 0.213 $lb/10^3$ gal (1.52E-03 lb/MMBtu) (estimated from equation SO_2=142S where S = the sulfur content in fuel oil (0.0015%), which is from "Criteria Pollutant Emission Factors for Fuel Oil Combustion" AP-42, Table 1.3-1.

The permit caps annual NO_2 emissions at 22.5 tons/year (i.e., should not exceed the established facility limit for NOx of 45,000 pounds per year). This annual limit is applied to estimate the annual pollutant emission rate.

Estimated short-term and annual emission rates for all pollutants for both natural gas and fuel oil are provided in **Tables 13-7** and **13-8**.

TABLE 13-7: Estimated Pollutant Emission Rates with Natural Gas Under Air State Facility Permit #2610100458

Pollutant Emission Factors	Number Of Units	Total Heat Input	Short-term Emission Rates		Annual Emission Rates	
lb/MMBtu		MMBtu/hr	lb/hr	g/sec	lb/year	g/sec
			$PM_{2.5}$ Emission Rates			
7.45E-03	3	53.1	3.96E-01	4.99E-02	3.42E+03	4.92E-02
			PM_{10} Emission Rates			
7.45E-03	3	53.1	3.96E-01	4.99E-02	3.42E+03	4.92E-02
			NOx Emission Rates			
9.80E-02	3	53.1	5.21E+00	6.56E-01	4.50E+04	6.48E-01
			SO_2 Emission Rates			
5.88E-04	3	53.1	3.12E-02	3.94E-03	2.70E+02	3.89E-03

TABLE 13-8: Estimated Pollutant Emission Rates with Fuel Oil No. 2 Under Air State Facility Permit #2610100458

Pollutant Emission Factors	Number Of Units	Heat Input Per Boiler	Short-term Emission Rates		Annual Emission Rates	
lb/MMBtu		MMBtu/hr	lb/hr	g/sec	lb/year	g/sec
			$PM_{2.5}$ Emission Rates			
1.52E-02	3	53.1	8.08E-01	1.02E-01	4.80E+03	6.90E-02
			PM_{10} Emission Rates			
1.70E-02	3	53.1	9.03E-01	1.14E-01	5.36E+03	7.71E-02
			NOx Emission Rates			
1.43E-01	3	53.1	7.59E+00	9.56E-01	4.50E+04	6.48E-01
			SO_2 Emission Rates			
1.52E-03	3	53.1	8.08E-02	1.02E-02	4.80E+02	6.90E-03

Results

Using an iterative analysis, it was determined that the maximum acceptable 1-hour NO_2 impact under the most conservative scenario (i.e., with fuel oil) would occur at a receptor height of 300 feet. With an impact of 72.7 ug/m^3 and an added 1-hour NO_2 background value of 104 ug/m^3, the total estimated 8th highest NO_2 concentration is 176.7 ug/m^3 -- about 94 % of the NAAQS of 188 ug/m^3. As such, 300 feet is used as a cutoff point for determining the maximum height at which operable windows and/or fresh air intakes could be located. This means that neither operable windows nor fresh air intakes could not be placed above this height on the 352-foot-tall building.

Based on this, all modeling runs were conducted with the maximum receptors heights of 300 feet above the ground. Approximately 4,000 receptors were placed on building faces to assure that maximum potential impacts are estimated.

Natural Gas

$PM_{2.5}$
The results of the $PM_{2.5}$ analysis are that the maximum 24-hour $PM_{2.5}$ and annual impacts with and without downwash are less than the *CEQR de minimis* criteria and the total concentrations are less than the 24-hour/annual $PM_{2.5}$ NAAQS. Therefore, $PM_{2.5}$ emissions from the Kent Village Air State facility would not significantly impact the proposed building.

24-Hour PM_{10}
The results of the 24-hour PM_{10} analysis are that the maximum total 24-hour PM_{10} concentrations with or without downwash are less than the 24-hour PM_{10} NAAQS of 150 $\mu g/m^3$. Therefore, the 24-hour PM_{10} emissions from the Kent Village Air State facility would not significantly impact the proposed building.

1-Hour NO_2
The results are that the maximum 1-hour NO_2 concentrations with or without downwash are less than the 1-hour NO_2 NAAQS. The maximum average annual NO_2 concentrations with and without downwash are less than the annual NO_2 NAAQS of 100 $\mu g/m^3$. Therefore, NO_2 emissions from the Kent Village Air State facility would not significantly impact the proposed building.

1-Hour SO_2
The results of the 1-hour SO_2 analysis with and without downwash are that the maximum total 4th highest daily 1-hour averaged SO_2 concentrations with or without downwash are less than the 1-hour SO_2 NAAQS of 196 $\mu g/m^3$. Therefore, 1-hour SO_2 emissions from the Kent Village Air State facility would not significantly impact the proposed building.

The results of the analysis with natural gas are that no exceedances of the CEQR *de minimis* criteria for $PM_{2.5}$ or NAAQS for all pollutants would occur from the Air State facility combustion emissions when burning natural gas in its boilers.

Fuel Oil

$PM_{2.5}$
The result of the $PM_{2.5}$ analyses are that the maximum estimated 24-hour and annual $PM_{2.5}$ impacts with or without downwash are less than the *CEQR de minimis criteria* and total concentrations are less than the PM2.5 24-hr/annual NAAQS. Therefore, PM_{25} emissions from the Kent Village Air State facility would not significantly impact the proposed building.

24-Hour PM_{10}
The results are that the 24-hour PM_{10} total concentrations with or without downwash are less than the 24-hour PM_{10} NAAQS. Therefore, the 24-hour PM_{10} emissions from the Kent Village Air State facility would not significantly impact the proposed building.

1-Hour NO_2

The results are that the 1-hour NO_2 concentrations with or without downwash are less than the 1-hour NO_2 NAAQS. The total annual NO_2 concentrations with or without downwash are less than the annual NAAQS. Therefore, the NO_2 emissions from the Kent Village Air State facility would not significantly impact the proposed building.

1-Hour SO_2

The result of the 1-hour SO_2 analysis is that the maximum 4th highest daily 1-hour SO_2 concentration with or without downwash is less than the 1-hour SO_2 NAAQS. Therefore, 1-hour SO_2 emissions from the Kent Village Air State facility would not significantly impact the proposed building.

The results of the analysis with fuel oil are that no exceedances of the CEQR *de minimis* criteria for $PM_{2.5}$ or NAAQS for all pollutants would occur from the Kent Village Air State facility's combustion emissions when burning fuel oil in its boilers.

A summary of the results for all averaging periods, with and without downwash effects, are presented in **Tables 13-9 and 13-10**. A 3-D top view of Kent Village stack in relation to the proposed building generated by the 3-D AERMOD Analyst is shown in **Figure 13-2.**

TABLE 13-9: Results of the Analysis with Downwash

Pollutant	Modeled Concentration	Background	Total Conc.	Evaluation Criteria
	µg/m^3	µg/m^3	µg/m^3	µg/m^3
Natural Gas				
24-hr $PM_{2.5}$	0.6	-	-	8.6 (*CEQR Criteria)*
	0.5	17.8	18.3	35 (NAAQS)
Annual $PM_{2.5}$	0.04	-	-	0.3 (*CEQR Criteria*)
	0.04	7.6	7.6	12 (NAAQS)
1-hr NO_2	26.7	104.0	130.7	188 (NAQQS)
Annual NO_2	0.5	27.6	28.1	100 (NAAQS
1-hr SO_2	0.2	13.4	13.6	196 (NAQQS)
24-hr PM_{10}	0.6	28	28.6	150 (NAQQS)
Fuel Oil #2				
24-hr $PM_{2.5}$	1.3	-	-	8.6 (*CEQR Criteria)*
	1.0	17.8	18.8	35 (NAAQS*)*
Annual $PM_{2.5}$	0.06	-	-	0.3 (*CEQR Criteria*)
	0.06	7.6	7.7	12(NAQQS)
1-hr NO_2	38.5	104.0	142.5	188 (NAAQS
Annual NO_2	0.5	27.6	28.1	100 (NAQQS)
1-hr SO_2	0.6	13.4	14.0	196 (NAQQS)
24-hr PM_{10}	1.4	28	29.4	150 (NAQQS)

Figure 13-2: Kent Village Housing Stack and Proposed Building at 500 Kent Ave

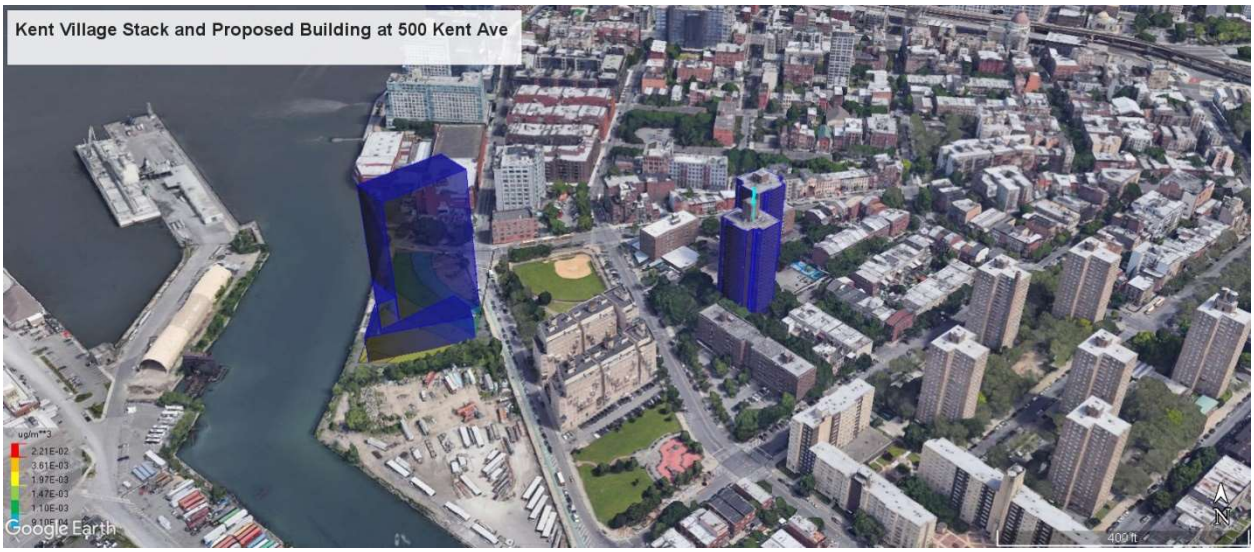


TABLE 13-10: Results of the Analysis without Downwash

Pollutant	Modeled Concentration µg/m³	Background µg/m³	Total Conc. µg/m³	Evaluation Criteria µg/m³
Natural Gas				
24-hr $PM_{2.5}$	1.5	-	-	8.6 (*CEQR Criteria)*
	1.4	17.8	19.2	35 (NAAQS)
Annual $PM_{2.5}$	0.06	-	-	0.3 (*CEQR Criteria*)
	0.06	7.6	7.7	12 (NAAQS)
1-hr NO_2	52.9	104.0	156.9	188 (NAAQS)
Annual NO_2	0. 1.1	27.6	28.7	100 (NAAQS)
1-hr SO_2	0.6	13.4	14.0	196 (NAQQS)
24-hr PM_{10}	1.5	28	29.5	150 (NAAQS)
Fuel Oil #2				
24-hr $PM_{2.5}$	2.7	-	-	8.6 (*CEQR Criteria)*
	2.2	17.8	20.0	35 (NAAQS*)*
Annual $PM_{2.5}$	0.07	-	-	0.3 (*CEQR Criteria*)
	0.07	7.6	7.7	12 (NAQQS)
1-hr NO_2	72.7	104.0	176,7	188 (NAAQS)
Annual NO_2	0.7	27.6	28.3	100 (NAQQS)
1-hr SO_2	0.9	13.4	14.3	196 (NAQQS)
24-hr PM_{10}	3.5	28	31.5	150 (NAQQS)

Conclusion

The result of the analysis of the large emission source – the nearby Kent Village Housing facility under the NYSDEC permit -- is that its combustion emissions would not significantly impact the

proposed building if operable windows and/or the fresh air intakes of the building will not be located higher than 300 feet above the ground. To ensure that would be no significant impacts, an E-designation should be placed on the proposed building requiring that operable windows and/or the fresh air intakes used to provide mechanical ventilation to the building are located at a height not more than 300 feet above the ground.

Proposed (E) Designation for the Project Site

The text of the (E) Designation restriction [E-738] that would be placed on the Project Site is outlined below.

> **Block 2023, Lot 10 (Development Site): Any new development on the above-referenced property should locate operable windows and/or fresh air intakes for building mechanical ventilation not higher than 300 feet height above the ground, to avoid any potential significant adverse air quality impacts.**