A. INTRODUCTION

According to the guidelines provided in the *City Environmental Quality Review (CEQR) Technical Manual*, air quality analyses are conducted in order to assess the effect of an action on ambient air quality (i.e., the quality of the surrounding air), or effects on a project because of ambient air quality. Air quality can be affected by "mobile sources," pollutants produced by motor vehicles, and by pollutants produced by fixed facilities, i.e., "stationary sources." As per the *CEQR Technical Manual*, an air quality assessment should be carried out for actions that can result in either significant adverse mobile source or stationary source air quality impacts.

The Applicant, Harrison Realty LLC, is proposing a rezoning to facilitate a new, predominantly residential, mixed-use development on two blocks in the South Williamsburg section of Brooklyn. The Project Area consists of the following two trapezoidal-shaped blocks:

(1) The "Northern Block" bounded on the north by a demapped segment of Walton Street, on the east by Harrison Street, on the south by Wallabout Street, and on the west by Union Avenue (Block 2249, Lots 23, 37, 41, and 122); and

(2) The "Southern Block" bounded on the north by Wallabout Street, on the east by Harrison Street, on the south by Gerry Street, and on the west by Union Avenue (Block 2265, Lot 14).

Figure 1-13 in Chapter 1, "Project Description," shows an illustrative site plan for the proposed action under the Reasonable Worst-Case Development Scenario (RWCDS). Under the proposed action/RWCDS, for analysis purposes, it is projected that eight (8) buildings would be built on these two blocks. The Northern Block would include Buildings A, B, and C, and the Southern Block would include Buildings D, E, F, G, and H.

Air quality, which is a general term used to describe pollutant levels in the atmosphere, would be affected by these changes. This analysis primarily estimates the potential impacts of the emissions from the heating, ventilation, and air conditioning (HVAC) systems of the proposed buildings. The HVAC emissions of each building could impact one of the other proposed buildings (project-on-project) or a nearby existing building (project-on existing) that is taller than or as tall as the proposed building.

A review of existing land uses show that there are no existing buildings taller than (or as tall as) the proposed buildings located within 400 feet of the Northern or Southern Blocks. As such, an analysis of project-on-existing impacts is generally not warranted. However, in accordance with a DCP guidance for this project, a project-on-existing screening analysis was conducted.

The potential air quality impacts of the HVAC emissions were estimated following the procedures and methodologies prescribed in the *CEQR Technical Manual*.

In addition:

- Because the number of action-generated vehicles (automobiles) would be below CEQR screening threshold values at any affected intersection, no significant mobile source air quality impacts are expected as a result of the proposed development. A brief explanation of the mobile source screening is provided for informational purposes;
- The *CEQR Technical Manual* states that projects resulting in parking facilities or applications to the City Planning Commission requesting the grant of a special permit or authorization for parking facilities should consult the lead agency regarding whether an air quality analysis of parking facilities is necessary. A garage analysis based on the proposed action/RWCDS has been provided; and
- A request for permits for existing industrial sources in the vicinity of the project area was submitted to NYC Department of Environmental Protection (DEP). As two permitted facilities (with air toxics emissions permits) were identified within a 400-foot radius of the rezoning area, an industrial source analysis has been provided. No major combustion sources with NYSDEC Title V or State Facility permits within a 1,000-foot radius were identified.

B. PRINCIPAL CONCLUSIONS

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

The stationary source analyses determined that there would be no potential significant adverse air quality impacts from fossil fuel-fired heat and hot water systems at the projected and potential development sites. An (E) designation (E-427) would be mapped on the project area tax lots as part of the zoning proposal to ensure the developments would not result in any significant air quality impacts from fossil fuel-fired heat and hot water systems emissions due to individual or groups of development sites. These would include fuel type restrictions for all buildings, requiring the use of natural gas-fired boilers, and stack location restrictions for some buildings.

An industrial source analysis determined that the proposed action would not result in any significant adverse air quality impacts related to the introduction of the sensitive uses to the project area.

As the proposed action/RWCDS would not exceed the analysis screening thresholds for mobile sources, detailed analysis is not required and the proposed action/RWCDS would not result in significant adverse impacts related to those concerns.

The parking facilities assumed to be developed as a result of the proposed action/RWCDS would not result in any significant adverse air quality impacts.

C. MOBILE SOURCE SCREENING

Changes in vehicular travel associated with a proposed action may have the potential to result in significant mobile source (vehicular related) air quality impacts. The potential impact of the vehicular emissions associated with the proposed action was considered.

Localized increases in CO levels may result from increased vehicular traffic volumes and changed traffic patterns in the study area as a consequence of the proposed action. According to the *CEQR Technical Manual* screening threshold criteria for this area of the City, if 170 or more project-generated vehicles pass through a signalized intersection in any given peak period, there is potential for mobile air quality impacts and a detailed analysis is required.

In addition, diesel-powered mobile source vehicles, especially heavy trucks and buses operating on diesel fuel, may contribute to levels of respirable particulates, most of which are particles with an aerodynamic diameter of less than or equal to 2.5 micrometers ($PM_{2.5}$). The *CEQR Technical Manual* specifies screening threshold criteria for heavy-duty diesel vehicles (HDDVs) including if 12 or more project-generated HDDVs travel on paved road with average daily traffic fewer than 5,000 vehicles.

The traffic analysis for the proposed action (see Chapter 12) indicates that the number of action-generated vehicles would be well below the 170-vehicle and 12-HDDV CEQR screening threshold values during the weekday AM, weekday midday, weekday PM, and Saturday midday peak hours at any affected intersection.

Furthermore, the proposed action would not result in any of the other conditions identified in Section 210 of Chapter 17 of the *CEQR Technical Manual* that could trigger the requirement for a detailed mobile source analysis.

Therefore, no detailed air quality analysis is required and no significant mobile source air quality impacts are expected as a result of the proposed development. The air quality analysis, therefore, focuses on potential stationary source impacts.

A garage emissions analysis is provided below in Section F.

D. STATIONARY SOURCE ANALYSIS

HVAC Screening

Relevant Air Pollutants

The US Environmental Protection Agency (EPA) has identified several pollutants, which are known as criteria pollutants, as being of concern nationwide. As the proposed buildings would be heated by natural gas, the two criteria pollutants associated with natural gas combustion – nitrogen dioxide (NO_2) and particulate matter smaller than 2.5 microns ($PM_{2.5}$) – were considered for 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 in order to protect public health and the nation's welfare, and New York has adopted the NAAQS as the State ambient air quality standards. This analysis addressed compliance of the potential impacts with the 1-hour and annual NO_2 NAAQS.

In addition to the NAAQS, the *CEQR Technical Manual* requires that projects subject to CEQR apply a $PM_{2.5}$ 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 impact criteria.

The current standards together with CEQR significant impact thresholds that were applied to this analysis, along with their health-related averaging periods, are provided in Table 13-1.

Table 13-1, Applicable National Ambient Air Quality Standards and CEQR Significant Threshold Criteria

Pollutant	Averaging Period	National and State Standards	CEQR Significant Impact Criteria (µg/m^3)
NO_2	1 Hour	0.10 ppm (188 µg/m3)	
	Annual	.053 ppm (100 µg/m3)	
$PM_{2.5}$	24 Hour	35 µg/m3	6.0
	Annual	12 µg/m3	0.3

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.

Notes: ppm = parts per million; µg/m3 = 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 are 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/m3) is the 3-year average of the 98th percentile of daily maximum 1-hour average concentrations in a year. For determining compliance with this standard, the EPA has developed a modeling approach for estimating 1-hour NO_2

concentrations that is comprised of 3 tiers: Tier 1, the most conservative approach, assumes a full (100 percent) conversion of NOx to NO_2; Tier 2 applies a conservative ambient NOx/NO_2 ratio of 80 percent to the NOx estimated concentrations; and Tier 3, which is the most precise approach, employs AERMOD's Plume Volume Molar Ratio Method (PVMRM) module. The PVMRM accounts for the chemical transformation of NO emitted from the stack to NO_2 within the source plume using hourly ozone background concentrations. When Tier 3 is utilized, AERMOD generates 8th highest daily maximum 1-hour NO_2 concentrations or total 1-hour NO_2 concentrations if hourly NO_2 background concentrations are added within the model, and averages these values over the numbers of the years modeled. Total estimated concentrations are generated in the statistical form of the 1-hour NO_2 NAAQS format and can be directly compared with the 1-hour NO_2 NAAQS standard.

Based on New York City Department of Planning (NYCDCP) guidance, Tier 1, as the most conservative approach, should initially be applied as a preliminary screening tool to determine whether violations of the NAAQS is likely to occur. If exceedances of the 1-hour NO_2 NAAQS were estimated, the less conservative Tier 3 approach should be applied.

The annual NO_2 standard is 0.053 parts per million (ppm or 100 µg/m3). In order to conservatively estimate annual NO_2 impacts, a NO_2 to NOx ratio of 0.75 percent, which is recommended by the NYCDEP for an annual NO_2 analysis, was applied.

$PM_{2.5}$ CEQR Significant Impact Criteria

CEQR Technical Manual guidance includes the following 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 24-hour $PM_{2.5}$ background concentration of 23 µg/m3 was obtained from Brooklyn JHS-126 monitoring station. It was compiled by the NYCDEP as the average of the 98th percentile for the latest 3 years of available monitoring data collected by the NYSDEC for 2013-2015 (*CEQR*, Page 27, Monitored Pollutant Background Level for Various Region within New York City, December 2015 Update). As the applicable background value is 23 µg/m3, half of the difference between the 24-hour $PM_{2.5}$ NAAQS and this background value is 6.0 µg/m3. As such, a significant impact criterion of 6.0 µg/m3 was used for determining whether the potential 24-hour $PM_{2.5}$ impacts of the proposed development are considered to be significant.

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

> *Predicted annual average $PM_{2.5}$ concentration increments greater than 0.3 µg/m3 at any receptor location for stationary sources.*

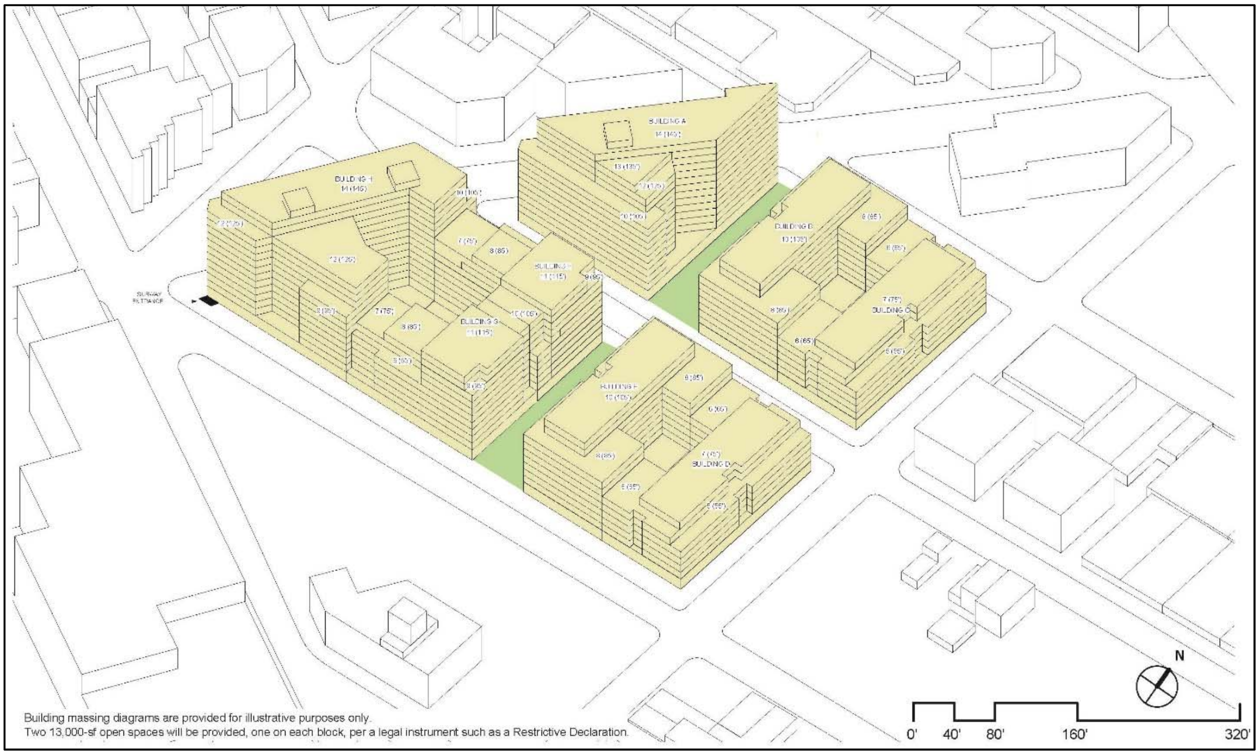
The above 24-hour and annual significant impact criteria were used to evaluate the significance of predicted $PM_{2.5}$ impacts.

RWCDS

Lots within the Northern and Southern Blocks are adjacent to each other. In addition, based on the RWCDS, the adjacent buildings on each block form a continuous street wall, with the exceptions of Building A on Block 2249, which is separated from Building B by a 65-foot wide open space and Buildings F and G on Block 2265, which are also separated from Building E by a 65-foot wide open space. (Figure 13-1). Adjacent buildings on each block are as follows:

- Block 2249: A; B and C
- Block 2265: E and D; H and F; H and G; and F and G.

Figure 13-1: Pfizer Site Proposed Developments on Blocks 2249 and 2265



Blocks 2249 and 2265 are separated from each other by the 70-foot wide Wallabout Street.

The sizes and heights of each building on Blocks 2249 and 2265 are provided in Table 13-2. The total gross floor area (gsf) under the RWCDS for each building, which include residential, retail, and other areas, was used for the analysis. Building heights are the maximum heights of the highest tier of each building where the HVAC exhaust stack for each building was assumed to be located.

Table 13-2: Buildings Parameters

Building No.	Zoning District	Block	Total Floor Area gsf	Building Height feet
Building A	R8A	2249	218,790	145
Building B	R7D w/ C2-4	2249	159,650	105
Building C	R7A w/ C2-4	2249	112,610	75
Building D	R7A w/ C2-4	2265	112,610	75
Building E	R7A w C2/4	2265	159,650	105
Building F	R8A &R7A&R7D w/C2-4	2265	116,180	115
Building G	R8A &R7A&R7D w/C2-4	2265	116,180	115
Building H	R8A w/ C2-4	2265	283,858	145

gsf– gross square feet of floor area

CEQR Screening Analysis

Project-on-Project Screening Analysis

Based on CEQR guidance, a screening analysis was conducted as a first step to predict whether the potential impacts of the HVAC emissions of each building would have the potential to be significant and therefore require a detailed analysis.

However, the *CEQR* screening procedure is not applicable to buildings that are less than 30 feet apart from the nearest building of similar or greater height. As such, the screening procedure cannot be used for those buildings on the same block that are adjacent to each other. However, it is applicable for buildings separated by the open space even within one block (e.g., Buildings A and B on Block 2249 and Buildings G, F, and E on Block 2265) or buildings located on the different blocks which are separated by the 70-foot wide Wallabout Street.

The screening analysis was applied for the following sixteen (16) building combinations:

1. The 145-foot tall A on Block 2249 on the 145-foot tall H on Block 2265
2. The 105-foot tall B on Block 2249 on the 145-foot tall A on the same block
3. The 105-foot tall B on Block 2249 on the 105-foot tall E on Block 2265
4. The 105-foot tall B on Block 2249 on the 115-foot tall F on Block 2265
5. The 75-foot tall C on Block 2249 on the 75-foot tall D on Block 2265
6. The 75-foot tall C on Block 2249 on the 75-foot tall E on Block 2265
7. The 75-foot tall C on Block 2249 on the 115-foot tall F on Block 2265
8. The 75-foot tall D on Block 2265 on the 75-foot tall C on Block 2249
9. The 75-foot tall D on Block 2265 on the 75-foot tall B on Block 2249
10. The 75-foot tall D on Block 2265 on the 145-foot tall A on Block 2249
11. The 105-foottall E on Block 2265 on the 145-foot tall A on the same block
12. The 105-foot tall E on Block 2265 on the 105-foot tall B on Block 2249
13. The 105-foot tall E on Block 2265 on the 115-foot tall F on Block 2249
14. The 105-foot tall E on Block 2265 on the 115-foot tall G on Block 2249
15. The 115-foot-tall F on Block 2265 on the 145-foot tall A on Block 2249

16. The 145-foot-tall H on Block 2265 on the 145-foot tall A on Block 2249

The total square footage of each building was used in the analysis, and the nomograph depicted on Figure 17-7 of the *CEQR Air Quality Appendix NO_2 Boiler Screen* (Residential Development-Natural Gas*)* for a corresponding stack height, was applied. This nomograph depicts size of the development versus distance below which a potential impact could occur, and provides a threshold distance. As required by *CEQR* screening procedures, the 30-foot curve for Buildings C and D was applied as the 30-foot curve height is closest to but not higher than the projected stack heights of 78 feet (which are based on building heights of 75 feet and an assumed stack height of 3 feet). Similarly, the 100-foot curve was applied for Buildings A, B, E, F, G, and H as the 100 feet curve height is closest to but not higher than the projected stack heights.

If the actual distance between a stack and an affected building is greater than the threshold distance for a building size, then that building passes the screening analysis (and no significant impact is predicted). However, if the actual distance is less than the threshold distance for a building, then there is a potential for a significant impact and a detailed analysis would be required.

The results of the screening analysis are presented in Table 13-3. As shown, the actual distances between all buildings (except buildings B and F, C and F, D and A, and E and A) are less than the threshold distance determined by nomograph, indicating that these buildings failed the screening analysis and a potential for significant impact exists. A detailed analysis, therefore is required for these buildings. Building B on F, C on F, D on A, and E on A passed the screening analysis and no further detailed analyses for these building are warranted.

Project-on-Existing Screening Analysis

Using the same CEQR methodology, the threshold distance was determined to be 105 feet for Building A, and 125 feet for Building H. As there are no existing buildings taller than buildings A and H within these distances, both buildings passed the screening analysis and no detailed analysis is warranted.

Detailed Analysis

A dispersion modeling analysis was conducted to estimate impacts from the HVAC emissions of each of the RWCDS buildings using the latest version of EPA's AERMOD dispersion model 7.12.1 (EPA version 16216r). In accordance with *CEQR* guidance, this analysis was conducted assuming stack tip downwash, urban dispersion surface roughness length, elimination of calms, with and without downwash effect on plume dispersion. AERMOD's Plume Volume Molar Ratio Method (PVMRM) module was to utilize 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 buildings (i.e., with and without downwash) and both results are reported.

Table 13-3: Results of the Screening Analysis for Buildings Located on Blocks 2249 and 2265

Building ID	Block	Floor Area	Stack Height	Nearest Building On Block	Potential B on B Impact	Distance to Nearest Building	Threshold Distance on Figure 17-7	CEQR Nomograph Results	
		sq. ft.	feet	feet		feet	feet	Pass	Fail
A	2249	**218,790**	148	Building H	A on H	68	105		**Fail**
B	2249	**159,650**	108	Building A	B on A	65	90		**Fail**
				Building E	B on E	66			**Fail**
				Building F	B on F	93		**Pass**	
C	2249	**112,610**	78	Building D	C on D	66	78		**Fail**
				Building E	C on E	66			**Fail**
				Building F	C on F	173		**Pass**	
D	2265	**112,610**	78	Building C	D on C	66	78		**Fail**
				Building B	D on B	66			**Fail**
				Building A	D on A	173		**Pass**	
E	2265	**159,650**	108	Building A	E on A	93	90	**Pass**	
				Building B	E on B	66			**Fail**
				Building F	E on F	65			**Fail**
				Building G	E on G	65			**Fail**
F	2265	**116,180**	118	Building A	F on A	68	79		**Fail**
H	2265	**283,858**	145	Building A	H on A	68	125		**Fail**

Emissions

Emission rates were estimated as follows:

- As all the proposed buildings would be heated by natural gas, emission rates of NOx and $PM_{2.5}$ were calculated based on annual natural gas usage corresponding to the gross floor area of each building, EPA AP-42 emission factors for firing natural gas combustion in small boilers, and heating value of natural gas;
- $PM_{2.5}$ emissions from natural gas combustion accounted for both filterable and condensable particulate matter;
- Short-term NO_2 and $PM_{2.5}$ emission rates were estimated by accounting for seasonal variation in heat and hot water demand; and
- The natural gas fuel usage factor 59.1 cubic foot per square foot per year was obtained from CEQR Table US1, Total Energy Consumption, Expenditures and Intensities, 2005, Part I: Housing Unit Characteristics and Energy Use Indicators for New York using more conservative factor for residential uses (even thou buildings are mix-used).

Table 13-4 provides pollutant emission rates from the boiler firing natural gas that were used in the dispersion analysis. The diameter of the stacks and the exhaust's exit velocities were estimated based on values obtained from NYCDEP "CA Permit" database for the corresponding boiler sizes (i.e., rated heat input or million BTUs per hour). Boiler sizes were estimated based on assumption that all fuel would be consumed during the 100-day (or 2,400-hour) heating season. The stack exit temperature was assumed to be 300°F (423°K), which is appropriate for boilers.

Meteorological Data

All analyses were conducted using the latest five consecutive years of meteorological data (2011-2015). Surface data was obtained from La Guardia Airport and upper air data was obtained from Brookhaven station, New York. The data were processed by Trinity Consultants, Inc. using the current EPA AERMET and EPA procedures. These meteorological data provide hour-by-hour wind speeds and directions, stability states, and temperature inversion elevations over the 5-year period. Five years of meteorological data were combined into a single multiyear file to conduct 24-hour $PM_{2.5}$ and 1-hour NO2 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

Because the closer Brooklyn JHS-126 monitoring station does not monitor hourly NO_2 and ozone concentrations, hourly NO_2 and hourly ozone background concentrations (for the purpose of conducting the 1-hour NO_2 Tier 3 analysis) were developed from available monitoring data collected by the New York State Department of Environmental Conservation (NYSDEC) at the Queens College monitoring station for 5 consecutive years (2011-2015), and compiled into AERMOD's required hourly emission (NO_2) and concentration (ozone) data formats.

The maximum 1-hour NO_2 background concentration at Queens College monitoring station of 60.2 ppb or 114 $\mu g/m^3$, which is 3-year average of the 98th percentile of daily maximum 1-hour concentrations for 2013-2015, and the annual NO_2 background concentration of 17.14 ppb or 32.3 $\mu g/m^3$, which is the maximum annual average for latest 3 years from Queens College monitoring station, were also used.

Stack and Receptor Locations

As previously discussed, buildings within the same block (except B and A, E and G/F) were assumed to be adjacent to each other. Therefore, the stack of each building was initially placed 10 feet from the lot line of the adjacent taller building, as required by the New York City Building Code as a minimum allowable distance. If exceedances of the $PM_{2.5}$ significant impact criteria were predicted, set-backs from the lot line were increased, in 10 foot increments, until the threshold distance at which building each building would pass the analysis was determined. For the analysis of buildings located on different blocks, the same stack locations (as were determined for buildings located within one block) were used. Modeling parameters are summarized in Table 13-5.

Table 13-4: $PM_{2.5}$ and NO_2 Emission Rates and Stack Parameters

Building ID	Block	Building Height	Stack Height	Total Floor Area	$PM_{2.5}$ Emission Rate		NO_2 Emission Rate		Estimated Boiler Size	Stack Parameters		
										Stack Dia.	Exit Vel.	Stack Temp.
		feet	feet	gsf	g/sec 24-hr	g/sec Annual	g/sec 1-hr	g/sec Annual	MMBtu/hr	m	m/sec	deg K
A	2249	145	148	218,790	5.16E-03	1.41E-03	6.79E-02	1.86E-02	5.5	0.4572	7.2	423
B	2249	105	108	159,650	3.76E-03	1.03E-03	4.95E-02	1.36E-02	4.0	0.3048	7.8	423
C	2249	75	78	112,610	2.66E-03	7.28E-04	3.49E-02	9.57E-03	2.8	0.3048	7.8	423
D	2265	75	78	112,610	2.66E-03	7.28E-04	3.49E-02	9.57E-03	2.8	0.3048	7.8	423
E	2265	105	108	159,650	3.76E-03	1.03E-03	4.95E-02	1.36E-02	4.0	0.3048	7.8	423
F	2265	115	118	116,180	2.74E-03	7.51E-04	3.60E-02	9.88E-03	2.9	0.3048	7.8	423
G	2265	115	118	116,180	2.74E-03	7.51E-04	3.60E-02	9.88E-03	2.9	0.3048	7.8	423
H	2265	145	148	283,858	6.69E-03	1.83E-03	8.81E-02	2.41E-02	7.1	0.4572	7.2	423

All of the proposed buildings are shaped as irregular tiered trapezoids with extended sections. There is also open space between Buildings A and B and Buildings G, F, and E. Given the complex shape of all buildings with multiple tiers, it was assumed that stack(s) on each building would be located on the highest tier of that building and that each building would be served by an individual HVAC system regardless of whether there would be one or two stacks.

The following detailed analyses were conducted for the sixteen (16) building-on-building combinations:

For the analyses of buildings within the same block, seven (7) combinations were considered:

- Analysis 1 and 2: Block 2249 -- B on A, and C on B
- Analysis 3 through 7: Block 2265 -- D on E; E on F; E on G; F on H; and G on H

For the analyses of buildings on adjacent blocks, nine (9) combinations were considered:

- Analysis 8 through 16: A on H and H on A; F on A, B on E and E on B; C on D and D on C; C on E; and D on B

In addition, the following detailed cumulative analyses were conducted:

- Buildings B and E together on A (Block 2249/2265)
- Buildings F and G together on H (Block 2265).

Receptors were placed around all faces of each buildings in 10 foot increments on all floor levels, starting at 10 feet above the ground and extending up to the upper windows (receptors) level which was setup 5 feet below roof level, to account for all potential impacts wherever they may occur.

Approximately 1,000 receptors were considered in the analysis for each building to assure that maximum impacts are estimated.

Table 13-5: Modeling Parameters for HVAC Analysis

Model	AERMOD (EPA Version 16216r)
Source Type	Point Sources
Number of emission points (stacks)	One or two on each building
Surface Characteristic	Urban Area Option
Urban Surface Roughness Length	1
Downwash effect	BPIP Program
Meteorological Data	Preprocessed by the AERMET meteorological preprocessor program by Trinity Consultants, Inc. Yearly meteorological data for 2011-2015 concatenated into single multiyear file for $PM_{2.5}$ modeling, as EPA recommended. The same set was used for 1-hr NO_2 modeling
Surface Meteorological Data	LaGuardia 2011-2015
Profile Meteorological Data	Brookhaven Station 2011-2015
Pollutant Background Concentrations	Brooklyn JHS-126 and Queens College 2 monitoring stations data for 2011-2015
$PM_{2.5}$ Analysis	Special procedure incorporated into AERMOD where model calculates concentration at each receptor for each year modeled, averages those concentrations across the number of years of data, and then selects the highest across all receptors of the 5-year averaged highest values

RESULTS

$PM_{2.5}$ Results

Results of the project-on-project $PM_{2.5}$ analysis for all sixteen (16) building combinations are presented in Table 13-6 and results for the cumulative analysis are presented in Table 13-7.

When considering results, it should be noted that when emissions from buildings of the same height impact each other (such as B on E or E on B, C on D or D on C, F on G or G on F, A on H or H on A), lesser impacts generally occur because the stack is 3 feet above the roof and the upper windows receptors (where the highest impacts occur) are 5 feet below the roof height, and, as such, the height separation between stack and receptors are 8 feet (or greater with plume rise).

When emissions from shorter stacks impact receptors on nearby taller buildings (especially if the buildings are adjacent to each other, as C on B or D on E, F and G on H), higher impacts may occur, and stack setbacks, as well as other measures may be necessary to avoid the potentially significant impacts. This is the case where the 75-foot tall Building C impacts the 105-foot tall Building B, the 75-foot tall Building D impacts the 105-foot tall Building E, the 115-foot Buildings

F and G impact the 145-foot Building H. This occurs because all these buildings are adjacent to each other and the separation between stacks and nearby receptors are relatively small. As a result, impacts from one stack were potentially significant, and two separated stacks on the roof were required. Using this approach, further analyses were conducted utilizing two stacks on these shorter buildings -- with half of the total emissions estimated for each building (based on its total gross floor area) exhausted through each of the two stacks. Results using this approach demonstrated that neither the CEQR significant impact criteria nor 1-hour NO_2 NAAQS were exceeded.

Table 13-6: $PM_{2.5}$ Analysis Results for Individual Buildings

Site ID	Receptor Sites	24-hr $PM_{2.5}$ Impacts	Annual $PM_{2.5}$ Impacts	CEQR Significant Impact Criteria 24hr/Annual
		$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$
Building A	Building H	0.98 [(1)]	0.04	6.0/0.3
Building B	Building A	5.25	0.11	6.0/0.3
	Building E	0.51	0.11	6.0/0.3
Building C	Building B	5.38	0.19	6.0/0.3
	Building D	0.49	0.02	6.0/0.3
	Building E	2.71	0.09	6.0/0.3
Building D	Building B	1.58	0.04	6.0/0.3
	Building C	0.31	0.02	6.0/0.3
	Building E	5.79	0.14	6.0/0.3
Building E	Building B	0.47	0.03	6.0/0.3
	Building F	3.55	0.11	6.0/0.3
	Building G	2.55	0.07	6.0/0.3
Building F	Building A	4.68	0.18	6.0/0.3
	Building G	1.68	0.04	6.0/0.3
	Building H	3.76	0.10	6.0/0.3
Building G	Building F	0.58	0.03	6.0/0.3
	Building H	4.96	0.13	6.0/0.3
Building H	Building A	0.92 [(1)]	0.03	6.0/0.3

(1) All results, except for buildings A and H, are with stack setbacks.

Results of analyses for each building-on-building combination as well as the cumulative impact assessment are presented below and summarized in Tables 13-6, 13-7, 13-8 and 13-9.

Building A on Building H

Building A would be separated from Building H by the 70-foot wide Wallabout Street, which reduces the potential impact of its emissions. In addition, because A and H would be the same height and the stacks are taller than the upper windows receptors, the potential impacts are relatively small. As such, no significant impacts are estimated with one stack located at the minimum distance (10 feet) from the lot line facing H (allowable by the Building Code). Therefore, no additional restrictions would be necessary for the stack on Building A.

Table 13-7: $PM_{2.5}$ Cumulative Analysis Results

Site ID	Receptor Sites	24-hr $PM_{2.5}$ Impacts	Annual $PM_{2.5}$ Impacts	CEQR Significant Impact Criteria 24hr/Annual
		$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$
Building B and E Combined	Building A	5.26	0.04	6.0/0.3
Building F and G Combined	Building H	5.25	0.11	6.0/0.3

Building B on Building A

Building B would be shorter than Building A but would be separated from A by a 65-foot wide open space, which reduces the potential impacts. However, the result of the analysis is that potentially significant impacts would occur with only one stack -- even if the stack were located at the edge of the roof of B furthest from A. As such, two stacks are recommended for Building B – one on northern part (Stack 1) and the second (Stack 2) on the southern part of the building's roof. Both stacks should be located at most 170 feet from the Harrison Avenue. The designated area for the stacks is shown on Figure 13-2. With these stack locations, no significant impacts are estimated.

Building B on Building E

Building B would be separated from Building E by the 70-foot wide Wallabout Street, which reduces potential impacts. In addition, because Building B and Building E would be the same height and the stacks are taller than the upper windows receptors, the potential impacts are less than those estimated for Building B on Building A. However, because the impact of Building B on Building A is critical for determining Building B's impacts and only one set of conditions can be used for one building, the two stacks with the setbacks determined for B on A impacts (Figure 13-2), would ensure no significant B on E impacts.

Building C on Building B

Building C would shorter than and adjacent to Building B, and preliminary analyses indicated that the potential impacts would be significant, and that two stacks are required to comply with applicable impact thresholds – one on the northern part of the building (Stack 1) and the second (Stack 2) on the southern part of the building roof. Both stacks should be located at most 36 feet from the Harrison Avenue. The designated area for these stacks is shown on Figure 13-3. With these stack locations, no significant impacts are estimated.

Figure 13-2: Designated Area for the Stacks on Building B

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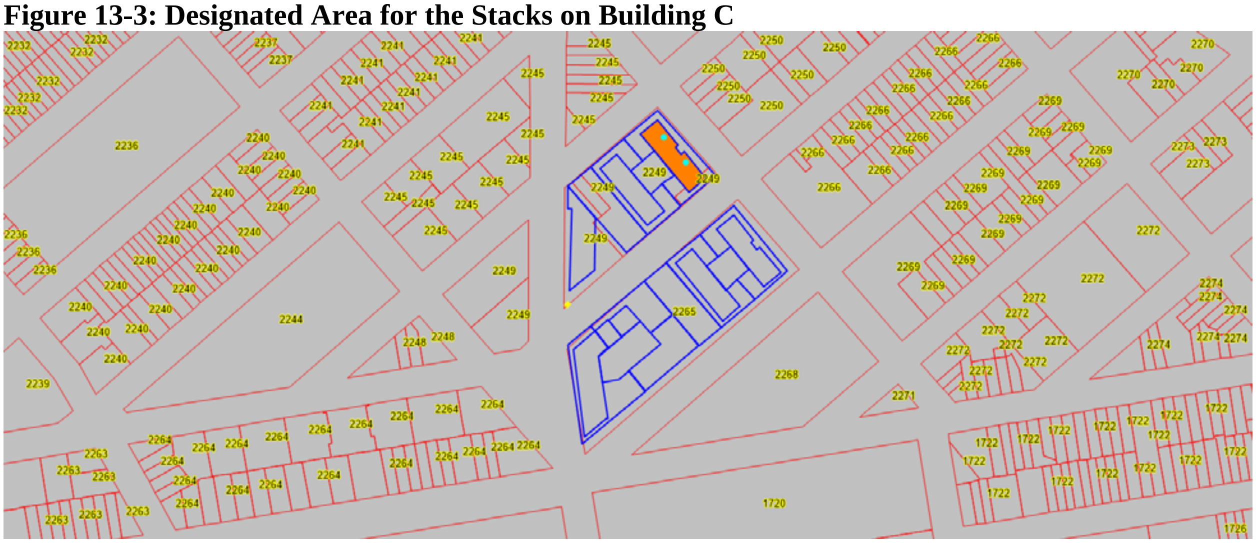
Figure 13-3: Designated Area for the Stacks on Building C



Building C on Building D and C on Building E

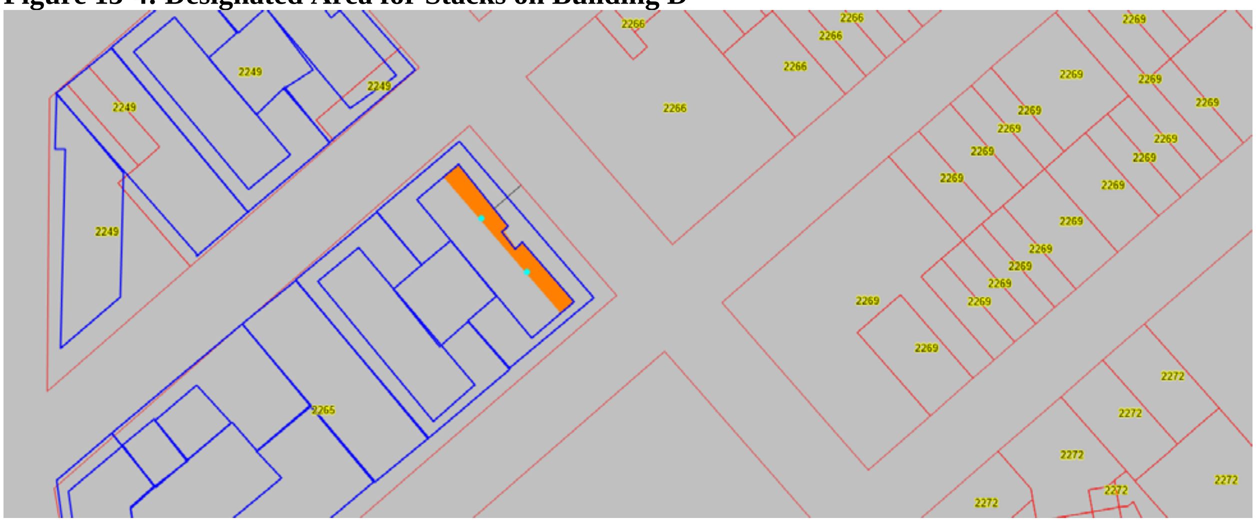
Building D would be separated from Building C by the 70-foot wide Wallabout Street, which reduces potential impacts. In addition, because Building C and Building D would be the same height and the stacks would be taller than the upper windows receptors, the potential impacts are not significant. On the other hand, the impacts of C on E (which is shorter than E) is higher. However, preliminary analysis results show that one stack would be sufficient to demonstrate no significant impacts on D or E.

However, because the impact of C on B is critical for determining Building C's impacts and the only one set of conditions can be used for one building, the stack locations (with setbacks) determined for C on B impacts (Figure 13-3) would apply for C regardless of its impacts on D or E.

Building D on Building E

Building D would be adjacent to and shorter than Building E, and preliminary analyses indicate potentially significant impacts, and that two stacks are required to comply with applicable guidance values– one on the northern part (Stack 1) and the second (Stack 2) on the southern part of the building's roof. Both stacks should be located at most 46 feet from the Harrison Avenue. The designated area for these stacks is shown on Figure 13-4. With these stack locations, no significant impacts are estimated.

Figure 13-4: Designated Area for Stacks on Building D



Building D on Building B and Building D on Building C

Buildings D, B, and C would be separated from Building B by the 70-foot wide Wallabout Street, which results in lower potential impacts. Buildings D and C would be the same height and due to fact that the stacks are taller than the upper windows receptors, the potential impact is even less. On the other hand, Building D would be shorter than Building B, which would elevate potential impacts. However, because the impact of Building D on adjacent Building E is critical and only one set of conditions can be used for one building, the stack locations with setbacks that were determined for D on E impacts would apply to Building D regardless of the impacts of D on B and D on C.

It should be noted that for Buildings B, D, and C, all distances from the stacks to the closest street necessary for (E) designations are determined in relation to the Union Avenue. However, these distances are different for Buildings B and C (which are located on Block 2249) and for Buildings D and E (which are located on Block 2265) due to the fact that Union Avenue is not parallel to these blocks but is at an angle to them.

Building E on Building F, Building E on Building G, and Building E on Building B

Building E would be shorter than both Buildings F and G but would be separated by a 65-foot wide open space, which reduces potential impacts. Buildings E and B are the same height and are separated by the 70-foot Wallabout Street, which also reduce the potential impacts. However, preliminary analyses show that one stack is not sufficient to comply with applicable guideline values, and two stacks are required. The minimum distance between these stacks should be at least 20 feet, and they could be located at the minimum distance (10 feet) from the lot line facing Buildings F and G or B allowed by the Building Code without exceeding the CEQR significant impact thresholds or the 1-hour NO_2 NAAQS.

Building F on Building H

Building F is shorter than and adjacent to Building H, and preliminary analyses indicate that the potential impacts are significant, and that two stacks (with setbacks) are required – one on northern part (Stack 1) and the other one (Stack 2) on southern part of the building's roof. Stack 1 should be located at least 177 feet from Union Avenue and Stack 2 should be located at least 194 feet from Union Avenue. The designated area for these stacks is shown on Figure 13-5. With these stack locations, no significant impacts are estimated.

Figure 13-5: Designated Area for Stacks on Building F

Building F on Building G and Building F on Building A

Building F and Building G would be adjacent to each other but would be the same height, which reduces the potential impact. Also, Building F is shorter than Building A and is separated from it by the 70-foot wide Wallabout Street, which also reduces potential impacts. Regardless, the impact of F on H is the critical for determining Building F impacts, and the stack locations (with setbacks) determined for F on H (which is adjacent to it) would apply regardless of the impact of Building F on Buildings G or A.

Building G on Building H

Because Building G would be shorter than and adjacent to Building H, and preliminary analyses indicate that potential impacts could be significant, and that two stacks (with setbacks) are required to comply with guideline values – one on northern part (Stack 1) and the other (Stack 2) on southern part of the building's roof. Stack 1 should be located at least 246 feet from the Union Avenue and Stack 2 should be located at least 266 from the Union Avenue. The designated area for these stacks is shown on Figure 13-6. With these stack locations, no significant impacts are estimated.

Figure 13-6: Designated Area for Stacks on Building G

Building G on Building F

Buildings G and F would be adjacent to each other and the same height, which reduces potential impacts. Estimated G on F impacts would not be significant even if the stacks were located at the 10 feet minimum distance from the lot line facing Building F. However, because only one set of stack conditions can be used for one building and the impact of G on H is the critical for determining building impacts, the locations for the two stacks (with setbacks) that were determined for G on H impacts would apply.

Building H on Building A

Building H would be separated from Building A by the 70-foot wide Wallabout Street, which reduces potential impacts. In addition, because Buildings H and A would be the same height and the stacks would be taller than the upper windows receptors, potential impacts are even less. As such, one stack (as in case of A on H) is sufficient even if it were located at the minimum distance (10 feet) from the lot line facing Building A (as allowable by the Building Code). Therefore, no additional restriction would be necessary for the Building H stack.

NO_2 Results

A conservative Tier 1 NO_2 analysis was initially conducted but was not sufficient to demonstrate compliance for the majority of building combinations. Therefore, a Tier 3 analysis (with the AERMOD PVMRM module) was conducted. Background hourly NO_2 concentrations are added internally within the model and the total 1-hour NO_2 concentration are estimated in the format directly comparable to the 1-hour NO_2 NAAQS. Even with Tier 3 analysis, which is less conservative than the Tier 1 analysis, 1-hour NO_2 impacts are the critical regardless of whether one or two stacks were modeled. For all building combinations, except A and H, two stacks on each building were required. The same stack locations (with setbacks) as determined for the $PM_{2.5}$ analysis were used. Results of the NO_2 analysis are provided in Table 13-8.

Table 13-8: Results of NO_2 Analysis for Project-on-Project

Site ID	Receptor Sites	1-hr NO_2 Total Conc.	Annual NO_2 Total Conc.(3)	NAAQS 1-hr/Annual
		µg/m³	µg/m³	µg/m³
Building A	Building H	145.8 (2)	32.5	188/100
Building B	Building A	172.5 (1)	33.4	188/100
	Building E	128.9 (2)	32.5	188/100
Building C	Building B	182.3 (1)	33.6	188/100
	Building D	127.9 (2)	32.5	188/100
	Building E	132.5 (1)	33.1	188/100
Building D	Building B	159.3 (2)	32.7	188/100
	Building C	125.4 (2)	32.5	188/100
	Building E	106.7 (2)	33.7	188/100
Building E	Building B	130.2 (2)	32.6	188/100
	Building F	175.4 (1)	33.4	188/100
	Building G	152.7 (2)	33.0	188/100
Building F	Building A	177.9 (1)	34.1	188/100
	Building H	174.1 (1)	33.2	188/100
	Building G	143.8 (2)	32.7	188/100
Building G	Building F	133.8 (2)	32.6	188/100
	Building H	185.0 (1)	33.6	188/100
Building H	Building A	154.9 (2)	32.6	188/100

(1) Tier 3 Analysis with AERMOD PVMRM module
(2) Tier 1 Analysis includes 1-hr NO_2 background value of 114 µg/m³
(3) Total annual NO_2 concentrations includes background value of 32.3 µg/m³

Table 13-9: 1-Hour NO_2 Cumulative Analysis Results

Site ID	Receptor Sites	1-hr NO_2 Total Conc.	Annual NO_2 Total Conc.(3)	NAAQS 1-hr/Annual
		μg/m^3	μg/m^3	μg/m^3
Building B and E Combined	Building A	176.4	33.4	188/100
Building F and G Combined	Building H	186.9	33.6	188/100

As shown, for all building combinations, the 1-hour NO_2 8th highest daily 1-hour total concentrations are less than the 1-hour NO_2 NAAQS of 188 μg/m^3. In addition, the maximum annual total NO_2 concentrations (with added background concentration of 32.3 μg/m^3) are also less than annual NO_2 NAAQS of 100 μg/m^3.

A summary of the results for all averaging time periods, with and without downwash effect, are presented in Table 13-10.

Table 13-10: Summary of Results (μg/m^3)

Pollutant	Modeled Concentrations	Background Conc.	Total Conc.	Evaluation Criteria
	μg/m^3	μg/m^3	μg/m^3	μg/m^3
		$PM_{2.5}$		
A on H				
24-hr $PM_{2.5}$	0.98/0.84	-	0.98	6.0 (*CEQR Criteria)*
Annual $PM_{2.5}$	0.04/0.04	-	0.04	0.3 (*CEQR Criteria*)
B on A (1)				
24-hr $PM_{2.5}$	0.47/5.25	-	5.25	6.0 (*CEQR Criteria)*
Annual $PM_{2.5}$	0.04/0.11	-	0.11	0.3 (*CEQR Criteria*)
B on E (1)				
24-hr $PM_{2.5}$	0.34/0.51	-	0.51	6.0 (*CEQR Criteria)*
Annual $PM_{2.5}$	0.05/0.11	-	0.11	0.3 (*CEQR Criteria*)
C on B (1)				
24-hr $PM_{2.5}$	5.36/5.38	-	5.38	6.0 (*CEQR Criteria)*
Annual $PM_{2.5}$	0.17/0.19	-	0.19	0.3 (*CEQR Criteria*)
C on D (1)				
24-hr $PM_{2.5}$	0.49/0.31		0.49	6.0 (*CEQR Criteria)*
Annual $PM_{2.5}$	0.02/0.01		0.02	0.3 (*CEQR Criteria*)
C on E (1)				
24-hr $PM_{2.5}$	1.87/2.71	-	2.71	6.0 (*CEQR Criteria)*
Annual $PM_{2.5}$	0.06/0.09	-	0.09	0.3 (*CEQR Criteria*)
D on B (1)				

Pollutant	Modeled Concentrations	Background Conc.	Total Conc.	Evaluation Criteria
	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$
24-hr $PM_{2.5}$	1.45/1.58	-	1.58	6.0 (*CEQR Criteria)*
Annual $PM_{2.5}$	0.04/0.04	-	0.04	0.3 (*CEQR Criteria*)
D on C (1)				
24-hr $PM_{2.5}$	0.29/ 0.31	-	0.31	6.0 (*CEQR Criteria)*
Annual $PM_{2.5}$	0.02/0.02	-	0.02	0.3 (*CEQR Criteria*)
D on E (1)				
24-hr $PM_{2.5}$	2.37/5.79	-	5.79	6.0 (*CEQR Criteria)*
Annual $PM_{2.5}$	0.05/0.14	-	0.14	0.3 (*CEQR Criteria*)
E on B (1)				
24-hr $PM_{2.5}$	0.45/0.47	-	0.47	6.0 (*CEQR Criteria)*
Annual $PM_{2.5}$	0.03/0.02	-	0.03	0.3 (*CEQR Criteria*)
E on F (1)				
24-hr $PM_{2.5}$	3.55/3.55	-	3.55	6.0 (*CEQR Criteria)*
Annual $PM_{2.5}$	0.11/0.11	-	0.11	0.3 (*CEQR Criteria*)
E on G (1)				
24-hr $PM_{2.5}$	2.42/2.55	-	2.55	6.0 (*CEQR Criteria)*
Annual $PM_{2.5}$	0.07/0.07	-	0.07	0.3 (*CEQR Criteria*)
F on A (1)				
24-hr $PM_{2.5}$	1.06/4.68	-	4.68	6.0 (*CEQR Criteria)*
Annual $PM_{2.5}$	0.04/0.18	-	0.18	0.3 (*CEQR Criteria*)
F on G (1)				
24-hr $PM_{2.5}$	1.68/0.46	-	1.68	6.0 (*CEQR Criteria)*
Annual $PM_{2.5}$	0.04/0.02	-	0.04	0.3 (*CEQR Criteria*)
F on H (1)				
24-hr $PM_{2.5}$	1.15/3.76	-	3.76	6.0 (*CEQR Criteria)*
Annual $PM_{2.5}$	0.04/0.1	-	0.1	0.3 (*CEQR Criteria*)
G on H (1)				
24-hr $PM_{2.5}$	1.89/4.96	-	4.96	6.0 (*CEQR Criteria)*
Annual $PM_{2.5}$	0.04/0.13	-	0.13	0.3 (*CEQR Criteria*)
G on F (1)				
24-hr PM2.5	0.58/0.36	-	0.58	6.0 (CEQR Criteria)
Annual PM2.5	0.03/0.02	-	0.03	0.3 (CEQR Criteria)
H on A				
24-hr $PM_{2.5}$	0.58/0.92	-	0.92	6.0 (*CEQR Criteria)*
Annual $PM_{2.5}$	0.02/0.03	-	0.03	0.3 (*CEQR Criteria*)
		NO_2		
A on H (3)				
1-hr NO_2	13.9/31.8	114	145.8	188 (NAQQS)
Annual NO_2	0.22/0.19/	32.3	32.5	100 (NAAQS
B on A (1,2)				
1-hr NO_2	111.4/172.5	-	172.5	188 (NAQQS)
Annual NO_2	0.42/1.09	32.3	33.4	100 (NAAQS)

Pollutant	Modeled Concentrations	Background Conc.	Total Conc.	Evaluation Criteria
	μg/m³	μg/m³	μg/m³	μg/m³
B on E (1,3)				
1-hr NO_2	11.5/14.9	114	128.9	188 (NAQQS)
Annual NO_2	0.21/0.18	32.3	32.5	100 (NAAQS)
C on B (1,2)				
1-hr NO_2	182.3/182.3	-	182.3	188 (NAQQS)
Annual NO_2	1.2/1.3	32.3	33.6	100 (NAAQS)
C on D (1,3)				
1-hr NO_2	9.1/13.9	114	127.9	188 (NAQQS)
Annual NO_2	0.24/0.12/	32.3	32.5	100 (NAAQS)
C on E (1,2)				
1-hr NO_2	131.9/132.5	-	132.5	188 (NAQQS)
Annual NO_2	0.60/0.84	32.3	33.1	100 (NAAQS)
D on B (1,3)				
1-hr NO_2	45.3/42.5	114	159.3	188 (NAQQS)
Annual NO_2	0.36/0.43	32.3	32.7	100 (NAAQS)
D on C (1,3)				
1-hr NO_2	9.3/11.4	114	125.4	188 (NAQQS)
Annual NO_2	0.18/0.15	32.3	32.5	100 (NAAQS)
D on E (1,2)				
1-hr NO_2	100.4/106.7	-	106.7	188 (NAQQS)
Annual NO_2	0.47/1.37	32.3	33.7	100 (NAAQS)
E on B (1,3)				
1-hr NO_2	13.6/16.2	114	130.2	188 (NAQQS)
Annual NO_2	0.28/0.23	32.3	32.6	100 (NAAQS)
E on F (1,3)				
1-hr NO_2	61.4/61.4	114	175.4	188 (NAQQS)
Annual NO_2	1.09/1.05	32.3	33.4	100 (NAAQS)
E on G (1,3)				
1-hr NO_2	38.7/38.7	114	152.7	188 (NAQQS)
Annual NO_2	0.66/0.66	32.3	33.0	100 (NAAQS)
F on A (1,2)				
1-hr NO_2	111.5/177.9	-	177.9	188 (NAQQS)
Annual NO_2	0.37/1.78	32.3	34.1	100 (NAAQS)
F on G (1,3)				
1-hr NO_2	18.3/29.8	114	143.8	188 (NAQQS)
Annual NO_2	0.37/0.22	32.3	32.7	100 (NAAQS)
F on H (1,2)				
1-hr NO_2	135.9/174.1	-	174.1	188 (NAQQS)
Annual NO_2	0.33/0.89	32.3	33.2	100 (NAAQS)
G on F (1,3)				
1-hr NO_2	19.8/14.2	114	133.8	188 (NAQQS)
Annual NO_2	0.26/0.16	32.3	32.6	100 (NAAQS)

Pollutant	Modeled Concentrations	Background Conc.	Total Conc.	Evaluation Criteria
	µg/m^3	µg/m^3	µg/m^3	µg/m^3
G on H (1,2)				
1-hr NO_2	121.9/185.0	-	185.0	188 (NAQQS)
Annual NO_2	0.43/1.32	32.3	33.6	100 (NAAQS)
H on A (3)				
1-hr NO_2	29.5/40.9	114	154.9	188 (NAQQS)
Annual NO_2	0.17/0.29	32.3	32.6	100 (NAAQS)

Notes:
(1) With stacks set back
(2) Tier 3 approach
(3) With Tier 1 analysis, 1-hr and annual NO_2 background concentrations of 114 µg/m^3 and 32.3 µg/m^3, respectively, are added to the estimated impacts
Modeled concentrations are shown with/without downwash effects

As mentioned previously, based on the HVAC analyses, no significant adverse impacts are anticipated based on the hypothetical building massing included in the RWCDS. However, there may be a potential for project-on-project impacts depending on the final design of the action-generated development. In order to avoid the potential for project-on-project impacts should the project site be developed at a lower density, an (E) designation (E-427) will be placed on the project site, requiring the future site developer to use natural gas. The text of the (E) designation is provided in Section G, “(E) Designation.” With adherence to the fuel type restrictions of E-427, the potential for significant adverse project-on-project impacts would be avoided.

E. INDUSTRIAL SOURCE ANALYSIS

In accordance with *CEQR Technical Manual* guidelines, an analysis of industrial sources is required when existing industrial uses that may impact the proposed development are operating with 400 feet of the rezoning area. A search conducted by the NYCDEP identified the following two permitted industrial sources that are currently operating within 400 feet of the proposed buildings.

- Harrison Dry Cleaners - located at 209 Harrison Avenue (Block 2274 Lot 2) and operated under permit PB014605Y; and
- Stainless steel welding operations - located at 78-82 Gerry Street (Block 2269 Lot 19) and operated utilizing four welding machines under permit PB0085-02J.

As such, analysis was conducted to determine whether emissions from these two facilities have the potential to significantly impact the proposed developments.

Air quality analyses were conducted, following the procedures outlined in the *CEQR Technical Manual*, to determine whether the proposed action would result in violations of health-related guideline values. The methodology and procedure utilized in this analysis are described below.

Data Sources

Information regarding emissions of toxic air pollutants was developed using the following procedure:

- A study area was developed that includes all air toxic emission sources located within 400 feet of the affected development sites;
- A search was performed to identify NYSDEC Title V permits and permits listed in the EPA Envirofacts database in this study area;
- The Open Accessible Space Information System (OASIS) mapping and data analysis application and Aerial photographs (via Google Earth) were reviewed to identify industrial uses within the study area;
- The formal request with blocks and lot numbers necessary to identify industrial source permits within 400 feet of the project site was submitted to DEP;
- Air permits for active permitted industrial facilities within 400 feet of the proposed development sites were acquired and reviewed to obtain the information necessary to conduct the toxic air analysis. Received from DEP permit applications served as the primary basis of data for this analysis; and
- Field observations were conducted to identify and validate the existence of the permitted facilities and determine if there are any non-permitted facilities currently operating within the study area.

Industrial Source Type

The Harrison Cleaner uses tetracloroethylene (PERC), which is a carcinogenic chemical, as a cleaning agent. According to the permit, Harrison Cleaners is a 4th generation dry-to-dry type non-vented refrigerated facility with totally enclosed system with built-in carbon absorber and vapor barriers which meet the requirement of Chapter 12 of Title 15 of the Rules of the City of New York (RCNY) for Dry Cleaning Facilities. According to these regulations, fugitive PERC emissions from any part of the dry-cleaning system must not exceed 50 ppm at any time, the primary control must achieve a concentration of 8600 ppm in the drum during the drying cycle, and the secondary control must be capable of reducing PERC concentration in the drum from 8600 ppm to 300 ppm.

However, the permit application contains no calculated PERC emission rates but only total quantity of solvent used per year (45 gal/year), and number of facility operating hours per day/year. Even presumably these type of facilities are not vented outside, review of similar permits and operations of dry cleaners shows that the 4th generation dry-to-dry non-vented facilities with built-in carbon absorber and vapor barriers provide no more than 98 percent of control efficiency while 2 percent of the PERC emissions are escaped as the fugitive emissions and released into the atmosphere through general ventilation roof vents (stacks), open doors, windows, and other openings throughout the facility even though fume hoods typically have plastic curtains on the sides (or a combination of walls and curtains) to minimize cross-flow drafts and provide better capture of fugitive emissions.

Based on total quantity of solvent used on annual basis and density of PERC (13.5 lb/gal), the number of pounds per year was estimated and 2 percent factor accounting for fugitive annual PERC emissions was applied. In order to estimate emission rate in grams per second for dispersion analysis, the total annual emissions were distributed evenly over 8760 hours/year. The short-term PERC emission rates were estimated based on 6 hours of daily operations and 280 days/year. Overall, the short-term 1-hour PERC emission rate was rounded off to 0.0009 g/sec and annual PERC emission rate to 0.00017 g/sec.

No information on pollutant types or amounts of emissions released from the welding facility are available from its permit application, and, therefore, data on type of pollutants and emission rates were obtained from the similar-operating facilities and/or calculated using available emission factors for welding operations. Based on research and AP-42 data for welding operations associated with the welding facility, particulate matter and particulate-phase hazardous air pollutants are the major concerns in the welding processes. Most of the particulate matter produced by welding is submicron in size and, as such, is considered to be $PM_{2.5}$ or PM_{10} (i. e., particles with 2.5 and 10 micrometers in aerodynamic diameter). The elemental composition of the fume varies with the electrode type and with the workpiece composition.

Gas metal arc welding of stainless steel, as per permit PB0085-02J information, is referred in AP-42 as a GMAW type of welding operations. The facility operates 6 hours a day for 250 days/year, and fumes are exhausted into the atmosphere through general ventilation. It was conservatively assumed, for the purpose of this analysis, that fume exhaust will contain both $PM_{2.5}$/PM_{10} particles, chromium, and nickel. The following AP-42 emission factors from Tables 12.19-1 and 12.19-2 were used to estimate potential emission rates from welding operations:

- PM2.5 – 5.4 pound (lb)/1,000 lb of electrode consumed (PM2.5 is assumed to be equal to PM10 for welding operation emissions);
- PM10– 5.4 lb/1,000 lb of electrode consumed;
- Chromium (Cr) – 0.524 lb/1,000 lb of electrode consumed; and
- Nickel (Ni) – 0.184 lb/1,000 lb of electrode consumed.

Because the amount of electrode consumed is unknown, it was conservatively assumed that 1 lb of electrode per hour per each of the four (4) welding machines are being consumed, with an annual consumption rate of 6,000 lb of electrode based on facility operating hours. The estimated potential emissions are as follows:

- Short-term PM2.5 = 5.4 lb/1,000 lb x 4 lb/hour (hr) = 0.0216 lb/hr = 0.0027 grams/second (g/sec)
- Annual PM2.5 = 5.4 lb/1,000 lb x 6,000 lb/year = 32.4 lb/year = 0.00047 g/sec
- Short-term PM10 = 5.4 lb/1,000 lb x 4 lb/hr = 0.0216 lb/hr = 0.0027 g/sec
- Short-term Chromium = 0.524 lb/1,000 lb x 4 lb/hr = 0.0021 lb/hr = 0.00026 g/sec
- Annual Chromium = 0.524 lb/1,000 lb x 6,000 lb/year = 3.14 lb/year = 0.000045 g/sec
- Short-term Nickel = 0.184 lb/1,000 lb x 4 lb/hr = 0.00074 lb/hr = 0.000093 g/sec
- Annual Nickel = 0.184 lb/1,000 lb x 6,000 lb/year = 1.10 lb/year = 0.000016 g/sec

Methodology

Toxic air pollutants can be grouped into two categories: carcinogenic air pollutants, and non-carcinogenic air pollutants. The New York State Department of Environmental Conservation (NYSDEC) has established short-term guideline concentrations (SGCs) and annual guideline concentrations (AGCs) to evaluate short-term and annual impacts of carcinogenic and non-carcinogenic pollutants. These are maximum allowable guideline concentrations that are considered acceptable concentrations below which there should be no adverse effects on the health would occur. These data are contained in the NYSDEC database (DAR-1). In DAR-1, AGCs for the carcinogenic pollutants is based on cancer risk of one per million. The NYSDEC and EPA does not consider an overall incremental cancer risk from a proposed action of less the one-in-one million to be significant. This value could be even increased to ten-in-one million, as per NYSDEC "Control of Toxic Ambient Air Contaminants (DAR-1)", if the emissions from the facility or facilities causing this increase are controlled using Best Available Control Technology (BACT).

Estimated one-hour and annual concentration of each pollutant are to be compared with its respective SGCs or AGCs to determine whether they exceed the guideline values. If no exceedances are found (respective ratios are less than 1), no adverse health effects would occur. For the carcinogenic pollutant such as PERC and nickel, the potential cancer risk for inhalation is estimated on annual basis using cancer risk factors. As such, the maximum annual average ambient concentration is multiplied by its unit risk factor to estimate the incremental cancer risk from PERC and nickel emissions as follows:

Incremental Risk = C_a x URF

where:
C_a = annual average ambient air concentration of PERC, $\mu g/m^3$
URF = PERC and nickel inhalation unit risk factors in $(\mu g/m^3)^{-1}$

If the incremental cancer risk is less than one-on-one million, no significant air quality impacts are predicted to occur due PERC release. Because PERC and nickel have also SGC values as non-carcinogenic pollutants, their short-term impact is estimated as ratio of C_{st}/SGC
Where,

C_{st} = short-term ambient air concentration of PERC or nickel, $\mu g/m^3$, and
SCG = NYSDEC short-term guideline concentration, $\mu g/m^3$.

Screening Analysis

For estimating potential impacts, the *CEQR Technical Manual* recommends using a screening procedure for industrial emission sources with toxic air pollutants as a first step in an analysis. This procedure uses pre-tabulated pollutant concentration values based on a generic emission rate of 1 gram per second from Table 17-3, "Industrial Source Screen," of the *CEQR Technical Manual* for the applicable averaging time periods. This approach, which can be used to estimate maximum short-term (1-hour) and annual average concentration values at various distances (from 30 to 400 feet) from an emission source, was used to assess the potential impacts of PERC, $PM_{2.5}$, PM_{10}, chromium, and nickel emissions from the permitted facilities.

In order to determine the shortest distance from the proposed developments to the toxic facilities, GIS-based shape files on a tax lot basis were developed that included development sites on Blocks 2249 and 2265 and the toxic facility. The shortest distance from the lot line of closest Block 2249 Lot 2 to the Dry Cleaners facility on Harrison Avenue is approximately 396 feet and the shortest distance from the lot line of closest Block 2269 Lot 19 to the welding facility on Gerry Street is approximately 398 feet. The closest distance from Table 17-3 of 400 feet was used.

At this distance, based on a 1 gram per second emission rate, the maximum estimated 1-hour and annual concentration values are 1,388 $\mu g/m^3$ and 54 $\mu g/m^3$, respectively. These 1-hour and annual concentrations were then multiplied by the actual pollutant emission rates and the actual 1-hour and annual concentrations compared to the applicable DAR-1 SGC and AGC values. These data are provided in Table 13-11 and 13-12.

Table 13-11: Estimated Short-term (1-hour) Concentration Ratios

Chemical Name	CAS No.	Short-term Emission Rates g/sec	Max Estimated 1-hour Concentration $\mu g/m^3$	SGC $\mu g/m^3$	C_{st}/SGC
PERC	00127-18-4	9.00E-04	4.92E-02	300	1.64E-04
$PM_{2.5}$	NY075-02-5	2.70E-03	1.47E-01	88	1.67E-03
PM_{10}	NY075-00-5	2.70E-03	1.47E-01	380	3.87E-04
Nickel	07440-02-0	9.27E-05	5.01E-03	2.0E-01	2.50E-02

The DAR-1 SCG value for PERC is 300 $\mu g/m^3$
The DAR-1 SCG value for $PM_{2.5}$ is 88 $\mu g/m^3$
The DAR-1 SCG value for PM_{10} is 380 $\mu g/m^3$
The DAR-1 SCG value for nickel is 2.0E-01 $\mu g/m^3$
Chromium (Cr) has no SCG values

As shown, estimated short-term (1-hour) ratios for PERC (as non-carcinogenic pollutant), $PM_{2.5}$, PM10, and nickel are less than their respective SGC guideline values. As such, no significant short-term PERC, $PM_{2.5}$, PM_{10}, and nickel impacts are estimated.

PERC and Nickel Cancer Risk and Annual Concentration Ratios Estimate

Annual guideline values (AGC) for PERC and nickel were developed by the NYSDEC based on a one-per-million basis and includes cancer risk factors of 2.5E-07 and 2.4E-04 $(\mu g/m^3)^{-1}$, respectively. The incremental cancer risk for these carcinogens were estimated by multiplying estimated annual concentrations by the unit risk factors. Results show that incremental cancer risks for these pollutants are less than the one-per-million cancer risk threshold (Table 13-12).

Estimated annual concentrations for $PM_{2.5}$ and chromium are also less than their respective guideline AGC values.

NYSDEC does not consider an incremental cancer risk from a proposed action of less than one-in-one million to be significant. As such, the potential impact of the PERC's and nickel emissions are not considered to be significant.

The estimated annual concentration of the $PM_{2.5}$ and chromium are also less than the applicable DAR-1 AGC values. As such, the potential impact of the $PM_{2.5}$ and chromium emissions are not considered to be significant.

Table 13-12: Estimated Annual Concentration Ratios and Incremental Cancer Risks

Chemical Name	CAS Number	Annual Emission Rate	Max Estimated Annual Concentration	DAR-1 AGC	C_a/AGC Ratio	Cancer Risk Factor	Incremental Cancer Risk
		g/sec	µg/m^3	µg/m^3		(µg/m^3)$^{-1}$	
PERC	00127-18-4	1.75E-04	9.44E-03	4		2.5E-07	2.4E-09
$PM_{2.5}$	NY075-02-5	4.70E-04	2.54E-02	12	2.12E-03		2.1E-03
Chromium	07440-47-3	4.52E-05	2.44E-03	45	5.43E-05		5.4E-05
Nickel	07440-02-0	1.59E-05	8.57E-04	4.2E-03		2.4E-04	2.1E-07

DAR-1 ACG value for PERC is 4 µg/m^3 per million which is based on cancer risk factor is 2.5E-07
DAR-1 ACG value for nickel is 4.2E-03 µg/m^3 per million which is based on cancer risk factor is 2.4E-04

Summary of Toxic Emissions Analysis

The results of this analysis indicate that there would be no exceedances of NYSDEC DAR-1 guideline SCG and AGC values or cancer risk thresholds for all pollutants that have the potential to be released from nearby toxic facilities. As such, the potential impacts of these emissions are not considered to be significant.

F. GARAGE EMISSONS ANALYSIS

Background Concentrations

Background concentrations are those pollutant concentrations originating from distant sources that are not directly included in the modeling analysis, including such sources as vehicular emissions on the streets within 1,000 feet and in the line of sight of the project site. Background concentrations are added to modeling results to obtain total pollutant concentrations at a project site.

For this project, background concentrations are needed for inclusion in the parking garage analysis. As discussed in Section C, a mobile source air quality analysis of intersections is not warranted based on the traffic that would be generated by the proposed action. The background concentrations for the nearest NYSDEC air quality monitoring stations surrounding the project site are presented in Table 13-13 and are based on three years of monitored data (2013-2015).[1] 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. The $PM_{2.5}$

[1] https://www.epa.gov/air-trends/air-quality-design-values

24-hour average background concentration of 24 µg/m^3 (based on the 2013 to 2015 average of 98th percentile concentrations) was used to establish the *de minimis* value.

TABLE 13-13, Maximum Background Pollutant Concentrations for Parking Garage Analysis

Pollutant	Average Period	Site Name	Concentration	NAAQS
CO	1-hour 8-hour	CCNY 160 Convent Avenue	2.3 ppm 1.5 ppm	35 ppm 9 ppm
$PM_{2.5}$	24-hour Annual	JHS 126 424 Leonard Street	23 µg/m^3 9.1 µg/m^3	28 µg/m^3 11 µg/m^3

Source: EPA 2013-2015 Design Values, https://www.epa.gov/air-trends/air-quality-design-values
CCNY = City College of New York

Parking Facilities Analysis

An analysis was conducted to evaluate future carbon monoxide (CO) and particulate matter (PM) concentrations with the operation of the parking facilities assumed to be developed as a result of the proposed action. The development plan would include eight buildings grouped into four clusters, and it was assumed that each cluster would have its own shared garage.

Emissions from vehicles using the parking facilities would potentially affect ambient levels of CO and PM in the immediate vicinity in the With Action Condition. Of the parking facilities associated with the development sites, the shared parking garage on the Southern Block for Buildings F, G, and H was analyzed since it has the maximum overall capacity (166 parking spaces) and the maximum predicted number of vehicle ins/outs, and therefore, the highest potential incremental concentrations of pollutants.

An analysis of the emissions from the outlet vents and their dispersion in the environment was performed, calculating pollutant levels in the surrounding area, using the methodology set forth in the *CEQR Technical Manual*. Emissions from vehicles entering, parking, and exiting the garage 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 five miles per hour was conservatively assumed for travel within the parking garage. In addition, all departing vehicles were assumed to idle for one minute before proceeding to the exit. The concentrations of CO and PM within the garage were calculated assuming a minimum ventilation rate, based on New York City Building Code requirements, of one cubic foot per minute of fresh air per gross square foot of garage area. To determine compliance with the NAAQS, CO concentrations were determined for the maximum eight-hour average period. (No exceedances of the one-hour standard would occur, and the eight-hour values are the most critical for impact assessment.)

To determine pollutant concentrations, the outlet vents were analyzed as a “virtual point source” using the methodology in EPA’s Workbook of Atmospheric Dispersion Estimates, AP-26. This methodology estimates CO and PM 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.

Since detailed design information on the garage is not available, it was conservatively assumed that both levels of the garage (below and at-grade) would be mechanically ventilated through a single exhaust.

The CO concentrations were determined for the time periods when overall garage usage would be the greatest, considering the hours when the greatest number of vehicles would exit the facility (PM concentrations were determined on a 24-hour and annual average basis). Traffic data for the parking garage analysis was derived from the trip generation analysis described in Chapter 12, "Transportation." Background and on-street concentrations were added to the modeling results to obtain the total ambient levels for CO and PM_{10}. The 24-hour average $PM_{2.5}$ background concentration was used to determine the *de minimis* criteria threshold.

$PM_{2.5}$ annual average impacts are assessed on an incremental basis and compared with the $PM_{2.5}$ *de minimis* criteria, without considering the annual background. The $PM_{2.5}$ 24-hour average background concentration of 23.0 $\mu g/m^3$ (based on the 2013 to 2015 average of 98th percentile concentrations measured at the JHS 126 monitoring station) was used to establish the *de minimis* value for the 24-hour increment, consistent with the guidance provided in the *CEQR Technical Manual*.

Results

Parking Facilities

Based on the methodology previously described, the maximum predicted CO and PM concentrations from the proposed parking facility serving Buildings F, G, and H was analyzed, assuming a near side sidewalk receptor on the same side of the street (seven feet) as the parking facility, and a far side sidewalk receptor on the opposite side of the street from the parking facility. Pollutant levels were also predicted on the building façade at a height of 6 feet above the vent. The total CO and PM_{10} concentrations include both background levels and contributions from traffic on adjacent roadways for the far side receptor only. $PM_{2.5}$ concentrations include contributions from project-generated trips on adjacent roadways for the far side receptor. Since detailed design information on the garage has not yet been finalized, the street with the highest traffic volume was assumed to be the adjacent roadway from the vent.

The maximum predicted eight-hour average CO concentration of all the receptors modeled is 1.8 ppm. This value includes a predicted concentration of 0.09 ppm from emissions within the parking garage and a background level of 1.7 ppm. The maximum predicted concentration is substantially below the applicable standard of 9 ppm and the *de minimis* CO criteria.

The maximum predicted 24-hour average PM_{10} concentration is 44.4 $\mu g/m^3$. This value consists of a predicted concentration of 0.4 $\mu g/m^3$ from the parking garage vent and a background concentration of 44 $\mu g/m^3$. The maximum predicted concentration is substantially below the applicable standard of 150 $\mu g/m^3$.

The maximum predicted 24-hour and annual average $PM_{2.5}$ increments are 0.3 $\mu g/m^3$ and 0.05 $\mu g/m^3$, respectively. These maximum predicted $PM_{2.5}$ increments are well below the respective $PM_{2.5}$ *de minimis* criteria of 6.0 $\mu g/m^3$ for the 24-hour average concentration and 0.3 $\mu g/m^3$ for the annual concentration. Therefore, the proposed action's parking garages would not result in any significant adverse air quality impacts.

G. (E) DESIGNATION

As noted in Section D, "Stationary Source Analysis," above, in order to ensure that there would be no significant $PM_{2.5}$ and NO_2 impacts, a roof-top stack(s) requirement through an (E) designation (E-427) would be placed on all buildings that would specify stack(s) location with their height above the ground, along with exclusive use of natural gas. This would ensure that the all buildings would not cause exceedances of the CEQR significant impact criteria or violation of the NAAQS and would therefore have no significant adverse air quality impacts.

Block 2249 Building A

Any future construction of Building A on Lot 122 would be required to comply with the following (E) designation:

> *Building A: Block 2249 Lots 122: Any new residential and/or commercial development on the above-referenced properties must use natural gas for HVAC systems and ensure that the heating, ventilating, and air conditioning stacks (2) are located at the highest tier or 148 feet above grade to avoid any potential significant air quality impacts.*

Block 2249 Building B

Any future construction of Building B on Lots 37 and 41 would be required to comply with the following (E) designation:

> *Building B: Block 2249 Lots 37 and 41: Any new residential and/or commercial development on the above-referenced properties must use natural gas for HVAC systems and ensure that the heating, ventilating, and air conditioning stacks (2) are located at the highest tier or 108 feet above grade and at most 170 feet from Harrison Avenue to avoid any potential significant air quality impacts.*

Block 2249 Building C

Any future construction of Building C on Lots 37 and 41 would be required to comply with the following (E) designation:

> *Building C: Block 2249 Lots 37 and 41: Any new residential and/or commercial development on the above-referenced properties must use natural gas for HVAC systems and ensure that the heating, ventilating, and air conditioning stacks (2) are located at the highest tier or 78 feet above grade and at most 33 feet (for Stack 1) and 36 feet (for Stack 2) from Harrison Avenue to avoid any potential significant air quality impacts.*

Block 2265 Building D

Any future construction of Building D on Lot 14 would be required to comply with the following (E) designation:

> *Building D: Block 2265 Lot 14: Any new residential and/or commercial development on the above-referenced properties must use natural gas for HVAC systems and ensure that the heating, ventilating, and air conditioning stacks (2) are located at the highest tier or 78 feet above grade and at most 46 feet from Harrison Avenue to avoid any potential significant air quality impacts. Datum Adherence to these conditions would avoid any potential significant adverse air quality impacts.*

Block 2265 Building E

Any future construction of Building E on Lot 14 would be required to comply with the following (E) designation:

> *Building E: Block 2265 Lot 14: Any new residential and/or commercial development on the above-referenced properties must use natural gas for HVAC systems and ensure that the heating, ventilating, and air conditioning stacks (2) are located at the highest tier or 108 feet above grade to avoid any potential significant air quality impacts.*

Block 2265 Building F

Any future construction of Building F on Lot 14 would be required to comply with the following (E) designation:

> *Building F: Block 2265 Lot 14: Any new residential and/or commercial development on the above-referenced properties must use natural gas for HVAC systems and ensure that the heating, ventilating, and air conditioning stacks (2) are located at the highest tier or 118 feet above grade and at least 177 feet and 194 feet from Union Avenue to avoid any potential significant air quality impacts.*

Block 2265 Building G

Any future construction of Building G on Lot 14 would be required to comply with the following (E) designation:

> *Building G: Block 2265 Lot 14: Any new residential and/or commercial development on the above-referenced properties must use natural gas for HVAC systems and ensure that the heating, ventilating, and air conditioning stacks (2) are located at the highest tier or 118 feet above grade and at least 246 feet and 266 feet from Union Avenue to avoid any potential significant air quality impacts.*

Block 2265 Building H

Any future construction of Building H on Lot 14 would be required to comply with the following (E) designation:

> *Building H: Block 2265 Lot 14: Any new residential and/or commercial development on the above-referenced properties must use natural gas for HVAC systems and ensure that the heating, ventilating, and air conditioning stack is located at the highest tier or 148 feet above grade to avoid any potential significant air quality impacts.*