3.11 AIR QUALITY

3.11.1 Introduction

The air quality analysis presents an assessment of the potential local and regional air quality impacts that could result from the pollutant emissions from mobile and stationary sources needed for the construction of Shaft 33B and the water main connections. This Section describes pollutant emissions estimation and modeling approaches, and identifies the technical data used in the analyses. As noted in Chapter 2, "Purpose and Need and Project Overview," New York City Department of Environmental Protection (NYCDEP) will require the contractor for Shaft 33B to reduce particulate matter emissions to the extent practicable by employing relatively new equipment (model years 2003 and newer), installing emissions controls on diesel equipment greater than 50 horsepower (hp), such as diesel particulate filters (DPFs) or diesel oxidation catalysts (DOCs), and using alternate means of powering the equipment, such as electricity. For diesel equipment greater then 50 hp in size that will likely not be able to implement DPFs, DOCs will be required. NYCDEP will require emissions controls for the ventilated enclosure for concrete trucks. In addition, the water main connection construction activities that would be contracted by the New York City Department of Design and Construction (NYCDDC) will be subject to New York City Local Law 77, which will require the use of Best Available Technology (BAT) for equipment at that time.[1] The air quality analyses described in this Section and undertaken for this Environmental Impact Statement (EIS) incorporated the benefits of such pollution reduction measures.

The procedures described in detail below outline the methodology that was applied to evaluate potential impacts at the Shaft Sites and the water main connections scenarios. Where quantified analyses were required to address potential impacts at different Shaft Site locations, the same methodologies were employed, but adjusted to reflect site-specific conditions. For the alternative Shaft Site locations, analyses were performed for both the raise bore and surface excavation methods. Since the reasonable worst-case water main connections scenario is expected to result in the maximum predicted air quality impacts associated with any water main option, potential air quality impacts from other possible water main connections were based on a comparative analysis with the modeled reasonable worst-case scenario.

[1] New York City Administrative Code § 24-163.3, adopted December 22, 2003, also known as Local Law 77, requires that any diesel-powered non-road engine with a power output of 50 hp or greater that is owned by, operated by or on behalf of, or leased by a city agency shall be powered by ultra low sulfur diesel fuel (ULSD), and utilize the best available technology (BAT) for reducing the emission of pollutants, primarily particulate matter and secondarily nitrogen oxides. NYCDEP is charged with defining and periodically updating the definition of BAT.

3.11.2 Pollutants For Analysis

Ambient air quality is affected by air pollutants produced by both motor vehicles and stationary sources. Emissions from motor vehicles are referred to as mobile source emissions, while emissions from fixed facilities are referred to as stationary source emissions. The U.S. Environmental Protection Agency (USEPA) and New York State have identified primary air quality pollutants of concern for New York City. These include carbon monoxide (CO), nitrogen dioxide (NO_2), ozone, lead, particulate matter and sulfur dioxide (SO_2). Typically, ambient concentrations of CO are predominantly influenced by mobile source emissions. Nitrogen oxide (NO) and NO_2, which are collectively referred to as nitrogen oxides (NO_x), and volatile organic compounds (VOCs) are emitted from both mobile and stationary sources. Ozone is formed in the atmosphere by complex photochemical processes that include NO_x and VOCs. Particulate matter (PM) is emitted from both stationary and mobile sources. Fine particulate matter is also formed when emissions of NO_x, sulfur oxides (SO_x), ammonia, organic compounds, and other gases react or condense in the atmosphere. Emissions of SO_2 are associated mainly with stationary sources such as boilers and electrical generators.

Carbon Monoxide

Carbon monoxide (CO), a colorless and odorless gas, is produced in the urban environment primarily by the incomplete combustion of gasoline and other fossil fuels. In New York City, approximately 80 to 90 percent of CO emissions are from motor vehicles. CO concentrations can vary greatly over relatively short distances. Elevated concentrations are usually limited to locations near crowded intersections and along heavily traveled and congested roadways. Consequently, CO concentrations must be predicted on a local (microscale) basis.

The construction of Shaft 33B and the water mains connections would result in CO emissions from mobile sources and construction equipment. Mobile sources include worker vehicles and diesel powered trucks. Increased traffic queuing due to lane closures caused by construction activities of the water main connections could result in additional emissions of CO. Therefore, a CO mobile source analysis was performed to assess the potential impacts from project-related mobile sources with and without conceptual traffic mitigation. Fossil fuel-fired construction equipment also emits CO. Therefore, emissions from on-site (stationary) construction sources were also evaluated for CO.

Nitrogen Oxides, Volatile Organic Compounds and Ozone

Nitrogen oxides (NO_x) and VOCs are of principal concern because of their role as precursors in the formation of ozone. NO_2 also has its own ambient air quality standard. Ozone is formed through a series of reactions that take place in the atmosphere in the presence of sunlight. Because the reactions are slow, and occur as the pollutants are diffusing downwind, ozone concentrations are often increased many miles from sources of the precursor pollutants. The effects of NO_x emissions from mobile sources are therefore generally examined only on a regional basis.

The change in regional mobile source emissions of these pollutants is related to the total number of vehicle trips and the vehicle miles traveled throughout the New York Metropolitan area. The construction and operation of Shaft 33B would not have a significant effect on the overall volume of vehicular travel in the metropolitan area. It would therefore not have any measurable impact on regional ozone levels. Therefore, an analysis of project-related impacts from mobile sources for these pollutants was not warranted.

The construction of Shaft 33B and the water main connections would result in emissions of NO_x from a variety of diesel-fueled heavy equipment used on-site during the construction period. Therefore, these stationary sources were evaluated for potential NO_x impacts. In order to conservatively estimate impacts from construction sources related to the project, this analysis applied NO_2 as 62 percent of NO_x emitted by construction equipment (based on the measured NO_2/NO_x ratio within New York City over the past several years).

Lead

Lead emissions in air are principally associated with industrial sources and motor vehicles that use gasoline containing lead additives. Most U.S. vehicles produced since 1975, and all produced after 1980, are designed to use unleaded fuel. As these newer vehicles have replaced the older ones, motor vehicle related lead emissions have decreased. As a result, ambient concentrations of lead have declined significantly. Nationally, the average measured atmospheric lead level in 1985 was only about one-quarter the level in 1975.

In 1985, USEPA announced new rules drastically reducing the amount of lead permitted in leaded gasoline. The maximum allowable lead level in leaded gasoline was reduced from the previous limit of 1.1 to 0.5 grams per gallon effective July 1, 1985, and to 0.1 grams per gallon effective January 1, 1986. Monitored concentrations of lead indicate that this action has been effective in significantly reducing atmospheric lead levels. Effective January 1, 1996, the Clean Air Act (CAA) banned the sale of the small amount of leaded fuel that was still available in some parts of the country for use in on-road vehicles, concluding the 25-year effort to phase out lead in gasoline. Even at locations in New York City where traffic volumes are very high, atmospheric lead concentrations are far below the national standard of 1.5 micrograms per cubic meter (three-month average). No significant sources of lead are associated with the project. Therefore, no analysis was warranted.

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

Particulate matter (PM) is emitted into the atmosphere from a variety of sources: industrial facilities, power plants, construction activity, as well as some natural sources. Gasoline-powered vehicles emit relatively small quantities of particles. Exhaust emitted from diesel-powered vehicles, especially heavy trucks and buses, contains large quantities of particles, and therefore, respirable particulate matter concentrations may be locally elevated near roadways with high volumes of such vehicles (e.g. in the vicinity of bus depots or truck marshaling yards). Particulate matter less than 10 µm in diameter (both PM_{10} and $PM_{2.5}$) has become of primary concern because it is respirable. Increased traffic queuing due to lane closures caused by construction activities of the water main connections could result in additional emissions of PM.

Therefore, a PM_{10} and $PM_{2.5}$ impact analysis was performed to assess the potential impacts from project-related mobile sources, with and without conceptual traffic mitigation.

Construction of Shaft 33B and the water main connections would result in emissions of PM_{10} and $PM_{2.5}$ from a variety of diesel-fueled heavy equipment used on-site during construction, and from the transfer and storage of construction, excavate, and fill materials that could result in fugitive dust. Therefore, these sources were evaluated for potential PM impacts. Potential incremental impacts of $PM_{2.5}$ from the construction of the shaft were also evaluated on a neighborhood scale.[2]

Sulfur Dioxide

In addition to boilers and generators, SO_2 sources also include non-road diesel-powered sources such as diesel trains, marine vessels and non-road construction equipment, such as the excavator, and on-road vehicles, primarily heavy duty trucks and buses. However, on-road diesel fuel regulations which will begin to take effect in 2006 will reduce SO_2 emissions from diesel vehicles to extremely low levels. No significant quantities are emitted from mobile sources. An analysis of project related impacts of SO_2 from off-site mobile sources was not warranted.

During the construction of Shaft 33B and the water main connections, all on-site non-road diesel engines would be employing ultra-low sulfur diesel (ULSD). However, an on-site analysis was performed to assess the potential impact from the relatively small amounts of SO_2 emissions expected with construction of the project.

Summary

The project would generate air pollutant emissions from mobile sources and construction activities. Two different analyses were conducted to assess the potential effects of construction of Shaft 33B and the water main connections on air quality:

- Potential increase in traffic queuing due to lane closures caused by construction activities could result in additional emissions of CO, PM_{10}, and $PM_{2.5}$. Therefore, air quality impacts from increased CO, PM_{10}, and $PM_{2.5}$ from construction-induced congestion were assessed.
- Impacts from emissions of exhaust gases from construction equipment and from fugitive dust from excavation and material handling. Impacts were assessed for potential Shaft Site and water main connections activities.

3.11.3 Air Quality Standards, Plans, and Thresholds Guidance

The methodology detailed in the *CEQR Technical Manual*, Chapter 3Q–Air Quality, was applied to the analyses. Other federal and state guidance was applied, as appropriate, to conduct project-specific analyses to assess air quality impacts. Outlined below is a summary of pertinent air

[2] Average impact over one square kilometer area.

quality standards. New York State uses these standards and thresholds guidance to assist in the determination of potential significant adverse air quality impacts.

National and State Air Quality Standards

As required by the CAA, primary and secondary National Ambient Air Quality Standards (NAAQS) have been established for six major air pollutants: CO, NO_2, ozone, respirable PM (both $PM_{2.5}$ and PM_{10}), SO_2, and lead. The primary standards protect public health and represent levels at which there are no known significant effects on human health. The secondary standards are intended to protect the nation's welfare, and account for air pollutant effects on soil, water, visibility, materials, vegetation, and other aspects of the environment. For NO_2, ozone, lead and PM, the primary and secondary standards are the same; there is no secondary standard for CO. USEPA promulgated additional NAAQS which became effective September 16, 1997: a new 8-hour standard for ozone, which replaced the previous 1-hour standard and in addition to retaining the PM_{10} standards, USEPA adopted 24-hour and annual standards for $PM_{2.5}$. The standards for these pollutants are presented in Table 3.11-1. These standards have also been adopted as the ambient air quality standards for New York State.

NAAQS Attainment Status and State Implementation Plans

The CAA, as amended in 1990 defines non-attainment areas (NAA) as geographic regions that have been designated as not meeting one or more of the NAAQS. When an area is designated as non-attainment by USEPA, the state is required to develop and implement a State Implementation Plan (SIP), which is a state's plan on how it will meet the NAAQS under the deadlines established by the CAA.

USEPA has re-designated New York City as in attainment for CO. The CAA requires that a maintenance plan ensure continued compliance with the CO NAAQS for former non-attainment areas. New York City is also committed to implementing site-specific control measures throughout the City to reduce CO levels, should unanticipated localized growth result in elevated CO levels during the maintenance period.

Manhattan has been designated as a moderate NAA for PM_{10}. On December 17, 2004, USEPA took final action designating the five boroughs of New York City as well as Nassau, Suffolk, Rockland, Westchester and Orange counties as $PM_{2.5}$ non-attainment areas under the CAA. State and local governments are required, by early 2008, to develop implementation plans designed to meet the $PM_{2.5}$ annual standard.

Nassau, Rockland, Suffolk, Westchester and the five counties of New York City had been designated as severe non-attainment for ozone 1-hour standard. In November 1998, New York State submitted its *Phase II Alternative Attainment Demonstration for Ozone*, which was finalized and approved by USEPA effective March 6, 2002, addressing attainment of the one-hour ozone NAAQS by 2007. New York State has recently submitted revisions to the SIP; these SIP revisions included additional emission reductions that USEPA requested to demonstrate attainment of the standard, and an update of the SIP estimates using two new USEPA models—

Table 3.11-1
Ambient Air Quality Standards

Pollutant	Primary		Secondary	
	ppm	$\mu g/m^3$	ppm	$\mu g/m^3$
Carbon Monoxide (CO)				
Maximum 8–Hour Concentration(1)	9	10,000	None	
Maximum 1–Hour Concentration(1)	35	40,000		
Lead				
Maximum Arithmetic Mean Averaged Over 3 Consecutive Months	N/A	1.5	N/A	1.5
Nitrogen Dioxide (NO_2)				
Annual Arithmetic Average	0.053	100	0.053	100
Ozone (O_3)				
1–Hour Average — revoked June 15, 2005	0.12	235	0.12	235
8–Hour Average(2)	0.08	157	0.08	157
Total Suspended Particles (TSP)				
Annual Mean	N/A	65	None	
Maximum 24–Hour Concentration	N/A	250		
Respirable Particulate Matter (PM_{10})				
Average of 3 Annual Arithmetic Means	N/A	50	N/A	50
24–Hour Concentration(1)	N/A	150	N/A	150
Fine Respirable Particulate Matter ($PM_{2.5}$)				
Average of 3 Annual Arithmetic Means	N/A	15	N/A	15
24–Hour Concentration(3)	N/A	65	N/A	65
Sulfur Dioxide (SO_2)				
Annual Arithmetic Mean	0.03	80	N/A	N/A
Maximum 24–Hour Concentration(1)	0.14	365	N/A	N/A
Maximum 3–Hour Concentration(1)	N/A	N/A	0.50	1,300

Notes: ppm – parts per million
$\mu g/m^3$ – micrograms per cubic meter
N/A – not applicable
Particulate matter concentrations are in $\mu g/m^3$. Concentrations of all gaseous pollutants are defined in ppm — approximately equivalent concentrations in $\mu g/m^3$ are presented.
TSP levels are regulated by a New York State Standard only. All other standards are National Ambient Air Quality Standards (NAAQS).
(1) Not to be exceeded more than once a year.
(2) Three–year average of the annual fourth highest daily maximum 8–hr average concentration.
(3)Not to be exceeded by the 98th percentile averaged over 3 years.

Sources: 40 CFR Part 50: National Primary and Secondary Ambient Air Quality Standards;
6 NYCRR Part 257: Air Quality Standards.

the mobile source emissions model MOBILE6, and the non-road emissions model NONROAD—which have been updated to reflect current knowledge of engine emissions, and the latest mobile and non-road engine emissions regulations. On April 15, 2004, USEPA designated these same counties as moderate non-attainment for the new 8-hour ozone standard, which became effective as of June 15, 2004 (with the entire Orange County area now considered to be in the Poughkeepsie moderate non-attainment area for the 8-hour ozone standard). USEPA revoked the 1-hour standard on June 15, 2005; however, the specific control measures for the 1-hour standard included in the SIP are required to stay in place until the 8-hour standard is attained. The discretionary emissions reductions in the SIP would also remain but could be revised or dropped based on modeling. A new SIP for ozone will need to be adopted by New York no later than June 15, 2007, with a target attainment deadline of June 15, 2010.

Incremental Air Quality Thresholds

In order to maintain concentrations lower than the NAAQS in attainment areas, or to ensure that concentrations will not be significantly increased in non-attainment areas, New York City has developed *de minimis* criteria to assess the potential significance of predicted CO or $PM_{2.5}$ impacts on air quality that would result from a project. These criteria are further explained below.

Carbon Monoxide Increment Criteria

The *CEQR Technical Manual* criteria set the minimum change in the mobile source CO concentration that defines a significant environmental impact. Potential significant increases with respect to CO concentrations in New York City are defined as: (1) an increase of 0.5 parts per million (ppm) or more in the maximum 8-hour average CO concentration at a location where the predicted Future Without the Project (No Build) 8-hour concentration is equal to or between 8 and 9 ppm; or (2) an increase of more than half the difference between the No Build concentrations and the 8-hour standard, when No Build concentrations are below 8 ppm. These criteria are known as the CO *de minimis* criteria. A mobile source impact analysis for CO is not suggested if the peak number of project-generated vehicles is less than 100 per hour.

$PM_{2.5}$ Increment Criteria

USEPA adopted 24-hour and annual standards for $PM_{2.5}$, which became effective September 16, 1997. The standards require that the total ambient $PM_{2.5}$ concentration not exceed the following values:

- An annual average of 15 $\mu g/m^3$; and
- 24-hour average of 65 $\mu g/m^3$.

These standards are aimed at protecting public health and welfare, and have been adopted by the State of New York.

USEPA has not set thresholds for determining the significant impact of particular programs or projects. For use in the City Environmental Quality review, NYCDEP is currently employing interim guidance criterion for determining the potential for significant adverse impacts from

predicted $PM_{2.5}$ concentrations from construction of NYCDEP projects, as follows: Predicted increase in ground-level neighborhood-scale annual average $PM_{2.5}$ concentrations greater than 0.1 μg/m^3 (i.e., the computed annual concentration averaged over receptors placed over a one-kilometer by one-kilometer grid, centered around the location where the maximum impact is predicted from stationary sources, or at a distance of at least 15 meters from an arterial roadway in the case of mobile sources) will be considered a potential significant adverse impact on air quality.

The New York State Department of Environmental Conservation (NYSDEC) released their policy on assessing and mitigating impacts of fine particulate matter emissions. NYSDEC's thresholds for determining potential significant impacts are as follows:

- A project with a potential annual primary PM_{10} emission of 15 tons or more will be deemed to have a potentially significant adverse impact if the project's maximum impacts are shown to constitute more than 0.3 μg/m^3, or more than 5 μg/m^3 on a 24-hour basis. Projects that exceed either the annual or 24-hour threshold will be required to prepare an Environmental Impact Statement (EIS) to assess the severity of the impacts, to evaluate alternatives, and to employ reasonable and necessary mitigation measures to minimize the $PM_{2.5}$ impacts of the source to the maximum extent practicable.
- If primary $PM_{2.5}$ emissions from the project do not equal or exceed 15 tons per year, then the $PM_{2.5}$ impacts from the project shall be deemed insignificant and no further assessment shall be required under NYSDEC's policy. The estimated annual $PM_{2.5}$ emissions from construction of the proposed shaft at any of the sites and its associated water main connections would be less than one ton per year (including the surface excavation method), well below the 15 tpy threshold for NYSDEC permitting and $PM_{2.5}$ guidance. The $PM_{2.5}$ impacts are deemed insignificant under this criterion and no further assessment is required under NYSDEC's policy.

Determination of Significance

For $PM_{2.5}$, actions that would result in predicted $PM_{2.5}$ concentration increments greater than the interim guidance criteria, would be considered to have the potential to result in significant adverse impacts. For CO, actions that would result in predicted CO concentrations greater than the CO *de minimis* criteria (from mobile sources only) described above would be considered to have the potential to result in significant adverse impacts.

For all other NAAQS, any action predicted to cause an exceedance of the NAAQS (see Table 3.11-1) would be deemed to have a potential significant adverse impact.

3.11.4 Existing Conditions

NYSDEC monitors ambient air quality at a number of locations throughout New York State, including the New York City Boroughs. Each of the NYSDEC air monitoring stations measures the ambient concentrations of one or several regulated air pollutants. The most recent year of

available data from these monitoring stations is the calendar year 2004. Data from these stations representative of the project area are summarized in Section 4.11.

3.11.5 Future Conditions Without the Project Methodology

In the Future Without the Project there were no analyses required for stationary or mobile sources associated with construction and operation of the shaft. Therefore, the following section provides only the mobile source analysis methodology for construction of the water main connections.

Mobile Sources

The prediction of vehicle-generated CO and PM emissions and their dispersion in an urban environment incorporates meteorological phenomena, traffic conditions, and physical configurations (e.g., street widths, sidewalk locations). Air pollutant dispersion models mathematically simulate how traffic, meteorology, and source-receptor geometry 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 it is necessary to predict the reasonable worst-case condition, most of these dispersion models predict conservatively high concentrations of pollutants, particularly under adverse meteorological conditions.

The mobile source analyses for the project employ models approved by USEPA that have been widely used for evaluating air quality impacts of projects in New York City, other parts of New York State, and throughout the country. The modeling approach includes a series of conservative assumptions relating to meteorology, traffic, and background concentration levels resulting in a conservatively high estimate of anticipated CO, PM_{10} and $PM_{2.5}$ concentrations that could ensue from mobile sources associated with the proposed project.

The following sections provide an overview of the analytical tools used to determine mobile source impacts.

Dispersion Model for Microscale Analyses

The maximum CO concentrations resulting from vehicle emissions were predicted using the CAL3QHC model Version 2.0.[3] The CAL3QHC model employs Gaussian (normal distribution) dispersion and includes an algorithm for estimating vehicular queue lengths at signalized intersections. CAL3QHC predicts dispersion of CO emitted from idling and moving vehicles. The queuing algorithm in the model accounts for site-specific traffic parameters, such as signal timing and delays to accurately predict the effects of idling vehicles. The CAL3QHC model has

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

been updated with an extended module, CAL3QHCR, which allows for the incorporation of hourly meteorological data into the modeling, instead of worst-case assumptions regarding meteorological parameters. This refined version of the model, CAL3QHCR, is employed if maximum predicted future CO concentrations are greater than the applicable ambient air quality standards or when *de minimis* thresholds are exceeded using the first-level CAL3QHC modeling. In these cases, a Tier I analysis is executed using the detailed meteorological data, but utilizing the same traffic data as the CAL3QHC screening analysis. Tier II analysis is an additional refinement, used if the CO concentrations are predicted to exceed the NAAQS or if increments are predicted to exceed the *de minimis* levels using the Tier I analyses.

To determine motor vehicle generated CO and PM concentrations adjacent to streets near the proposed project area, the CAL3QHCR model was applied. This version of the model can utilize hourly traffic and meteorology data, and is therefore more appropriate for calculating concentrations for time averaging periods greater than 1-hour.

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 accumulation of pollutants at a particular location (receptor), and atmospheric stability accounts for the effects of vertical mixing in the atmosphere.

Tier II Analyses—CAL3QHCR.

In order to accurately reflect the potential mobile source CO and PM impacts from the project, a Tier II analysis was performed with the CAL3QHCR model, which includes the modeling of hour-by-hour concentrations based on hourly traffic data and 5 years of monitored hourly meteorological data. These analyses were undertaken to predict maximum 24-hour and annual average PM levels, and maximum 1-hour and 8-hour average CO concentrations. The data consists of surface data collected at LaGuardia Airport and upper air data collected at Brookhaven, New York for the period 1999-2003. All hours are modeled, and the highest resulting concentration for each averaging period is presented.

Analysis Year

An air quality analysis was performed for 2008, the year by which construction of the water main connections would start. The future analysis was performed for both the Future Without the Project (No Build) and the Future With the Project (Build). In addition, potential combined impacts from construction of the water main connections and Shaft Site were assessed where appropriate.

Vehicle Emissions Data

Engine Emissions

Vehicular CO and PM engine emission factors were computed using the USEPA mobile source emissions model, MOBILE6.2.[4] This is the most current, recently released emissions model capable of calculating engine emission factors for various vehicle types, fuel type (gasoline, diesel, or natural gas), meteorological conditions, vehicle speeds, vehicle age, roadway types, number of starts per day, engine soak time, and various other factors that influence emissions, such as inspection maintenance programs. The inputs used in MOBILE6.2 incorporate the most current guidance available from the NYSDEC and the *CEQR Technical Manual*.

Vehicle classification data were based on field studies (see Section 4.9, "Traffic and Parking") and data obtained from the New York City Department of Transportations *New York City Bridge Traffic Volumes, 2001*. Credits that are recommended by NYSDEC were used to accurately reflect the inspection and maintenance program. The inspection and maintenance programs require inspections of automobiles and light trucks to determine if pollutant emissions from the vehicles' exhaust systems are in compliance with emission standards. Vehicles failing the emissions test must undergo maintenance and pass a repeat test to be registered in New York State. The general categories of vehicle types for specific roadways were further categorized into subcategories based on their relative fleet-wide distribution.[5]

An ambient temperature of 50[a] Fahrenheit was used. The use of this temperature is recommended in the *CEQR Technical Manual* for the borough of Manhattan.

PM emission rates included fugitive road dust to account for its impacts in local microscale analyses. However, fugitive road dust was not included in the neighborhood scale $PM_{2.5}$ microscale analysis, since it is generally considered to be an insignificant contribution on that scale.

Traffic Data

Traffic data for the air quality analysis were derived from existing traffic counts, projected future growth in traffic, and other information developed as part of the traffic analysis for the proposed action (see Section 4.9, "Traffic and Parking"). Traffic data for the Future Without and With the Project were employed in the respective air quality modeling scenarios.

For particulate matter and CO analyses, the peak AM, mid-day and PM period traffic volumes were used as a baseline; traffic volumes for the non-peak hours were determined by adjusting the total peak period volumes by the 24-hour distributions of actual measured on-street baseline vehicle counts collected for the project. The peak hour project-generated trips were assumed to

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4 USEPA, *User's Guide to MOBILE6.1 and MOBILE6.2: Mobile Source Emission Factor Model*, EPA420-R-02-028, October 2002.

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

occur during each hour of the construction shift. If construction work would occur outside the normal working hours, incremental particulate matter concentrations would be expected to be less than or comparable to those determined in these analyses.

Background Concentrations

Background concentrations for mobile sources are those pollutant concentrations not directly accounted for through the modeling analysis, which directly accounts for vehicle-generated emissions on the streets within 1,000 feet and line-of-sight of the receptor location. Background concentrations must be added to mobile source modeling results to obtain total pollutant concentrations at a study location.

The 8-hour average background concentration used in this analysis was 2.9 ppm for the 2008 predictions, which is based on the highest 8-hour measurements over the years 2000-2004 at the NYSDEC's P.S. 59 monitoring station. The 1-hour background employed in the analysis was 4.7 ppm.

The PM_{10} annual and 24-hour background concentrations were based on the highest and second highest concentrations, respectively, measured over the most recent 3-year period at the nearest NYSDEC monitoring site (see Table 3.11-5 for a summary of pollutant background levels in the mobile and stationary source analyses). The background concentrations for the annual and 24-hour periods were 19 $\mu g/m^3$ and 50 $\mu g/m^3$, respectively, for this analysis. For the $PM_{2.5}$ analysis, the 24-hour background value used in the analysis was 41.7 $\mu g/m^3$.

Mobile Source Analysis Sites

Two sites were analyzed for the assessment of CO, $PM_{2.5}$ and PM_{10} potential impacts (see Table 3.11-2). These intersections were selected because they are the locations in the Study Area where the greatest air quality impacts and maximum changes in the concentrations would be anticipated due to baseline traffic volumes and potential restrictions on traffic movements along First Avenue for the reasonable worst-case route. Impacts of potential diverted traffic as a result of water main construction were also assessed.

Table 3.11-2
Mobile Source Analysis Intersection Locations

Analysis Site	Location
1	E. 59th Street and First Avenue
2	E. 57th Street and First Avenue

Receptor Locations

Multiple receptors (i.e. precise locations at which concentrations are predicted) were modeled at each of the selected analysis sites; receptors were placed along the approach and departure links at spaced intervals. The receptors were placed at sidewalk or roadside locations near intersections with continuous public access. Elevated receptors were also placed at residential

locations due to the Site's proximity to the Queensboro Bridge, and to coincide with the elevated receptors for the stationary source modeling.

Receptors in the annual $PM_{2.5}$ neighborhood scale models were placed at a distance of 15 meters, from the nearest moving lane, based on the NYCDEP procedure for neighborhood scale corridor $PM_{2.5}$ modeling. For the local $PM_{2.5}$ analysis, the 24-hour average microscale model was run with the same receptor placement that was used in the PM_{10} mobile source modeling analysis.

Stationary Construction Sources

In the Future Without the Project at the Shaft Sites and for the water main connections route, with respect to stationary (construction) emission sources, air quality is anticipated to be similar to that described for the existing conditions. Land uses are expected to remain the same in this neighborhood and since air quality regulations mandated by the CAA are anticipated to maintain or improve, it can be expected that the air quality conditions in the Future Without the Project would be no worse than those that presently exist. Therefore, no quantified analysis was performed for this scenario.

3.11.6 Future Conditions With the Project Methodology

In the Future With the Project there would be no significant mobile or stationary source emissions associated with the operation of the shaft, thus, no additional analyses were required for mobile or stationary sources associated with operation of the shaft.

The analytical methodologies for the construction at the Shaft Sites are presented first, followed by the water main connections methodologies.

Shaft Sites

An air emissions profile was developed for the duration of shaft construction to determine the worst case short-term and annual periods (i.e., peak site-wide air emissions). $PM_{2.5}$ was utilized as the indicator pollutant to determine the relative emissions by stage of construction. Methodologies were then developed to determine potential effects on air quality using the worst case periods. Provided below is a summary of the procedures used to calculate construction emissions and to model their potential impacts. Since the procedures involved the use of numerous reference equations, construction data, and spreadsheets, additional details are included in Appendix 11. This methodology section utilizes the preferred Shaft Site as an example of the procedures followed. As discussed in the pertinent sections for the alternative Shaft Sites, the same methodology was adapted to the likely construction conditions relative to these sites.

Mobile Sources

A quantitative mobile sources analysis (for on-street sources) was not performed for the construction of the Shaft Sites because construction-generated volumes were below screening thresholds in the *CEQR Technical Manual*.

While the construction of the shaft at the E. 54th Street/Second Avenue Shaft Site would occur within the street, the potential mobile source impacts from related traffic disruptions for this Shaft alternative were evaluated by comparison with the mobile source impacts modeled from the street surface disruptions under the reasonable worst-case route water main connections analyses. The reasonable worst-case route analysis simulated greater potential street surface disruptions than those expected for the construction of the E. 54th Street and Second Avenue Shaft Site; therefore, the predictions of mobile source air quality impacts for the reasonable worst-case route for the water main connections along First Avenue would be greater than those impacts expected for the E. 54th Street/Second Avenue Shaft Site.

Emissions from on-street motor vehicles may affect the ground level concentrations at receptors analyzed for stationary source pollutants. To address these additional contributions to the stationary source emissions analysis, the maximum modeled mobile source concentrations from on-street vehicular traffic under the Future Without the Project conditions for the reasonable worst-case water main route (see Section 5.11 in Chapter 5, "Water Main Connections") were added to the regional measured backgrounds (See Table 3.11-5) to develop worst-case local baseline conditions for CO, PM_{10}, and $PM_{2.5}$ 24-hour.

Stationary Sources

A stationary source analysis was conducted to evaluate potential construction impacts at the Shaft Site. Construction of the shaft would include a number of activities, such as excavation, rock drilling, materials handling, and concrete pouring. The analysis was performed following USEPA and *CEQR Technical Manual* suggested procedures and analytical tools as further discussed below, to determine source emission rates. The estimated emission rates were then used as input to an air quality dispersion model to determine the potential impacts.

Construction Equipment Emissions

The Shaft Site analysis considered the impacts of emissions from all on-site fuel burning equipment, as well as fugitive dust from on-site construction-related activities. Construction sources include exhausts on heavy equipment, fugitive dust from excavation/transfer activities, and entrained road dust. In order to determine the worst-case stages of construction from an air quality perspective, for both the short-term (e.g., 24-hours or less) and long term (e.g., annual averages) $PM_{2.5}$ emissions generated by on-site construction activities were developed for each construction stage, using USEPA models for the size of equipment (in horsepower), and the anticipated frequency for the use of such equipment on-site. For the worst-case stage of construction from an air quality perspective, total site-wide emissions for CO, NO_x, SO_2, PM_{10}, and $PM_{2.5}$, were calculated from the various construction sources.

Construction Data

The construction analyses for the Shaft Site use an emission estimation method and a modeling approach that has been previously used for evaluating air quality impacts of construction projects in New York City. The approach includes an estimated monthly construction work schedule, the number of each equipment type, and rated horsepower of each unit. The level of construction

activities would vary from month to month. Daily usage rates were also applied to each piece of equipment and an operating schedule of 7:00 a.m. to 11:00 p.m. (two 8-hour shifts per day) five days per week was used for the analysis. Table 3.11-3 provides an example of the estimated equipment, horsepower and usage factor for the first and third stage of construction for the preferred Shaft Site. In this table, Stages 1 and 3 are presented, because the worst-case short term

Table 3.11-3
Example of Estimated Construction Equipment Data for Preferred Shaft Site

Equipment for Peak Stages	Rated Size (Horse Power)	Stage 1 Usage Factor (percent)	Stage 3 Usage Factor (percent)
Excavator	200	25	5
Front End Loader	150	30	5
Derrick Crane	275	N/A	25
Backhoe	150	10	N/A
Telescoping Crane	150	20	N/A
Concrete Pump	100	N/A	25
Concrete Truck[a]	300	N/A	3 per hour
Dump Truck	300	1.5 per hour	N/A
Flatbed Truck[a]	300	1.5 per hour	1 per hour
Pile Drilling Rig	200	25	N/A

Notes: N/A –Equipment not required in this Stage

a. The on-road trucks traveling to and from the site were conservatively estimated to equal the peak vehicle per hour presented above for each of the 16 hours per work day.

emissions (e.g. maximum 24-hour emissions) were computed to occur in the first stage, and the maximum annual (12 month rolling average) emissions were estimated to occur in Stage 3 for the preferred Shaft Site. Additional information on specific construction stages at the preferred Shaft Site is provided in Section 4.1, "Project Description," in Chapter 4, "Preferred Shaft Site." Similarly, information on specific construction stages for the alternative Shaft Sites is provided in Section 6.1 for the E. 59th Street/Second Avenue Shaft Site, Section 7.1 for the E. 61st Street Shaft Site, and Section 8.1 for the E. 54th Street/Second Avenue Shaft Site.

Specific construction information used to calculate emissions generated from the construction process includes but is not limited to the following:

- the number of units and fuel-type of construction equipment to be used;
- rated horsepower (hp) for each piece of equipment;
- equipment usage factors (percent);
- hours of operation on-site;
- the maximum excavation and processing rates on a typical peak day;
- average speed of heavy vehicles; and
- average vehicle miles traveled by heavy vehicles.

Engine Exhaust Emissions

The sizes, the types and the number of construction equipment were estimated based on the construction activities schedule. Emission factors for NO_X, CO, PM_{10}, $PM_{2.5}$, and SO_2 from the combustion of fuel (ULSD) for on-site construction equipment were developed using the USEPA NONROAD Emission Model (Version 2.3c, April 2004)[6]. The model is based on source inventory data accumulated for specific categories of off-road equipment. The emission factors for each type of equipment were calculated from the output files for the NONROAD model (i.e., calculated from regional emissions estimates). However, these emission factors were not applied to trucks. Emission rates for NO_X, CO, SO_2, PM_{10} and $PM_{2.5}$ from combustion of fuel for on-site dump trucks, concrete trucks, and flatbed trucks were developed using the USEPA MOBILE6.2 Emission Model. A maximum of three minute idle time was employed for the dump and flatbed trucks. For analysis purposes, it was assumed that the concrete trucks would operate up to 90 percent of the time on-site for the 24 hour average emission rates.

The emission factors for the Shaft Site analyses took into consideration the exclusive use of relatively new equipment (i.e., emission factors were derived based on model year 2003). In addition, estimated PM emission rates for this equipment were reduced to account for add-on control technologies on the equipment for the Shaft Site construction. NYCDEP undertook an evaluation of diesel-fueled equipment that would be utilized during construction of the shaft, and has made a determination of the equipment that would likely be able to implement diesel particulate filters (DPFs). For diesel equipment greater then 50 hp in size that will likely not be able to implement DPFs, diesel oxidation catalysts (DOCs) will be required. NYCDEP will continue its evaluation of the use of controls on the diesel fuel combustion-related emissions of concrete trucks. For analysis purposes in the EIS, the emissions from concrete trucks were simulated as uncontrolled. Table 3.11-4 presents a list of the expected equipment to be used for construction of the shaft, and the associated PM control technology and control efficiency (i.e., estimated reduction in PM emissions from the control technology).

[6] After the Draft EIS was completed, USEPA released a new version of the NONROAD model (NONROAD2005). An examination of the emission factors from the updated NONROAD model was undertaken for the Final EIS. The results of this analysis indicated that there were no substantive changes in emission factors for this analysis with the updated model, and the emission factors were not updated.

Table 3.11-4
Estimated Minimum Particulate Matter (PM) Control for Shaft Site Construction Equipment

Equipment	Likely Maximum Feasible Control Technology	Minimum $PM_{10}/PM_{2.5}$ Control Efficiency
Excavator	DPF	90%
Front End Loader	DPF	90%
Derrick Crane	DOC	25%
Backhoe	DPF	90%
Telescoping Crane	DOC	25%
Concrete Pump	DPF	90%
Concrete Truck	None[a]	0%
Dump Truck	None	0%
Flatbed Truck	None	0%
Paver	DPF	90%
Pile Drilling Rig	DOC	25%
Compactor	None	0%
Pavement Cutter	None	0%

Notes: DPF = Passive Diesel particulate filter
DOC = Diesel Oxidation Catalyst
a. NYCDEP will require emissions controls for the ventilated enclosure for concrete trucks. For analysis purposes in the EIS, the emissions from concrete trucks were simulated as uncontrolled.

In addition, the maximum predicted local annual average NO_2 concentrations were conservatively calculated assuming that 62 percent of the NO_x emitted from the construction of the project would convert to NO_2 in the immediate area near the construction site.

More detailed examples of the emission rates for the analysis are included in Appendix 11 for $PM_{2.5}$, PM_{10}, NO_x, SO_2, and CO. The 8-hour, 24-hour and annual emission rates were adjusted from the peak hour emissions value based on the expected hours of operation for the various stages. These factors are presented for all equipment used within the duration of construction in the stage description tables in Appendix 11.

Fugitive Emission Sources

Road dust emissions from vehicle travel were calculated using equations from USEPA's AP-42, Section 13.2 for paved roads. PM_{10} emissions were estimated for concrete trucks, dump trucks and flatbed trucks traveling in and out of the Shaft Sites. For short-term impacts at the preferred Shaft Site, Stage 1 of construction was identified as the worst-case period based on the estimation of PM emissions over the entire construction period, and a conservative estimate of three trucks per hour for each of 16 hours per day was applied in the analysis. For the determination of maximum annual impacts, at the preferred Shaft Site Stage 3 of construction was identified as the worst-case annual emissions stage from the estimation of pollutant emissions over the entire construction period. A conservative estimate of three trucks per hour

for each of 16 hours of operation per day for concrete trucks and one truck per hour for flatbed trucks was used. Average vehicle weights used in the analysis were 30 tons for the concrete trucks and dump trucks, and 8 tons for the flatbed trucks. A reasonably conservative distance for all the Shaft Sites of 80 feet per vehicle trip (160-foot round trip) was used. In addition, the AP-42 equation used to calculate road dust requires the use of a silt loading factor. A road surface silt loading factor of 2.4 grams per square meter was selected from AP-42 Table 13.2.1-3. The contractor will be required to implement a dust control plan that will require water spraying; this control method would provide at least a 50 percent reduction in PM_{10} emission. In addition, since on-site travel speeds will be restricted to less than 5 miles per hour, on-site truck and equipment travel will not be a significant contributor to fugitive emissions. At the alternative Shaft Sites, the same methodology was applied to determine the worst-case stages of construction from an air quality perspective.

Particulate matter emission would also be generated by material handling activities (i.e., loading/drop operations for excavation and removal of soil and rock). Estimates of air emissions from these activities were developed using USEPA's AP-42 Section 13.2.4 Equation 1. Excavation rates used for the analysis were 14.2, 35.5 and 11.8 tons removed per hour for the excavator, backhoe and loader, respectively.

Dispersion Modeling

Potential impacts from the construction equipment were evaluated using the Industrial Source Complex Short Term (ISCST3) dispersion model developed by USEPA, and described in *User's Guide for the Industrial Source Complex (ISC3) Dispersion Models* (EPA-454/B-95-003a). The ISCST3 model calculates pollutant concentrations from one or more points (e.g., exhaust stacks) based on hourly meteorological data, and has the capability of calculating pollutant concentrations where the plume from the exhaust stack is affected by the aerodynamic wakes and eddies (downwash) produced by nearby structures. The ISCST3 analyses of potential impacts from exhaust stacks were made using stack tip downwash, buoyancy-induced dispersion, gradual plume rise, urban dispersion coefficients and wind profile exponents, no collapsing of stable stability classes, and elimination of calms.

Building downwash was considered but not used in the air dispersion model. Building downwash would not be expected to be a significant factor in determining maximum ground level concentrations, and there would be no on-site buildings. In addition, since the modeling was predicting conservative estimates of direct impacts from the sources to nearby receptors, use of building downwash algorithms would result in lesser impacts than those yielded in this assessment.

Source Simulation

During construction, various types of construction equipment would be used at different locations throughout the Site. Some of the equipment is mobile and would operate throughout the Shaft Site while some would remain stationary on-site at distinct locations. Stationary emission sources include the telescoping and derrick cranes, the concrete pump, the concrete trucks (which would be enclosed in a ventilated structure), and the pile drilling rig. These

sources were considered to be point sources and were placed at fixed locations. The input data for point sources included stack heights that were equivalent to the height of engine exhaust points or tailpipes and an exhaust temperature of 250° C (a temperature within the normal operating range of most diesel engines). Based on estimated fuel consumption rates per 100 hp and potential pressure drops with diesel particulate filters on the exhaust, a stack velocity of 4.3 feet per second (or 1.31 meters per second) per 100 hp was used for each exhaust point along with a diameter of six inches (or 0.1524 meters) except for the exhaust for the concrete truck enclosure, which used a default exhaust velocity (recommended as a default value in the *CEQR Technical Manual*) from the ventilated enclosure of 0.001 meters per second.

The excavator, loader, backhoe, dump truck and flatbed truck would operate throughout the Site. These sources were simulated as volume sources for the purpose of modeling analysis, and their emissions were distributed evenly across the construction site.

Receptor Locations

ISCST3 was used to predict maximum pollutant concentrations at nearby locations of likely public exposure ("receptors"). Discrete receptors were placed along sidewalks and residential buildings. Sidewalk receptors were placed at the middle of the sidewalk and spaced 25 feet apart. Residential receptors were placed at the nearest windows facing the construction site. A wall would initially be constructed at the preferred Shaft Site. This wall would block the direct impacts on sidewalks immediately adjacent to the site from the construction site. Sidewalk receptors were set at 1.8 meters above the terrain.

Meteorological Data

The meteorological data set consisted of the latest five years of data that are available: surface data collected at LaGuardia Airport (1999-2003) and upper air data collected at Brookhaven, New York (1999-2003).

Background Concentrations

Where needed to determine potential air quality impacts from the construction of the project, background ambient air quality data for criteria pollutants were added to the predicted off-site concentrations developed for the air quality impact analysis (Table 3.11-5). The background data was obtained from NYSDEC monitoring stations. The nearest station (P.S. 59, located at E. 59th Street and Second Avenue), or the most representative monitoring data was used for the analysis, as explained below.

For the maximum annual values, the most recent five years (2000 through 2004) were used to develop conservative estimates of the annual background level for NO_2, CO and SO_2 for this impact assessment. In determining the SO_2 background values for the 3-hour and 24-hour periods, the second highest values for each averaging period were tabulated for each year and the highest value over the five-year period was conservatively selected as the background level. For the 1-hour and 8-hour CO background values, the highest values for each year were tabulated and the highest value over the five-year period was selected as the background level

Table 3.11-5
Background Air Quality Data for Analyses

Pollutant	Monitoring Station	Averaging Period	Background Concentration (µg/m^3)[a]
NO_2	P.S. 59	Annual	71
$PM_{2.5}$	P.S. 59	24-hour	41.7
PM_{10}	JHS 126	24-hour	50
		Annual	19
SO_2	P.S. 59	3-hour	202
		24-hour	123
		Annual	37
CO	P.S. 59	1-hour (ppm)	4.7
		8-hour (ppm)	2.9

Note: **a.** Concentrations are in µg/m^3 except for CO which is in parts per million (ppm).

For PM_{10} (particulate matter less than 10 microns in aerodynamic diameter), three years of data, 2002 through 2004 were used to calculate the background values. For PM_{10}, there has been no data available from the P.S. 59 station since 1998. Therefore, the background data from the nearest operating monitoring station, JHS 126, located in the northwest section of Brooklyn, was used. The annual PM_{10} background value was the average of the annual concentrations from the three years. To obtain the 24-hour PM_{10} background values, the second highest values for each year were tabulated and the highest value over the three-year period was selected as the background level. For $PM_{2.5}$, background values were based on the highest 24-hour background levels recorded at P.S. 59 over the period 2000-2004. As discussed earlier, no localized or regional impact assessments were required for lead or ozone.

In addition to the background values reported in Table 3.11-5, in order to account for emissions from on-street motor vehicles which may affect the levels at receptors for stationary source pollutants, the maximum modeled mobile source concentrations from on-street vehicular traffic for the worst-case water main route were added with the background values to develop worst case total concentrations for CO, $PM_{2.5}$ and PM_{10} modeled stationary source impacts. The combined concentrations of the background values and the maximum modeled mobile source concentrations are labeled as the baseline concentrations in the stationary source analysis.

Water Main Connections

Construction of the water main connections is expected to commence in the year 2008 with several segments of construction to follow. Similar to the approach for the Shaft Site, an air emissions profile was developed for the duration of water mains construction to determine the peak air emissions for the short-term and annual periods. Similar methodologies were then applied to determine potential affects on air quality using the worst-case periods. In addition, where there could be potential combined impacts from water main and Shaft Site construction, these were also computed. Provided below is a summary of the procedures used to calculate construction emissions and to model their impacts. Since the procedures involved the use of

numerous reference equations, construction data, and spreadsheets, additional details are included in Appendix 11.

Mobile Sources

The mobile source methodology for the Future With the Project follows the general methodology described for the Future Without the Project; however, the traffic data representative for the Future With the Project and potential changes in the number of moving lanes due to construction activities (and ensuing predicted changes in speed following the guidance in the *CEQR Technical Manual*) and the additional truck trips associated with the water mains construction were included in the assessment.

Stationary Sources

A stationary source analysis was conducted to evaluate potential impacts from the on-site construction of water main connections. Construction of the water main connections would likely include a number of activities, such as excavation, pavement cutting, materials handling, and paving. The analysis was performed following USEPA and *CEQR Technical Manual* suggested procedures and analytical tools as further discussed below, to determine source emission rates. The estimated emission rates were then used as input to an air quality dispersion model to determine the potential impacts.

Construction Equipment Emissions

The water main connections analysis considered the impacts from all on-site fuel burning equipment, as well as fugitive dust from on-site construction-related activities. Construction sources include exhausts on heavy equipment and fugitive dust from excavation/transfer activities. The reasonable worst-case route travels from the preferred Shaft Site along First Avenue to connect with the existing trunk main at Third Avenue between E. 55th and E.56th Streets. For both the short-term (24-hours or less) and long term (annual average) conditions, emissions generated by on-site construction activities for the reasonable worst-case water main route were developed. The on-site emissions generated by the water main connections from the alternative Shaft Sites are expected to be the same or less than those along the reasonable worst-case route, as the usage of equipment and duration of construction for each segment would be the same. Through the use of USEPA models and equipment expected to be used on-site, the potential $PM_{2.5}$ emissions for each segment of water main construction were developed. Based on the profiles of the likely equipment, size of equipment (in horsepower), and the anticipated frequency for the use of such equipment, the worst-case air quality stage was estimated for the on-site combustion sources and fugitive emissions from construction. For the worst-case stage of construction, total site-wide emissions for CO, NO_x, SO_2, PM_{10}, and $PM_{2.5}$, were calculated from the various construction sources.

Construction Data

The construction analyses for the water main connections use an emission estimation method and a modeling approach that has been previously used for evaluating air quality impacts of construction projects in New York City. The approach includes an estimated monthly construction work

schedule, the number of each equipment type, and rate horsepower of each unit. The level of construction activities would vary from month to month for the duration of water main construction. A construction schedule of one shift per day from 7:00 a.m. to 3:00 p.m. five days per week was used for the analysis. If 8-hours of work would occur during another time period, the emission estimates would be the same as those presented in these analyses. The worst-case peak hourly, peak daily and annual emission rates were then applied to the respective analyses.

Additional information on specific construction segments for the water main connections is provided in Section 5.1, "Project Description," in Chapter 5, "Water Main Connections." For the purposes of this modeling analysis, the first three segments of the water main construction sequence were further broken down into sub-segments based on the construction equipment resource schedules. Segment 1 was broken down into sub-segments 1a, 1b, 1c, and 1d. Segment 2 was broken down into sub-segments 2a, 2b, 2c, and 2d. Segment 3 was broken down into sub-segments 3a, 3b, 3c, and 3d. The equipment, power output, and usage factor for Segment 1a (worst-case short-term emissions for water main construction only), Segment 1c (worst-case short-term emissions for combined analysis of water main, venturi chamber, and Shaft Site construction), and the average usage factor over the course of 12 months (used for the annual average analysis) for the reasonable worst-case route are presented in Table 3.11-6. Appendix 11 includes additional information on the determination of the worst-case stages.

Table 3.11-6
Water Main Connections
Construction Equipment Data

Water Main Equipment	Rated Power Output (horsepower)	Segment 1a Usage Factor (percent)	Segment 1c Usage Factor (percent)	Annual Average Usage Factor (percent)
Front-end Loader	150	N/A[a]	10	3.8
Telescoping Crane	150	N/A[a]	25	8.7
Excavator	400	50	50	40.4
Concrete Truck	300	N/A[a]	20	4.8
Dump Truck[b]	300	3 per hour	3 per hour	3 per hour
Flatbed Truck[b]	300	3 per hour	3 per hour	3 per hour
Compressor	50	25	N/A[a]	7.7
Dewatering Pump	25	50	90	61.9
Paver	200	N/A[a]	N/A[a]	7.7
Compactor	25	N/A[a]	10	7.7
Pavement Cutter	25	15	N/A[a]	1.5
Generator for Welding	25	N/A[a]	25	8.7
Chain saw, gas	5	25	25	7.7

Notes: **a.** This equipment does not operate in the worst-case stage.
b. The on-road trucks traveling to and from the site were conservatively estimated to equal the peak vehicle per hour presented above for each of the 8 hours per work day. When summed up, this would equal more than the total number of trucks expected throughout the construction.

Specific construction information used to calculate emissions generated from the construction process includes but is not limited to the following:

- the number of units and (fuel) type of construction equipment to be used;
- rated horsepower for each piece of equipment;
- equipment usage factors (percent);
- hours of operation on-site;
- the maximum excavation and processing rates on a typical peak day;
- average speed of all construction equipment and heavy vehicles; and
- average vehicle miles traveled by heavy vehicles.

Engine Exhaust Emissions

The methodology for determining engine exhaust emissions was the same as that used in the shaft construction analysis. Based on discussions with NYCDDC representatives, the likely effect of Local Law 77 on construction equipment utilized on future New York City capital projects was incorporated into the analysis. The development of the latest NONROAD emission factors for the water mains analyses assumed the use of relatively new equipment (2005 model year), because recent discussion with equipment suppliers about the effect of Local Law 77 indicates that newer equipment will be leased in the region in order to achieve compliance. For the analysis year of 2008, emission factors were derived for equipment model year 2005 rather than emission factors for the general population of available equipment. In addition, estimated PM emission rates for this equipment were reduced to account for add-on control technologies that will be installed for each equipment type in the future as a result of Local Law 77. NYCDEP evaluated the likely diesel equipment that would be utilized during construction of the water mains, and determined which equipment would likely be able to implement DPFs. For diesel equipment greater then 50 hp in size that will likely not be able to implement DPFs, diesel oxidation catalysts (DOCs) will be required. Table 3.11-7 presents a list of the equipment expected to be used for construction of the water main connections, and the associated PM control technology and control efficiency. As discussed for the Shaft Sites, the contractor will be required to implement a dust control plan that will require water spraying; this control method would provide at least a 50 percent reduction in PM_{10} emission. In addition, since on-site travel speeds will be restricted to less than 5 miles per hour, on-site equipment and truck travel will not be a significant contributor to fugitive emissions.

A more detailed discussion of the emission rates for the analysis is included in Appendix 11 for $PM_{2.5}$, PM_{10}, NO_x, SO_2, and CO. The 8-hour, 24-hour and annual emission rates were adjusted from the peak hour emissions value based on the expected equipment usage during the hours of operation. These factors are presented for all equipment used in Appendix 11.

Table 3.11-7
Estimated Minimum Particulate Matter (PM) Control for Water Main Construction Equipment

Equipment	Likely Maximum Feasible Control Technology	Minimum $PM_{10}/PM_{2.5}$ Control Efficiency
Excavator	DPF	90%
Front End Loader	DPF	90%
Telescoping Crane	DOC	25%
Concrete truck	None	0%
Dump truck	None	0%
Flatbed truck	None	0%
Compressor	DOC	25%
Dewatering pump	None	0%
Paver	DPF	90%
Compactor	None	0%
Pavement Cutter	None	0%
Chain saw, gas	None	0%
Generator for Welding	None	0%

Notes: DPF = Passive Diesel Particulate Filter
DOC = Diesel Oxidation Catalyst

Fugitive Emission Sources

The activities during water main construction that would have the greatest potential to generate significant quantities of fugitive dust would be excavation/soil transfer and loading operations. Fugitive emissions would be generated by excavators and loaders excavating the soil (overburden/rock) and dropping it into dump trucks and/or stockpiles. Fugitive dust emissions were determined for the peak period of each key emission source (e.g., peak soil removal, peak rock removal). The peak period for each of these activities was determined from the estimated construction schedule. Re-suspended road dust is accounted for in the CAL3QHCR dispersion modeling of mobile source emissions. There would be very little, if any, on-site truck travel during water main construction. The trucks would drive in and out along the avenue with the general traffic and are accounted for the mobile source dispersion model. Therefore, fugitive emissions from mobile sources on paved surfaces were considered negligible.

The resultant emission rates were used as the input to the dispersion modeling to predict the maximum localized impacts from the construction activities.

Dispersion Modeling

Potential impacts from the construction equipment were evaluated using the Industrial Source Complex Short Term (ISCST3) dispersion model developed by USEPA. The ISCST3 analyses of potential impacts from exhaust stacks were made using stack tip downwash, buoyancy-induced dispersion, gradual plume rise, urban dispersion coefficients and wind profile exponents, no collapsing of stable stability classes, and elimination of calms.

Building downwash was considered but not used in the air dispersion model. Building downwash would not be expected to be a significant factor in determining maximum ground level concentrations, and there would be no on-site buildings. In addition, since the modeling method used predicts conservative estimates of direct impacts from the sources on nearby receptors, use of building downwash algorithms would result in lesser impacts than those yielded in this assessment.

Source Simulation

During construction, various types of construction equipment would be used at different locations. Some of the equipment is mobile and would operate in specified areas while some would remain stationary on-site at distinct locations. Stationary construction exhaust emission sources (such as the crane, compressor, the dewatering pump, and the generator) were considered to be point sources and were placed at fixed locations along the reasonable worst case route for peak hours and daily averaging periods. Since these sources would be moved down the water mains connections route throughout the project, these sources were represented as area sources at an appropriate exhaust height for the annual analyses. The placement of each individual source is an estimate of where it may be located during the construction period and was selected according to the expected locations in the nearest proximity to receptors and other sources, thus providing a worst-case assessment. Some of the on-site construction equipment sources are considered mobile sources. These sources were considered to be volume sources. Volume source emissions were distributed evenly across the expected areas of the construction site they would traverse in the given time period of analysis. Although under the reasonable worst-case route, the construction area would expand by an additional lane during mid-day hours (10:00 a.m. to 3:00 p.m.) the modeling of emission sources conservatively simulated all of the expected operating equipment to be within 14 feet of the eastern sidewalk for all analysis periods.

The input data for point sources included stack heights that were equivalent to the height of engine exhaust points or tailpipes and an exhaust temperature of 250ºC (a temperature within the normal operating range of most diesel engines). Based on estimated fuel consumption rates per 100 hp and potential pressure drops with diesel particulate filters on the exhaust, a stack velocity of 4.3 feet per second (or 1.31 meters per second) per 100 hp was used for the crane stack velocity along with a diameter of six inches (or 0.1524 meters). For the compressor, the dewatering pump, and the generator, worst-case default stack parameters (recommended in the *CEQR Technical Manual*) for the stack velocity and diameter of 0.001 meters per second and 0 inches, respectively, were applied in the analysis.

Mobile on-site equipment was modeled as volume sources. In accordance with recommendation in the *ISC User's Guide*, the volume sources were modeled with an initial vertical and horizontal dimension to the volume source plumes. This is because mobile source emissions are turbulently mixed near the source and occupy some initial depth.

Receptor Locations

ISCST3 was used to predict maximum pollutant concentrations at receptors that would be located along the reasonable worst-case route. Given the projected construction efforts along

First Avenue for the reasonable worst-case route, receptors were placed at locations along the corridor of the modeled segments. Discrete receptors were placed along adjacent sidewalks and residential buildings. For the reasonable worst-case route analysis, sidewalk receptors were placed at the middle of the sidewalk and spaced 25 feet apart, at the intersections of E. 59th Street and First Avenue and at E. 57th Street and First Avenue, and along First Avenue between E. 59th Street and E. 55th Street. Residential receptors were placed at the nearest windows facing the construction site, at a height of 15 feet and 30 feet. Residential receptors were placed along First Avenue between E. 59th Street and E. 55th Street and along E. 59th Street facing the Queensboro Bridge. The water main connections analysis also includes the receptors used in the Shaft 33B modeling analysis for the Shaft Sites, described above. These receptors were also located near sidewalks, windows, intersections and at open spaces. Sidewalk receptors were set at 1.8 meters above the terrain.

Meteorological Data.

The meteorological data set consisted of the latest five years of concurrent meteorological data that are available: surface data collected at LaGuardia Airport (1999-2003) and upper air data collected at Brookhaven, New York (1999-2003).

Background Concentrations

In addition to the background values reported in Table 3.11-5, in order to account for emissions from on-street motor vehicles which may affect the levels at receptors for stationary source pollutants, the maximum modeled mobile source concentrations from on-street vehicular traffic for the Future Without the Project were added with the background values to develop worst case baseline concentrations for CO, $PM_{2.5}$ and PM_{10} modeled stationary source impacts.

Combined Impacts –Shaft Sites and Water Main Connections

Although the exact timing of the water mains construction is uncertain at this time, the earliest they would be under construction would be 2008. Thus, it is possible that portions of the water main construction could overlap with the final stages of Shaft Site construction. For the preferred Shaft Site, it was determined that if the construction of the water main connections would start from the Shaft Site, it would overlap with Stage 3 of the Shaft Site construction, scheduled for 2008. Therefore, a combined impact analysis for the construction of the water main connections and Shaft 33B Stage 3 construction was performed using the methodologies described above.

Operation

In the future, when the shaft and the water main connections are operable, project-induced traffic would be negligible and no appreciable stationary sources of air emissions would be on-site. Therefore, there would be no significant adverse air quality impacts with operation of the Shaft Site and the water main connections and no analyses were warranted.

◆