Appendix 11.4: Shaft 33B Stationary Air Quality Analysis – 61st Street

A. SUMMARY

An analysis of the potential for air quality impacts from on-site construction equipment is presented below for the Shaft 33B project site at 61st Street between First and Second Avenues. The estimated construction was divided into several distinct stages and sub-stages of construction activities which may vary in duration from two to twelve months. An analysis of the expected emissions over time from the various stages a construction was generated to determine the worst-case short and long term emissions from projected on-site construction activities. The emissions profile that was generated included reasonable estimates of the type, size, operating hours and emissions controls that NYCDEP expects to implement for the on-site equipment at each stage of the construction period. Based on these analyses, Stage 1 was determined to be the period of maximum projected short-term construction emissions and Stage 3 (12 months in duration) was determined to be the period of maximum projected annual construction emissions for the raise bore method of construction. Since there is the potential to undertake surface excavation at this Shaft Site, a comparative analysis of the potential emissions for surface excavation was also performed. A graphical depiction of the raise ore analysis is presented in Figures 1 and 2 of Attachment 11.5.A for short-term and annual periods, respectively.

B. CONSTRUCTION EQUIPMENT

During construction at the Shaft 33B site, various types of fuel burning construction equipment would be used at different locations throughout the site. The release of airborne pollutants from the combustion of fuel and fugitive dust created by heavy vehicles traveling and operating in work areas are the two main sources of air emissions for the worst case analyses. The equipment was assumed to operate on an intermittent basis for 16 hours per day during the primary work shift (i.e., 7 AM to 3 PM) and secondary work shift (3PM to 11PM). Some of the equipment is mobile and would operate in specified areas while some would remain stationary on-site at distinct locations (including concrete trucks which remain parked under an enclosure). Presented in Table 11.4-1 is a list of the construction equipment expected to be on-site during the peak short-term and annual construction periods. The peak periods were determined using construction equipment resource schedules and activities occurring on-site.

Table 11.4-1 On-Site Construction Equipment for Peak Short Term and Annual Period

Equipment Type	Analysis Period	Mobile or Stationary
Excavator	Short-term and Annual	Mobile
Front End Loader	Short-term and Annual	Mobile
Derrick Crane	Annual Only	Stationary
Backhoe	Short-term Only	Mobile
Telescoping Crane	Short-term Only	Stationary
Concrete Pump	Annual Only	Stationary
Concrete Truck #1	Annual Only	Mobile
Dump Truck #1	Short-term Only	Stationary
Flatbed Truck #1	Short-term and Annual	Mobile
Pile Drilling Rig	Short-term Only	Stationary

Stationary emission sources were considered to be point sources and were placed at fixed locations. The placement of each individual source is an estimate of where they may be located during the construction period. Mobile source equipment was considered to be volume sources because emissions are turbulently mixed near the source and occupy an initial depth. Volume source emissions were distributed evenly across the construction site since this equipment would operate throughout the site.

As previously mentioned, potential impacts on air quality from construction activities are generally associated with air pollutants emitted as engine exhaust. Other potential impacts are related to fugitive dust that is generated by mobile sources and operational construction activities. The pollutants of most concern (among criteria pollutants) include nitrogen oxides (NO_X) and particulate matter ($PM_{10}/PM_{2.5}$), although carbon monoxide (CO) was modeled as well in order to obtain a cumulative impact with mobile source impacts (due to lane restrictions), as was sulfur dioxide (SO_2). Short-term air quality impacts (i.e., periods of 24 hours or less) were determined by modeling equipment in use and the expected hours of operation for the peak period of Stage 1. Annual air quality impacts were determined by modeling equipment in use and the expected hours of operation for the peak period of Stage 3 (which lasts 12 months). Although the construction period lasts for several years, the air emissions associated with the construction activities are less during non peak stages (see Figures 1 and 2 of Attachment 11.4.A).

C. SOURCE EMISSION CALCULATIONS

FUEL COMBUSTION

The emission factors for combustion of fuel for on-site construction equipment (excluding heavy duty diesel trucks) were developed using the USEPA NONROAD Emissions Model for the year 2006 (since the construction contract begins in 2006). The model is based on source inventory data accumulated for specific categories of off road equipment. Data provided in the output files from the NONROAD model were used to derive these emission factors for each type of equipment that is expected to be present on-site during construction activities. Input to the NONROAD model included analysis year, region of the country or New York State, the equipment name/category, the type of fuel and the sulfur content of the fuel (in this case Ultra Low Sulfur Fuel).

Since the equipment used on-site is expected to be fairly new (i.e., model year 2003 and later), the NONROAD emission factors derived from the model for the 2006 analysis year were based on specific year 2003 model equipment in the output. Emission reductions from expected diesel particulate filters (DPFs) and diesel oxidation catalysts (DOCs) were included in the assessment. Per the methodology described in Chapter 3, "Impact Methodologies," Section 3.11 "Air Quality", emission rates were estimated utilizing a 90 percent PM reduction efficiency for DPFs and 25 percent PM reduction efficiency for DOCs. In addition, the emission calculations accounted for the use of ultra-low sulfur diesel (ULSD) fuel. The model derived emission factors for NO_X, PM, CO and SO_2 used to calculate (pre-control) fuel combustion emission rates are provided in Table 11.4-2.

Emission rates of NO_X, PM, CO and SO_2 from combustion of fuel for on-road heavy duty diesel vehicles (HDDV) operating on-site were developed using the USEPA MOBILE6.2 emissions model (a modeling year of 2006 was used for the analysis). This model provides emission factors in grams per vehicle-mile (for NO_X and CO) and grams per hour (for PM and SO_2). For this analysis, idling time on-site was limited to a total of 3 minutes per vehicle for the dump trucks and flatbed trucks in accordance with NYC idling laws. However, the concrete trucks are exempt from idling laws since the engine must remain on to keep the cement mixer operating. For analysis purposes, it was assumed that the concrete trucks would operate up to 90% of the time on-site for the 24 hour average emission rates.

ESTIMATED EMISSION RATES FROM COMBUSTION SOURCES

Based on the fuel combustion emission factors described above, emission rates have been calculated for each type of equipment expected to be on-site. These emission rates with sample calculations are provided in Table 11.4-3.

FUGITIVE DUST EMISSIONS

On-site construction equipment have the potential to generate fugitive dust (PM_{10} for this analysis) due to construction vehicles (mobile sources) traveling on paved portions of the site. Emission rates for these activities were developed using equations presented in USEPA's AP-42 "A Compilation of Air Pollution Emission Factors." Emission factors for particulate matter generated by mobile sources are provided in grams per vehicle-mile. On-site speeds would be restricted to 5 miles per hour or less due site restrictions. The maximum distance traveled on-site in any one hour on paved roads is estimated to be 80 feet per vehicle (160 feet round trip). The travel distances are a conservative approximation of the maximum distance that most trucks might travel during soil transfer and concrete pouring operations.

During construction, the contractor will be required to implement a water spray dust control program, which should provide at least a 50 percent reduction in PM_{10} emissions.

Particulate matter emissions would also be generated by heavy equipment performing operational 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 (Equation 1 from Section 13.2.4). Excavation rates in tons per hour were estimated.

ESTIMATED EMISSION RATES FROM FUGITIVE SOURCES

PM_{10} emission rates from on-site mobile sources are provided in Table 11.4-4 for heavy trucks operating on paved roads. The table includes sample calculations of emission factors and short-term emission rates for PM_{10} ($PM_{2.5}$ are considered negligible when vehicles speeds are restricted to 5 mph or less). Key parameters in the AP-42 calculations included silt loading and vehicle weights. Vehicle weights were estimated and a value of 2.4 grams per square meter was selected for the silt loading on paved site roads. This silt loading is a conservative estimate taken from AP-42 and is referenced in the sample calculation provided in Table 11.4-4.

The PM_{10} and $PM_{2.5}$ emission rates for soil and rock transfer activities are provided in Table 11.4-5. The PM_{10} and $PM_{2.5}$ fractions of TSP were estimates taken from AP-42 Section 13.2.4. A mean wind speed of 12.5 miles per hour and a soil moisture content of 14% used in the AP-42 equation are referenced in the sample calculation provided in Table 11.4-5.

OPERATIONAL PARAMETERS

In order to predict the maximum short-term and annual impacts from construction activities, it is necessary to determine the most conservative emission rates based upon overall emissions generated by onsite activities. Using utilization estimates (described in Chapter 2, "Project Overview") and USEPA emissions models and the methodology described in Section 3.11 "Air Quality Methodology", it was determined that Stage 1 represented the most conservative case short-term period and Stage 3 represented the most conservative annual period.

D. DISPERSION MODELING ANALYSIS

A dispersion modeling analysis was performed to estimate incremental and total concentrations of air pollutants associated with emissions produced by on-site construction activities at the preferred Shaft Site. The analysis was conducted using the ISCST3 dispersion model and was performed in accordance with USEPA and the *CEQR Technical Manual*. Where applicable, the predicted total concentrations of criteria pollutants were compared to applicable air quality standards and interim guidance values to help evaluate the potential for significant adverse impacts.

MODEL INPUT

The on-site construction sources can be divided into two groups; stationary and mobile sources. Stationary equipment types were modeled as point sources. 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 250º C (a temperature within the normal operating range of most diesel engines). A nominal value of 4.3 feet per second or 1.31 meters per second (per 100 hp) was used for the stack velocity of each exhaust point along with a diameter of six inches or 0.1524 meters. The one exception is the concrete truck which used a default exhaust velocity of 0.001 meters per second due to the effects of the enclosure discussed earlier.

Mobile source equipment types were modeled as volume sources. In accordance with recommendations 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. The initial depth used in the modeling analysis was a conservative approximation related to the engine exhaust heights.

The receptor layout used in the modeling analysis included discrete off-site receptors that were placed in areas of public access including nearby open space and sidewalks across the street from the 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. However, receptors were placed at additional discrete locations surrounding the site at elevated locations (i.e., nearby windows). Source input data is provided in Table 11.4-6. A site diagram is also provided in Attachment 11.4.B.

The modeling scenario included a set of on-site construction sources that operated only during the two shift work period from 7 AM to 11 PM. The model was run with surface meteorological data from LaGuardia and upper air data from Brookhaven for the years 1999-2003. Urban dispersion coefficients were used for the analysis and building downwash was not evaluated for on-site structures because the stack heights of construction equipment were so close to ground level.

Finally, emission rates used as model input for the analysis are provided in Tables 11.4-7 through 11.4-11 for $PM_{2.5}$, PM_{10}, NO_X, SO_2, and CO, respectively. The tables present post-control emission rates (i.e., they include the application of emission reductions discussed earlier regarding the use of DOC's and DPF's for the control of PM). The 8-hour, 24-hour and annual emission rates presented in the tables were further adjusted from the peak hour emissions value with the application of daily usage factors specific to each piece of equipment (see Chapter 2 "Project Overview". The peak annual emissions of PM_{10} are approximately 0.05 tons per year (well below the 15 tpy NYSDEC threshold).

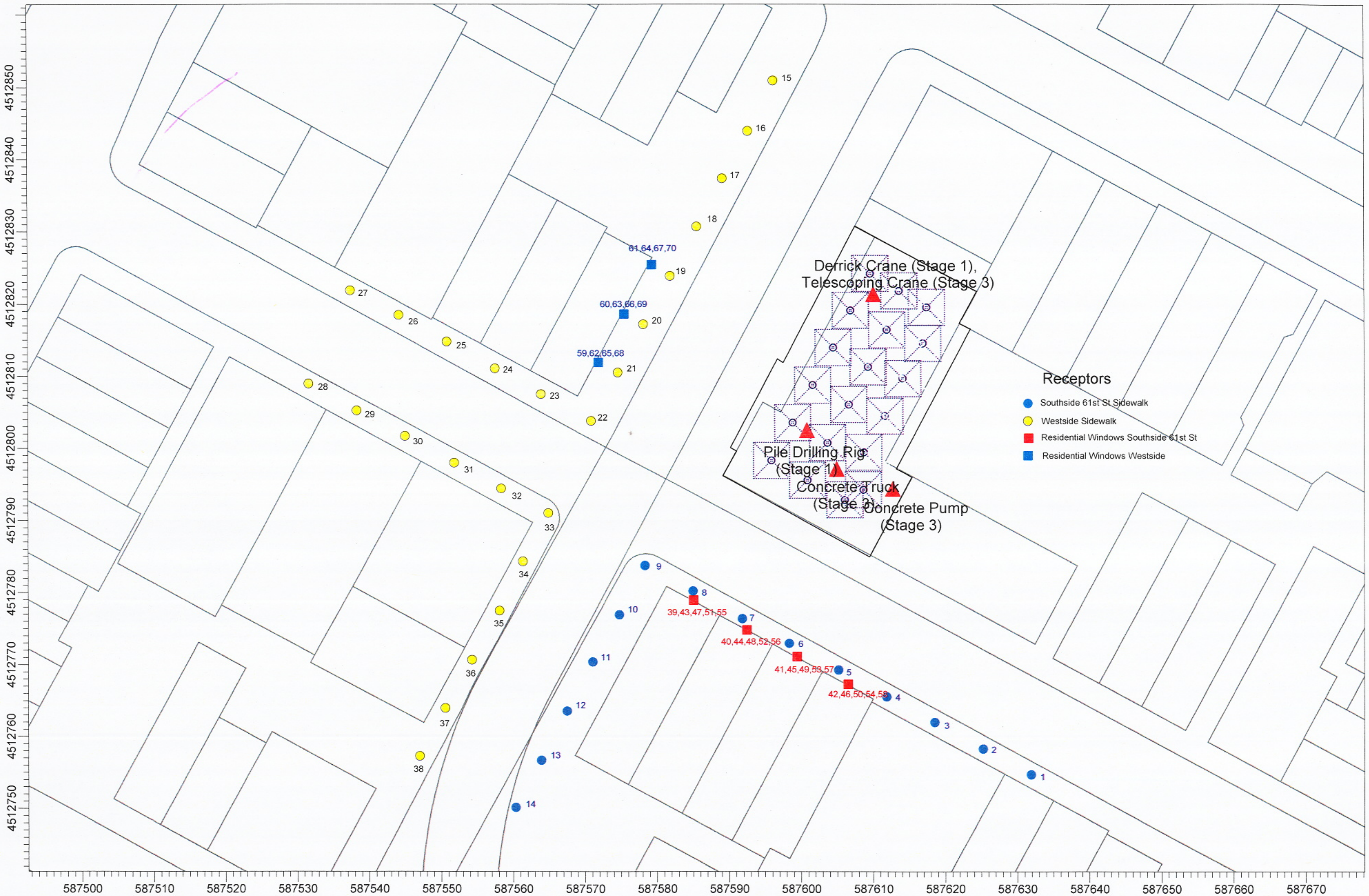
In addition, a NO_2 to NO_X conversion ratio of less than 20% for diesel engine exhaust in a very localized region near the source of emissions is expressed in the following cited literature; Seinfeld, J.H., Pandis, S.N. *Atmospheric Chemistry and Physics*, Chapter 5, "Figure 5.14", (John Wiley and Sons, Inc.). However, 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 (which is based on the regional measured NO_2/NO_x ratio within New York City over the past several years).

E. SURFACE EXCAVATION METHOD

The analysis of potential impacts from construction of Shaft 33B at the 61st Street alternative site was performed using data relevant to the raise bore method of excavation. This type of excavation procedure is expected to be the method utilized if the Shaft contractor would be able to utilize the tunnel as a means of supplying compressed air to the Shaft construction site, and to remove materials through the tunnel. However, as described in Chapter 2, "Project Overview", there is a potential for utilization of an alternative method of construction referred to as the "surface excavation method" at this Shaft Site. Based on the modeled results for the raise bore method and the relative emissions profile for the surface excavation method, a qualitative analysis of potential impacts from the surface excavation method is presented in Section 7.11of the DEIS. With respect to the affects on air quality, the surface excavation method includes higher daily usage factors for most fuel burning equipment, a larger excavator (400 HP) and a diesel compressor would likely be required onsite. A graphical depiction comparing the emissions profile for both methods is presented in Figures 3 and 4 of Attachment 11.4.C for short-term and annual periods, respectively.

PROJECT TITLE:

Shaft33B - Short Term/Annual
61st St between 1st Ave and 2nd Ave (Alternative Site)



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