Appendix B: Air Quality Technical Appendix

NJ TRANSITGRID
TRACTION POWER SYSTEM

AIR QUALITY
TECHNICAL APPENDIX

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1.0 INTRODUCTION

This air quality technical appendix evaluates two proposed design configurations for the NJ TRANSIT TRACTION POWER SYSTEM Main Facility power generation. The facility will be constructed on a parcel of land that is currently owned by the Hudson County Improvement Authority (HCIA), referred to as the Koppers Koke Site, which lies within the Koppers Coke Redevelopment Area in the Town of Kearny, New Jersey.

The proposed facility will be fueled by natural gas. A range of equipment configurations are being evaluated for optimal plant output relative to Project needs and funding availability, ranging from 104MW to 140MW. Two design configurations under the Build Alternative were evaluated for air quality impacts – a worst-case simple-cycle plant with five gas turbines and a worst-case combined-cycle plant with five gas turbines and a heat recovery system with two steam turbines.

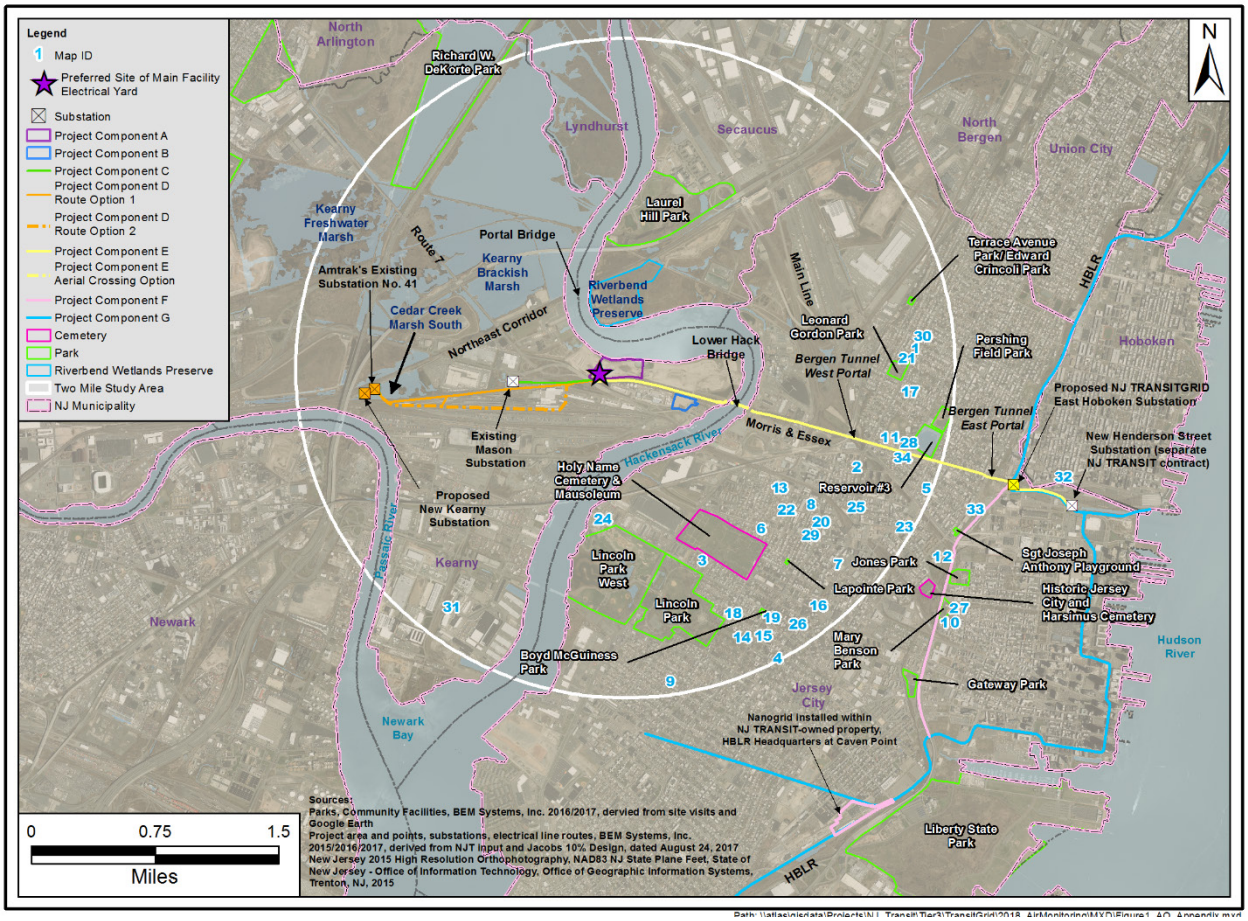
The proposed facility would be located on approximately 26 acres of HCIA-owned property within the Redevelopment Area – approximately 20 acres for the Main Facility within the Koppers Koke Site (Project Component A), and a six-acre parcel for the connection to a high-pressure natural gas pipeline and metering station (Project Component B).

The proposed power-generating facility will not be located immediately adjacent to any sensitive land uses (i.e., “sensitive receptors,” such as residences, schools, hospitals, or nursing homes). However, residential units and nursing homes within Hudson, Bergen, and Essex counties are located within five miles (air quality modeling radius) of the facility boundary, and the potential impacts on these sensitive uses were considered in this analysis. Figure 1 shows the proposed facility’s location as well as the surrounding area. Also shown are locations of identified sensitive land uses.

This Technical Appendix examines the potential localized air quality impacts of the gas-fired turbine emissions under the No Action and Build Alternative, and provides the methodologies and assumptions used to estimate these impacts. The potential impacts of the emergency black-start system, and the proposed emergency generators for the nanogrid at HBLR Headquarters at Caven Point (Project Component F), which are likely to be minimal because they would only be operated during emergency conditions, are not considered in this analysis but will be addressed as part of the project’s permitting process.

Baseline conditions are first established by describing the applicable air pollutants for analysis as well as relevant air quality standards, the air quality attainment status of the study area, and the most recent representative monitored ambient air quality data. The methodologies and assumptions used to assess the potential impacts of the alternatives are then discussed, and a summary of the results of these analyses is provided.

Figure 1: Proposed Main Facility Near Kearny, Hudson County, NJ



2.0 REGULATORY CONTEXT

2.1 Air Pollutants for Analysis

Several air pollutants have been identified by the U.S. Environmental Protection Agency (EPA) as being of concern nationwide. These pollutants, known as "criteria pollutants," are carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), particulate matter (PM_{10} and $PM_{2.5}$), sulfur dioxide (SO_2), and lead (Pb). Ambient concentrations of CO are predominantly influenced by motor vehicle activity (i.e., "mobile sources"). Emissions of volatile organic compounds (VOCs) and nitrogen oxides are associated with both mobile and stationary sources. These can react to form O_3, which is the main constituent of smog. NO_2 is emitted from both mobile and stationary sources (e.g., industrial facilities, power plants, etc.). Emissions of SO_2 are associated mainly with stationary sources. Emissions of particulate matter are associated mainly with stationary sources and diesel-fueled mobile sources (heavy trucks and buses). Lead emissions, which historically were principally influenced by motor vehicle activity, have been substantially reduced, due to the elimination of lead from gasoline.

Hazardous air pollutants (HAPs), also known as toxic air pollutants or air toxics, are emitted from both mobile and stationary sources, as well as natural sources (e.g., volcanic eruptions and forest fires). HAPs are pollutants that cause or may cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental and ecological effects. Ambient concentrations of each of these air pollutants will be impacted by the proposed project, and each of these air pollutants from the proposed power generating project have been evaluated.

Carbon Monoxide

CO is a colorless and odorless gas that is generated in the urban environment primarily by the incomplete combustion of fossil fuels in motor vehicles. In New Jersey, most of the CO emissions are from motor vehicles. Prolonged exposure to high levels of CO can cause headaches, drowsiness, loss of equilibrium, or heart disease. CO concentrations can vary greatly over relatively short distances. Relatively high concentrations of CO are typically found near congested intersections, along heavily used roadways carrying slow-moving traffic, and in areas where atmospheric dispersion is inhibited by urban "street canyon" conditions.

VOCs, Nitrogen Oxides, and Photochemical Oxidants (Ozone)

VOCs are emitted principally from the storage, handling, and use of fossil fuels. Nitrogen oxides (NOx) constitute a class of compounds that include NO_2 and nitric oxide, both of which are emitted by motor vehicles (e.g., cars, trucks and buses, and off-road equipment) and stationary sources (e.g., power plants). In addition to contributing to the formation of ground-level O_3 and fine particle pollution, NO_2 is linked to a number of adverse effects on the respiratory system. Both VOCs and NOx are also of concern because most of those compounds react in sunlight to form photochemical oxidants, including O_3. This reaction occurs comparatively slowly and ordinarily takes place far downwind from the site of actual pollutant emission sources. O_3 is a colorless toxic gas that interferes with the transfer of oxygen in the bloodstream, depriving sensitive tissues (e.g., brain and heart) of oxygen. The effects of exposure to VOCs, NOx, and O_3 are eye, nose, and throat irritation, as well as headaches, loss of coordination, and nausea. Long-term exposure may increase the risk of contracting respiratory diseases, such as asthma or chronic obstructive pulmonary disease.

Particulate Matter

Particulate matter is a broad class of air pollutants that exist as liquid droplets or solids, with a wide range of sizes and chemical composition. Particulate matter is emitted by a variety of sources, both natural and man-made. Natural sources include the condensed and reacted forms of natural organic vapors, salt particles resulting from the evaporation of sea spray, wind-borne pollen, fungi, molds, algae, yeasts, rusts, bacteria, and debris from live and decaying plant and animal life, particles eroded from beaches, desert, soil and rock, and particles from volcanic and geothermal eruptions and forest fires. Major man-made sources of particulate matter include the combustion of fossil fuels such as vehicular exhaust, power generation and home heating, chemical and manufacturing processes, all types of construction (including that from equipment exhaust and re-entrained dust), agricultural activities, and wood-burning fireplaces. Fine particulate matter is also derived from combustion material that has

volatilized and then condensed to form primary particulate matter (often after release from a stack or exhaust pipes) or from precursor gases reacting in the atmosphere to form secondary particulate matter. It is also derived from mechanical breakdown of coarse particulate matter (e.g., from building demolition or roadway surface wear). Of particular health concern are those particles that are smaller than or equal to 10 microns (PM_{10}) in size and 2.5 microns ($PM_{2.5}$) in size. The principal health effects of airborne particulate matter are on the respiratory system.

Sulfur Oxides

High concentrations of SO_2 affect breathing and may aggravate existing respiratory and cardiovascular disease. SO_2 emissions are generated from the combustion of sulfur-containing fuels–oil and coal–largely from stationary sources such as coal and oil-fired power plants, steel mills, refineries, pulp and paper mills, and nonferrous smelters. In urban areas, especially in the winter, smaller stationary sources such as residential boilers contribute to elevated SO_2 levels. Ambient SO_2 levels recorded in the area have complied with ambient air quality standards for over twenty years.

Lead

Lead emissions are principally associated with industrial sources and motor vehicles using gasoline containing lead additives. Lead poisoning can cause abdominal pain, constipation, headaches, irritability, memory problems, and tingling in the hands and feet. As the availability of leaded gasoline has decreased, motor vehicle-related lead emissions have decreased resulting in a significant decline of concentrations of lead and atmospheric lead concentrations in the region are well below national standards. Lead emissions are not expected to result from the burning of natural gas. Since natural gas turbines generate minimal amounts of lead emissions, an analysis of lead is not warranted.

HAPs

EPA is working with state and local governments to reduce air emissions of 187 toxic air pollutants, also known as HAPs, to the environment. These pollutants could be carcinogenic and/or damage the immune system, as well as cause neurological, reproductive (e.g., reduced fertility), developmental, respiratory and other health problems. Examples of toxic air pollutants include benzene, which is found in gasoline; perchloroethylene which is emitted from some dry-cleaning facilities; and methylene chloride, which is used as a solvent and paint stripper by several industries. Examples of other listed air toxics include dioxin, asbestos, toluene, and metals such as cadmium, mercury, chromium, and lead compounds.

2.2 National/State Ambient Air Quality Standards

National Ambient Air Quality Standards (NAAQS) are concentrations for each of the criteria pollutants specified by EPA that have been developed primarily to protect human health. Secondary standards have been developed to protect the nation's welfare and account for the effect of air pollution on soil, water, vegetation and other aspects of general welfare. Based on how these pollutants adversely affect health, health-related averaging periods have also been established for these pollutants. These standards, together with their health-related averaging periods, are presented in Table 1.

New Jersey's ambient air quality standards are similar to the NAAQS and include a 12-month and a 24-hour secondary standard for SO_2; and 12-month and 24-hour primary and secondary standards for total suspended particulate matter. These were not considered in this analysis, as the project's impacts on these pollutants over these time periods are considered to be minimal but will be considered as part of the Title V permitting process.

Table 1 National Ambient Air Quality Standards (NAAQS)

	Primary		Secondary	
	ppm	µg/m³	ppm	µg/m³
Carbon Monoxide (CO)				
8-Hour Average (1)	9	10,000	None	
1-Hour Average (1)	35	40,000		
Lead (Pb)				
Rolling 3-Month Average	NA	0.15	NA	0.15
Nitrogen Dioxide (NO_2)				
1-Hour Average (2)	0.100	188	None	
Annual Average	0.053	100	0.053	100
Ozone (O_3)				
8-Hour Average (3)	0.070	150	0.070	150
Respirable Particulate Matter (PM_{10})				
24-Hour Average (1)	NA	150	NA	150
Fine Respirable Particulate Matter ($PM_{2.5}$)				
Annual Mean	NA	12	NA	12
24-Hour Average (4)	NA	35	NA	35
Sulfur Dioxide (SO_2)				
1-Hour Average (5)	0.075	196	NA	NA
Maximum 3-Hour Average (1)	NA	NA	0.50	1,300

Notes:

ppm – parts per million (unit of measure for gases only)

µg/m³ – micrograms per cubic meter (unit of measure for gases and particles, including lead)

NA – not applicable

All annual periods refer to calendar year.

Standards are defined in ppm. Approximately equivalent concentrations in µg/m³ are presented.

(1) Not to be exceeded more than once a year.

(2) 3-year average of the annual 98th percentile daily maximum 1-hr average concentration, which is equivalent to the 8th highest concentration. Effective April 12, 2010.

(3) 3-year average of the annual fourth highest daily maximum 8-hr average concentration. EPA has lowered the NAAQS down from 0.075 ppm effective December 2015.

(4) Not to be exceeded by the annual 98th percentile (which is equivalent to the 8th highest concentration) when averaged over 3 years.

(5) EPA revoked the 24-hour and annual primary standards, replacing them with a 1-hour average standard. Effective August 23, 2010. 3-year average of the annual 99th percentile daily maximum 1-hr average concentration (which is equivalent to the 15th highest concentration).

Source: 40 CFR Part 50: *National Primary and Secondary Ambient Air Quality Standards*.

2.3 Attainment Designations

EPA has designated areas of the country as meeting (attainment) or not meeting (nonattainment) the NAAQS on a pollutant by pollutant basis – these areas are known as attainment and nonattainment areas. Also, previously designated nonattainment areas that have demonstrated attainment are known as maintenance areas. The Clean Air Act (CAA) requires states to develop plans to attain and maintain the NAAQS in all areas of the country – attainment plans to attain the standards in areas designated nonattainment for a NAAQS and maintenance plans for attainment/maintenance areas.

2.4 Nonattainment New Source Review and Prevention of Significant Deterioration (NNSR/PSD) Increments

Projects that emit pollutants in nonattainment areas are required to offset emissions (i.e., reduce emission elsewhere to compensate for emissions generated), and dispersion modeling is usually required to demonstrate that no new exceedances would occur and/or that the existing exceedance would not be exacerbated. Emissions are reviewed under the "Nonattainment New Source Review" (NNSR) program, which requires strict emission controls meeting the Lowest Achievable Emission Rate (LAER) with no regard to cost. The need for emission offsets is also determined as part of the permitting process.

Prevention of Significant Deterioration (PSD) increments are the amounts of pollution an attainment/maintenance area is allowed to increase. PSD increments prevent the air quality in clean areas from deteriorating to the level set by the NAAQS. The NAAQS is a maximum allowable concentration "ceiling." A PSD increment, on the other hand, is the maximum allowable increase in concentration that is allowed to occur above a baseline concentration (usually an existing condition concentration) for a pollutant. Significant deterioration is said to occur in an attainment area when the amount of new pollution would cause an exceedance of an applicable PSD increment. It is important to note, however, that pollutant levels are not permitted to deteriorate beyond the concentrations allowed by the applicable NAAQS regardless of the PSD increment. Air dispersion computer modeling is used to demonstrate compliance with PSD increments.

The State of New Jersey (as well as most of the Northeast) is designated as a nonattainment area for O_3. Therefore, emissions of O_3 precursors (NOx and VOCs) will require LAER emission controls and offsets; however, since O_3 impacts are felt far downwind of an emission source, dispersion modeling for O_3 is not required under NNSR/PSD. The Project area is also designated as a maintenance area for $PM_{2.5}$ and CO, and an attainment area for NO_2, SO_2, and PM_{10}. The applicable PSD increments for these designations are provided in Table 2. Dispersion modeling has been performed to confirm compliance with the PSD increments and NAAQS.

Table 2 Applicable PSD Increments (µg/m³) *

Pollutant	Averaging Period	PSD Increment
$PM_{2.5}$	24-hr	9
	Annual	4
PM_{10}	24-hr	30
	Annual	17
NO_2	Annual	25
SO_2	3-hr	512
	24-hr	91
	Annual	20

***Note:** No PSD increments have been developed for CO, 1-hour NO_2, or 1-hour SO_2.
Source: 40 CFR 52.21 - Prevention of Significant Deterioration of Air Quality.

2.5 Applicable Emissions Regulations

Federal regulations applicable to a new power generating facility include the EPA's Title V and NNSR/PSD Emissions Offset Rule permitting requirements. In addition, New Source Performance Standards (NSPS) have been promulgated that establish allowable emission rates on a pollutant-by-pollutant basis that apply to all new fuel combustion systems. Also, EPA has developed Maximum Achievable Control Technology (MACT) standards to reduce the effects of HAPs generated by industry by establishing emission limits based on air toxic emission levels already achieved by the best-performing similar facilities.

EPA has delegated authority to administer these programs to the New Jersey Department of Environmental Protection (NJDEP). Applicable State regulations provided in the New Jersey Administrative Code (NJAC) include State of the Art (SOTA) criteria and Reasonable Available Control Technology (RACT) requirements. Additional NJAC regulations that may be applicable to the proposed facility include Title 7, Chapter 27, Subchapters 8 (Permits and Certificates for Minor Facilities and Major Facilities without an Operating Permit), 18 (Emission Offset Rules), and 22 (Title V Operating Permits).

In addition, in accordance with NJDEP permitting policy, all new or modified sources of air pollution applying for pre-construction or operating permits are required to conduct a risk assessment for air toxics if they emit certain amounts of these contaminants. As such, an air toxics analysis was conducted in accordance with New Jersey's Risk Assessment for Air Contaminant Emissions contained in NJDEP's Technical Manual 1003.

In general, Transportation and/or General Conformity requirements apply to proposed major projects in nonattainment or maintenance areas. However, the Build Alternative is exempt from these requirements (for both operation and construction) since it is "presumed to conform," meaning that it will meet the approved emissions budget for the area through the Title V permitting process.

2.6 Emission Control Requirements of Applicable Regulations

An operating permit is a comprehensive regulatory document that is enforceable. It lists all air pollution sources including combustion equipment, air pollution control devices, and the rules and regulations that apply to the facility as well as operational requirements, emission limits, and monitoring and reporting requirements. Permitting requirements are determined by the type of source, operation of the source, potential emissions, and the location of the facility.

Emission control technologies are required on a pollutant-by-pollutant basis under the NNSR/PSD program. If a proposed facility is classified as a "major" facility for a pollutant in a nonattainment area, the use of LAER technology (i.e., with no regard to costs) and emission offsets may be required for that pollutant. If the plant's permitted emissions are estimated to be below the threshold limits for pollutants in attainment with NAAQS, less restrictive best available control technology (BACT) requirements will apply to that pollutant. BACT/LAER determinations will be completed for the selected turbine types and sizes based on an analysis of the EPA database of recent permits, and BACT/LAER analyses of recent NNSR/PSD applications. These requirements will be determined by NJDEP on a case-by-case basis.

Emission controls may also be required under the MACT and NSPS programs based on the type of emission source, and to meet New Jersey's RACT and SOTA requirements.

Based on estimated emission rates of the range of equipment configurations for the Build Alternative, it is anticipated that the use of dry low NOx (DLN) combustion, selective catalytic reduction (SCR), and oxidation catalyst systems will be required to successfully permit the proposed facility in accordance with NJDEP and EPA requirements. These technologies, which will be incorporated into the design of the microgrid and are assumed for this analysis, substantially reduce NOx and CO emissions, and cause smaller reductions in VOC and HAP emissions. A wet injection system, which was not assumed for this analysis, may also be included to further reduce NOx emissions. The final emission control requirements will be determined as part of the Title V permitting process.

3.0 AFFECTED ENVIRONMENT

3.1 Meteorology and Climate

Local meteorological and topographical features influence the dispersion of plumes from the plant's exhaust stacks and greatly affect the impacts of a plant's emissions. To account for these factors in this analysis, five years of data collected by the National Weather Service at Newark Airport were used in the modeling analyses for this project to represent the types of meteorological conditions (wind directions, wind speeds, temperatures, mixing heights, etc.) experienced in the study area. The topography surrounding the project site was also included.

The dominant feature of the atmospheric circulation over North America is the broad, undulating flow from west to east across the middle latitudes of the continent. These "prevailing westerlies" shift north and south and vary in strength during the year, exerting a major influence on the weather throughout

the State. Local meteorological data show that the prevailing wind directions are from the southwest and north. Lighter winds are most frequently from the southeast quadrant, while higher wind speeds are most often associated with westerly winds. Terrain in the study area is relatively flat and marshy. To the northeast are ridges oriented roughly in a south-southwest to north-northeast direction. They rise to an elevation of about 200 feet at 4.5 to 5 miles and to 500 to 600 feet at 7 to 8 miles.

3.2 Monitored Ambient Pollutant Levels

Representative monitored ambient air quality data for the project area are shown in Table 3. These data, which were, in general, collected from ambient monitoring stations closest to the Main Facility (Project Component A), were used to develop the baseline data used in the modeling analyses. These baseline values were then added to predicted project impacts under the Build Alternative to estimate total pollutant concentrations.

These data were compiled by the NJDEP and are for the years 2013 through 2015, the latest calendar years for which data are currently available. Except for O_3, the monitored levels for all pollutants do not exceed national or State ambient air quality standards.

Table 3 Representative Monitored Ambient Air Quality Data for Criteria Pollutants 2013 to 2015

Pollutants and Averaging Times	Monitored Data				NAAQS	Monitoring Site Location
	2013	2014	2015	3 Year Avg		
						2828 Kennedy Blvd, Jersey City, NJ
Carbon monoxide (ppm) 8-hour (2nd Max)	1.8	1.8	1.6	NA	9	
1-hour (2nd Max)	2.7	2.5	2.5	NA	35	
						Veterans Park on Newark Bay, 25th Street near Park Road, Bayonne, NJ
Ozone (ppm) 8-hour (4th-highest Daily Max) # days > Standard	0.066 1	0.072 2	0.072 6	0.072	0.075*	
						Veterans Park on Newark Bay, 25th Street near Park Road, Bayonne, NJ
Nitrogen dioxide (µg/m3) 1-hour (98th percentile) Annual	 52 16.2	 61 17.1	 57 16.5	 57 16.6	 188 100	
						Consolidated Firehouse 355 Newark Avenue, Jersey City, NJ
PM10 (µg/m3) 24-Hour (2nd Max)	43	37	44	41	150	
PM2.5 (µg/m3) Annual Arithmetic Mean	10.5	10.5	10.3	10.4	12	Consolidated Firehouse 355 Newark Avenue, Jersey City, NJ
24-Hour (98th percentile)	29	24	26	26	35	Health Department 714 31st Street Union City, NJ
Sulfur dioxide (ppb) 1-hour (99th percentile)	10	10	5	8	75	Veterans Park on Newark Bay, 25th Street near Park Road, Bayonne, NJ

* The recent change in the ozone standard, from 0.075 to 0.070, was not reflected in the values shown on this table. This is because the AIRS Database compared the number of days that the standard was exceeded in 2013, 2014, and 2015 with the standard that was in effect at that time.

Notes:

1. NA = not applicable; ppb = parts per billion; ppm = parts per million: µg/m3 = microgram per cubic meter.
2. Exceedances of the NAAQS are shown in bold.
3. If data exist from more than one monitor or more than one city, the maximum value is shown on table.

Source: EPA, AIRS Database, http://www.epa.gov/airdata, accessed May 2016.

4.0 ANALYSIS METHODOLOGY

4.1 Dispersion Model

The EPA AERMOD model, which was used in this analysis, is a steady-state dispersion model that is most often used to estimate pollutant concentrations to determine compliance with regulatory requirements. The latest version of EPA's AERMOD stationary sources air quality dispersion model (version 16216r; USEPA, 2017) was employed to predict ambient pollutant concentrations resulting from the range of equipment configurations for the Build Alternative options of the Main Facility (Project Component A) using reasonable worst-case assumptions. The model was utilized in this analysis in accordance with the NJDEP Division of Air Quality Technical Manual 1002, *Guideline on Air Quality Impact Modeling Analysis* (November 2009). Highlights of the modeling approach include the following:

- While multiple equipment and building configurations have been considered, the option of a large enclosed Main Facility building was assumed for this analysis. This option would provide a conservative (high) estimate of pollutant concentrations near the site boundary (the nearest local receptor), which are all projected to be below threshold levels.
- Inputs to the model for the dispersion modeling analysis include the location and stack parameters of the five gas-turbine stacks located on the roof of the main heating plant building; heating plant parameters for downwash calculations; calculated emission rates and stack parameters under each equipment configuration; five consecutive years of meteorological data (to capture typical and atypical weather characteristics); background pollutant concentrations; and applicable information on nearby land use and topography.
- The analysis was conducted using regulatory default options such as elevated terrain algorithms, calm processing routines, missing data processing routines, and the use of a 4-hour half-life for exponential decay of SO_2 for urban sources.
- An urban dispersion surface roughness length was applied in the model based on the land use and population density in a two-mile radius from the site (as specified in the model).
- While not required by the Air Quality Technical Manual 1002, a broader receptor grid with a conservative five-mile radius from the site was used to evaluate air quality.
- The AERMOD Building Profile Input Parameters algorithm was employed to estimate building profile input parameters for downwash effect calculations.
- This analysis applied the $PM_{2.5}$ special procedure incorporated into AERMOD, which 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.
- Analyses were conducted employing the downwash algorithm of the AERMOD model. This algorithm accounts for the effects of wind flows around physical structures.
- Equipment configurations that were examined include simple-cycle plants (i.e., only natural gas turbines), combined-cycle plants (i.e., natural gas turbines with heat recovery systems to run steam turbines), and hybrid-cycle plants (i.e., some natural gas turbines with and some without heat recovery systems to run steam turbines).

- Results are particularly affected under design options with steam turbines that capture exhaust heat due to a lower stack exit temperature and exit velocity. For this analysis, two configurations of five natural gas turbines were modeled. A simple-cycle plant was evaluated, and a combined-cycle plant with heat recovery on all natural gas turbines to run two steam turbines was evaluated. While the addition of the heat recovery system and steam turbines would not increase the amount of emissions, it would change the dispersion of the emissions in the atmosphere. The current project design includes one steam turbine, which would reduce stack exit temperatures to a lesser extent, which would have a lower effect on nearby ground-level emissions concentrations.

4.2 Surface Characteristics

The AERMOD modeling system uses the EPA AERMET program to process meteorological data. Values of three surface characteristics (surface roughness length, Bowen ratio, and albedo) are required inputs for AERMET. Albedo is a measure of the reflectivity of the surface; Bowen ratio is a measure of the heat and moisture fluxes (i.e., flows) from the surface; and roughness length is a measure of terrain roughness (obstacles to wind flow) as "seen by" surface wind.

The EPA's AERSURFACE tool (version 13016) was used to determine the needed surface characteristic values. AERSURFACE was developed by the EPA to provide realistic and objectively determined surface characteristic values for use in the AERMET meteorological preprocessor.

Although the use of AERSURFACE is not required for regulatory applications involving AERMOD, the EPA states that the calculation methods recommended in the AERSURFACE User's Guide (EPA, 2008) and implemented in AERSURFACE should be followed unless a case-specific justification is provided for an alternative method.

The AERSURFACE User's Guide (EPA, 2008) was followed in order to obtain realistic and reproducible surface characteristic values for input to AERMET. National Land Cover Data (NLCD92) used in AIRSURFACE processing was obtained from the Multi-Resolution Land Use Consortium (MRLC). This dataset provides land cover data at a spatial resolution of 30 meters and based on a 21-category classification scheme. The recommended default value of one (1) kilometer was used to define the radius of the study area used for surface roughness.

Soil moisture determination will adjust the Bowen ratio estimated by AERSURFACE. EPA guidance recommends that soil moisture conditions be determined by precipitation levels on an annual, seasonal, or monthly basis as wet, dry, or average. Specifically, precipitation of a modeled period is compared to 1981-2010 precipitation record. The 30^{th} and 70^{th} percentile values of precipitation distribution from 1981-2010 is calculated. Per U.S. EPA guidance, each modeled period is classified as "wet" if its precipitation is higher than the 70^{th} percentile value, "dry" if its precipitation is lower than the 30^{th} percentile value, and "average" if it is between the 30^{th} and 70^{th} percentile values. This precipitation classification is then applied to soil moisture determination.

Following the methodology described above, precipitation data for meteorological station KEWR in Newark Airport was acquired and analyzed and classified, and soil moisture determinations were performed on an annual basis. The values used in this preliminary analysis are provided in Table 4. Since 2011 and 2014 have both "wet" surface moisture determination, a same set of surface characteristics parameters output by AERSURFACE was used in AERMET processing of these two years. For the same reason, a same set of surface characteristics parameters was used for 2012, 2013, and 2015 AERMET processing because their surface moisture determination is "dry." Surface roughness length was analyzed for 12 equal sectors. AERSURFACE automatically defined 30-degree sectors starting with 0° (North).

Table 4 AERSURFACE Input Parameters

AERSURFACE Parameter	Value
Met Station Latitude	40.682717
Met Station Longitude	74.169289
Datum	NAD 1983
Radius for Surface Roughness (km)	1.0
Vary by Sector?	Yes
Number of Sectors	12
Temporal Resolution	Seasonal
Continuous Winter Snow Cover?	No
Station Located at Airport?	Yes
Arid Region?	No
Soil Moisture Classification	Wet (2011, 2014), Dry (2012, 2013, 2015)

Table 5 lists surface characteristics parameters produced by AERSURFACE that were used in the AERMET processing.

Table 5 AERSURFACE Output Surface Characteristics Parameters

Season	Sector	2012, 2013, 2015 (Dry)			2011, 2014 (Wet)		
		Albedo	Bowen Ratio	Surface Roughness Length	Albedo	Bowen Ratio	Surface Roughness Length
Winter	1	0.16	1.46	0.122	0.16	0.55	0.122
Winter	2	0.16	1.46	0.068	0.16	0.55	0.068
Winter	3	0.16	1.46	0.067	0.16	0.55	0.067
Winter	4	0.16	1.46	0.081	0.16	0.55	0.081
Winter	5	0.16	1.46	0.07	0.16	0.55	0.07
Winter	6	0.16	1.46	0.088	0.16	0.55	0.088
Winter	7	0.16	1.46	0.092	0.16	0.55	0.092
Winter	8	0.16	1.46	0.108	0.16	0.55	0.108
Winter	9	0.16	1.46	0.078	0.16	0.55	0.078
Winter	10	0.16	1.46	0.083	0.16	0.55	0.083
Winter	11	0.16	1.46	0.079	0.16	0.55	0.079
Winter	12	0.16	1.46	0.081	0.16	0.55	0.081
Spring	1	0.16	1.38	0.146	0.16	0.54	0.146
Spring	2	0.16	1.38	0.07	0.16	0.54	0.07

Spring	3	0.16	1.38	0.068	0.16	0.54	0.068
Spring	4	0.16	1.38	0.084	0.16	0.54	0.084
Spring	5	0.16	1.38	0.074	0.16	0.54	0.074
Spring	6	0.16	1.38	0.099	0.16	0.54	0.099
Spring	7	0.16	1.38	0.101	0.16	0.54	0.101
Spring	8	0.16	1.38	0.128	0.16	0.54	0.128
Spring	9	0.16	1.38	0.085	0.16	0.54	0.085
Spring	10	0.16	1.38	0.089	0.16	0.54	0.089
Spring	11	0.16	1.38	0.083	0.16	0.54	0.083
Spring	12	0.16	1.38	0.087	0.16	0.54	0.087
Summer	1	0.16	1.31	0.17	0.16	0.53	0.17
Summer	2	0.16	1.31	0.071	0.16	0.53	0.071
Summer	3	0.16	1.31	0.069	0.16	0.53	0.069
Summer	4	0.16	1.31	0.09	0.16	0.53	0.09
Summer	5	0.16	1.31	0.08	0.16	0.53	0.08
Summer	6	0.16	1.31	0.116	0.16	0.53	0.116
Summer	7	0.16	1.31	0.11	0.16	0.53	0.11
Summer	8	0.16	1.31	0.159	0.16	0.53	0.159
Summer	9	0.16	1.31	0.097	0.16	0.53	0.097
Summer	10	0.16	1.31	0.099	0.16	0.53	0.099
Summer	11	0.16	1.31	0.086	0.16	0.53	0.086
Summer	12	0.16	1.31	0.094	0.16	0.53	0.094
Fall	1	0.16	1.46	0.168	0.16	0.55	0.168
Fall	2	0.16	1.46	0.071	0.16	0.55	0.071
Fall	3	0.16	1.46	0.069	0.16	0.55	0.069
Fall	4	0.16	1.46	0.09	0.16	0.55	0.09
Fall	5	0.16	1.46	0.08	0.16	0.55	0.08
Fall	6	0.16	1.46	0.116	0.16	0.55	0.116
Fall	7	0.16	1.46	0.11	0.16	0.55	0.11
Fall	8	0.16	1.46	0.157	0.16	0.55	0.157
Fall	9	0.16	1.46	0.096	0.16	0.55	0.096
Fall	10	0.16	1.46	0.099	0.16	0.55	0.099
Fall	11	0.16	1.46	0.086	0.16	0.55	0.086
Fall	12	0.16	1.46	0.093	0.16	0.55	0.093

4.3 Land Use

In addition to meteorological conditions, the transport of pollutants from emission sources to nearby sensitive land uses is also influenced by natural topographical conditions and manmade structures that affect air flow. EPA has developed techniques for representing these effects based on land use data obtained from the USGS.

The proposed Project is located on industrially zoned land, and the land use in the vicinity of the Project Development Area is primarily urban. Selection of the appropriate dispersion coefficients for air quality modeling is determined using the EPA-preferred land use classification technique provided in 40 CFR 51, Appendix W (also known as the "Auer" technique). This classification technique involves assessing Auer's categories (i.e., urban, rural, water) to the land within a 3-km radius of the Project Development Area (Auer, 1978) and quantifies the percentage of this area in various land use categories.

The most recent available land use data, which is from 2011, were obtained from the USGS, and a 3-km radius circle was inscribed electronically around the specified facility in ArcMap. All data were georeferenced and tabulated using the categories shown in Table 6 for urban and rural designations.

Figure 2 shows the layout of the land use where greens, yellows and browns are farmland, forests, and grasses, pinks are non-urban developed lands, and red and dark red are urban areas. Table 7 shows the results of this land categorization process. As can be seen, the area is mostly (53.9 percent) urban. Therefore, urban dispersion coefficients and mixing heights were determined to be appropriate for use in this modeling analysis.

Table 6 Urban / Rural Categories

2011 NLCD Land Cover Classification		Auer Land-Use Classification		Modeling TAD Rural or Urban
11	Open Water	A5	Water Surfaces	Rural
12	Perennial Ice/Snow	A5	Water Surfaces	Rural
21	Developed, Open Space	A1	Metropolitan Natural	Rural
22	Developed, Low Intensity	R1	Common Residential	Rural
23	Developed, Medium Intensity	I1, I2, C1, R2, R3	Industrial/Commercial/Compact Residential	Urban
24	Developed, High Intensity	I1, I2, C1, R2, R3	Industrial/Commercial/Compact Residential	Urban
31	Barren Land	A3	Undeveloped (Grasses/Shrub)	Rural
41	Deciduous Forest	A4	Undeveloped (Wooded)	Rural
42	Evergreen Forest	A4	Undeveloped (Wooded)	Rural
43	Mixed Forest	A4	Undeveloped (Wooded)	Rural
52	Shrub/Scrub	A3	Undeveloped (Grasses/Shrub)	Rural
71	Grassland/Herbaceous	A3	Undeveloped (Grasses/Shrub)	Rural
81	Pasture/Hay	A2	Agricultural	Rural
82	Cultivated Crops	A2	Agricultural	Rural
90	Woody Wetlands	A4	Undeveloped (Wooded)	Rural
95	Emergent Herbaceous Wetlands	A3	Undeveloped (Grasses/Shrub)	Rural

Figure 2: Distribution of Land Use within Three Kilometers of the Proposed Facility

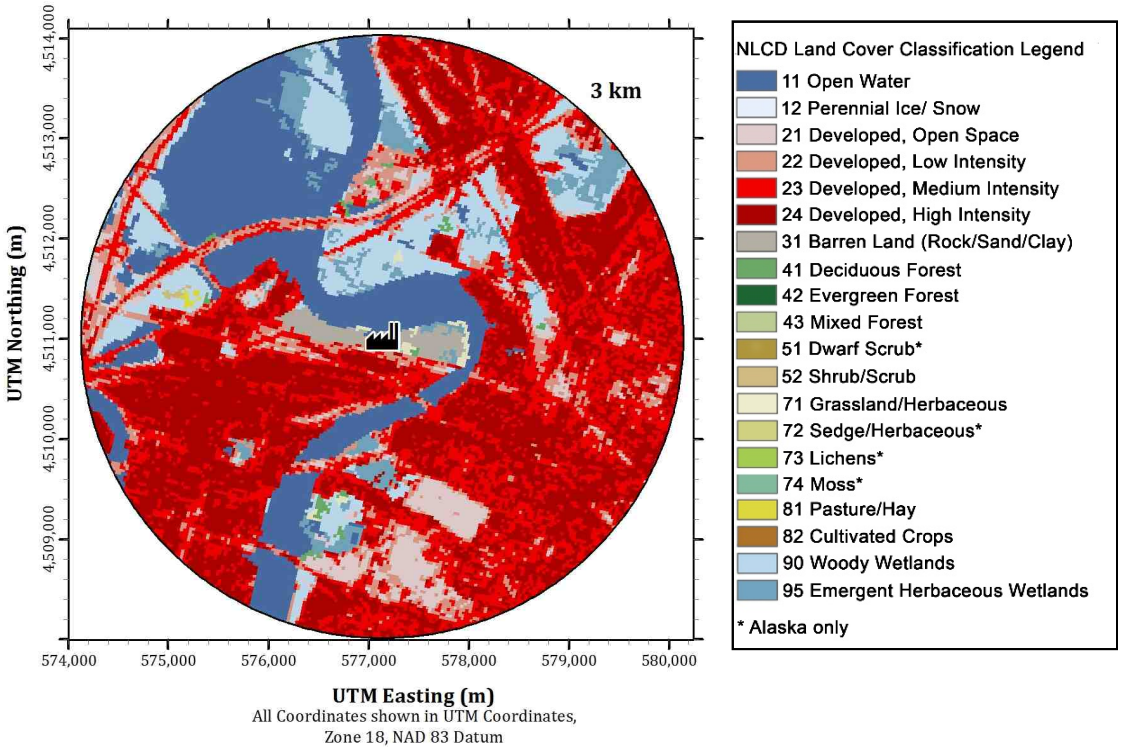


Table 7 Specified Facility Urban/Rural Determination

Percent Land Categorization ArcGIS Analysis Results for Facility		
Category ID	**Category Description**	**Percent**
11	Open Water	18.8%
21	Developed, Open Space	4.4%
22	Developed, Low Intensity	8.4%
23	Developed, Medium Intensity	23.4%
24	Developed, High Intensity	30.5%
31	Barren Land	1.3%
41	Deciduous Forest	0.4%
42	Evergreen Forest	0.0%
43	Mixed Forest	0.0%
52	Shrub/Scrub	0.1%
71	Grassland/Herbaceous	0.3%
81	Pasture/Hay	0.1%
82	Cultivated Crops	0.0%
90	Woody Wetlands	8.8%
95	Emergent Herbaceous Wetlands	3.6%
	Total	100%
	Urban	53.9%
	Rural	46.1%

4.4 Receptors

Receptor sites (i.e., locations at which pollutant concentrations are estimated through dispersion modeling analyses) were selected at locations anticipated to be most impacted by emissions from the proposed facility. Receptor grids consisting of more than 14,000 discrete receptors and 700 boundary receptors were developed specifically for this analysis that contains five nested (overlapping) Cartesian grids. The grids have a total land coverage of 10 miles by 10 miles (16 kilometers by 16 kilometers) centered around the Main Facility (see Figure 3).

The following receptor grids were developed:

- Boundary receptors = 7.6 meters (m) (25 feet) spacing around the perimeter of the Project Development Area, delineating the area to which the public will not have access;
- Inner grid = 25 m (82 feet) spacing out to a distance of 500 m (1,641 feet);
- Second grid = 50 m (164 feet) spacing out to a distance of 1,000 m (3,281 feet);
- Third grid = 100 m (328 feet) spacing out to a distance of 5,000 m (3.1 miles); and
- Fourth grid = 250 m (820 feet) spacing out to a distance of 8,000 m (5 miles).

The 25-meter inner receptor spacing grid was extended to provide higher resolution in the vicinity of peak predicted impacts. For NO_2, the fourth grid was extended to a distance of 8,000 meters (five miles)

from the project site, with 250-meter spacing, in order to define the Significant Impact Area for this pollutant.

Receptor elevations were assigned using the EPA's AERMAP software tool (version 06341; EPA, 2004b), which is designed to extract elevations from USGS National Elevation Dataset data at 1/3 arc second resolution in GeoTIFF format (USGS, 2002). This represents the highest resolution digital terrain data available from the USGS. A topographic map of the model region was generated using the AERMAP elevations.

4.5 Stack Heights

A Good Engineering Practice (GEP) stack height analysis was conducted in accordance with EPA guidance to evaluate whether the plumes emitted from the turbine stacks would be subject to building wake effects. If the stacks are sufficiently close to large buildings or other structures, the exhaust plumes from these stacks can be entrained in the buildings' wake. The resulting "downwash" reduces the effective release height and leads to increase nearby ground-level ambient concentrations. Building downwash effects must be evaluated when a stack is less than the "formula" GEP stack height, which is defined as follows for each stack:

HGEP = HB + 1.5LB where:

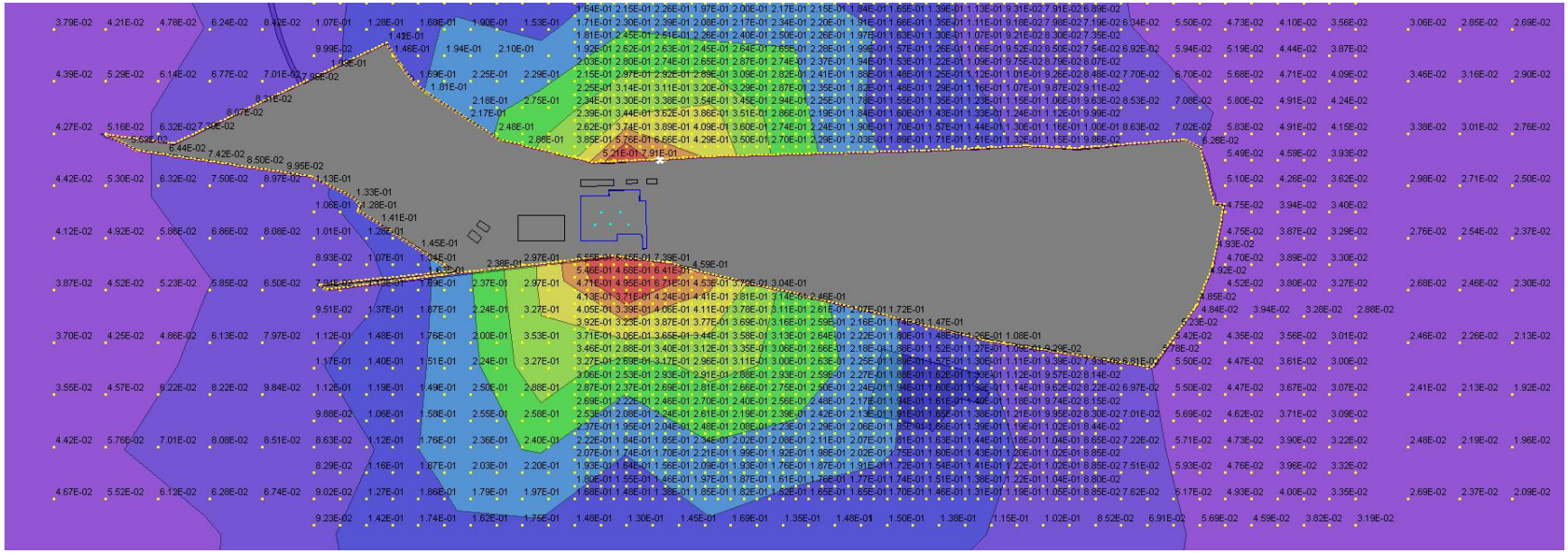
- HGEP = formula GEP stack height;
- HB = the building's height above the stack's base; and
- LB = the lesser of the building's height or maximum projected width.

A second definition of GEP stack height is the "regulatory" GEP stack height, which is either 65 meters (213 feet) or the formula GEP stack height, whichever is greater. Sources are not allowed to take credit for reduced ambient air concentrations that result from stacks that are higher than regulatory GEP stack heights.

The EPA Building Profile Input Program (BPIP) (EPA, 1995) produces the model input information necessary to account for building wake effects, based on the dimensions of buildings in the vicinity of the stacks. The Plume Rise Model Enhancement (PRIME) version of BPIP (BPIPPRM) (Schulman, et al., 1997) was used with the AERMOD atmospheric dispersion modeling system. BPIP uses a digitized blueprint of the facility's buildings and stacks as well as other nearby structures.

Based on preliminary design, the height of the turbine exhaust stacks was evaluated as being 150 feet above ground surface.

Figure 3: Receptor Network Grid System around the Facility



The results of the BPIP analysis for the combustion turbine stacks indicate that the main building containing the turbines would be the "controlling" structure for determining the GEP heights the turbine stacks. Based on the projected length and width of the most conservative controlling structure, the GEP stack height was estimated to be 213 feet. This would be the maximum height that would be allowed in the modeling analysis for plant permitting purposes (although lower stack heights could be considered). In addition, there is a Federal Aviation Administration (FAA) height limit for any structure at this site (based on air traffic patterns near Newark Liberty Airport) of 200 feet.

Based on preliminary design, the exhaust stacks heights were assumed to be 150 feet. However, this height could be raised to 200 feet (i.e., the FAA limit), which would reduce estimated pollutant concentrations, if required to demonstrate regulatory compliance.

4.6 Air Toxics

Pollutants

The EPA AP-42 Document (Compilation of Air Pollutant Emissions Factors) lists numerous toxic pollutants associated with burning natural gas that have the potential to be emitted from natural gas-fired combustion turbines. Of the toxic air pollutants emitted from combustion turbines, eleven individual toxic pollutants– acetaldehyde, acrolein, benzene, 1,3-butadiene, benzo(a)pyrene, ethylbenzene, formaldehyde, naphthalene, propylene oxide, toluene, xylenes – and a group of Polycyclic Aromatic Hydrocarbons (PAH) are identified. Because PAH is a group of chemicals but not individual compounds, the NJDEP recommends that benzo(a)pyrene (CAS No. 50-32-8) be used as a substitute for PAH or that the PAH group be separated into individual PAHs that have established guideline values. For this analysis, it was assumed that benzo(a)pyrene would represent the whole group of PAHs.

Short-term and annual emission rates were estimated for each of the eleven pollutants based on AP-42 emission factors and the heat input of turbines (with each natural gas turbine rated at 237 million British Thermal Units [MMBtu]/hour heat input). Annual emission rates are based on 8,760 hours of continuous operation per year, with five 22MW natural gas turbines, which is the configuration with the greatest potential emission rate. Estimated hourly and annual emission rates of each pollutant together with computed hazardous quotients and cancer risks are provided in Tables 8 and 9, respectively.

Assessment Methodology

NJDEP utilizes two approaches to perform risk assessment for the Air Quality Permitting Program: risk screening and comprehensive risk assessment. Risk screening consists of a simplified first-level (conservative) screening procedure, and, if adverse health impacts are predicted, a more detailed second-level screening is required. First-level risk screening uses generalized worst-case assumptions and simple worksheet calculations to estimate cancer and noncancer risks from inhalation of emissions proposed in a permit application. In place of dispersion modeling, air impact values are used to estimate dispersion and dilution of emitted pollutants, and the resulting ambient air concentrations. The screening process is designed to overestimate the risk for most sources. For detailed analyses, EPA's

AERMOD dispersion model is used following the same methodologies used for the criteria pollutant analysis.

The "NJDEP Division of Air Quality Risk Screening Worksheet for Long-Term Carcinogenic and Noncarcinogenic Effects and Short-Term Effects," was used for this first-level risk screening. Along with facility name and other associated information, the following information is required:

- Stack height, in feet
- Distance to property line, in feet
- Chemical-specific emissions (Q) in tons/year
- Chemical-specific emissions (Q_h) in pounds/hour

When the stack height and distance to property line are inserted into worksheet, the program calculates the appropriate annual air impact value (C') and 24-hour air impact value (C'_{st}). Incremental cancer risk (IR) and hazard quotients (HQ) are calculated when the chemical-specific emission rates are inserted. Cancer risks and hazard quotients are then summed up in order to give an indication of the magnitude of the risk of individual chemicals.

To calculate risk, the Risk Screening Worksheet uses contaminant-specific inhalation toxicity data in the form of unit risk factors (URFs) for carcinogens and reference concentrations (RfCs) for noncarcinogenic effects. The risk screening procedure considers only inhalation exposure. For carcinogens and long-term noncarcinogens, continuous lifetime exposure is assumed. For short-term noncarcinogenic effects, the exposure time is assumed to be 1, 4, 6, 7, 8 or 24 hours, depending on the chemical. To evaluate risk, appropriate ambient air concentrations are estimated.

For first-level risk screening, instead of site-specific modeling of an emissions source, several simplifying assumptions are made, and ambient air concentrations of air toxics are estimated using predetermined air impact values. The air impact values are developed by NJDEP DAQ using dispersion models. The air impact values provide estimates of the normalized ambient air concentrations [C'], based on emission rates, stack heights, and nearest distances to property line. The C' values are in units of $\mu g/m^3$ per ton per year [$(ug/m^3)/(ton/year)$], or $\mu g/m^3$ per pound per hour [$(ug/m^3)/(lb/hour)$]. Air impact values are estimated based on stack height and distance to property line.

There are two different air impact values, one for annual impacts (C') and one for short-term impacts (C'_{st}). The short-term health effects are calculated using the 24-hour impacts. For carcinogens, the exposure averaging time is annual. For noncarcinogenic effects, the exposure averaging time for a contaminant, either annual or 24 hours or less, is based on the health endpoint and averaging time used in developing the reference concentration.

The program multiplies chemical-specific emission rates by the air impact values to determine maximum annual or short-term ambient air concentrations. It is assumed that source operations are at the

maximum allowable emission rates for a year, day, or hour(s). It is also assumed that the receptors are exposed to these ambient concentrations for the entire exposure period.

For long-term exposure to carcinogens and noncarcinogens, the maximum annual emission rate [Q], in tons/year, is used to determine [C], the maximum annual average air concentration, as follows:

C = C' x Q, where:

C = maximum annual average air concentration, µg/m^3

C' = normalized annual air concentration, (µg/m^3)/(ton/year)

Q = maximum annual emission rate, ton/year

To evaluate short-term and acute exposures to noncarcinogens, pounds/hour emission rates [Q_h] are used to estimate maximum 24-hour average air concentrations [C_{st}] as follows:

$C_{st} = C'_{st} \times Q_h$, where:

C_{st} = maximum 24-hour average air concentration, µg/m^3

C'_{st} = normalized 24-hour average air concentration, (µg/m^3)/(lb/hour)

Q_h = maximum hourly emission rate, lb/hour

Many short-term RfCs have exposure periods less than 24 hours. To estimate exposure for the other averaging times (1-, 4-, 6-, 7-, and 8-hours), appropriate conversion factors are used.

Carcinogens

The maximum annual average ambient concentration of a chemical is multiplied by its unit risk factor to get the incremental cancer risk from each chemical as follows. The incremental cancer risk is considered insignificant if it is below one in a million (1E-06).

Cancer Risk = C x URF, where:

C = maximum annual average ambient air concentration of a pollutant, µg/m^3

URF = pollutant-specific inhalation unit risk factor, (µg/m^3)$^{-1}$

Noncarcinogens

The appropriate ambient concentration (long-term or short-term) of a chemical is divided by its reference concentration(s) to get the hazard quotient for each chemical – both for long-term hazard quotients (HQ) and short-term hazard quotients (HQ_{st}). If the hazard quotient is less than 1, the health effects are considered not significant and no further analysis is required.

Long-Term Hazard Quotient

Hazard Quotient = C/RfC, where:

C = maximum annual average ambient air concentration, µg/m^3

RfC = pollutant-specific reference concentration, µg/m^3

Short-Term Hazard Quotient

Hazard Quotient$_{st}$ = C_{st}/RfC_{st} , where:

C_{st} = maximum short-term ambient air concentration, µg/m^3

RfC_{st} = pollutant-specific short-term reference concentration, µg/m^3

5.0 EMISSION RATES

Preliminary estimates have been made to predict short-term and annual emission rates that would be generated by the gas-fired turbines under the proposed Build Alternative and evaluated both a simple-cycle plant (with five 22MW natural gas turbines) and a combined-cycle plant (with five 22MW natural gas turbines, and two 40MW steam-driven turbines) to help evaluate the worst-case scenario for emission rates. These emission rates were then used to determine whether the impacts of these design configurations have the potential to significantly impact localized air quality levels. As previously discussed, the current project design includes one steam turbine, which would reduce stack exit temperatures to a lesser extent, which would have a lower effect on nearby ground-level emissions concentrations.

5.1 Worst-Case Simple-Cycle Emission Rates

The emission sources responsible for most of the potential emissions from this configuration are the five natural gas turbines. Maximum emission rates from these turbines under peak load conditions, therefore, are the focus of this worst-case atmospheric dispersion modeling analysis. It is assumed that all five turbines would operate 8,760 hours per year under full load. Subsequent modeling for the Title V permit will include consideration of operations over a range of turbine loads and operating scenarios.

Short-term and annual emissions of all pollutants from the proposed equipment have been estimated based upon emission factors associated with the application of LAER DLN+SCR[1] control technology for NOx, CO and VOCs (HAPs); oxidation catalyst systems; NJDEP's SOTA emission standards; EPA's AP-42 emission factor for SO_2; and EPA's recently developed $PM_{2.5}/PM_{10}$ emission factors.

The PM emission factors used in this analysis are based on recent studies where EPA determined that AP-42 emission factors significantly overestimate the condensable portion of $PM_{2.5}$ emissions in the total $PM_{2.5}$ emissions by, in some cases, a factor of 20. As a result, in 2010 EPA developed and made available a comprehensive spreadsheet of alternate $PM_{2.5}/PM_{10}$ emission factors (referenced in Tables 8 and 9) for the various combustion units firing natural gas. The alternate $PM_{2.5}$ emission factor for combustion turbines used in this analysis, which was obtained from this spreadsheet and includes both filterable and condensable particles, is 4.22E-04 lb/MMBtu. The alternate PM_{10} emission factor, which was obtained from the same spreadsheet and includes filterable and condensable particles, is 5.1E-04 lb/MMBtu.

[1] LAER = Lowest Achievable Emission Rate; DLN = dry low NO_x combustion; SCR = selective catalytic reduction

It is estimated by the project's engineers that each gas-turbine will consume up to 237 MMBtu/hour of heat input and use SCR and oxidation catalysts (per NJDEP SOTA) to control CO and NOx emissions. Emission rates estimated for the applicable pollutants for each turbine and combined for the whole plant under the worst-case simple-cycle and worst-case combined-cycle plant configurations are provided in Tables 8 through 13.

Table 8 Estimated $PM_{2.5}$ Emission Rates for Each Gas Turbine Under the Worst-Case Simple-Cycle and Worst-Case Combined-Cycle Plant Configurations

Unit ID	EPA Alternate Emission Factor (1)	Heat Input Per Unit	$PM_{2.5}$ Emission Rates			
			Annual Average Emission Rate		Peak Short-term Emission Rate	
	lb/MMBtu	MMBtu/hour	lb/year	g/sec	lb/hour	g/sec
Turbine	4.22E-04	237	876	1.26E-02	9.99E-02	1.26E-02

1. For gas-turbines EPA alternate emission factor is 4.22E-04 lb/MMBtu which includes 1.08E-04 lb/MMBtu and 3.14E-04 lb/MMBtu for filterable and condensable particles, respectively. Factors were converted from lb/MMscf by assuming a heat value of 1,020 Btu/scf. https://www.pca.state.mn.us/sites/default/files/aq-ei1-07.xls

Table 9 Estimated PM_{10} Emission Rates for Each Gas Turbine Under the Worst-Case Simple-Cycle and Worst-Case Combined-Cycle Plant Configurations

Unit ID	EPA Alternate Emission Factor (1)	Heat Input Per Unit	PM_{10} Emission Rates			
			Annual Average Emission Rate		Peak Short-term Emission Rate	
	lb/MMBtu	MMBtu/hour	lb/year	g/sec	lb/hour	g/sec
Turbine	5.1E-04	237	1,059	1.52E-02	1.21E-01	1.52E-02

1. For gas-turbines EPA alternate emission factor is 5.1E-04 lb/MMBtu which includes 1.96E-04 lb/MMBtu and 3.14E-04 lb/MMBtu for filterable and condensable particles, respectively. Factors were converted from lb/MMscf by assuming a heat value of 1,020 Btu/scf. https://www.pca.state.mn.us/sites/default/files/aq-ei1-07.xls

Table 10 LAER Estimated NO_2 Rates for Each Gas Turbine Under the Worst-Case Simple-Cycle and Worst-Case Combined-Cycle Plant Configurations

Unit ID	LAER Emission Factors	Heat Input Per Unit	NO_2 Emission Rates			
			Annual Average Emission Rate		Peak Short-term Emission Rate	
	lb/MW-hour	MW	lb/year	g/sec	lb/hour	g/sec
Turbine	0.1	23	20,148	2.9E-01	2.3E+00	2.90E-01

1. LAER DLN+SCR NOx emission factors for turbines is 0.1 lb/MW-hour

Table 11 Estimated SO_2 Emission Rate for Each Gas Turbine Under the Worst-Case Simple-Cycle and Worst-Case Combined-Cycle Plant Configurations

Unit ID	Heat Input Per Unit	AP-42 Emission Factors (1)	SO_2 Emission Rates		
			Annual Average Emission Rate		Peak Short-term Emission Rate
	MMBtu/h	lb/MMBtu	lb/year	g/sec	g/sec
Turbine	237	0.0006	1,246	1.79E-02	1.79E-02

1. AP-42 SO_2 emission factor for gas turbines is 0.0006 lb/MMBtu

Table 12 Estimated CO Emission Rates for Each Gas Turbine Under the Worst-Case Simple-Cycle and Worst-Case Combined-Cycle Plant Configurations

Unit ID	LAER Emission Factors (1)	Heat Input	CO Emission Rates			
			Annual Average Emission Rate		Peak Short-term Emission Rate	
	lb/MMBtu	MMBtu/hour	lb/year	g/sec	lb/hour	g/sec
Turbine	0.007	237	14,533	2.09E-01	1.66E+00	2.09E-01

1. Emission factor (equivalent to 1.66 lb/hr) is based on oxidation catalysts achieving an 85% reduction in uncontrolled emissions.

Table 13 LAER Estimated VOC Emission Rates for Each Gas Turbines Under the Worst-Case Simple-Cycle and Worst-Case Combined-Cycle Plant Configurations

Unit ID	LAER Emission Factors (1)	Heat Input	VOC Emission Rates			
			Annual Average Emission Rate		Peak Short-term Emission Rate	
	lb/MMBtu	MMBtu/hour	lb/year	g/sec	lb/hour	g/sec
Turbine	0.004	237	8,305	8,305	1.19E-01	9.48E-01

1. Emission factor (equivalent to 0.95 lb/hr) is based on LAER control technology (oxidation catalysts) achieving a 75% reduction in uncontrolled emissions.

The estimated emission rates and stack parameters used in the modeling analyses are summarized in the Table 14.

Table 14 Stack Parameters and Per Unit Emission Rates Used in the Analysis of the Simple-Cycle Units *

Parameter	Units	Simple-Cycle
Fuel Type		Natural Gas
Ambient	degrees Kelvin	293 (68°F) (68°F)
Percent Load Rate	%	100
Duct Burner		No
Stack Diameter	feet	10
Stack Heights	feet	150
Stack Temperature	°F	1,050
Stack Exit Velocity	feet/second	66
NOx Emission Rate	grams/second	0.29
$PM_{2.5}$ Emission Rate	grams/second	0.0126
PM_{10} Emission Rate	grams/second	0.0152
SO_2 Emission Rate	grams/second	0.0179
CO Emission Rate	grams/second	0.209

***** Data are per turbine

5.2 Worst-Case Combined-Cycle Emission Rates

The worst-case combined-cycle plant configuration includes five natural gas turbines and two steam turbines. Because exhaust gases from steam turbines would be routed back to the gas-turbine exhaust stacks without any additional fuel combustion, the same emission rates as those used for the simple-cycle plant configuration were used in the modeling analyses for the combined-cycle plant configuration. The major difference in the analysis is that the recovery of heat to drive the steam turbines would substantially lower the exhaust plume's temperature and exit velocity, which would lower plume rise and, therefore, potentially increase impacts close to the plant boundary. Table 15 provides the stack parameters and emission rates used for the worst-case combined-cycle plant configuration.

6.0 ASSESSMENT OF POTENTIAL AIR QUALITY IMPACTS

6.1 No Action Alternative

Under the No Action Alternative, the microgrid would not be constructed and NJ TRANSIT (and Amtrak) would continue to rely on the commercial grid for traction power in the core service territory, which would be unavailable during emergency conditions.

Table 15 Stack Parameters and Per Unit Emission Rates Used in the Analysis of the Combined-Cycle Units *

Parameter	Units	Combined-Cycle
Fuel Type		Natural Gas
Ambient	degrees Kelvin	293 (68 °F)
Percent Load Rate	%	100
Duct Burner		No
Stack Diameter	feet	10
Stack Heights	feet	150
Stack Temperature	°F	300
Stack Exit Velocity	feet/second	33
NOx Emission Rate	grams/second	0.29
$PM_{2.5}$ Emission Rate	grams/second	0.0126
PM_{10} Emission Rate	grams/second	0.0152
SO_2 Emission Rate	grams/second	0.0179
CO Emission Rate	grams/second	0.209

* Data are per turbine

6.2 Worst-Case Simple-Cycle Plant

The results of the modeling analysis are summarized in Table 16, and discussed below.

$PM_{2.5}$ Results

EPA guidance for $PM_{2.5}$ modeling recommends that impacts for the peak 24-hour and annual average time periods be evaluated by averaging the maximum impacts for each year over the 5-year analysis period. Following this guidance, special procedures were incorporated into the AERMOD model so that concentrations are estimated at each receptor for each year modeled, and these concentrations are then averaged across the number of years of data, and the highest 5-year averaged values for all receptors are identified. These values are reported in Table 16.

As shown, the maximum estimated 24-hour and annual $PM_{2.5}$ impacts are less than the allowable PSD increments of 9 ug/m^3 and 4 ug/m^3, respectively, and the maximum estimated total concentration, which includes the background concentration, is less than the 24-hour $PM_{2.5}$ NAAQS of 35 ug/m^3. The total annual $PM_{2.5}$ concentration with added background concentration is less than the annual $PM_{2.5}$ NAAQS of 12 ug/m^3. As such, the maximum potential impact of the $PM_{2.5}$ emissions is not considered to be significant.

Figure 4 shows a contour map of estimated 24-hour $PM_{2.5}$ concentrations for the simple-cycle plant and Figure 5 shows 24-hour $PM_{2.5}$ concentration contours overlapped over the local topography in the study area.

Figure 4: $PM_{2.5}$ Contour Map for the Worst-Case Simple-Cycle Plant

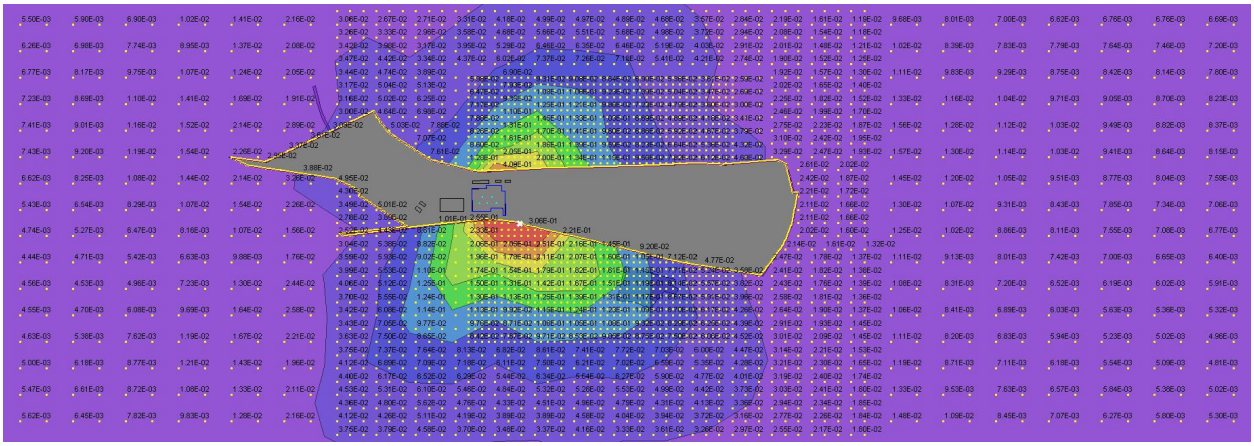
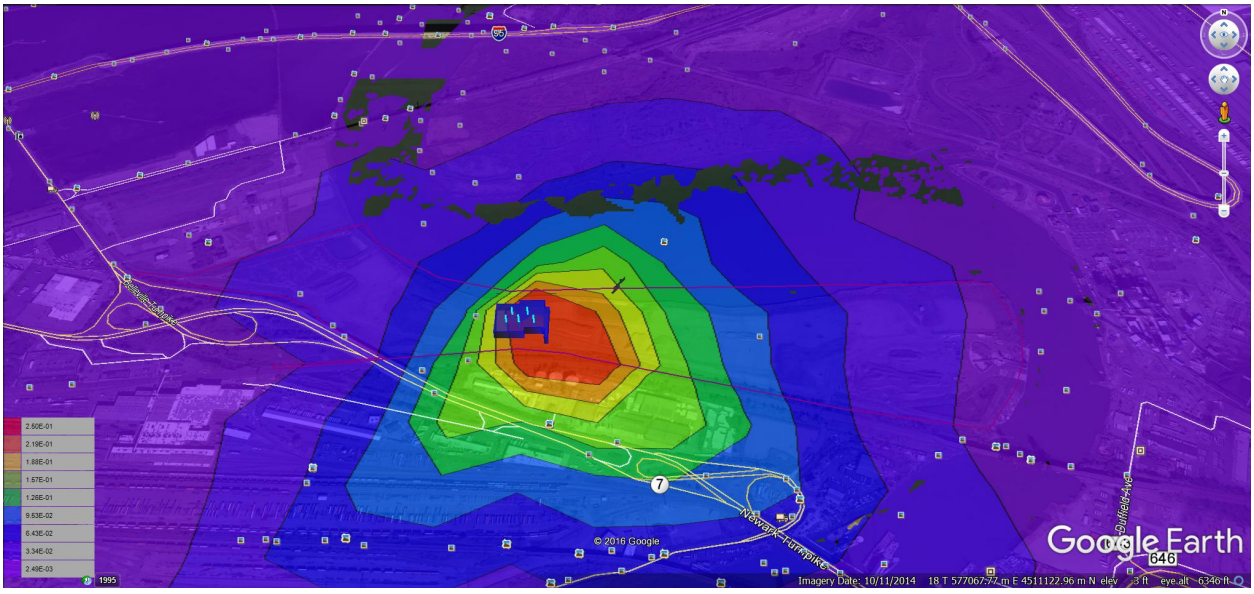


Figure 5: $PM_{2.5}$ Contour Map for the Worst-Case Simple-Cycle Plant Overlapped on Local Topography



PM_{10} Results

The maximum estimated 24-hour impact is less than the allowable PSD increment of 30 ug/m^3, and the maximum estimated total concentration is less than the 24-hour PM_{10} NAAQS of 150 ug/m^3. As such, the potential impact of the PM_{10} emissions is not considered to be significant.

NO_2 Results

The results of the analysis demonstrate compliance with 1-hour NO_2 NAAQS. The 8th highest daily maximum 1-hour NO_2 total concentration (which corresponds with the 98th percentile level, as defined

in Table 1, with the added background concentration) is less than the 1-hour NO_2 NAAQS of 188 ug/m^3. In addition, the total annual NO_2 concentration, with added background concentration, is also less than the annual NO_2 NAAQS of 100 ug/m^3. As such, the potential impact of the NO_2 emissions is not considered to be significant.

CO and SO_2 Results

The results of the analysis for these pollutants are that the estimated maximum concentrations are below the applicable NAAQS for these pollutants. As such, the potential impacts of the CO and SO_2 emissions are not considered to be significant. Therefore, the air quality impacts of the proposed worst-case simple-cycle plant configuration are not considered to be significant.

Table 16 Maximum Predicted Pollutant Impacts for the Worst-Case Simple-Cycle Plant (ug/m^3)

Pollutant	Averaging Period	Max Impact	Background Concentration	Total Conc.	NAAQS	Applicable PSD Increment
$PM_{2.5}$	24-hr	0.47	26	26.5	35	9
	Annual	0.05	10.4	10.5	12	4
PM_{10}	24-hr	0.65	41	41.7	150	30
	Annual	Negligible (1)	N/A (2)	N/A	N/A	17
NO_2	1-hr	14.7	107 (3)	121.7	188	N/A
	Annual	1.3	16.6 (3)	17.9	100	25
SO_2	1-hr	0.95	20.9	21.9	196	N/A
	3-hr	Negligible (4)	N/A	N/A	N/A	512
	24-hr	Negligible (4)	N/A	N/A	N/A	91
	Annual	Negligible (4)	N/A	N/A	N/A	20
CO	8-hr	11	1,889	1,900	10,000	N/A

Notes:
(1) Negligible based on the results of the 24-hour analysis.
(2) N/A = not applicable
(3) PPM values shown in Table 3 were converted to ug/m^3.
(4) Negligible based on the results of the 1-hour analysis.

6.3 Worst-Case Combined-Cycle Plant

Similar to the results estimated for the simple-cycle plant configuration, the results for the combined-cycle plant configuration (see Table 17) are that the maximum estimated:

- 24-hour and annual $PM_{2.5}$ impacts are less than applicable PSD increments;
- 24-hour and annual $PM_{2.5}$ total concentrations (i.e., with added background concentrations) are less than applicable NAAQS;
- Annual NO_2 impacts are less than applicable PSD increment;

- 1-hour and annual NO_2, 24-hour PM_{10}, 8-hour CO, and 1-hour SO_2 concentrations are less than applicable NAAQS; and
- 24-hour PM_{10} impact is less than the applicable PSD increment.

Figure 6 shows a contour map of estimated 24-hour $PM_{2.5}$ concentrations for the worst-case combined-cycle plant configuration and Figure 7 shows 24-hour $PM_{2.5}$ concentration contours overlapped over the local topography in the study area.

Figure 6: $PM_{2.5}$ Contour Map for the Worst-Case Combined-Cycle Plant

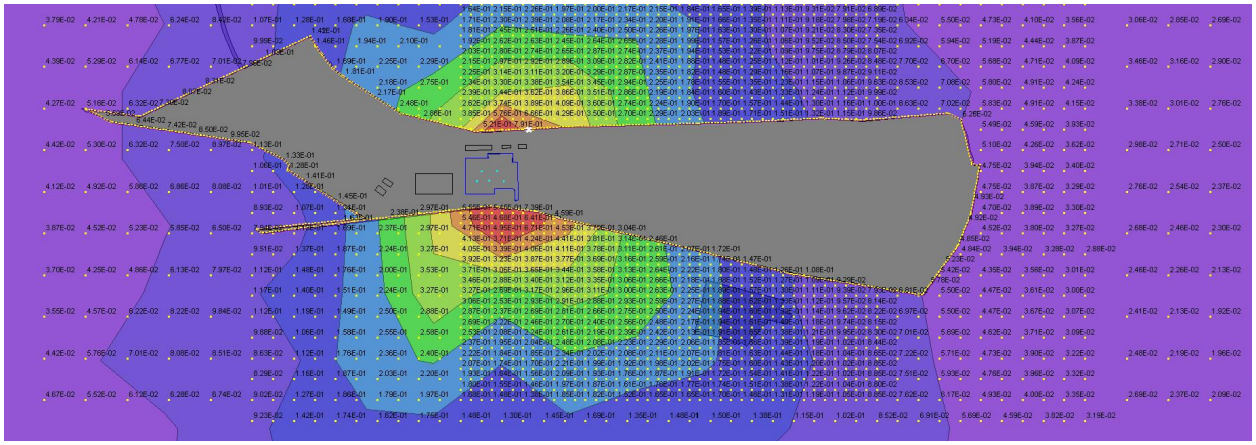
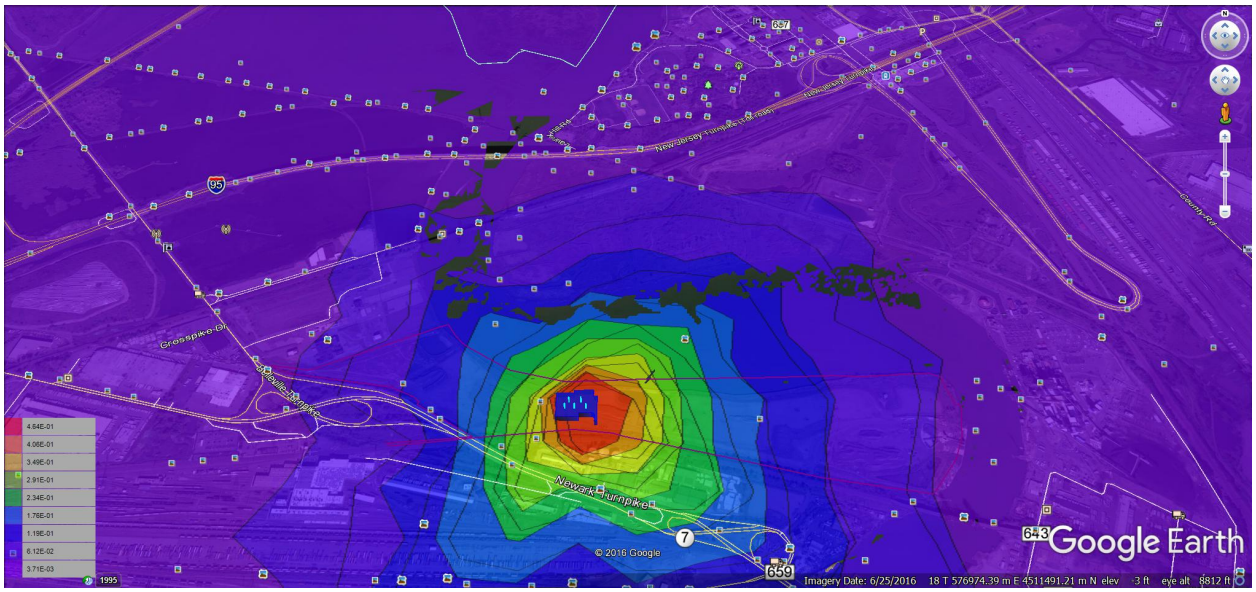


Figure 7: $PM_{2.5}$ Contour Map for the Worst-Case Combined-Cycle Plant Overlapped on Local Topography



Although these values are higher than those estimated for the simple-cycle plant (primarily due to the lower exit temperatures of the steam turbines' exhausts), the result of this analysis indicates that the combined-cycle plant would also not cause an exceedance of an applicable PSD increment or applicable NAAQS for all pollutants. As such, the potential impacts for the worst-case combined-cycle plant are also not considered to be significant.

Table 17 Maximum Predicted Pollutant Impacts for the Worst-Case Combined-Cycle Plant (ug/m^3)

Pollutant	Averaging Period	Max Impact	Background Concentration	Total Conc.	NAAQS	Applicable PSD Increment
$PM_{2.5}$	24-hr	0.91	26	26.9	35	9
	Annual	0.14	10.4	10.5	12	4
PM_{10}	24-hr	1.1	41	42.1	150	30
	Annual	Negligible (1)	N/A (2)	N/A	N/A	17
NO_2	1-hr	26.8	107 (3)	133.8	188	N/A
	Annual	3.2	16.6 (3)	19.8	100	25
SO_2	1-hr	1.7	20.9	22.6	196	N/A
	3-hr	Negligible (4)	N/A	N/A	N/A	512
	24-hr	Negligible (4)	N/A	N/A	N/A	91
	Annual	Negligible (4)	N/A	N/A	N/A	20
CO	8-hr	18.1	1,889	1,907	10,000	N/A

Notes:

Notes:

(1) Negligible based on the results of the 24-hour analysis.
(2) N/A = not applicable
(3) PPM values shown in Table 3 were converted to ug/m^3.
(4) Negligible based on the results of the 1-hour analysis.

Based on the results of the modeling analysis of the worst-case scenarios for the simple-cycle and combined-cycle plants, no significant adverse air quality impacts would occur from the operation of Project Component A under the Build Alternative, whether a simple-cycle or combined-cycle configuration was implemented. The results of the modeling analysis indicate that neither configuration of the Build Alternative would result in criteria pollutant concentrations above the federal NAAQS or project impacts that exceed PSD increment levels if emission control technology for applicable pollutants is incorporated into the design of the Main Facility.

7.0 ASSESSMENT OF POTENTIAL AIR TOXICS IMPACTS

A conservative, screening-level, HAPs analysis was conducted, as per NJDEP guidance, that assumed that all emissions from the turbines would be released from five 150-foot tall stacks, and that these units would be operating 8,760 hours per year. Both potential short-term effects and long-term risks were estimated.

The results of the short-term HAPS screening analysis, which are provided in Table 18, show that the short-term hazard quotient (representing non-carcinogenic health effects) for each of the pollutants is less than 1. As such, the estimated short-term ambient impact is expected to be less than the reference concentration; therefore, the short-term non-carcinogenic health effect is negligible, and no further analysis is required.

The results of the long-term HAPS screening-level analysis are provided in Table 19. The long-term hazard quotients (which are all less than 1) indicate that there are no significant long-term, non-carcinogenic health effects. The first-level screening analysis indicated, however, that the incremental cancer risk for two carcinogens – formaldehyde (which account for about two-thirds of all HAPs emissions) and benzo(a)pyrene (which represents the group of PAHs) – exceeds the guideline value of one in a million. Because the first-level risk screening results exceed the guideline values, a more detailed analysis was conducted for these two pollutants. This detailed analysis, using the AERMOD model, more accurately estimates ambient air concentrations by using anticipated annual operations, actual stack and source-specific data, and actual meteorological data.

The detailed analysis for formaldehyde and benzo(a)pyrene took into consideration reductions in HAPS emissions resulting from the use of oxidation catalysts. According to EPA AP-42, utilizing an oxidation catalyst for CO emission control could also reduce HAPS emissions, particularly formaldehyde, by approximately 85 to 90 percent. Similar emission reductions are also applicable, as per EPA, for other VOC/HAPs pollutants. Because of uncertainties regarding the exact percent of control, and for the conservative purpose of this analysis, a lower control efficiency of 80 percent was applied to conservatively estimate formaldehyde (as well as benzo(a)pyrene) emissions impacts.

An analysis of formaldehyde using the AERMOD model was conducted for both the simple-cycle and combined-cycle plant configurations. The results were that the estimated cancer risk of formaldehyde under either configuration would be less than the one-per-million EPA/NJDEP threshold. To estimate benzo(a)pyrene cancer risk, the annual concentration of the benzo(a)pyrene was proportionally estimated from concentration of the formaldehyde. The results were that the incremental cancer risk of benzo(a)pyrene was estimated to be less than one-per-million. Therefore, no significant impact of the VOC/HAPs emissions on either a short-term or annual basis is predicted.

Table 18 Potential Short-Term Air Toxic Impacts

Pollutant Name	CAS No.	Emission Factors [1]	Total Heat Input	Hourly Emission Rate	Short-term Ambient Conc.	Reference Conc.	Hazard Quotient	
				Q_h [2]	C_{st} [3]	RfC_{st} [4]	HQ_{ST} [5]	Result[6]
		lb/MMBtu	MMBtu/hr	lb/hr	ug/m^3	ug/m^3		
Acetaldehyde	75-07-0	4.00E-05	1,185	4.74E-02	7.08E-01	470	1.5E-03	Negl.
Acrolein	107-02-8	6.40E-06		7.58E-03	1.14E-01	2.5	4.5E-02	Negl.
Benzene	71-43-2	1.20E-05		1.42E-02	2.13E-01	27	7.9E-03	Negl.
1,3-Butadiene	106-99-0	4.30E-07		5.10E-04	7.64E-03	660	1.2E-05	Negl.
Benzo(a)pyrene [7]	50-32-8	1.88E-07		2.23E-04	3.92E-02	N/A	N/A	N/A
Ethylbenzene	100-41-4	3.20E-05		3.79E-02	2.27E-01	1,000	2.3E-04	Negl.
Formaldehyde	50-00-0	7.10E-04		8.41E-01	1.26E+01	55	2.3E-01	Negl.
Naphthalene [8]	91-20-3	1.30E-06		1.54E-03	2.31E-02	N/A	N/A	N/A
Propylene Oxide	75-56-9	2.90E-05		3.44E-02	5.16E-01	3,100	1.7E-04	Negl.
Toluene	108-88-3	1.30E-04		1.54E-01	2.31E+00	37,000	6.2E-05	Negl.
Xylenes	1330-20-7	6.40E-05		7.58E-02	1.14E+00	22,000	5.2E-05	Negl.

(1) Emission factors are from EPA AP-42 Section 3.1.4-3 and Table 3.1-3.

(2) Q_h= Hourly Emission Rate (in pounds per hour)

(3) $C_{st} = C_{st}' \times Q_h$ = Short-Term Average Ambient Air Concentration. These values are from NJDEP Division of Air Quality Risk Screening Worksheet for Long-Term Carcinogenic and Noncarcinogenic Effects and Short-Term Effects" (www.nj.gov/dep/aqpp/risk.html).

(4) RfC_{st} = Short-term Reference Concentration (for noncarcinogenic effects). These values are from NJDEP Division of Air Quality Risk Screening Worksheet for Long-Term Carcinogenic and Noncarcinogenic Effects and Short-Term Effects" (www.nj.gov/dep/aqpp/risk.html).

(5) $HQ_{st} = C_{st}/RfC_{st}$ = Hazard Quotient for short-term noncarcinogenic effects

(6) Result = The result of comparing HQ_{st} to a value of 1. Negl = negligible

(7) Benzo(a)pyrene has no guideline concentration (RfC) values. Emission factor is conservatively taken from EPA AP-42 Section 3.3, Table 3.3-2

(8) Naphthalene has no guideline concentration (RfC) values

Table 19 Potential Long-Term Air Toxic Impacts

Pollutant Name	CAS No.	Emission Factors	Total Heat Input	Annual Emission Rate	Annual Ambient Conc.	Unit Risk Factor	Incremental Risk	Cancer Risk Result	Reference Conc.	Hazard Quotient	Non-Carcinogenic Health Effect Result
				Q [1]	C [2]	URF [3]	IR [4]		RfC [5]	HQ [6]	
		lb/MMBtu	MMBtu/hr	tons/year	ug/m^3	[(ug/m^3)$^{-1}$]			ug/m^3		
Acetaldehyde	75-07-0	4.00E-05	1,185	2.08E-01	4.90E-02	2.20E-06	1.1E-07	Negl.	9	5.4E-03	Negl.
Acrolein	107-02-8	6.40E-06		3.32E-02	7.80E-03	N/A [9]	-	-	0.02	3.9E-01	Negl.
Benzene	71-43-2	1.20E-05		6.23E-02	1.50E-02	7.8E-06	1.2E-07	Negl.	3	5.0E-03	Negl.
1,3-Butadiene	106-99-0	4.30E-07		2.23E-03	5.20E-04	3.0E-05	1.6E-08	Negl.	2	2.6E-04	Negl.
Benzo(a)pyrene [7,8]	50-32-8	1.88E-07		1.95E+00	1.22E-05	1.1E-03	1.3E-08	Negl	N/A	N/A	N/A
Ethyl benzene [8]	100-41-4	3.20E-05		1.66E-01	3.90E-02	2.5E-06	9.8E-08	Negl.	N/A	N/A	N/A
Formaldehyde [7]	50-00-0	7.10E-04		3.69E+00	4.60E-02	1.3E-05	6.0E-07	Negl	9	5.1E-03	Negl.
Naphthalene	91-20-3	1.30E-06		6.75E-03	1.60E-03	3.4E-05	5.4E-08	Negl.	3	5.3E-04	Negl.
Propylene Oxide	75-56-9	2.90E-05		1.51E-01	3.50E-02	3.7E-06	1.3E-07	Negl.	30	1.2E-03	Negl.
Toluene	108-88-3	1.30E-04		6.75E-01	1.60E-01	N/A	-	N/A	5,000	3.2E-05	Negl.
Xylenes	1330-20-7	6.40E-05		3.32E-01	7.80E-02	N/A	-	N/A	100	7.8E-04	Negl.

[1] Q= Annual Emission Rate (in pounds per hour)
[2] C= C' x Q = Annual Average Ambient Air Concentration
[3] URF = unit risk factor (for carcinogenic risk)
[4] IR = incremental cancer risk = C x URF (considered negligible if below 1E-06).
[5] RfC = Reference Concentration (for noncarcinogenic effects)
[3-5] These values are from NJDEP Division of Air Quality Risk Screening Worksheet for Long-Term Carcinogenic and Noncarcinogenic Effects and Short-Term Effects" www.nj.gov/dep/aqpp/risk.html
[6] HQ = C/RfC = Hazard Quotient for long-term noncarcinogenic effects
[7] Benzo(a)pyrene emission factor was obtained from AP-42 Table 3.3-2. Annual ambient concentrations of formaldehyde and benzo(a)pyrene are AERMOD-estimated
[8]) Benzo(a)pyrene and ethylbenzene have no RfC values
[9] N/A = Not applicable -- no applicable risk factor

8.0 PROJECT LEVEL AIR QUALITY CONFORMITY

Section 176(c) of the CAA of 1977, as amended (42 U.S.C. § 7506), forbids any department, agency, or instrumentality of the Federal Government from engaging in, supporting in any way or providing financial assistance for, licensing or permitting, or approving, any activity which does not conform to a State Implementation Plan (SIP) after the activity has been approved or promulgated. As defined in Section 176(c)(1), conformity to an implementation plan means conformity to an implementation plan's purpose of eliminating or reducing the severity and number of violations of the NAAQS and achieving expeditious attainment of such standards; and that such activities will not: 1) cause or contribute to any new violation of any NAAQS in any area; 2) increase the frequency or severity of any existing violation of any NAAQS in any area; or 3) delay timely attainment of any NAAQS or any required interim emission reductions or other milestones in any area. Projects that are funded and approved by the Federal Transit Administration are subject to the transportation conformity regulations at Subpart A of 40 CFR Part 93.

The proposed Project is exempt from both Transportation and General Conformity requirements for operation and construction since it is "presumed to conform," meaning that it will meet the approved *de minimus* emissions budget through the Title V permitting process. The New Jersey Transportation Planning Authority (NJTPA) is the authorized Metropolitan Planning Organization for the 13-county northern New Jersey region. The NJTPA has responsibility under federal law for the investment of federal transportation funding. To be eligible for federal funds, a proposed project must be included in the NJTPA-approved Transportation Improvement Program (TIP). In developing the TIP, the NJTPA cooperates with the NJDOT and NJ TRANSIT to determine how both federal and state transportation funding can be most cost effectively applied to meeting transportation needs. The Project is also included in the State's TIP, indicating the project's emissions are accounted for the area's allowable emission budget, as specified in the SIP for New Jersey.

9.0 MITIGATION

As designed, neither configuration of the Build Alternative would cause significant air quality impacts; therefore, no mitigation is needed. Additional emission reduction controls technologies, however, may be incorporated into the proposed Project's design during the facility's Title V permitting process.