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AIR QUALITY AND GREENHOUSE GAS TECHNICAL REPORT – BACKUP GENERATORS ONLY

VANTAGE DATA CENTERS
SANTA CLARA, CALIFORNIA

RAMBOLL ENVIRON

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ACRONYMS AND ABBREVIATIONS

AERMOD	American Meteorological Society/Environmental Protection Agency regulatory air dispersion model
AQ	Air Quality
ARB	California Air Resources Board
aREL	Acute Reference Exposure Level
ASF	Age Sensitivity Factor
BAAQMD	Bay Area Air Quality Management District
Cal/EPA	California Environmental Protection Agency
CAP	Criteria Air Pollutant
CEQA	California Environmental Quality Act
CH_4	Methane
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide equivalent
CPF	Cancer Potency Factor
cREL	Chronic Reference Exposure Level
DPF	Diesel Particulate Filter
DPM	Diesel Particulate Matter
GHG	Greenhouse Gas
HI	Hazard Index
HQ	Hazard Quotient
HRA	Health Risk Assessment
MAF	Modelling Adjustment Factor
MEISR	Maximally Exposed Individual Sensitive Receptor
N_2O	Nitrogen Dioxide
NOx	Nitrous Oxide
OEHHA	Office of Environmental Health Hazard Assessment
$PM_{2.5}$	Fine Particulate Matter Less than 2.5 Micrometers in Aerodynamic Diameter
PM_{10}	Respirable Particulate Matter Less than 10 Micrometers in Aerodynamic Diameter
ppm	part per million
REL	Reference Exposure Level

ROG	Reactive Organic Gas
RPS	Renewables Portfolio Standard
TAC	Toxic Air Contaminant
TOG	Total Organic Gas
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey

Units

g	Gram
kg	Kilogram
m	Meter
MT	Metric Ton
MW	Megawatts
MWh	Megawatts Hour
µg	Microgram
µg/m^3	Micrograms per cubic meter
m^3/kg-day	Milligrams per kilogram per day
m^3	Cubic meters
mg	Milligram
s	Second
tpy	Ton per Year
yr	Year

EXECUTIVE SUMMARY

Vantage Data Centers' Mathew Street development ("the Project") is a proposed new data center in Santa Clara, California. The Project would be located on a 8.97-acre plot bounded by existing occupied buildings to the West, rail tracks to the East, a Home Depot location to the North and Mathew Street to the South. The proposed plan for the Project includes forty-seven (47) 3-megawatts (MW) emergency generators and one (1) 500-kilowatts (kW) life safety generator to provide back-up power for the data center which may draw up to 74 MW critical and 99.8 MW total of power from the grid. This report evaluates the air quality (AQ) and greenhouse gas (GHG) impacts, together with risks and hazards associated with the Project backup generators (the "power plant").

At the request of Vantage Data Centers, Ramboll Environ US Corporation (Ramboll Environ) conducted a California Environmental Quality Act (CEQA) analysis of criteria air pollutants (CAPs) and precursor emissions associated with the proposed operation of the backup generators in 2016. Ramboll Environ also estimated GHG emissions from operation of the backup generators and performed a health risk assessment (HRA) of operation of the backup generators. This report serves as an update to the previous analysis in 2016 using updated project descriptions and characteristics and only evaluates the changes associated with the Project power plant. The local air agency, the Bay Area Air Quality Management District (BAAQMD) has published CEQA Guidelines for use in determining significance, which will apply here for AQ and GHG (BAAQMD 2011).[1] As shown in **Table ES-1**, the relevant thresholds for the Project are:

- Operational CAP and precursor emissions
- Local carbon monoxide (CO) concentrations
- Operational GHG emissions
- Excess lifetime cancer risk, chronic HI, acute HI, and $PM_{2.5}$ concentrations from operation on off-site receptors; and
- Cumulative excess lifetime cancer risk, chronic HI, and $PM_{2.5}$ concentration from construction and surrounding sources on off-site receptors.

Since construction emissions associated with the grading, concrete pad construction, and placement of the backup generators are negligible, construction emissions and relevant thresholds are not being evaluated. Project health impacts from diesel particulate matter and speciated on-road total organic gas (TOG) emissions were calculated consistent with guidance in BAAQMD's 2011 CEQA guidelines (BAAQMD 2011) and the 2015 California Environmental Protection Agency (Cal/EPA) Office of Environmental Health Hazard Assessment (OEHHA) Hot Spots Guidance (2015). Consistent with BAAQMD and OEHHA Hot Spots guidance, health impacts were based on emissions of toxic air contaminants (TACs). Concentrations of TACs were estimated using AERMOD, a Gaussian air dispersion model recommended by United States Environmental Protection Agency (USEPA), California Air

[1] A March 2012 Alameda County Superior Court judgment determined that the BAAQMD had failed to evaluate the environmental impacts of the land use development patterns that would result from adoption of the thresholds and ordered the thresholds set aside. The Court of Appeal reversed that judgment and the California Supreme Court decided the limited issue that CEQA does not require an analysis of the environment's impact on a project, with the exception of schools.

Resources Board (ARB), and BAAQMD for use in preparing environmental documentation for stationary sources. Health impacts were calculated using the TAC concentrations and TAC toxicities and exposure assumptions consistent with the 2015 OEHHA Hot Spots guidance.

Table ES-1 shows the previous and updated Project emissions and the BAAQMD CEQA thresholds. Updated Project operational GHG emissions are 5,460 metric tonnes per year (MT/yr), a 32% percent change from the previous Project description.

Table ES-1: Summary of Backup Generator Operational Emissions

	ROG	NOx [2]	PM_{10}	$PM_{2.5}$
Operational Daily Emissions (lb/day)				
Previous Generator Emissions	2.1	178	0.43	0.43
Updated Generator Emissions	3.3	262	0.63	0.63
Percent change from MND	57%	48%	47%	47%
BAAQMD CEQA Thresholds	***54***	***54***	***82***	***54***
Operational Annual Emissions (tpy)				
Previous Generator Emissions	0.38	33	0.08	0.08
Updated Generator Emissions	0.60	48	0.12	0.12
Percent change from MND	58%	45%	50%	50%
BAAQMD CEQA Thresholds	***10***	***10***	***15***	***10***

Project operations would contribute maximum local CO concentrations of 0.55 parts per million (ppm) on a 1-hour average and 0.40 ppm on an 8-hour average. These impacts are below the respective BAAQMD thresholds of significance of 20.0 ppm and 9.0 ppm.

2 NOx emissions will be capped or offset through the air permitting process with the BAAQMD.

Table ES-2 shows the previous and updated Project health impacts and the BAAQMD CEQA thresholds. Only the Executive Summary of this report outlines the changes in results due to changes in the project description/master plan (comparing to numbers from the Mitigated Negative Declaration (MND)). The remainder of this report only discusses methodologies and results of the updated Project description.

Table ES-2: Summary of Backup Generator Operational Health Impacts at the Maximally Exposed Individual Sensitive Receptor (MEISR)

	Excess Lifetime Cancer Risk in one million	**Noncancer Chronic HI (unitless)**	**Noncancer Acute HI (unitless)**	**$PM_{2.5}$ Concentration (μg/m³)**
Project Operational Health Impacts				
Previous Generator Impact	0.30	0.000079	0.67	0.00039
Updated Generator Impact	0.40	0.00011	0.68	0.00053
Percent change from MND	33%	39%	2%	36%
BAAQMD CEQA Thresholds	***10***	***1***	***1***	***0.3***

1. INTRODUCTION

This report replaces the previously submitted Air Quality Technical Report in Appendix E. The previous version of the report was completed prior to the 1-hour NO_2 analysis. A refined 1-hour NO_2 modelling analysis revealed the need to update the designed generator stack heights. This report provides an updated model (modeling files attached separately) that is consistent with the stack parameters presented in the 1-hour NO_2 model (and SPPE application) and also provides updated health risk impacts based on the new stack heights.

Additionally, this report has corrected some errors in language identified within the previous report. The AERMOD version used for modeling was previously defined as version 15181 and has been corrected to state that AERMOD version 16216r was used. The text also previously stated that there were four construction phases, this has been corrected to state that there are three construction phases.

At the request of Vantage Data Centers, Ramboll Environ US Corporation (Ramboll Environ) has prepared this technical report documenting air quality (AQ) and greenhouse gas (GHG) analyses for the construction and operational activities of the proposed data center, located on three land parcels on Mathew Street, in Santa Clara, California (referred to as the "Project"). The analyses follows the Bay Area Air Quality Management District (BAAQMD) California Environmental Quality Act (CEQA) Guidelines released in 2011 (BAAQMD 2011).[3]

1.1 Project Description

The proposed Project spans from 651 to 825 Mathew Street and is bounded by Lafayette Street to the West, rail tracks to the East, a Home Depot location to the North and Mathew Street to the South in Santa Clara, California. The property is an approximately 8.97-acre lot. The proposed location and boundary are shown in **Figure 1**. The proposed Project will be a data center developed over three construction phases from 2017 to 2022. At full build-out, the project will include forty-seven (47) 3-megawatts (MW) capacity Tier-2 emergency generators with diesel particulate filters (DPF) (a total backup capacity of 96 MW), one 500-kilowatts (kW) life safety generator, three office buildings, surface street parking spaces, 72 adiabatic air-cooled chillers, and 12 direct expansion make-up air units. This report is only assessing impacts from operations of the backup generators (the "power plant").

1.2 Objective and Methodology

The BAAQMD 2011 CEQA Guidelines contain recommended thresholds for operational criteria air pollutant (CAP) and precursor emissions, GHG emissions, and risks and hazards associated with toxic air contaminant (TAC) emissions from an individual project (BAAQMD 2011). This report evaluates the AQ and GHG impacts, together with risks and hazards associated with backup generator operational activities, on off-site receptors and the cumulative impact to off-site sensitive receptors from backup generator operations and surrounding sources.

[3] A March 2012 Alameda County Superior Court judgment determined that the BAAQMD had failed to evaluate the environmental impacts of the land use development patterns that would result from adoption of the thresholds and ordered the thresholds set aside. The Court of Appeal reversed that judgment and the California Supreme Court decided the limited issue that CEQA does not require an analysis of the environment's impact on a project, with the exception of schools.

1.3 Thresholds Evaluated

The AQ analysis of this report evaluates the daily and annual regional emissions of criteria pollutants and precursors from operation of the backup generators and evaluates these emissions against BAAQMD's May 2011 significance thresholds for emissions (BAAQMD 2011). These thresholds are as follows:

Operational CAP Emissions:

- Average daily emissions of ROG greater than 54 lb/day, or maximum annual emissions of 10 tons per year (tpy);
- Average daily emissions of NOx greater than 54 lb/day, or maximum annual emissions of 10 tpy;
- Average daily emissions of PM_{10} greater than 82 lb/day, or maximum annual emissions of 10 tpy; and
- Average daily emissions of $PM_{2.5}$ greater than 54 lb/day, or maximum annual emissions of 10 tpy.

Local carbon monoxide (CO) concentrations:

- 8-hour average concentration of 9.0 parts per million (ppm)
- 1-hour average concentration of 20.0 ppm

The GHG analysis of this report evaluates the GHG emissions from operation of the Project and evaluates these emissions against BAAQMD's May 2011 significance thresholds for emissions. These thresholds are as follows:

- Stationary source direct GHG emissions of 10,000 metric tonnes per year (MT/yr)

The health risk assessment (HRA) in this report evaluates the estimated cancer risk, noncancer chronic hazard index (HI), acute HI, and $PM_{2.5}$ concentration associated with construction and operation of the Project's emissions of Toxic Air Contaminants (TACs). The Toxic Air Contaminants considered are those included in BAAQMD Rule 2-5, New Source Review of Toxic Air Contaminants. No chronic or acute health impacts are shown for CAPs, including NO_2, consistent with BAAQMD CEQA guidance. The HRA evaluates potential sensitive receptor locations including:

- "Residential dwellings, including apartments, houses, condominiums;
- Schools, colleges, and universities;
- Daycares;
- Hospitals; and
- Senior-care facilities." (BAAQMD 2012a)

Ramboll Environ conducted a sensitive receptor search within the 1,000-foot zone of influence, and determined that the only sensitive receptors are residential dwellings to the southwest of the Project site. However, for completeness, Ramboll Environ also included a nearby soccer facility directly south of the Project site as a potential sensitive receptor.

To meet the above stated objectives, this HRA was conducted consistent with the following guidance:

- Air Toxics Hot Spots Program Risk Assessment Guidelines (Office of Environmental Health Hazard Assessment [OEHHA] 2015);
- May 2011 BAAQMD CEQA Guidelines (BAAQMD 2011); and
- BAAQMD Recommended Methods for Screening and Modeling Local Risks and Hazards (BAAQMD 2012a).

Ramboll Environ compared the results of emissions and health risk analyses to the BAAQMD 2011 CEQA significance thresholds. Operational health impacts of the backup generators were compared against the BAAQMD 2011 CEQA single source thresholds. The thresholds are:

Single Source Impacts:

- An excess lifetime cancer risk level of more than 10 in one million;
- A noncancer chronic HI greater than 1.0;
- A noncancer acute HI greater than 1.0; and
- An incremental increase in the annual average $PM_{2.5}$ concentration of greater than 0.3 micrograms per cubic meter ($\mu g/m^3$).

If a project does not exceed the identified significance thresholds, its emissions would not be cumulatively considerable. For reference, the BAAQMD 2011 cumulative CEQA significance thresholds are:

- An excess lifetime cancer risk level of more than 100 in one million;
- A noncancer chronic HI greater than 10.0; and
- An annual average $PM_{2.5}$ concentration of greater than 0.8 micrograms per cubic meter ($\mu g/m^3$).

1.4 Report Organization

This technical report is divided into eight sections as follows:

Section 1.0 – Introduction: describes the purpose and scope of this technical report, the objectives and methodology used in this technical report, and the report organization.

Section 2.0 – Emission Estimates: describes the methods used to estimate the emissions of CAPs, GHGs, and TACs from the Project;

Section 3.0 – Estimated Air Concentrations: discusses the air dispersion modeling, the selection of the dispersion models, the data used in the dispersion models (e.g., terrain, meteorology, source characterization), and the identification of residential and sensitive locations evaluated in this technical report.

Section 4.0 – Risk Characterization Methods: provides an overview of the methodology for conducting the HRA.

Section 5.0 – Project Health Risk Assessment: presents the estimated emissions of CAPs and GHGs, estimated excess lifetime cancer risks, chronic noncancer HIs, acute noncancer HIs, and $PM_{2.5}$ concentrations for the Project.

Section 6.0 – References: includes a listing of all references cited in this report.

2. EMISSION ESTIMATES

Ramboll Environ estimated CAP, GHG, and TAC emissions from the operation of the backup generators. The CAPs of interest include ROG, NOx, $PM_{2.5}$ and PM_{10}. There is no mass emissions threshold for CO, although the mass emissions are necessary for CO concentration impact modeling, so Ramboll Environ also estimated CO emissions from operation of the Project. The GHGs of interest include carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), which are commonly combined by global warming potential-weighted average into carbon dioxide equivalents (CO_2e). One of the TACs of interest is diesel particulate matter (DPM), emissions of which are assumed to be equal to exhaust PM_{10} from backup diesel engines during operation. Other TACs are speciated from TOG from on-road emissions from gasoline vehicles. These emissions estimates were used to compare to BAAQMD thresholds and as inputs to the HRA. The methodologies used by Ramboll Environ are summarized below.

Tables 1a and **1b** present the backup generator characteristics and assumptions used in the emissions estimation.

2.1 Calculation Methodologies for Operational Emissions

Emissions from backup generator operations were estimated using manufacturer's data for stationary sources (emergency generators).

2.1.1 Stationary Sources

The proposed Project includes 48 diesel back-up generators including one life safety generator, the locations of which are shown in **Figure 3**. **Table 1a and Table 1b** presents controlled emission factors used to calculate daily and annual criteria pollutant emission rates as well as uncontrolled emission factors and DPF abatement efficiencies used to calculate the controlled emission factors. Ramboll Environ used United States Environmental Protection Agency (USEPA) D2 Certification Cycle emissions factors with reductions, based on the information provided by project sponsor. Engine emissions are based on non-emergency operations (primarily the schedule of testing that is required for the generators) and the planned number of hours of non-emergency operations (in accordance with BAAQMD Regulation 2, Rule 5). Consistent with BAAQMD permitting methods, no load factor is applied. Annual non-emergency operation is limited to 50 hours, as stated in the Airborne Toxic Control Measure for Stationary Toxic Compression Ignition Engines (Section 93115, Title 17, CCR). Emission rates were averaged over the period of a year since the emergency generators could potentially be tested at any time of day or day of year. **Tables 2** and **3** present the daily and annual CAP emissions from non-emergency operation of the backup engines, with annual GHG emissions also presented in **Table 5**. GHG emissions were calculated following the same methodology as described above for CAPs. The USEPA engine certification emission factors include CO_2. Ramboll Environ used the USEPA Mandatory Reporting Rule emission factors for CH_4 and N_2O emissions (USEPA 2013), which were added to develop a carbon dioxide equivalent (CO_2e) emission factor using the same global warming potentials as in CalEEMod®.

2.1.2 Summary of Project Operational GHG Emissions

GHG emissions from the emergency generators are subject to the BAAQMD CEQA threshold for stationary sources. GHG emissions for backup generator operations are presented in **Table 5**. Based on the maximum allowable hours of operation annually, generators are estimated to emit 5,460 MT CO_2e/yr, below the BAAQMD stationary source threshold of 10,000 MT CO_2e/yr.

3. ESTIMATED AIR CONCENTRATIONS

Backup generator operational activities will generate emissions that will be transported outside of the physical boundaries of the Project site, potentially impacting nearby sensitive receptors such as residential areas. Methodologies to estimate concentrations resulting from generator operational activities are provided below. Ramboll Environ performed a refined HRA for non-emergency operation of the emergency generators.

3.1 Chemical Selection

The cancer risk, chronic, and acute hazards in the HRA for the Project construction and stationary source operation were based on TAC emissions from the Project. Modeled sources of TACs include on-road construction traffic, off-road construction equipment, and diesel-powered emergency generators. Accordingly, the chemicals to be evaluated in the HRA were DPM, speciated total organic gases (TOG) in diesel exhaust, and speciated evaporative and exhaust TOGs from gasoline vehicles. DPM emissions are assumed to be equal to Exhaust PM_{10} from on- and off-road construction equipment, and exhaust PM_{10} from backup diesel engines during operation. Other TACs are speciated from total organic gases (TOG) from on-road emissions from gasoline vehicles.

Diesel exhaust, a complex mixture that includes hundreds of individual constituents, is identified by the State of California as a known carcinogen (California Environmental Protection Agency [Cal/EPA] 1998). Under California regulatory guidelines, DPM is used as a surrogate measure of exposure for the mixture of chemicals that make up diesel exhaust as a whole. Cal/EPA and other proponents of using the surrogate approach to quantifying cancer risks associated with the diesel mixture indicate that this method is preferable to use of a component-based approach. A component-based approach involves estimating risks for each of the individual components of a mixture. Critics of the component-based approach believe it will underestimate the risks associated with diesel as a whole mixture because the identity of all chemicals in the mixture may not be known and/or exposure and health effects information for all chemicals identified within the mixture may not be available. Furthermore, Cal/EPA has concluded that "potential cancer risk from inhalation exposure to whole diesel exhaust will outweigh the multi-pathway cancer risk from the speciated components" (OEHHA 2003). The DPM analyses for cancer and chronic hazards will be based on the surrogate approach, as recommended by Cal/EPA. In the absence of an acute toxicity value for diesel exhaust, speciated TOG will be used as a conservative estimate.

For the analysis of local CO concentrations, Ramboll Environ used operational CO emissions from stationary sources during project operation.

3.2 Sources of Emissions

The relevant emissions sources of TACs for the refined HRA are off-road equipment and on-road trucks during construction and emergency generators during operation. Emissions estimates for operational mobile sources are not included in the refined HRA since BAAQMD screening tools are used to assess operational mobile source health impacts. Emissions of CO from project operation are from emergency generators only. The screening level for operational traffic is 44,000 vehicles per hour (BAAQMD 2011), which is 100 times higher than total daily trip generation from the project. As such operational traffic is a *de minimis* contributor to operational CO emissions. **Table 11** shows the maximum CO emissions per generator, using the USEPA engine certification emission factor. The CO concentrations analysis is conservative in that it assumes all 48 emergency generators are in use at the same time during the worst meteorological conditions for the respective averaging periods.

3.3 Air Dispersion Modeling

The latest version of AERMOD (Version 16216r) was used to evaluate ambient air concentrations of CO, DPM, $PM_{2.5}$ and TOG at off-site receptors from both Project construction sources and the non-emergency use of the backup generators. For each receptor location, the model generates air concentrations that result from emissions from multiple sources. If unit emissions (i.e., 1 g/s) are modelled, the resultant value for each receptor location is called the air dispersion factor.

Air dispersion models such as AERMOD require a variety of inputs such as source parameters, meteorological conditions, topographical information, and receptor parameters. Modeling parameters are shown in **Table 6**. Construction source parameters are from BAAQMD modeling performed in support of the San Francisco Community Risk Reduction Plan (SF CRRP) (Bay Area Air Quality Management District, San Francisco Department of Public health, San Francisco Planning Department 2012). The Project boundary is shown in **Figure 1**.

Meteorological data: Air dispersion modeling requires the use of meteorological data that ideally are spatially and temporally representative of conditions in the immediate vicinity of the site under consideration. Ramboll Environ used surface meteorological data from the San Jose Airport for years 2009 through 2013, with upper air data collected at the Oakland Airport for the same time period.

Terrain considerations: Elevation and land use data were imported from the National Elevation Dataset maintained by the United States Geological Survey (USGS 2013). An important consideration in an air dispersion modeling analysis is the selection of whether or not to model an urban area. Here the model assumes an urban land use as has been done for similar projects in the area. Ramboll Environ will use 126,251, the 2014 population of the City of Santa Clara, as the urban population in AERMOD (US Census Bureau 2014). This is a conservative underestimate of the population that contributes to the urban heat island effect in the vicinity of the Project.

Emission rates: Emissions were modeled using the unit rate emissions method for all but CO, such that each source has a unit emission rate (i.e., 1 gram per second [g/s]) and the model estimates dispersion factors with units of ($\mu g/m^3$)/(g/s). Actual emissions were multiplied by the dispersion factors to obtain concentrations. CO modeling used actual emission rates in g/s.

Emitting activities were modeled to reflect the actual hours of operation. For Project construction, emissions were modeled to occur between 7 AM and 4 PM, a span of 9 hours, although equipment operation may total less than 9 hours. For Project operation, generators were modeled as if they could operate at any hour of the day.

For annual average ambient air concentrations, the estimated annual average dispersion factors were multiplied by the annual average emission rates. For maximum hourly ambient air concentrations, the estimated maximum hourly dispersion factors were multiplied by the maximum hourly emission rates.

Source parameters: Source locations and parameters are necessary to model the dispersion of air emissions. Operational source locations are shown in **Figure 2**. At full buildout, there are twenty-three generators that will be stacked at double height on top of twenty-four generators on ground-level and the life safety generator will be single stacked, so **Figure 2** shows locations for all 48 generators. Source parameters are detailed in **Table 6**.

The operational sources (i.e., emergency generators) were represented by point sources with identical exit temperatures, exit velocities and exit diameters (750.85 degrees K, 59.2 meter (m)/s and 0.51 m, respectively), based on manufacturer information. The life safety generator was represented as an individual point source with a stack temperature of 823.15 degrees K, stack velocity of 49.34 m/s and exit diameter of 0.2 meters, based on manufacturer information. The stack heights for the generators were provided by the Project Sponsor. All stack heights, for both single and double storied generators, will be at the same height. The modeled stack height for all generators is 13.77 meters above ground.

Receptors: Nearby sensitive receptor populations were identified within a 1,000-m buffer of the Project site, which is larger than the Project's 1,000-foot zone of influence. As discussed above, sensitive receptors include residents to the southwest of the Project site and a soccer facility south of the Project site. A receptor grid was created to cover all potential sensitive receptors within 1,000-m of the Project site. A fine grid of receptors with 25-m spacing was modeled out to 500 m, and a coarse grid with 50-m spacing was modeled out to 1,000 m. Modeled off-site receptors are shown in Figure 4. Receptors were modeled at 1.8 meters of height, consistent with BAAQMD guidance for breathing height. As discussed previously, average annual and maximum hourly dispersion factors were estimated for each receptor location.

Concentrations: As discussed above, for all but CO modeling emissions were modeled using the unit rate emission factor method, such that the model estimates dispersion factors based on an emission rate of 1 g/s and the dispersion factors have units of [μg/m^3]/[g/s]. Estimated emissions were multiplied by the dispersion factors to obtain concentrations. CO modeling used maximum 1-hour and 8-hour emissions from emergency generator use.

Modeling Adjustment Factor: OEHHA (2015) recommends applying an adjustment factor to the annual average concentration modeled assuming continuous emissions (i.e., 24 hours per day, seven days per week), when the actual emissions are less than 24 hours per day and exposures are concurrent with the emitting activities. Operational emissions for the Project are modeled with the assumption that they can occur at any hour of the day. MAFs are shown in **Table 7**.

4. RISK CHARACTERIZATION METHODS

The following sections discuss in detail the various components required to conduct the HRA.

4.1 Project Sources Evaluated

As discussed in Section 1.3, excess lifetime cancer risk, chronic and acute HIs, and $PM_{2.5}$ concentrations were evaluated for off-site sensitive receptor exposures to emissions from Project construction and operation. The TACs of concern are those in BAAQMD Rule 2-5, so no health impacts from CAPs are considered in this analysis, consistent with BAAQMD CEQA Guidance.

4.2 Exposure Assessment

Potentially Exposed Populations: This assessment evaluated off-site receptors potentially exposed to Project emissions from operational activities. These exposed populations include residential and recreational receptors at a nearby soccer field. Both long-term health impacts (cancer risk, chronic HI, and $PM_{2.5}$ concentration) and acute hazards were evaluated for the residential and recreational locations.

Exposure Assumptions: The exposure parameters used to estimate excess lifetime cancer risks due to operational activities were obtained using risk assessment guidelines from OEHHA (2015) and draft guidelines from the BAAQMD that indicate how the BAAQMD would integrate the 2015 OEHHA Guidelines (BAAQMD 2016), unless otherwise noted, and are presented in **Table 7**. Based on the TACs considered, the only relevant exposure pathway is inhalation, so this HRA considers inhalation exposure only.

For offsite residential receptors, Ramboll Environ selected conservative exposure parameters assuming that exposure would begin during the third trimester of a residential child's life. Ramboll Environ used 95^{th} percentile breathing rates up to age 2, and 80^{th} percentile breathing rates above age 2, consistent with BAAQMD guidance (2016). For operation, off-site residents were assumed to be present at one location for a 30-year period, beginning with exposure in the third trimester.

For offsite recreational soccer receptors, Ramboll Environ selected exposure parameters using the conservative assumption that a child would be located at the soccer facility starting at age 2, then that same child would continue to be exposed by participating in activities at the facility as they got older. For operation, the child was assumed to be present one day a week for one hour per day for a full 30 years. Operational exposures used the 95^{th} percentile 8-hour moderate intensity breathing rate from the OEHHA guidelines.

Calculation of Intake: The dose estimated for each exposure pathway is a function of the concentration of a chemical and the intake of that chemical. The intake factor for inhalation, IF_{inh}, can be calculated as follows:

$$IF_{inh} = \frac{DBR * FAH * EF * ED * CF}{AT}$$

Where:

IF_{inh}	=	Intake Factor for Inhalation (m^3/kg-day)
DBR	=	Daily Breathing Rate (L/kg-day)

FAH	=	Fraction of Time at Home (unitless)
EF	=	Exposure Frequency (days/year)
ED	=	Exposure Duration (years)
AT	=	Averaging Time (days)
CF	=	Conversion Factor, 0.001 (m^3/L)

The chemical intake or dose is estimated by multiplying the inhalation intake factor, IF_{inh}, by the chemical concentration in air, C_i. When coupled with the chemical concentration, this calculation is mathematically equivalent to the dose algorithm given in the OEHHA Hot Spots guidance (2015).

4.3 Toxicity Assessment

The toxicity assessment characterizes the relationship between the magnitude of exposure and the nature and magnitude of adverse health effects that may result from such exposure. For purposes of calculating exposure criteria to be used in risk assessments, adverse health effects are classified into two broad categories – cancer and non-cancer endpoints. Toxicity values used to estimate the likelihood of adverse effects occurring in humans at different exposure levels are identified as part of the toxicity assessment component of a risk assessment.

Excess lifetime cancer risk and chronic HI calculations for project operation utilized the toxicity values for DPM from diesel generators. Acute HI calculations utilized the toxicity values for TACs from speciated diesel TOG for diesel generators. The speciation profiles used are presented in **Table 8**. The toxicities of each chemical are shown in **Table 9**. The TACs of concern have inhalation health effects only.

4.4 Age Sensitivity Factors

The estimated excess lifetime cancer risks for a resident child was adjusted using the age sensitivity factors (ASFs) recommended by OEHHA (2015). This approach accounts for an "anticipated special sensitivity to carcinogens" of infants and children. Cancer risk estimates are weighted by a factor of 10 for exposures that occur from the third trimester of pregnancy to two years of age and by a factor of three for exposures that occur from two years through 15 years of age. No weighting factor (i.e., an ASF of one, which is equivalent to no adjustment) is applied to ages 16 to 30 years. **Table 10** shows the ASFs used.

4.5 Risk Characterization

4.5.1 Estimation of Cancer Risks

Excess lifetime cancer risks are estimated as the upper-bound incremental probability that an individual will develop cancer over a lifetime as a direct result of exposure to potential carcinogens. The estimated risk is expressed as a unitless probability. The cancer risk attributed to a chemical is calculated by multiplying the chemical intake or dose at the human exchange boundaries (e.g., lungs) by the chemical-specific cancer potency factor (CPF).

The equation used to calculate the potential excess lifetime cancer risk for the inhalation pathway is as follows:

$$Risk_{inh} = C_i \times CF \times IF_{inh} \times CPF \times ASF$$

Where:

$Risk_{inh}$	=	Cancer risk; the incremental probability of an individual developing cancer as a result of inhalation exposure to a particular potential carcinogen (unitless)
C_i	=	Annual average air concentration for chemical during $activities_i$ ($\mu g/m^3$)
CF	=	Conversion factor (mg/μg)
IF_{inh}	=	Intake factor for inhalation (m^3/kg-day)
CPF_i	=	Cancer potency factor for $chemical_i$ (mg chemical/kg body weight-day)$^{-1}$
ASF	=	Age sensitivity factor (unitless)

4.5.2 Estimation of Chronic and Acute Noncancer Hazard Quotients/Indices

Chronic HQ

The potential for exposure to result in adverse chronic noncancer effects is evaluated by comparing the estimated annual average air concentration (which is equivalent to the average daily air concentration) to the noncancer chronic reference exposure level (cREL) for each chemical. When calculated for a single chemical, the comparison yields a ratio termed a hazard quotient (HQ). To evaluate the potential for adverse chronic noncancer health effects from simultaneous exposure to multiple chemicals, the chronic HQs for all chemicals are summed, yielding a chronic HI.

$$HQi = Ci / cREL$$

Where:

HQi	=	Chronic hazard quotient for chemical i
HI	=	Hazard index
Ci	=	Annual average concentration of chemical i (μg/m3)
cRELi	=	Chronic noncancer reference exposure level for chemical i ($\mu g/m^3$)

Acute HI

The potential for exposure to result in adverse acute effects is evaluated by comparing the estimated one-hour maximum air concentration of chemical to the acute reference exposure level (aREL) for each chemical evaluated in this analysis. When calculated for a single chemical, the comparison yields an HQ. To evaluate the potential for adverse acute health effects from simultaneous exposure to multiple chemicals, the acute HQs for all chemicals are summed, yielding an acute HI.

$$HQi = Ci / aREL$$

Where:

HQi	=	Acute hazard quotient for chemical i
HI	=	Hazard index

C_i = One-hour maximum concentration of chemical i (µg/m3)

$aREL_i$ = Acute reference exposure level for chemical i (µg/m³)

5. PROJECT HEALTH RISK ASSESSMENT

In this section, the Project HRA results are presented for each of the BAAQMD CEQA thresholds.

As discussed in Section 1.3, the single source significance thresholds for health risks and hazards from Project operation are:

- An excess lifetime cancer risk level of more than 10 in one million;
- A chronic noncancer HI greater than 1.0;
- A noncancer acute HI greater than 1.0; and
- An incremental increase in the annual average $PM_{2.5}$ of greater than 0.3 µg/m^3.

5.1 Operational HRA

Table 13 shows the excess lifetime cancer risk, chronic noncancer HI, acute noncancer HI and annual $PM_{2.5}$ concentration at the MEISR during backup generator operation. The incremental increase in cancer risk due to Project operation is 0.40 in one million at the MEISR. The chronic and acute noncancer HIs at the respective MEISRs, which are not in the same location, are 0.00011 and 0.68. The annual $PM_{2.5}$ concentration due to Project operation is 0.00053 µg/m^3. **Table 13** gives the coordinates of each MEISR.

As noted in Section 3.4, Local CO concentrations over both 1-hour and 8-hour averaging times are shown in **Table 11**. Pollutant concentrations at the 1-hour and annual MEISRs for Project operation are listed in **Table 12**.

5.2 Cumulative HRA

The BAAQMD CEQA Guidelines establish numerical criteria for determining when an emissions increase is considered cumulatively considerable and thus triggers the need for a quantitative cumulative impacts assessment.

In developing thresholds of significance for air pollutants, BAAQMD considered the emission levels for which a project’s individual emissions would be cumulatively considerable. If a project does not exceed the identified significance thresholds, its emissions would not be cumulatively considerable, resulting in less-than-significant air quality impacts to the region‘s existing air quality conditions. Therefore, additional analysis to assess cumulative impacts is unnecessary, but an analysis of cumulative sources is performed here for completeness. Ramboll Environ used the BAAQMD Stationary Source Screening Tool for Santa Clara County (BAAQMD 2012b) to identify existing permitted stationary sources within 1,000 feet of the MEISR. Ramboll Environ submitted a stationary source inquiry form to the BAAQMD to request updates and received the response in **Appendix B**. **Table 14** summarizes the risks and hazards at the MEISR from existing stationary sources. Some existing stationary source addresses do not match the location shown in the tool’s Google Earth interface. Any source identified as being within 1,000 feet of the MEISR in the Google Earth interface is included in this analysis. When the BAAQMD provided updated HRSA results, as for Facility #19686, the updated HRSA results are used in **Table 14**.

BAAQMD on-road traffic tools were used along with existing trip count data to estimate health-risk impacts and $PM_{2.5}$ concentrations from on-road traffic. Traffic count data for Lafayette Street, the largest roadway in the vicinity of the Project, were taken from the Kimley Horn traffic study for the intersection of Lafayette Street and Walsh Avenue. The

BAAQMD Roadway Screening Analysis Calculator (BAAQMD 2015) provides screening risk estimates for traffic for north-south roadways and east-west roadways in Santa Clara County. The peak hour traffic volume of 1,515 vehicles was conservatively used as the average daily traffic value input into the BAAQMD tool. Lafayette Street was treated as a north-south roadway with the MEISR to the west at a distance of 10 feet. As shown in **Table 14** the cancer risk from on-road traffic is 1.60 in one million and the $PM_{2.5}$ concentration is 0.033 μg/m^3. Caltrain was not considered in this cumulative assessment as the trains will be electric by Project operation in 2020,[4] so there will be no exhaust emissions impacts.

For TACs, the project would have a cumulatively considerable impact if project emissions would result in:

- Non-compliance with a qualified risk reduction plan; or
- An excess lifetime cancer risk level of more than 100 in one million;
- A chronic noncancer HI greater than 10; and
- An incremental increase in the annual average $PM_{2.5}$ of greater than 0.8 μg/m^3.

Based on the project-level analysis included above, the project would not have a cumulatively considerable impact based on these BAAQMD criteria:

- There is no qualified risk reduction plan in effect for the City of Santa Clara.
- The Project would not exceed the BAAQMD cumulatively considerable thresholds relative to the region's existing air quality conditions per the BAAQMD criteria.

Because the project would not meet the BAAQMD CEQA Guidelines criteria for a contribution to any potential adverse cumulative air health risk impacts from either construction or operation, it would not contribute to any potential adverse cumulative air impact on sensitive receptors.

As shown in **Table 14**, existing stationary sources contribute levels of $PM_{2.5}$ above the BAAQMD CEQA threshold of significance for $PM_{2.5}$ concentrations, although the Project contribution is less than significant.

[4] www.caltrain.com/projectsplans/CaltrainModernization/Modernization/PeninsulaCorridorElectrificationProject.html

6. REFERENCES

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TABLES

Table 1a
Emergency Generator Emission Factors
McLaren Project
Santa Clara, California

Generator Information

Make	Caterpillar
Model	C175-16
USEPA Tier	2
USEPA Engine Family	HCPXL106.NZS
Generator Output at 100% Load (kilowatt)	3,000
Engine Output at 100% Load (horsepower)	4,423

Control Efficiency (DPF) Information

Make	Johnson Matthey
Model	CRT® Particulate Filter System

Pollutant	Uncontrolled Emission Factors[1] (g/hp-hr)	Control Efficiency at 100% Load	Controlled Emission Factors[2] (g/hp-hr)
NOx	4.2	0%	4.2
ROG	0.18	70%	0.05
CO	1.3	80%	0.25
PM	0.067	85%	0.010
$PM_{2.5}$	0.067	85%	0.010
CO_2[3]	522	0%	522
CH_4[4]	0.021	0%	0.021
N_2O[4]	0.0042	0%	0.0042
CO_2e[5]	523	0%	523

Notes:

1. Uncontrolled Emission Factors are from USEPA Engine Family Certification.
2. Controlled Emission Factors are the USEPA Engine Family Certification emission factors with reductions assuming a Johnson Matthey CRT® Particulate Filter System on each engine.
3. Emissions factor from AP-42, Vol. I, Section 3.3, Table 3.3-1 for Uncontrolled Gasoline and Diesel Industrial Engines.
4. Emissions factors from 40 CFR 98, Subpart C, Table C-2. Petroleum emissions listed as 3 g CH_4/mmBtu and 0.6 g N_2O/mmBtu. Assumed conversion factor of 7000 Btu/hp-hr per AP-42 Vol I, Table 3.3-1.
5. Global warming potential values of 1 for CO_2, 21 for CH_4, and 310 for N_2O from 40 CFR Part 98 Table A-1 (2011 version) as referenced in the CA MRR, were used to convert emissions to metric tones of carbon dioxide equivalents in accordance with 40 CFR Part 98.2.

Table 1a
Emergency Generator Emission Factors
McLaren Project
Santa Clara, California

Abbreviations:

CH_4 - methane	hr - hour
CO - carbon monoside	N_2O - nitrous oxide
CO_2 - carbon dioxide	NMHC - Non-methane hydrocarbon
CO_2e - carbon dioxide equivalents	NOx - oxides of nitrogen
g - gram	PM - Particulate Matter
hp - horsepower	USEPA - United States Environmental Protection Agency

References:

Peterson Power Systems. 2015. Manufacturer's Performance Data for Model C175-16.

Johnson Matthey Proposal No. GR-394 to Peterson

USEPA. 2015. Large Engine Certification Data for Model Year 2015. Available at: https://www3.epa.gov/otaq/documents/eng-cert/nrci-cert-ghg-2015.xls.

Table 1b
Life Safety Generator Emission Factors
McLaren Project
Santa Clara, California

Generator Information

Make	Perkins
Model	SD/MD500
USEPA Tier	2
USEPA Engine Family	HCPXL15.2NZS
Generator Output at 100% Load (kilowatt)	500
Engine Output at 100% Load (horsepower)	762

Control Efficiency (DPF) Information

Make	Johnson Matthey
Model	CRT® Particulate Filter System

Pollutant	Uncontrolled Emission Factors[1] (g/hp-hr)	Control Efficiency at 100% Load	Controlled Emission Factors[2] (g/hp-hr)
NOx	4.0	0%	4.0
ROG	0.072	70%	0.022
CO	1.2	80%	0.24
PM	0.067	85%	0.010
$PM_{2.5}$	0.067	85%	0.010
CO_2[3]	522	0%	522
CH_4[4]	0.021	0%	0.021
N_2O[4]	0.0042	0%	0.0042
CO_2e[5]	523	0%	523

Notes:

1. Uncontrolled Emission Factors are from USEPA Engine Family Certification.
2. Controlled Emission Factors are the USEPA Engine Family Certification emission factors with reductions assuming a Johnson Matthey CRT® Particulate Filter System on each engine.
3. Emissions factor from AP-42, Vol. I, Section 3.3, Table 3.3-1 for Uncontrolled Gasoline and Diesel Industrial Engines.
4. Emissions factors from 40 CFR 98, Subpart C, Table C-2. Petroleum emissions listed as 3 g CH_4/mmBtu and 0.6 g N_2O/mmBtu. Assumed conversion factor of 7000 Btu/hp-hr per AP-42 Vol I, Table 3.3-1.
5. Global warming potential values of 1 for CO_2, 21 for CH_4, and 310 for N_2O from 40 CFR Part 98 Table A-1 (2011 version) as referenced in the CA MRR, were used to convert emissions to metric tones of carbon dioxide equivalents in accordance with 40 CFR Part 98.2.

Table 1b
Life Safety Generator Emission Factors
McLaren Project
Santa Clara, California

Abbreviations:

CH_4 - methane
CO - carbon monoside
CO_2 - carbon dioxide
CO_2e - carbon dioxide equivalents
g - gram
hp - horsepower
hr - hour
N_2O - nitrous oxide
NMHC - Non-methane hydrocarbon
NOx - oxides of nitrogen
PM - Particulate Matter
USEPA - United States Environmental Protection Agency

References:

Peterson Power Systems. 2015. Manufacturer's Performance Data for Model C175-16.

Johnson Matthey Proposal No. GR-394 to Peterson

USEPA. 2015. Large Engine Certification Data for Model Year 2015. Available at: https://www3.epa.gov/otaq/documents/eng-cert/nrci-cert-ghg-2015.xls.

Table 2
Engine Emissions, Daily
McLaren Project
Santa Clara, California

Engine Model	Engine Horsepower	Controlled Emissions by Pollutant				
		Quantity of Engines	Operational Hours per Engine per Year	Pollutant	Average Daily Emissions (lb/day)	CEQA Threshold (lb/day)
C175-16	4,423	47	50	NOx	262	54
				ROG	3.3	54
				CO	16	-
				PM_{10}[1]	0.63	82
				$PM_{2.5}$[1]	0.63	54
C15	762	1	50	NOx	0.92	54
				ROG	0.0050	54
				CO	0.055	-
				PM_{10}[1]	0.0023	82
				$PM_{2.5}$[1]	0.0023	54

Notes:

1. Emission factors for PM_{10} and $PM_{2.5}$ are conservatively assumed to be equal to the PM emission factor, and are multiplied by (100% - 85%) to account for the proposed DPF, which has a minimum PM abatement efficiency of 85%.
2. Controlled Emission Factors are the 100% Load emission factors from the USEPA Engine Family Certification with reductions assuming a Johnson Matthey CRT® Particulate Filter System on each engine.

Abbreviations:

CH_4 - methane
CO - carbon monoside
CO_2 - carbon dioxide
CO_2e - carbon dioxide equivalents
N_2O - nitrous oxide
NMHC - Non-methane hydrocarbon
NOx - oxides of nitrogen
PM - Particulate Matter
USEPA - United States Environmental Protection Agency

References:

Peterson Power Systems. 2015. Manufacturer's Performance Data for Model C175-16.
Johnson Matthey Proposal No. GR-394 to Peterson
USEPA. 2015. Large Engine Certification Data for Model Year 2015. Available at: https://www3.epa.gov/otaq/documents/eng-cert/nrci-cert-ghg-2015.xls.

Table 3
Engine Emissions, Annual
McLaren Project
Santa Clara, California

Engine Model	Engine Horsepower	Controlled Emissions by Pollutant[2]				
		Quantity of Engines	Operational Hours per Engine per Year	Pollutant	Average Annual Emissions (ton/year)	CEQA Threshold (ton/year)
C175-16	4,423	47	50	NOx	48	10
				ROG	0.60	10
				CO	2.9	-
				PM_{10}[1]	0.12	15
				$PM_{2.5}$[1]	0.12	10
C15	762	1	50	NOx	0.17	10
				ROG	9.0E-04	10
				CO	0.010	-
				PM_{10}[1]	4.2E-04	15
				$PM_{2.5}$[1]	4.2E-04	10

Notes:

1. Emission factors for PM_{10} and $PM_{2.5}$ are conservatively assumed to be equal to the PM emission factor, and are multiplied by (100% - 85%) to account for the proposed DPF, which has a minimum PM abatement efficiency of 85%.
2. Controlled Emission Factors are the 100% Load emission factors from the USEPA Engine Family Certification with reductions assuming a Johnson Matthey CRT® Particulate Filter System on each engine.

Abbreviations:

CH_4 - methane
CO - carbon monoxide
CO_2 - carbon dioxide
CO_2e - carbon dioxide equivalents
N_2O - nitrous oxide
NMHC - Non-methane hydrocarbon
NOx - oxides of nitrogen
PM - Particulate Matter
USEPA - United States Environmental Protection Agency

References:

Peterson Power Systems. 2015. Manufacturer's Performance Data for Model C175-16.
Johnson Matthey Proposal No. GR-394 to Peterson
USEPA. 2015. Large Engine Certification Data for Model Year 2015. Available at: https://www3.epa.gov/otaq/documents/eng-cert/nrci-cert-ghg-2015.xls.

Table 4
Operational Mass Emissions of Criteria Air Pollutants
McLaren Project
Santa Clara, California

Emissions Source	CAP Emissions [ton/year]				CAP Emissions [lb/day]			
	ROG	NO_x	PM_{10} Total	$PM_{2.5}$ Total	ROG	NO_x	PM_{10} Total	$PM_{2.5}$ Total
Emergency Generators	0.60	48	0.12	0.12	3.3	263	0.63	0.63
BAAQMD Stationary Source Offsets	-	-48	-	-	-	-263	-	-
Total Project Emissions	**0.60**	**0**	**0.12**	**0.12**	**3.3**	**0**	**0.63**	**0.63**
BAAQMD Significance Threshold	10	10	15	10	54	54	82	54

Abbreviations:

BAAQMD - Bay Area Air Quality Management District

CAP - Criteria Air Pollutant

lb - pounds

NOx - nitrogen oxides

ROG - reactive organic gases

PM_{10} - particulate matter less than 10 microns

$PM_{2.5}$ - particulate matter less than 2.5 microns

Table 5
Operational Mass Emissions of Greenhouse Gases
McLaren Project
Santa Clara, California

Emissions Source	GHG Emissions[1]	Units
Emergency Generators	5,460	MT CO_2e/yr
BAAQMD Stationary Source Threshold	**10,000**	

Abbreviations:

BAAQMD - Bay Area Air Quality Management District
CO_2e - carbon dioxide equivalents
GHG - greenhouse gas
MT - metric ton
SP - service population
yr - year

RAMBOLL ENVIRON

Table 6
Modeling Parameters
McLaren Project
Santa Clara, California

Emergency Generator Model

Source	Source Type	Number of Sources[1]	Release Height (m)	Exit Temperature (K)	Exit Velocity (m/s)	Exit Diameter (m)
Back-Up Generators	Point	47	13.77 meters, double stacked	750.85	59.23	0.51

Life Safety Generator Model

Source	Source Type	Number of Sources[1]	Release Height (m)	Exit Temperature (K)	Exit Velocity (m/s)	Exit Diameter (m)
Life-Safety Generator	Point	1	13.77 meters	823.15	49.34	0.2

[1] Forty-seven identical generators will be installed at the Project site. Actual stack locations are yet to be determined so they were assumed to be one third from the outside edge of the generator.

Abbreviations:

K - Kelvin
m - meter
s - second

Table 7
Exposure Parameters, 2015 OEHHA Methodology
McLaren Project
Santa Clara, California

Period	Receptor Type	Receptor Age Group	Exposure Parameters						
			Daily Breathing Rate (DBR)[1] (Resident: L/kg-day, Soccer Child L/kg-hr)	Exposure Duration (ED)[2] (years)	Fraction of Time at Home (FAH)[3] (unitless)	Exposure Frequency (EF)[4] (days/year)	Averaging Time (AT) (days)	Modeling Adjustment Factor (MAF) (unitless)	Intake Factor, Inhalation (IF_{inh}) (m^3/kg-day)
Operation	Offsite Resident	3rd Trimester	361	0.25	1	350	25,550	1	0.0012
		Age 0-<2 Years	1,090	2	1	350	25,550	1	0.030
		Age 2-<16 Years	572	14	1	350	25,550	1	0.11
		Age 16-30 Years	261	14	1	350	25,550	1	0.050
	Soccer Child	Age 2-<16 Years	65	14	N/A	52	25,550	1	0.0019
		Age 16-30 Years[5]	30	16	N/A	52	25,550	1	9.8E-04

Notes:

1. Daily breathing rates reflect default breathing rates from OEHHA 2015 as follows: Resident: 95th percentile for 3rd trimester and age 0-<2 years; 80th percentile for ages 2-<9 years, 2-<16 years, and 16-30 years. Soccer Child: 95th percentile moderate intensity for all ages.
2. The total exposure duration for operation reflects the default residential exposure duration from Cal/EPA 2015.
3. Fraction of time at home (FAH) was conservatively assumed to be 1 for all age groups for residential exposure. FAH is not applicable to recreational soccer receptors.
4. Exposure frequency reflects default exposure frequency for residents from Cal/EPA 2015. For Soccer Child receptors, it was assumed that children would attend the soccer facility once a week for 52 weeks.
5. Exposure for children using the soccer facility was assumed to start at age 2 since children younger than 2 cannot participate in the activities at this facility. For operational exposures, 30-year exposure was evaluated starting at age 2 and the 16-30 year breathing rate was assumed for ages 16-32.

Calculation:

Resident:

IF_{inh} = DBR * ED * FAH * EF * CF / AT

CF = 0.001 (m^3/L)

Table 7
Exposure Parameters, 2015 OEHHA Methodology
McLaren Project
Santa Clara, California

Abbreviations:

Cal/EPA - California Environmental Protection Agency

L - liter

kg - kilogram

m^3 - cubic meter

Reference:

Cal/EPA. 2015. Air Toxics Hot Spots Program. Risk Assessment Guidelines. Guidance Manual for Preparation of Health Risk Assessments. Office of Environmental Health Hazard Assessment (OEHHA). February.

Available online at: http://oehha.ca.gov/air/hot_spots/hotspots2015.html.

Table 8
Speciation Values
McLaren Project
Santa Clara, California

Source	Emission Type	Fraction	Chemical[1]
Diesel Offroad Equipment (Generators)	Exhaust PM	1.0	Diesel PM
	Exhaust TOG	0.0019	1,3-Butadiene
		0.074	Acetaldehyde
		0.020	Benzene
		0.0031	Ethylbenzene
		0.15	Formaldehyde
		0.0016	n-Hexane
		3.0E-04	Methanol
		0.015	Methyl Ethyl Ketone
		9.0E-04	Naphthalene
		0.026	Propylene
		6.0E-04	Styrene
		0.015	Toluene
		0.0061	m-Xylene
		0.0034	o-Xylene
		0.0010	p-Xylene

Notes:

1. Compounds presented in this table are only those air toxic contaminants with toxicity values from Cal/EPA (2015) evaluated in the health risk assessment. Speciation profiles presented in this table are from the following sources:

   Diesel offroad exhaust, TOG: ARB 818 / EPA 3161

Abbreviations:

ARB - Air Resources Board
BAAQMD - Bay Area Air Quality Management District
Cal/EPA - California Environmental Protection Agency
PM - particulate matter
TOG - total organic gas
USEPA - United States Environmental Protection Agency

References:

ARB. Speciation Profiles Used in ARB Modeling. Available online at: http://www.arb.ca.gov/ei/speciate/speciate.htm#specprof

BAAQMD. 2011. Recommended Methods for Screening and Modeling Local Risks and Hazards. May.

Cal/EPA. 2015. OEHHA/ARB Consolidated Table of Approved Risk Assessment Health Values. May 13.

USEPA. SPECIATE 4.3. Available online at: http://cfpub.epa.gov/si/speciate/

Table 9
Toxicity Values
McLaren Project
Santa Clara, California

Chemical[1]	Cancer Potency Factor $(mg/kg\text{-}day)^{-1}$	Chronic REL ($\mu g/m^3$)	Acute REL ($\mu g/m^3$)
Diesel PM	1.1	5.0	-
Acetaldehyde	0.010	140	470
Benzene	0.10	3.0	27
1,3-Butadiene	0.60	2.0	660
Chlorine	-	0.20	210
Copper	-	-	100
Ethylbenzene	0.0087	2,000	-
Formaldehyde	0.021	9.0	55
n-Hexane	-	7,000	-
Manganese	-	0.090	-
Methanol	-	4,000	28,000
Methyl Ethyl Ketone	-	-	13,000
Naphthalene	0.12	9.0	-
Propylene	-	3,000	-
Styrene	-	900	21,000
Toluene	-	300	37,000
Xylenes	-	700	22,000

Notes:

1. Chemicals presented in this table reflect air toxic contaminants in the proposed fuel types that are expected from off-road equipment, on-road truck trips, automobile traffic, and propane generators.

Abbreviations:

- \- not available or not applicable
$\mu g/m^3$ - micrograms per cubic meter
ARB - Air Resources Board
Cal/EPA - California Environmental Protection Agency
$(mg/kg\text{-}day)^{-1}$ - per milligram per kilogram-day
OEHHA - Office of Environmental Health Hazard Assessment
PM - particulate matter
REL - reference exposure level

Reference:

Cal/EPA. 2015. OEHHA/ARB Consolidated Table of Approved Risk Assessment Health Values. May 13.

Table 10
Age Sensitivity Factors
McLaren Project
Santa Clara, California

Receptor Age Group	Age Sensitivity Factor[1] (ASF)
3rd Trimester	10
Age 0-<2 Years	10
Age 2-<16 Years	3
Age 16-30 Years	1

Notes:

[1.] Based on Cal/EPA 2015.

Abbreviation:

Cal/EPA: California Environmental Protection Agency

References:

Cal/EPA. 2015. Air Toxics Hot Spots Program. Risk Assessment Guidelines. Guidance Manual for Preparation of Health Risk Assessments. Office of Environmental Health Hazard Assessment (OEHHA). February.

Available online at: http://oehha.ca.gov/air/hot_spots/hotspots2015.html.

Table 11
Carbon Monoxide Analysis
McLaren Project
Santa Clara, California

Averaging Period	Generator Type	Dispersion Factor at Maximum CO Concentration Location[1]	CO Emission Rate	Concentration
		$\mu g/m^3$ / g/s	lb/hr / gen	ppm
1-hr	Emergency Generators	1,980	2.5	0.55
	Life Safety Generator	169	0.40	
8-hr	Emergency Generators	1,438	2.5	0.40
	Life Safety Generator	121	0.40	

Notes:

1. This concentration reflects the highest modeled concentration for the respective averageing periods.

Abbreviations:

CO - carbon monoxide
gen - generator
$\mu g/m^3$ - microgram per meter cubed
g/s - gram per second
lb - pound
hr - hour
ppm - parts per million

Table 12
Concentrations at the Operational MEISR
McLaren Project
Santa Clara, California

Pollutant	Generators[4]
Annual Concentration ($\mu g/m^3$)[1,2]	
Diesel PM	5.3E-04
$PM_{2.5}$[2]	5.3E-04
1-hr Concentration ($\mu g/m^3$)[2]	
1,3-butadiene	0.36
acetaldehyde	14
Acrolein	--
benzene	3.8
ethylbenzene	0.59
formaldehyde	28
n-hexane	0.30
methanol	0.057
methyl ethyl ketone (mek) (2-butanone)	2.8
naphthalene	0.17
o-xylene	0.65
propene	4.9
styrene	0.11
toluene	2.8
Xylenes[5]	2.0

Notes:

1. Maximum annual emissions were reported for the scenario receptors with the highest cancer risk, chronic HI, and $PM_{2.5}$ concentration (Annual MEISRs).
2. Note that the presented $PM_{2.5}$ concentration includes estimated fugitive dust emissions.
3. Maximum one hour emissions were reported for the scenario receptors with the highest Acute HI (Acute MEISRs).
4. The table below lists the 2 MEISR locations:

Generators	UTMx	UTMy
Annual	593075	4135550
1-hr	593213.01	4135690.45

5. Xylene 1-hr concentrations include o-xylene concentrations shown above.

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Table 12
Concentrations at the Operational MEISR
McLaren Project
Santa Clara, California

Abbreviations:

HI - health index
MEISR - Maximally Exposed Individual Sensitive Receptor
$PM_{2.5}$ - fine particulate matter less than 2.5 microns
UTM - Universal Transverse Mercator coordinate system
$\mu g/m^3$ - micrograms per cubic meter
hr - hour
m - meter

Table 13
Project-Related Operational Health Risk Impacts to the MEISR
McLaren Project
Santa Clara, California

Emission Source	Cancer Risk Impact (in one million)	Chronic Non-Cancer Hazard Index	Acute Non-Cancer Hazard Index	Annual $PM_{2.5}$ Concentration ($\mu g/m^3$)
Emergency Generators	0.40	1.1E-04	0.68	5.3E-04
Project Operational Total	0.40	1.1E-04	0.68	5.3E-04
BAAQMD Significance Threshold	10	1	1	0.3

Notes:

1. The cancer risk, chronic HI, and annual PM2.5 MEISR is located at UTM coordinates: UTMx = 593075, UTMy = 4135550
2. The acute HI MEISR is located at UTM coordinates: UTMx = 593125, UTMy = 4135700

Abbreviations:

BAAQMD - Bay Area Air Quality Management District
HI - health index
MEISR - Maximally Exposed Individual Sensitive Receptor
$PM_{2.5}$ - fine particulate matter less than 2.5 microns
UTM - Universal Transverse Mercator coordinate system
$\mu g/m^3$ - micrograms per cubic meter

Table 14
Summary of Cumulative Health Risk Impacts to the MEISR
McLaren Project
Santa Clara, California

Emission Source	Cancer Risk Impact (in one million)	Chronic Non-Cancer Hazard Index	Acute Non-Cancer Hazard Index	Annual $PM_{2.5}$ Concentration (ug/m^3)
Project Operational Generators	0.40	1.1E-04	0.68	5.3E-04
Subtotal, Project Impacts	0.40	1.1E-04	0.68	5.3E-04
Existing Stationary Sources				
M's Refinishing (Facility #5269)	1.63	0.06	N/A	0
Bay Area Surgical Group (Facility #16964)	2.72	0.001	N/A	0.001
Microsoft Corporation (Facility #19686)	11	0.008	N/A	0.033
FMG Enterprises Inc (Facility #4400)	0.03	0	N/A	0
Memorex Dirve LLC (Facility #10299)	2.43	0.006	N/A	0
Mission Trail Waste Systems (Facility #8313)	0.43	0.003	N/A	29.5
Process Stainless Lab, Inc (Facility #17041)	0	0	N/A	0
Vivid Inc (Facility #11467)	0	0	N/A	0.037
Byington Steel Treating, Inc (Facility #4712)	0	0	N/A	0
West Coast Vanities (Facility #15355)	0	0	N/A	0
AMCO Auto Body & Painting (Facility #16494)	0	0	N/A	0
HGM (Facility #14667)	0	0	N/A	0
Choice Auto Body (Facility #17000)	0	0	N/A	0
Lafayette Street	1.60	NA	NA	0.033
Subtotal, Background Sources	19.4	0.08	0.00	29.6
Total Cumulative Impact	**20**	**0.078**	**0.68**	**30**
BAAQMD Significance Threshold	100	10	10	0.8

Table 14
Summary of Cumulative Health Risk Impacts to the MEISR
McLaren Project
Santa Clara, California

Notes:

1. The existing residential locations experiencing maximum project impacts are presented in the previous two tables.

Abbreviations:

BAAQMD - Bay Area Air Quality Management District
HI - health index
MEISR - Maximally Exposed Individual Sensitive Receptor
$PM_{2.5}$ - fine particulate matter
ug/m^3 - micrograms per cubic meter
UTM - Universal Transverse Mercator coordinate system

FIGURES

RAMBOLL ENVIRON

DRAFTED BY: DATE:

Project Boundary
McLaren Project
Vantage Data Centers
Santa Clara, California

FIGURE
1

PROJECT

RAMBOLL ENVIRON

DRAFTED BY: DATE:

Generator Locations

McLaren Project

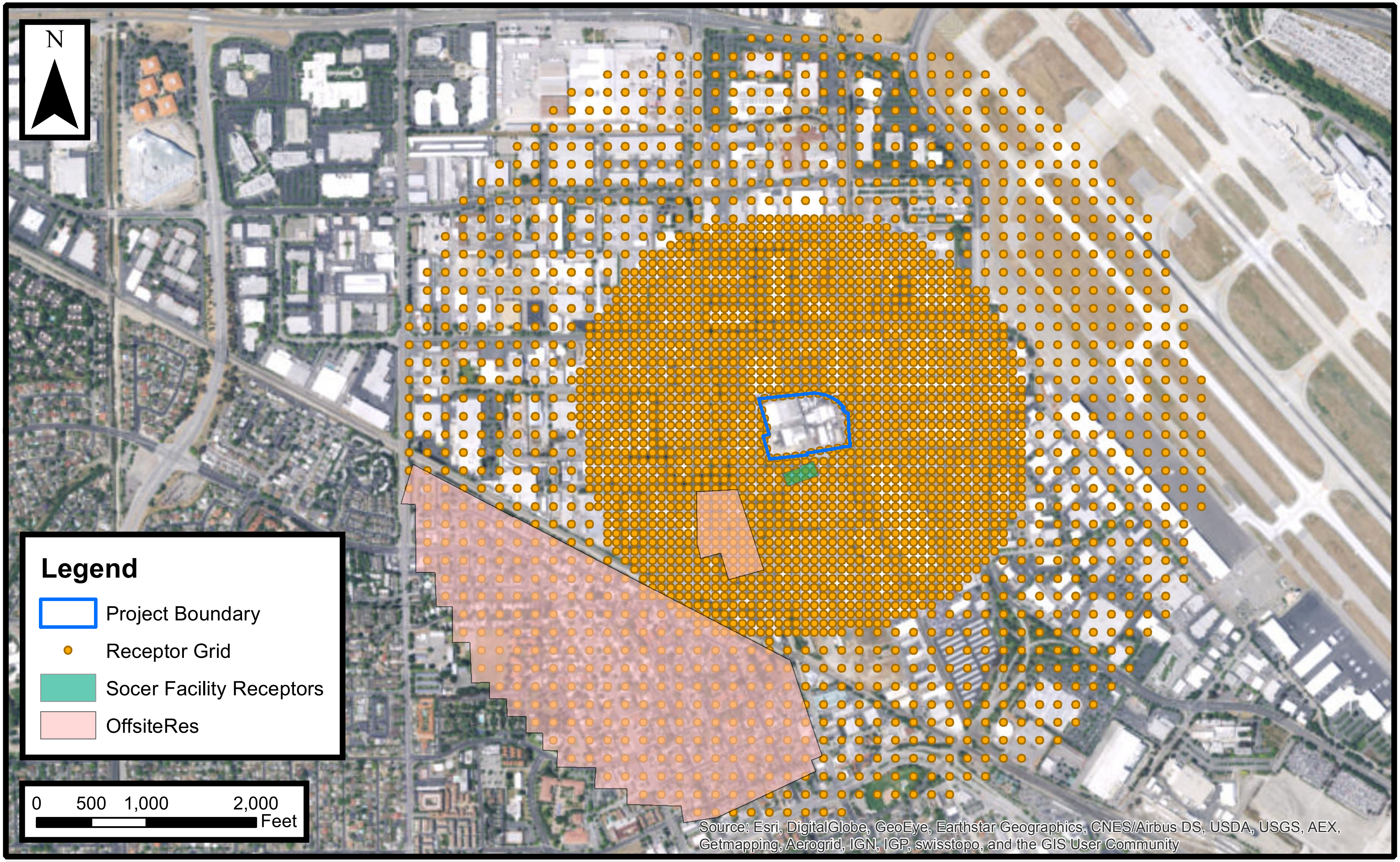
Vantage Data Centers

Santa Clara, California

FIGURE

2

PROJECT



RAMBOLL ENVIRON

Receptor Grid
McLaren Project
Vantage Data Centers
Santa Clara, California

FIGURE
3

DRAFTED BY: DATE: PROJECT