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AIR QUALITY AND CLIMATE CHANGE IMPACT ASSESSMENT

Carli Mine Expansion Project
Sacramento County, California

April 18, 2019

Prepared for: Vulcan Materials Company, Western Division dBA
Sacramento Aggregates
11501 Florin Road
Sacramento, CA 95830

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MODELING FILES

Can be found at https://bit.ly/2l5lzQM or obtained by contacting Sespe Consulting.

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Air Quality and Climate Change Impact Assessment

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Sacramento County, California

April 18, 2019

1.0 EXECUTIVE SUMMARY

This Air Quality, Health Risk, and Climate Change Impact Assessment (Report) has been prepared to quantify and determine the significance of air quality, health risk, and climate change impacts associated with the proposed expansion of an additional 151 acres (The Carli Expansion) to the Sacramento Aggregates mining and processing facility operated by Triangle Rock Products LLC, and owned by CalMat Materials dba Vulcan Materials (Vulcan). Located in Sacramento county, the facility consists of an existing sand and gravel mine and processing plant. Vulcan is proposing to expand their current mining operations, operate a new ready mix concrete (RMC) batch plant and associated maintenance facility, and install/operate a new portable asphalt and concrete recycle plant within the existing facility.

Specifically, Vulcan is proposing to:

- Expand the mining area to encompass an additional 151 acres (The Carli Expansion) located west of the existing processing plant.
- Operate a ready mix concrete (RMC) batch plant and associated maintenance facility.
- Operate a portable crushing plant to recycle asphalt and concrete rubble on-site.

Sespe Consulting, Inc. (Sespe) has prepared this Report to determine the potential air quality, health risk, and climate change impacts of the project. Project emissions were determined by subtracting existing facility emissions (Baseline) from planned emissions post-expansion (Future) to determine the incremental change in emissions resulting from the Project. Baseline emissions were estimated using the 2008 Triangle Rock Final Environmental Impact Report, aggregates production records, and other site specifications provided by Vulcan. Future emissions estimates include updates to facility operation procedures and equipment, which result in lower emissions.

The Report uses Sacramento Metropolitan Air Quality Management District (SCAQMD) approved methods in combination with current best practices, including methods from the Health Risk Assessment (HRA) Guidelines (OEHHA, 2015) to quantify the impacts associated with the Project. Forecasted Project emissions are compared to applicable pollutant thresholds, and analyzed with EPA AERMOD and HARP2 health risk assessment modeling software.

The Report has the following findings with respect to Air Quality and Greenhouse Gasses (GHG), which address the specific impact statements within the CEQA Guidelines Appendix G Environmental Checklist Form:

1.1 Air Quality

a) The Project would not conflict with or obstruct implementation of any applicable air quality plan. Potential conflicts with applicable air quality plans have been analyzed and ruled out (see Section 4.5.1).

b) The Project would not violate any air quality standard or contribute substantially to an existing or projected air quality violation. Project activity will be taking place in a new location but not involve a significant change in emissions (see Section 4.5.2).

c) The project does not result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable Federal or State ambient air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors). Project Criteria Pollutant daily emissions are below SMAQMD Air Quality Significance Thresholds (see Section 4.5.3).

d) After mitigation, the Project would not expose sensitive receptors to substantial pollutant concentrations. Using US EPA-approved dispersion modeling software, it has been determined that sensitive receptors are not subject to significant exposure provided the following mitigation measures are in place (see Section 4.5.4):

    i) The Project will maintain offroad mining vehicle fleet engines at EPA certified Tier 4 Interim or cleaner.

    ii) The Project will implement enhanced dust control methods to increase overall control efficiency from 68% to 80%.

e) The Project would not create objectionable odors affecting a substantial number of people. Previous emissions were not objectionable and no significant odor causing activities would result due to the Project (see Section 4.5.5).

1.2 Greenhouse Gasses

a) The Project would not generate GHG emissions, either directly or indirectly, that may have a significant impact on the environment. The Project was found to have CO_2e emissions below the SCAQMD screening threshold (see Section 5.5.1).

b) The Project would not conflict with an applicable plan, policy or regulation adopted for the purpose of reducing the emissions of GHGs. Potential conflicts with applicable air quality plans have been analyzed and ruled out (see Section 5.5.2).

2.0 INTRODUCTION

Vulcan Materials Company (Vulcan) owns the Sacramento Aggregates mine and processing plant located in the County of Sacramento. Vulcan is proposing to expand its current Sacramento Aggregates mining operations to the property immediately west of the existing processing plant. The expansion area is referred to as the Carli Expansion Project (Project). The Sacramento Aggregates sand and gravel mining operation consists of permitted Phases I – X and Expansion Phases E-1, E-2 and E-3. The Carli expansion will add Phase T to the approved operations and will be implemented in two mining phases, Phases T-1 and T-2.

This Air Quality and Climate Change Impact Assessment (AQCCIA) presents technical information and analysis describing reasonably foreseeable changes to the environment that would occur with the Project and the addition of a portable recycle plant for asphalt and concrete along with the associated diesel-fired generator set.(Figure 1, Appendix A).

Project impacts on regional and local environmental setting are assessed for construction and operation using current standard practices and the State CEQA Guidelines (14 CCR §15000 et. seq.). This AQCCIA primarily follows the *Guide to Air Quality Assessment* (SMAQMD, 2016) and *Air Toxics Hot Spots Program Guidance Manual for the Preparation of Risk Assessments* (OEHHA, 2015).

This report has two sections: air quality and GHG that are each sub-divided into the following sections:

- **Regulatory setting**. This subsection describes the characteristics of pollutants as well as federal, state[1], and local regulations that apply to the Project.
- **Environmental setting**. This subsection describes the existing physical environment (i.e., CEQA baseline)[2] for the region and adjacent to the Project site.
- **Significance thresholds**. This subsection presents the state CEQA Guidelines Appendix G checklist items which are the primary thresholds used along with the SMAQMD significance criteria that are applied to determine the significance of the Project.
- **Methodology**. This subsection describes the design features of the Project, emissions calculation methods, emissions that are in the Baseline for the Project, and health risk assessment (HRA) methods used for this Project.
- **Project-level impacts and mitigation measures**. This subsection presents the results of Project impact analyses prepared using the methodology; compares each impact to significance criteria; makes a determination of significance; proposes mitigation measures to reduce significant impacts to less than significant levels or the maximum extent feasible.

[1] The words “federal,” “national,” and “state” are capitalized when referring to a specific rule, regulation or other item that could be unique (e.g., State CEQA Guidelines in preceding paragraph. The words are not capitalized when describing items in general terms not specific to this nation or state. As presented in this bullet; federal, state and local are levels of government/regulation; and thus are not capitalized.

[2] The word “baseline” is capitalized in this report when referring to the Project Baseline and is not capitalized when referring to the concept of baseline under CEQA and/or baselines for other projects, plans, regulations, etc.

3.0 PROJECT DESCRIPTION

The Sacramento Aggregates mine and processing plant is located at 11501 Florin Road in Sacramento County, California. Vulcan purchased the property immediately west of the current mining operation. The Project would be on 140 acres of the 151-acre property and provide an estimated 10,330,000 tons of reserves for the Sacramento Aggregate operation.

The Project would involve excavating 6,300 tons per day or approximately 1,965,600 tons of material annually, and is estimated to take approximately 10 years. In addition, the Project would allow for operation of a portable asphalt and concrete recycling plant (Recycle Plant), an associated diesel-fired generator, and a Ready Mix Concrete (RMC) production plant. Production from both the Recycle and RMC plants would substitute for mined materials so that the combined production would not change from the above amounts previously approved in the *Final Environmental Impact Report – Sacramento Aggregates Expansion: Community Plan Amendment, Rezone, Use Permit and Reclamation Plan Amendment* (Sacramento County, 2008) herein referred to as the “2008 FEIR.”

Figure 2 (Appendix A) presents a site plan showing the Project site (designated as “Phase T”), and three (3) related projects that are discussed in this report:

1. Existing Sacramento Aggregates processing facility located north and east of the Project site will receive material from the Project by way of conveyor (Phases III, IX, and X);
2. Existing Sacramento Aggregates mine (Phase E); and
3. Existing composting facility located on the Project site.

The Project would expand the area that can be mined to include Phase T. The rate of mining would remain unchanged from the existing setting which is governed by market demand and the economics of inelastic demand. As such, the production rate would continue to be fluctuate with the ebb and flow of the construction industry. Appendix B contains a discussion of the economics of aggregates that govern how much is made and sold.

The 2008 FEIR contains air quality impact analysis for Phase E operations that are occurring today and is used as the Baseline condition for this report. Appendix C contains relevant technical reports from the 2008 FEIR appendices.

Aside from extracting aggregate reserves from the adjacent Carli property, the existing mining and processing operations would remain unchanged with the Project and are thus not part of the Project. Approved production and processing rates for the existing mining operation and processing plant would remain unchanged or decrease due to the substitution of materials processed by the proposed Recycle or RMC plants. The mining activities currently being conducted in the previously approved Phase E area south of Florin Road would be completed prior to extracting materials from the Project site (i.e., Phase T).

Access to the Project site would be from the existing Sacramento Aggregate facility entrance road. Because production and processing rates would remain unchanged from the existing rates, the off-site highway truck traffic would also remain unchanged. Thus, off-site impacts were omitted from the Project emissions.

The planned end use for the Project site would be open space and grazing. Activities on the Project site would be completed within the time limits of the currently approved Use Permit (01-ZGB-UPB-0107) which is 2033. Reclamation of the Project site is designed to complement the currently approved reclamation activities planned for the existing phases of the mining operation.

Normal operating hours for mining activities are listed below but the Zoning Administrator may permit different mining operation hours on an interim basis from the specified hours if the Administrator finds that the public benefit outweighs the community hardship:

- Monday through Friday: 7:00 A.M. until 10:00 P.M
- Saturday: 7:00 A.M. until 3:00 P.M.
- Sunday and labor union holidays: no mining.
- Ready Mix Concrete Production May take place 24 hours a day and on weekends.

The Carli expansion would be mined starting in the northern portion of the site, extend south around the existing composting facility, then progress east, and finally extend northeast to excavate the area currently occupied by the composting operation. The proposed excavation setbacks would be the same as for the existing permitted operations (i.e., 30 feet from the Florin Road right-of-way and 30 feet from the Eagles Nest Road right-of-way). The setbacks would be landscaped to match the existing landscaping on the northeast and southeast sides of Florin Road and create a visual barrier between the roads and the mining activities. The landscaping would include the same native and/or landscape varieties of plants within a 15 feet wide planting area.

Mining equipment used at the Project site would be existing equipment from Phase E mining operations with the exception that cleaner engines would be and/or have been implemented to comply with California Air Resources Board (CARB) or SAQMD regulations. Overburden and aggregate on the Project site would be removed using existing equipment including a hydraulic excavator, a bulldozer, and front end loaders. The excavated aggregate ore would be transported to an existing, extendable, and electrified conveyor system by existing haul trucks and/or loaders prior to being conveyed east to the existing processing plant. Other existing mobile equipment that may be used includes a motor-grader, a water truck, and a service truck.

In addition to the historic mining activities in Phase E and the existing composting activities on the Project site, stockpiles of broken asphalt pavement and/or Portland cement concrete (PCC) from nearby demolition projects would be stored on-site. A portable Recycle Plant and associated diesel-fired generator would be brought on-site approximately once per quarter to crush and screen accumulated material. Materials produced by the portable Recycle Plant would substitute for virgin mined materials so that total production and off-site truck trips from the neighboring Sacramento Aggregates facility would remain unchanged.

An estimated 6,372,000 cubic yards of overburden would be removed in phases to expose the aggregate resources. Average ground surface elevation at the site is 108 feet above mean sea level (AMSL). Aggregate would be mined to an estimated depth of between 70 and 75 feet below the existing surface. Table 1 presents the quantities of materials that would be handled by the Project.

Table 1. Quantities of Materials Handled

Type of Material	Quantity
Rock (aggregate)	10,330,000 net tons produced[a]
Overburden	6,372,000 cubic yards[a]
Fill Back	6,069,000 cubic yards[a]
Ready Mix Concrete	450,000 cubic yards per year[b]
Recycled Materials	150,000 tons per year[b]

[a]Based on email from Kevin Torell of Vulcan Materials Company dated 2/26/2017.

[b]Conservative estimates for modeling purposes. The reasonably foreseeable maximum production rate associated with the Ready Mix Concrete plant is approximately 200,000 cubic yards per year.

4.0 AIR QUALITY

This AQCCIA was prepared using current best practices including the *Guide to Air Quality Assessment in Sacramento County* (SMAQMD, 2016) and the *Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments* (OEHHA, 2015).

4.1 Regulatory Setting

4.1.1 Characteristics of Air Pollutants

Both the state and the federal governments have established health-based criteria called Ambient Air Quality Standards (AAQS) for six air pollutants. These “criteria pollutants” are ozone (O_3), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), lead (Pb), and suspended particulate matter ($PM_{2.5}$ and PM_{10}). Each criteria pollutant is described more fully below and associated AAQS are presented in Table 2.

Many constituents in air emissions other than criteria pollutants may result in health effects and are regulated as toxic air contaminants (TACs) using health risk assessment methods (i.e., as opposed to comparing concentration of criteria pollutant to an AAQS). Diesel particulate matter (DPM) and respirable crystalline silica (RCS) are two TACs of concern associated with Project sources and are also discussed below. Appendix D contains information from the American Thoracic Society (ATS) on what constitutes an adverse health effect from air pollution which is the standard used by the Office of Environmental Health Hazard Assessment (OEHHA) and CARB in setting AAQS and exposure levels used for health risk assessment (HRA).

Ozone – Ozone (smog) is formed by photochemical reactions between oxides of nitrogen (NO_X) and volatile organic compounds (VOC), rather than being directly emitted. Generally, air districts prioritize NOx reductions over VOC reductions because NOx reductions would have greater effect on reducing ozone concentrations and be more protective of public health. O_3 is a pungent, colorless gas typical of photochemical smog. Elevated O_3 concentrations may result in reduced lung function, particularly during vigorous physical activity. This health effect is particularly acute in sensitive receptors such as the sick, the elderly, and young children. O_3 levels peak during summer and early fall.

Breathing ground-level ozone can result in a number of health effects that are observed in broad segments of the population. Some of these effects include: induction of respiratory symptoms; decrements in lung function; and inflammation of airways. Respiratory symptoms may include: coughing; throat irritation; pain, burning, or discomfort in the chest when taking a deep breath; and chest tightness, wheezing, or shortness of breath. In addition to these effects, evidence from observational studies indicates that higher daily ozone concentrations are associated with increased asthma attacks, increased hospital admissions, increased daily mortality, and other markers of morbidity. The consistency and coherence of the evidence for effects upon asthmatics suggests that ozone can make asthma symptoms worse and can increase sensitivity to asthma triggers.

Carbon Monoxide – Carbon monoxide (CO) is formed by the incomplete combustion of fossil fuels, almost entirely from automobiles. It is a colorless, odorless gas that can cause dizziness, fatigue, and impairments to central nervous system functions.

The severity of symptoms due to CO exposure increases with the blood carboxyhemoglobin (COHb) level. The first signs of CO exposure include mild headache and breathlessness with moderate exercise. Continued exposure may lead to more severe headache, irritability, impaired judgment and memory, and rapid onset of fatigue. Persons that may be more sensitive to CO exposure include those having an existing cardiovascular disease or anemia; fetuses of pregnant women; smokers; and persons exposed to methylene chloride.

Nitrogen Oxides – Nitrogen oxides (NO_X) is a generic term for the mono-nitrogen oxides which include nitric oxide (NO) and nitrogen dioxide (NO_2). NO is a colorless, odorless gas and NO_2 is a reddish brown gas. NO_X is formed from fuel combustion under high temperature or pressure. NO_X is a primary component of the photochemical smog reaction. It also contributes to other pollution problems, including a high concentration of fine particulate matter, poor visibility, and acid deposition (i.e., acid rain). NO_X decreases lung function and may reduce resistance to infection. Acute exposure to NO_2 may cause pulmonary edema, pneumonitis, and bronchitis. NO_2 is considered a relatively insoluble, reactive gas, such as phosgene and ozone. Once inhaled, NO_2 reaches the lower respiratory tract, affecting mainly the bronchioles and the adjacent alveolar spaces, where it may produce pulmonary edema within hours.

Sulfur Dioxide – Sulfur dioxide (SO_2) is a colorless, irritating gas formed primarily from combustion of fuels containing sulfur. Industrial facilities also contribute to gaseous SO_2 levels. SO_2 irritates the respiratory tract, can injure lung tissue when combined with fine particulate matter, and reduces visibility and the level of sunlight. People with asthma and children are particularly sensitive to and are at increased risk from the effects of SO_2 air pollution

Lead – Lead (Pb) was phased out of use in gasoline and paint. It is present at trace concentrations in a variety of other materials including most natural materials extracted from the earth's crust. Once in the bloodstream, Pb can cause damage to the brain, nervous system, and other body systems. Children are highly susceptible to the effects of Pb.

Particulate Matter – Particulate matter (PM) pollution consists of very small liquid and solid particles floating in the air. Some particles are large or dark enough to be seen as soot or smoke. Others are so small they can be detected only with an electron microscope. Particulate matter is a mixture of materials that can include smoke, soot, dust, salt, acids, and metals. Particulate matter also forms when gases emitted from motor vehicles and industrial sources undergo chemical reactions in the atmosphere. PM_{10} refers to particles less than or equal to 10 microns in aerodynamic diameter. $PM_{2.5}$ refers to particles less than or equal to 2.5 microns in aerodynamic diameter and are a subset of PM_{10}.

There are sources of PM_{10} in both urban and rural areas. PM_{10} and $PM_{2.5}$ are emitted from stationary and mobile sources, including diesel trucks and other motor vehicles, power plants, industrial processing, wood burning stoves and fireplaces, wildfires, dust from roads, construction, landfills, and agriculture, and fugitive windblown dust. Because particles originate from a variety of sources, their chemical and physical compositions vary widely. In addition, it is now believed that $PM_{2.5}$ concentrations are highly dependent on several precursors which, like NOx and ROG for ozone, undergo chemical reactions in the environment that changes them to $PM_{2.5}$.

PM_{10} and $PM_{2.5}$ particles are small enough to be inhaled into, and lodge in, the deepest parts of the lung, evading the respiratory system's natural defenses. Health problems may occur as the body reacts to these foreign particles.

Acute and chronic health effects associated with high particulate levels include the aggravation of chronic respiratory diseases, heart and lung disease, and coughing, bronchitis, and respiratory illnesses in children. Recent mortality studies have shown a statistically significant direct association between mortality and daily concentrations of particulate matter in the air. Non health-related effects include reduced visibility and soiling of buildings. PM_{10} can increase the number and severity of asthma attacks, cause or aggravate bronchitis and other lung diseases, and reduce the body's ability to fight infections. PM_{10} and $PM_{2.5}$ can aggravate respiratory disease, and cause lung damage, cancer, and premature death.

Although particulate matter can cause health problems for everyone, certain people are especially vulnerable to adverse health effects of PM_{10}. These "sensitive populations" include children, the elderly, exercising adults, and those suffering from chronic lung disease such as asthma or bronchitis. Of greatest concern are recent studies that link PM_{10} exposure to the premature death of people who already have heart and lung disease, especially the elderly. Acidic PM_{10} can also damage manmade materials and is a major cause of reduced visibility in many parts of the United States.

Respirable Crystalline Silica – Respirable crystalline silica (RCS) refers to crystalline silicon dioxide with aerodynamic diameter less than four (4) microns (i.e., 0.0004 cm). Crystalline silica or quartz is ubiquitous in nature. Most dust generated by construction and mining activities including blasting produces dust particles larger than 4 microns. These particles are too large to reach the alveoli of the lungs which are the target organ. Thus, RCS constitutes a tiny fraction of the dust from these sources and does not represent a significant health risk to neighbors of these types of projects. In order to result in toxic effects the silica needs to be crystalline, smaller than 4 microns, inhaled, and not exhaled.

Inhalation of RCS initially causes respiratory irritation and an inflammatory reaction in the lungs. Silicosis results from chronic exposure; it is characterized by the presence of histologically unique silicotic nodules and by fibrotic scarring of the lung. Lung diseases other than cancer associated with silica exposure include silicosis, tuberculosis/silicotuberculosis, chronic bronchitis, small airways disease, and emphysema. Ambient air exposures do not cause concern but levels to which workers (e.g., miners, sandblasters) may be exposed have been shown to cause cancer.

Diesel Particulate Matter. Diesel particulate matter (DPM) is used as a surrogate for the mixture of compounds in diesel exhaust that have the potential to contribute to mutations in cells that can lead to cancer. These compounds include, but are not limited to, arsenic, benzene, formaldehyde, and nickel.

Long-term exposure to diesel exhaust particles poses the highest cancer risk of any TAC evaluated by OEHHA. CARB has estimated that about 70 percent of the cancer risk that the average Californian faces from breathing TACs stems from diesel exhaust particles. In a comprehensive assessment of diesel exhaust, OEHHA analyzed more than 30 studies of people who worked around diesel equipment, including truck drivers, railroad workers, and equipment operators. The studies showed these workers were more likely than workers who were not exposed to diesel emissions to develop lung cancer. These studies provide strong evidence that long-term occupational exposure to diesel exhaust increases the risk of lung cancer. Other researchers and scientific organizations, including the National Institute for Occupational Safety and Health (NIOSH), have calculated similar cancer risks from diesel exhaust as those calculated by OEHHA.

Exposure to diesel exhaust can have immediate health effects. Diesel exhaust can irritate the eyes, nose, throat and lungs, and it can cause coughs, headaches, lightheadedness, and nausea. People with allergies, existing cardiovascular disease, the elderly, and children considered sensitive populations for DPM exposure. Exposure to diesel exhaust also causes inflammation in the lungs, which may aggravate chronic respiratory symptoms and increase the frequency or intensity of asthma attacks.

4.1.2 Federal

The Clean Air Act (CAA) is the comprehensive Federal law that regulates air emissions from stationary and mobile sources. Congress established much of the basic structure of the CAA in 1970, and made major revisions in 1977 and 1990. Table 2 presents Federal and State AAQS. “The Clean Air Act in a Nutshell: How It Works” (EPA, 2013) contains a thorough yet concise summary of how US EPA implements the CAA.Table 3 also identifies how the CAA applies to the Project.

Table 2 State and Federal Ambient Air Quality Standards

Pollutant	Averaging Time	California Standards[1]		National Standards[2]		
		Concentration[3]	Method[4]	Primary[3,5]	Secondary[3,6]	Method[7]
Ozone (O_3)[8]	1 Hour	0.09 ppm (180 $\mu g/m^3$)	Ultraviolet Photometry	—	Same as Primary Standard	Ultraviolet Photometry
	8 Hour	0.070 ppm (137 $\mu g/m^3$)		0.070 ppm (137 $\mu g/m^3$)		
Respirable Particulate Matter (PM_{10})[9]	24 Hour	50 $\mu g/m^3$	Gravimetric or Beta Attenuation	150 $\mu g/m^3$	Same as Primary Standard	Inertial Separation and Gravimetric Analysis
	Annual Arithmetic Mean	20 $\mu g/m^3$		—		
Fine Particulate Matter ($PM_{2.5}$)[9]	24 Hour	—	—	35 $\mu g/m^3$	Same as Primary Standard	Inertial Separation and Gravimetric Analysis
	Annual Arithmetic Mean	12 $\mu g/m^3$	Gravimetric or Beta Attenuation	12.0 $\mu g/m^3$	15 $\mu g/m^3$	
Carbon Monoxide (CO)	1 Hour	20 ppm (23 mg/m^3)	Non-Dispersive Infrared Photometry (NDIR)	35 ppm (40 mg/m^3)	—	Non-Dispersive Infrared Photometry (NDIR)
	8 Hour	9.0 ppm (10 mg/m^3)		9 ppm (10 mg/m^3)	—	
	8 Hour (Lake Tahoe)	6 ppm (7 mg/m^3)		—	—	
Nitrogen Dioxide (NO_2)[10]	1 Hour	0.18 ppm (339 $\mu g/m^3$)	Gas Phase Chemi-luminescence	100 ppb (188 $\mu g/m^3$)	—	Gas Phase Chemi-luminescence
	Annual Arithmetic Mean	0.030 ppm (57 $\mu g/m^3$)		0.053 ppm (100 $\mu g/m^3$)	Same as Primary Standard	
Sulfur Dioxide (SO_2)[11]	1 Hour	0.25 ppm (655 $\mu g/m^3$)	Ultraviolet Fluorescence	75 ppb (196 $\mu g/m^3$)	—	Ultraviolet Flourescence; Spectro-photometry (Pararosaniline Method)
	3 Hour	—		—	0.5 ppm (1,300 $\mu g/m^3$)	
	24 Hour	0.04 ppm (105 $\mu g/m^3$)		0.14 ppm (for certain areas)[10]	—	
	Annual Arithmetic Mean	—		0.030 ppm (for certain areas)[10]	—	
Lead[12,13]	30 Day Average	1.5 $\mu g/m^3$	Atomic Absorption	—	—	High Volume Sampler and Atomic Absorption
	Calendar Quarter	—		1.5 $\mu g/m^3$ (for certain areas)[12]	Same as Primary Standard	
	Rolling 3-Month Average	—		0.15 $\mu g/m^3$		
Visibility Reducing Particles[14]	8 Hour	See footnote 14	Beta Attenuation and Transmittance through Filter Tape	**No National Standards**		
Sulfates	24 Hour	25 $\mu g/m^3$	Ion Chromatography			
Hydrogen Sulfide	1 Hour	0.03 ppm (42 $\mu g/m^3$)	Ultraviolet Fluorescence			
Vinyl Chloride[12]	24 Hour	0.01 ppm (26 $\mu g/m^3$)	Gas Chromatography			

Footnotes on next page. Source: CARB, May 4, 2016

1. California standards for ozone, carbon monoxide (except 8-hour Lake Tahoe), sulfur dioxide (1 and 24 hour), nitrogen dioxide, and particulate matter (PM_{10}, $PM_{2.5}$, and visibility reducing particles), are values that are not to be exceeded. All others are not to be equaled or exceeded. California ambient air quality standards are listed in the Table of Standards in Section 70200 of Title 17 of the California Code of Regulations.
2. National standards (other than ozone, particulate matter, and those based on annual arithmetic mean) are not to be exceeded more than once a year. The ozone standard is attained when the fourth highest 8-hour concentration measured at each site in a year, averaged over three years, is equal to or less than the standard. For PM_{10}, the 24 hour standard is attained when the expected number of days per calendar year with a 24-hour average concentration above 150 µg/m3 is equal to or less than one. For $PM_{2.5}$, the 24 hour standard is attained when 98 percent of the daily concentrations, averaged over three years, are equal to or less than the standard. Contact the US EPA for further clarification and current National policies.
3. Concentration expressed first in units in which it was promulgated. Equivalent units given in parentheses are based upon a reference temperature of 25°C and a reference pressure of 760 torr. Most measurements of air quality are to be corrected to a reference temperature of 25°C and a reference pressure of 760 torr; ppm in this table refers to ppm by volume, or micromoles of pollutant per mole of gas.
4. Any equivalent measurement method, which can be shown to the satisfaction of the ARB to give equivalent results at or near the level of the air quality standard, may be used.
5. National Primary Standards: The levels of air quality necessary, with an adequate margin of safety, to protect the public health.
6. Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.
7. Reference method as described by the US EPA. An “equivalent method” of measurement may be used but must have a “consistent relationship to the reference method” and must be approved by the US EPA.
8. On October 1, 2015, the National 8-hour ozone primary and secondary standards were lowered from 0.075 to 0.070 ppm.
9. On December 14, 2012, the National annual $PM_{2.5}$ primary standard was lowered from 15 $\mu g/m^3$ to 12.0 $\mu g/m^3$. The existing National 24- hour $PM_{2.5}$ standards (primary and secondary) were retained at 35 $\mu g/m^3$, as was the annual secondary standard of 15 $\mu g/m^3$. The existing 24-hour PM_{10} standards (primary and secondary) of 150 $\mu g/m^3$ also were retained. The form of the annual primary and secondary standards is the annual mean, averaged over 3 years.
10. To attain the 1-hour National standard, the 3-year average of the annual 98th percentile of the 1-hour daily maximum concentrations at each site must not exceed 100 ppb. Note that the National 1-hour standard is in units of parts per billion (ppb). California standards are in units of parts per million (ppm). To directly compare the National 1-hour standard to the California standards the units can be converted from ppb to ppm. In this case, the National standard of 100 ppb is identical to 0.100 ppm.
11. On June 2, 2010, a new 1-hour SO_2 standard was established and the existing 24-hour and annual primary standards were revoked. To attain the 1-hour National standard, the 3-year average of the annual 99th percentile of the 1-hour daily maximum concentrations at each site must not exceed 75 ppb. The 1971 SO_2 National standards (24-hour and annual) remain in effect until one year after an area is designated for the 2010 standard, except that in areas designated nonattainment for the 1971 standards, the 1971 standards remain in effect until implementation plans to attain or maintain the 2010 standards are approved. Note that the 1-hour National standard is in units of parts per billion (ppb). California standards are in units of parts per million (ppm). To directly compare the 1-hour National standard to the California standard the units can be converted to ppm. In this case, the National standard of 75 ppb is identical to 0.075 ppm.
12. The CARB has identified lead and vinyl chloride as 'toxic air contaminants' with no threshold level of exposure for adverse health effects determined. These actions allow for the implementation of control measures at levels below the ambient concentrations specified for these pollutants.
13. The National standard for lead was revised on October 15, 2008 to a rolling 3-month average. The 1978 lead standard (1.5 $\mu g/m^3$ as a quarterly average) remains in effect until one year after an area is designated for the 2008 standard, except that in areas designated nonattainment for the 1978 standard, the 1978 standard remains in effect until implementation plans to attain or maintain the 2008 standard are approved.
14. In 1989, CARB converted both the general statewide 10-mile visibility standard and the Lake Tahoe 30-mile visibility standard to instrumental equivalents, which are "extinction of 0.23 per kilometer" and "extinction of 0.07 per kilometer" for the statewide and Lake Tahoe Air Basin standards, respectively.

Table 3 Applicability of US EPA Activities under the CAA to the Project

US EPA Activity	Applicable to Project Sources?
Establish air quality standards.	Yes, see **Impact AQ-2**.
Designate quality of air in attainment areas.	No, the Project is not an attainment area.
Administrate state implementation plans.	No, the Project is not a SIP.
Require additional programs in nonattainment areas.	Yes, the Project would comply with SMAQMD programs and rules that address nonattainment.
Provide guidance on control techniques.	No, the Project would employ standard controls.
Regulate interstate air pollution.	No, the Project is not a state.
Require plans to maintain clean air after a nonattainment area meets the standard.	Yes, the Project would comply with SMAQMD programs and rules that maintain attainment.
Preserve clean air in attainment areas.	Yes, the Project would comply with SMAQMD programs and rules that preserve attainment.
Adopt National standards for new stationary sources.	No, the Project has no stationary sources.
Adopt National standards or guidelines for consumer and commercial products.	No, the Project does not buy products that emit air pollutant from vendors outside the country.
Adopt National standards for new vehicles and engines, and fuels.	No, the Project does not manufacture vehicles, engines, or fuels.
Regulate emissions from oil drilling on the Outer Continental Shelf.	No, the Project is not located on the Outer Continental Shelf.
Regulate hazardous air pollutants.	No, the Project has no stationary sources.
Protect visibility in National parks by regulating regional haze.	No, does not include a major stationary source.
Control acid rain by regulating NO_2 and SO_2 emissions from power plants.	No, the Project does not include a power plant or other major source of combustion pollutants.
Protect stratospheric ozone by regulating ozone-depleting compounds (e.g., chlorofluorocarbons).	No, the Project would purchase refrigerants and other classes of products from a U.S. vendor.
Regulate major sources of air pollution by administrating a Federal operating permit program.	No, the Project is a minor source that does not require a Federal operating permit.

Source: (EPA, 2013).

Regulations Affecting New Diesel Engines

US EPA regulates emissions from new non-road (i.e., offroad, portable, and stationary) internal combustion engines by tiered standards (e.g., compression-ignition engines in 40 CFR 89.112, 40 CFR 1039.101, and 40 CFR 1039.102). Emissions from new non-road engines are regulated using standards that apply by model year, class of vehicle, and fuel type (e.g. heavy-heavy duty diesel engines in 40 CFR 86.004-11, 40 CFR 86.007-11, and 40 CFR 86.099-11). These regulations affect manufacturers but are relevant to the Project because diesel engines are the primary source of Project emissions besides dust.

Engine tiers are emissions standards that were phased-in by size and model year between 1996 and 2015. Tier 0 engines are engines that were built before the applicable engine tier standard came into effect for each engine size. Although the regulations require Tier 4 Final engines in 2015, manufacturing has not kept up with demand in the 100 to 174 hp and 750+ hp size categories. The EPA Nonroad Compression-Ignition Engines: Exhaust Emission Standards chart (Appendix I)presents the emissions factors for each tier.

4.1.3 State

4.1.3.1 Criteria Pollutants

The State of California began to set California ambient air quality standards (CAAQS) in 1969. The CAAQS are generally more stringent than the NAAQS. In addition to the six criteria pollutants covered by the NAAQS, there are CAAQS standards for sulfates, hydrogen sulfide, vinyl chloride, and visibility reducing particles. These standards are also listed in Table 2.

Originally, there were no attainment deadlines for the CAAQS. However, the California Clean Air Act (CCAA) provided a timeframe and a planning structure to promote their attainment. The CCAA required nonattainment areas in the State to prepare attainment plans and proposed to classify each such area on the basis of the submitted plan. The attainment plans require a minimum 5 percent annual reduction in the emissions of nonattainment pollutants unless all feasible measures have been implemented. The Sacramento County area of the Sacramento Valley Air Basin (SVAB) is currently classified as a nonattainment area for three criteria pollutants: O_3, PM_{10}, and $PM_{2.5}$.

4.1.3.2 Toxic Air Contaminants

The CARB Statewide comprehensive air toxics program was established in the early 1980s. The Toxic Air Contaminant Identification and Control Act (AB 1807, 1983) created California's program to reduce exposure to air toxics. The Air Toxics "Hot Spots" Information and Assessment Act (AB 2588, 1987) requires a Statewide air toxics inventory, notification of people exposed to a significant health risk, and facility plans to reduce these risks.

Under AB 1807, CARB is required to use certain criteria in the prioritization for the identification and control of air toxics. In selecting substances for review, CARB must consider criteria relating to "the risk of harm to public health, amount or potential amount of emissions, manner of, and exposure to, usage of the substance in California, persistence in the atmosphere, and ambient concentrations in the community." AB 1807 also requires CARB to use available information gathered from the AB 2588 program to include in the prioritization of compounds. The list of TACs includes all Federal HAPs plus the following pollutants: 1,2-dibromoethane, 1,2-

dichloroethane, hexavalent chromium, cadmium, inorganic arsenic, nickel, inorganic lead, diesel particulate matter, and environmental tobacco smoke (17 CCR § 93000 and §93001).

Under AB 2588, facilities are required to report air toxic emissions, ascertain health risks and notify nearby residents of significant risks. In September 1992, the Hot Spots Act was amended by Senate Bill 1731, which required facilities that pose a significant health risk to reduce their risk through a risk management plan. The emissions inventory and risk assessment methodologies from the AB2588 Program are incorporated into this AQCCIA as discussed in the methodology subchapter (Sections 4.4).

Diesel Emissions

In July 2007, CARB adopted an airborne toxic control measure (ATCM) for in-use off-road diesel vehicles (13 CCR § 2449 et seq.). This regulation required that specific fleet average requirements be met for NO_x emissions and for particulate matter emissions. Where average requirements cannot be met, BACT requirements apply. The regulation also included several recordkeeping and reporting requirements. In response to AB 8 2X, the regulations were revised in July 2009 (effective December 3, 2009) to allow a partial postponement of the compliance schedule in 2011 and 2012 for existing fleets. On December 17, 2010, CARB adopted additional revisions to further delay the deadlines reflecting reductions in diesel emissions due to the poor economy and overestimates of diesel emissions in California. The revisions delayed the first compliance date until no earlier than January 1, 2014, for large fleets, with final compliance by January 1, 2023. The compliance dates for medium fleets were delayed until an initial date of January 1, 2017, and final compliance date of January 1, 2023. The compliance dates for small fleets were delayed until an initial date of January 1, 2019, and final compliance date of January 1, 2028. Correspondingly, the fleet average targets were made more stringent in future compliance years. The revisions would also accelerate the phase-out of equipment, preventing older equipment from being added to fleets over time:

- Tier 1 or higher has been required since September 13, 2013 when the US EPA authorized the waiver needed by CARB to regulate in-use mobile engines.
- Tier 2 or higher engines on January 1, 2013, without exception; and
- Tier 3 or higher engines on January 1, 2018 (January 1, 2023, for small fleets).

On October 28, 2011 (effective December 14, 2011), the Executive Officer of CARB approved amendments to the ATCM regulation. The amendments included revisions to the applicability section and additions and revisions to the definitions. The regulation was amended to combine the PM and NO_x fleet average targets under one, instead of two, sections. The amended fleet average targets are based on the NO_x fleet average emissions factors from previous versions of the rule with credit given for PM reduction, and the section regarding PM performance requirements was deleted completely. The BACT requirements, if a fleet cannot comply with the fleet average requirements, were restructured and clarified. Other amendments to the regulations included minor administrative changes to the regulatory text.

The CARB Portable Diesel-Fueled Engine ATCM (17CCR § 93116 et. seq.) contains fleet average DPM standards for three size categories of engines (< 175 hp, 175 to 750 hp, > 750 hp) which are each required to meet more stringent fleet average emissions characteristics on January 1 of 2013, 2017, and 2020. CARB has determined that engine control systems and new, cleaner engines are not available in sufficient quantities to allow fleet owners to upgrade to meet fleet average emissions levels before future compliance dates (1/1/2017 and 1/1/2020). CARB proposed amendments to the ATCM and the Portable Equipment Registration Program (PERP) to address this issue which may be heard by the Board in the near future. ACTM compliance for engines greater than 750 hp is proposed to be delayed three (3) years until 1/1/2020 in the most recent draft of the regulation (November 2016).

Naturally Occurring Asbestos (NOA)

The following two ATCMs for naturally-occurring asbestos (NOA) have been adopted by CARB and each allows the Air Pollution Control Officer of the local air district to exempt sand and gravel operations like the Project that are located on alluvial deposits:

- Asbestos ATCM for Surfacing Applications (17 CCR § 93106) restricts the asbestos content of material used in surfacing applications such as unpaved roads, parking lots, driveways, and walkways. The ATCM excludes "sand and gravel operations" from requirements in the ATCM except for the section allowing the Air Pollution Control Officer (APCO) to require geologic evaluation or asbestos testing. "Sand and gravel operation" means any aggregate-producing facility operating in alluvial deposits.
- Asbestos ATCM for Construction, Grading, Quarrying, and Surface Mining Operations (17 CCR § 93105) requires the implementation of mitigation measures to minimize emissions of asbestos-laden dust unless an exemption in the ATCM applies. Applicable to this Project, the ATCM states that the "APCO may provide an exemption for crushing, screening and conveying equipment, stockpiles, and off-site material transport at a sand and gravel operation if the operation processes only materials from an alluvial deposit."

Given the exemptions provided, this AQCCIA assumes that there is no asbestos in dust generated by the Project.

4.1.4 Sacramento Metropolitan Air Quality Management District

The Sacramento Air Pollution Control District was formed by the Sacramento County Board of Supervisors in December of 1959. In July of 1996, the SMAQMD was created under Health and Safety Code Sections 40960 et. seq. to monitor, promote, and improve air quality in the County of Sacramento. It is one of 35 regional air quality districts in California.

SMAQMD is designated by EPA as part of the Sacramento Federal Ozone Nonattainment Area (SFNA), which is comprised of all of Sacramento and Yolo Counties, the eastern portion of Solano County, the southern portion of Sutter County, the western slopes of El Dorado and Placer Counties up to the Sierra crest, and includes four other local air districts. SMAQMD is responsible for monitoring air pollution within the Basin and for developing and administering programs to reduce air pollution levels below the health-based standards established by the State and Federal governments.

CARB coordinates and oversees both state and Federal air pollution control programs in California. CARB also oversees activities of local air quality management agencies and is responsible for incorporating air quality management plans for local air basins into a State Implementation Plan (SIP) for US EPA approval. The SMAQMD has adopted several air quality management or “attainment” plans to achieve State and National AAQS and comply with CCAA and CAAA requirements. The SMAQMD continuously monitors progress in implementing attainment plans and periodically reports to CARB and the US EPA. It also periodically revises attainment plans to reflect new conditions and requirements in accordance with schedules mandated by the CCAA and CAAA.

4.1.4.1 Air Quality Management Plans

Discussion in this section is paraphrased from text on the SMAQMD website (http://www.airquality.org/Air-Quality-Health/Air-Quality-Plans).

The Sacramento region was designated nonattainment for four of the six criteria pollutants: ozone, $PM_{2.5}$, PM_{10} and carbon monoxide. The Sacramento region currently meets the National Ambient Air Quality Standard (NAAQS) for carbon monoxide, lead, nitrogen dioxide, PM_{10} and sulfur dioxide. Maintenance plans for carbon monoxide and PM_{10} are listed below. The Federal CAA requires plans to identify how nonattainment areas will attain the NAAQS by the attainment date. Key elements of these plans include emission inventories, emission control strategies and rules, motor vehicle budgets, air quality data analyses, modeling and air quality trends. EPA reviews air quality plans to make sure they are consistent with the requirements of the CAA.

Ozone Plans to Attain Federal Standards

The Sacramento ozone planning region includes all of Sacramento and Yolo counties and portions of Placer, El Dorado, Solano, and Sutter counties. The region was classified as a severe nonattainment area for the 1997 8-hour NAAQS of 84 ppb. In 2013, the regional air districts developed the Sacramento Regional 8-Hour Ozone Attainment and Reasonable Further Progress Plan to address how the region would attain the 1997 8-hour standard. This plan was approved by U.S. EPA effective March 2, 2015 (80 FR 4795).The region shows that it attained the 1997 8-hour NAAQS based on ambient data for the 2013–2015 monitoring period.

Plans and reports that have been developed in the past to meet requirements of previous NAAQS include:

- Sacramento Regional 8-Hour Ozone Milestone Report (2011) This report demonstrates how existing control strategies have provided the emission reductions needed to meet the Federal Clean Air Act requirements for reasonable further progress toward attainment of the 1997 8-hour NAAQS.
- Sacramento Area Regional Ozone Attainment Plan (1994) This report shows how the region attained the 1979 1-hour ozone NAAQS. The districts of the Sacramento region developed the attainment plan in November 1994.
- 1-Hour Ozone Attainment Determination Request for the Sacramento Federal Ozone Nonattainment Area (2010). A request for supplemental information was prepared and approved by the board, submitted but never acted upon by EPA. It will be resubmitted in conjunction with the former 1997 8-hour NAAQS to show attainment of both standards.

- Exceptional Events Demonstration for High Ozone in the Sacramento Regional Nonattainment Area Due to Wildfires (2011) This report demonstrates how wildfires contributed to high ozone concentrations in 2008.

In 2015, EPA promulgated a new 8-hour NAAQS of 70 ppb. In 2016, the California Air Resource Board recommended that the region be designated nonattainment in their report Recommended Area Designations for the 0.70 ppm Federal 8-Hour Standard. EPA is expected to make a final classification and determination by October 1, 2017 (based on 2014-2016 data).

Particulate Matter Plans to Attain Federal Standards

The Sacramento $PM_{2.5}$ planning region was classified as attainment for the 2012 annual average $PM_{2.5}$ NAAQS of 12 µg/m^3, and classified as nonattainment in 2009 for the 2006 24-hour $PM_{2.5}$ NAAQS of 35µg/m^3. The region prepared the $PM_{2.5}$ Maintenance Plan and Redesignation Request (2013) to address how the region would attain the 24-hour $PM_{2.5}$ standard. The region attained the standard based on 2009–2011 monitoring data, but postponed the submittal of the plan because of high concentrations from 2012 that caused exceedances. The submittal of this Plan will be updated based on monitoring data for 2015 and 2016, which shows that the region will be able to attain the $PM_{2.5}$ standard. The particulate matter planning region includes all of Sacramento County, the eastern portion of Yolo County, the western portions of El Dorado and Placer counties and the northeast portion of Solano County.

On May 10, 2017, U.S. EPA found that the Sacramento $PM_{2.5}$ Nonattainment Area attained the 2006 24-hour $PM_{2.5}$ NAAQS by the attainment date of December 31, 2015 (82 FR 21711). EPA's finding of attainment is based on complete, quality-assured and certified $PM_{2.5}$ monitoring data for 2013 – 2015. The Regional Air Districts, which make up the nonattainment area, will be preparing an implementation/maintenance plan and redesignation request in 2018 for the Sacramento Region. (SMAQMD, 2017).

The Sacramento region was classified as attainment for the 1997 PM_{10} 24-hour NAAQS of 150 µg/m^3. In October 2010, the SacMetro AQMD prepared the PM_{10} Implementation /Maintenance Plan and Redesignation Request for Sacramento County (2010). EPA approved the PM_{10} Plan, which allowed EPA to proceed with the redesignation of Sacramento County as attainment for the PM_{10} NAAQS (78 FR 59261, 2013).

Carbon Monoxide Plans to Attain Federal Standards

The Sacramento region is currently designated attainment for both the 1-hour NAAQS of 35 parts per millions (ppm) and the 8-hour standard of 9 ppm. A maintenance plan was developed for CO in 1996. The 2004 Revision to the California State Implementation Plan for Carbon Monoxide extends the 1996 CO maintenance plan demonstration to 2018.

Plans to Attain Calfornia Standards

Sacramento County meets the State AAQS for sulfur dioxide, nitrogen dioxide and carbon monoxide. The Sacramento Region is currently designated nonattainment for State AAQS applicable to ozone and particulate matter. State planning has been completed for individual counties.

In accordance with the CCAA, the SMAQMD prepared and submitted the 1991 Air Quality Attainment Plan (AQAP) to address Sacramento County's nonattainment status for the State ozone and carbon monoxide (CO) AAQS, and although not required, PM_{10}. The 1991 AQAP was designed to make expeditious progress toward attaining the State ozone standard and contained schedules for control programs on stationary sources, transportation and indirect sources, and a vehicle/fuels program.

The CCAA requires that by the end of 1994 and once every three years thereafter, districts are to assess their progress toward attaining CAAQS. The triennial assessment reports the level of air quality improvement and the amounts of emission reductions achieved from control measures for the preceding three-year period. The most current update to this report by the SMAQMD is the 2015 Triennial Report and Progress Plan.

California Health and Safety Code section 40924(a) requires districts to prepare an Annual Progress Report and submit the report to the CARB summarizing its progress in meeting the schedules for developing, adopting, and implementing the air pollution control measures contained in the district's Triennial Reports by December 31 of each year. The most current update to this report by the SMAQMD is the 2015 Annual Progress Report Plan.

SMAQMD will develop future control measures through implementation of the various air quality plans followed by a rulemaking process for each new measure. The Project may be affects by certain new measures/rules and would then need to comply. SMAQMD has posted a list of potential rulemaking in 2017 (Appendix C). Project activities are fairly common as they are similar to construction grading. Thus, it is expected that the Project would be able to comply with any new measures that may be adopted in the future.

4.1.4.2 Rules and Regulations

The following SMAQMD rules are applicable to Project sources.

Rule 201 (General Permit Requirements)

The Project has no stationary sources that would require a permit but may be considered by the SMAQMD to be part of the existing aggregates processing facility stationary source and/or the portable Recycle Plant and associated portable diesel generator may be subject to SMAQMD permit requirements.

Rule 201 provides an orderly procedure for the review of new sources of air pollution and of the modification and operation of existing sources through the issuance of permits. Various exemptions from obtaining a permit exist and include: vehicles used to transport passengers or freight (Sec. 111.1); repairs or maintenance not involving changes to any equipment for which a permit has been granted (Sec. 121); and other equipment deemed by the Air Pollution Control Officer and which would emit any pollutants without the benefit of air pollution control devices less than 2 pounds in any 24 hour period (Sec. 122).

Rule 202 (New Source Review)

The Project has no stationary sources that would require a permit but may be considered by the SMAQMD to be part of the existing aggregates processing facility stationary source and/or the portable Recycle Plant and associated portable diesel generator may be subject to SMAQMD permit requirements.

Rule 202 provides for the issuance of authorities to construct and permits to operate at new and modified stationary air pollution sources and to provide mechanisms, including emission offsets, by which authorities to construct such sources may be granted without interfering with the attainment or maintenance of ambient air quality standards. The pollutants regulated under Rule 202 are VOC, NO_X, SO_X, PM_{10}, $PM_{2.5}$, CO and Pb. BACT is required if the emissions of VOC, NO_X, SO_X, PM_{10}, or $PM_{2.5}$ exceed 2 pounds per 24 hour period (i.e., not exempt from permit under Rule 201). BACT is triggered for CO at 550 lb/day; Pb at 3.3 lb/day, and ammonia has no BACT trigger level. In addition, emission offsets to mitigate an increase in emissions from a new or modified stationary source would be required if the facility's emissions exceed:

- 5,000 pounds per quarter each of NO_x or VOC;
- 13,650 pounds per quarter of SO_x;
- 7,300 pounds per quarter of PM_{10};
- 15 tons per year of $PM_{2.5}$;
- 49,500 pounds per quarter of CO; and
- 100 tons per year of ammonia (if ammonia is determined to be a necessary part of the $PM_{2.5}$ control strategy).

Rule 209 (Limiting Potential to Emit)

The Project has no stationary sources that would require a permit but may be considered by the SMAQMD to be part of the existing aggregates processing facility stationary source. Thus, SMAQMD may include emissions from certain activities on the Project site when assessing the potential to emit for the aggregates processing facility.

The purpose Rule 209 is to eliminate the need for certain stationary sources to obtain a Title V operating permit pursuant to District Rule 207, Title V - Federal Operating Permit Program. Stationary sources subject to Rule 209 are those whose actual emissions are less than or equal to 50% of those of a major stationary source, but whose potential emissions are equal to or greater than the major stationary source thresholds. These stationary sources must comply with emissions limitations set in this rule. This process is also referred to as a "synthetic minor."

Rule 210 (Synthetic Minor Source Status)

The Project has no stationary sources that would require a permit but may be considered by the SMAQMD to be part of the existing aggregates processing facility stationary source and/or the portable Recycle Plant and associated portable diesel generator may be subject to SMAQMD permit requirements.

The purpose of Rule 210 is to allow owners or operators of specified stationary sources that would otherwise be major stationary sources to request and accept federally enforceable emissions limits sufficient to enable the sources to be considered synthetic minor stationary sources.

Rule 401 (Ringelmann Chart/Opacity)

Rule 401 prohibits emissions of visible air contaminants from any potential source of air contaminants. The rule prohibits air contaminants, other than water vapor, from resulting in greater than Number 1 on Ringelmann Chart (i.e., 20 percent opacity) for a combined period of more than 3 minutes of any hour.

Rule 402 (Nuisance)

To protect the public health, Rule 402 prohibits any person from discharging such quantities of air contaminants that cause injury, detriment, nuisance, or annoyance to any considerable number of persons or to the public.

Rule 403 (Fugitive Dust)

Rule 403 requires persons to take reasonable precautions not to cause or allow dust from being airborne beyond the property line from which the emission originates. Reasonable precautions include, but are not limited to: use of water or chemical dust suppressant and other means approved by SMAQMD.

Rule 404 (Particulate Matter)

Rule 404 establishes a particulate matter emission standard. Discharge of PM from any source in excess of 0.23 g/dscf (i.e., 0.1 gr/dscf) is prohibited unless otherwise allowed by Rule 406 (see below).

Rule 405 (Dust and Condensed Fumes)

Rule 405 limits PM emissions using a table of allowable emissions rates that vary based on process weight rate calculations. For instance, activities that handle 400 ton/hr (800,000 lb/hr) of material are limited to 28.4 lb/hr of PM emissions.

Rule 406 (Specific Contaminants)

Rule 406 limits the emission of sulfur compounds and combustion contaminants by establishing concentration limits. Sulfur compounds measured as SO_2 are limited to 0.2% by volume except as provided in Rule 420 (below). Combustion contaminants are limited to the amounts in Rule 404 (above).

Rule 420 (Sulfur Content of Fuels)

Rule 420 prohibits burning of gaseous fuel containing sulfur compounds in excess of 1.14 grams per cubic meter (50 grains per 100 cubic feet) of gaseous fuel, or any liquid fuel or solid fuel having a sulfur content in excess of 0.5% by weight.

Rule 904 (Air Toxics Control Measures)

Rule 904 implements the provisions of Title 17, Division 3, Chapter 1, Subchapter 7.5 of the California Code of Regulations in effect 5-26-11 which are adopted by reference. ATCMs that may apply to the Project are discussed in Section 4.1.3.2 above.

4.1.4.3 SMAQMD CEQA Guidelines

The SMAQMD CEQA webpage (http://airquality.org/businesses/ceqa-land-use-planning) links to documents prepared by the Agency that pertain to the following:

- Project Review Principles guide staff's review of plans and projects.
- CEQA Guidance & Tools include the Guide to Air Quality Assessment in Sacramento County, thresholds of significance and emissions estimating models.
- Recommended Mitigation measures for operational and construction emissions.
- Roadway Protocol to assess potential cancer risk to receptors located near major roadways.
- Model Air Quality Element contains policies for general plans.

Within the CEQA & Tools section, the Guide to Air Qulaity Assessment in Sacramento County contains definitions of dust control practices used in this document. These include

I. Basic Construction Emission Control Practices

i. Water all exposed surfaces two times daily. Exposed surfaces include, but are not limited to soil piles, graded areas, unpaved parking areas, staging areas, and access roads.

ii. Cover or maintain at least two feet of free board space on haul trucks transporting soil, sand, or other loose material on the site.

iii. Limit vehicle speeds on unpaved roads to 15 miles per hour (mph).

iv. All roadways, driveways, sidewalks, parking lots to be paved should be completed as soon as possible. In addition, building pads should be laid as soon as possible after grading unless seeding or soil binders are used.

II. Enhanced Exhaust Control Practices

i. Water exposed soil with adequate frequency for continued moist soil. However, do not overwater to the extent that sediment flows off the site.

ii. Suspend excavation, grading, and/or demolition activity when wind speeds exceed 20 mph

iii. Install wind breaks (e.g., plant trees, solid fencing) on windward side(s) of construction areas.

iv. Plant vegetative ground cover (fast-germinating native grass seed) in disturbed areas as soon as possible. Water appropriately until vegetation is established. UNPAVED ROADS (ENTRAINED ROAD DUST)

v. Install wheel washers for all exiting trucks, or wash off all trucks and equipment leaving the site.

vi. Treat site accesses to a distance of 100 feet from the paved road with a 6 to 12-inch layer of wood chips, mulch, or gravel to reduce generation of road dust and road dust carryout onto public roads.

vii. Post a publicly visible sign with the telephone number and person to contact at the lead agency regarding dust complaints. This person shall respond and take corrective action within 48 hours. The phone number of the District shall also be visible to ensure compliance

4.1.5 Sacramento County General Plan Air Quality Policies

The Sacramento County General Plan has a number of policies for air quality. The Air Quality Element contains a single overarching Goal: "*Improve air quality to promote the public health, safety, welfare, and environmental quality of the community.*" Consistent with that goal the Element identifies three (3) objectives which are each divided into Policies and Implementation Measures that the County will take under the Policies. Listed below are the the Objectives followed by detailed discussion of each Policy and Implementation Measure in the Element:

- **Multidisciplinary Coordination**:The integration of air quality planning with land use, transportation and energy planning processes to provide a safe and healthy environment. This objective is addressed by Policies AQ-1 through AQ-4 below.
- **Motor Vehicle Emissions**: A reduction in motor vehicle emissions through a decrease in the average daily trips and vehicle miles traveled and an increasing reliance on the use of low emission vehicles. This objective is addressed by Policies AQ-5 through AQ-11 below.
- **Reducing Air Pollutants**: Compliance with AAQS to reduce all air pollutants, including ozone-depleting compounds to ensure the protection of the stratospheric ozone layer. This objective is addressed by Policies AQ-12 through AQ-22 below.

	Air Quality Element Policies	Applicability to Project
1.	New development shall be designed to promote pedestrian/bicycle access and circulation to encourage community residents to use alternative modes of transportation to conserve air quality and minimize direct and indirect emission of air contaminants.	N/A. Pedestrian/bicycle access to Project site is undesireable.
2.	Support Regional Transit's efforts to secure adequate funding so that transit is a viable transportation alternative. Development shall pay its fair share of the cost of transit facilities required to serve the project.	N/A. Off-site transportation is not part of the Project.

	Air Quality Element Policies	Applicability to Project
3.	Buffers and/or other appropriate mitigation shall be established on a project-by-project basis and incorporated during review to provide for protection of sensitive receptors from sources of air pollution or odor. The California Air Resources Board's "Air Quality and Land Use Handbook: A Community Health Perspective", and the AQMD's approved Protocol (Protocol for Evaluating the Location of Sensitive Land uses Adjacent to Major Roadways) shall be utilized when establishing these buffers.	The 30-foot buffers from public roads result in buffer from sensitive receptors. Additional buffers would be considered if additional mitigation were warranted. Section 4.5 discusses Project impacts and mitigation measures.
4.	Developments which meet or exceed thresholds of significance for ozone precursor pollutants as adopted by the SMAQMD, shall be deemed to have a significant environmental impact. An Air Quality Mitigation Plan shall be submitted to the County of Sacramento prior to project approval, subject to review and recommendation as to technical adequacy by the SMAQMD.	Section 4.5 discusses Project impacts, proposed mitigation measures, and residual impacts which result in less than significant impacts.
5.	Reduce emissions associated with vehicle miles travelled and evaporation by reducing the surface area dedicated to parking facilities; reduce vehicle emissions associated with "hunting" for on-street parking by implementing innovative parking innovative parking solutions including shared parking, elimination of minimum parking requirements, creation of maximum parking requirements, and utilize performance pricing for publicly owned parking spaces both on- and off-street, as well as creating parking benefit districts.	N/A. Vehicles would not park on the Project site and off-site transportation is not part of the Project
6.	Provide incentives for the use of transportation alternatives, including a program for the provision of financial incentives for builders that construct ownership housing within a quarter mile of existing and proposed light rail stations.	N/A. The Project could not receive incentives because off-site transportation is not part of the Project.
7.	Implement a model trip reduction program for County employees which may include, but not be limited to, flexible and compressed work schedules, commuter matching services, telecommuting, preferential carpool/vanpool parking, carpool/vanpool and transit subsidies, and all other commute alternative incentives.	N/A. Employees of the Project are not employees of the County.
8.	Promote mixed-use development and provide for increased development intensity along existing and proposed transit corridors to reduce the length and frequency of vehicle trips.	N/A. The Project site is industrial and could not incorporate mixed-uses.
9.	When park-and-ride facilities are requested by transit providers, the spaces provided for the park-and-ride facility may be counted as part of the total amount of parking required by the zoning code.	N/A. Off-site transportation is not part of the Project.
10.	Encourage vehicle trip reduction and improved air quality by requiring development projects that exceed the SMAQMD's significance thresholds for operational emissions to provide on-going, cost-effective mechanisms for transportation services that help reduce the demand for existing roadway infrastructure.	N/A. Off-site transportation is not part of the Project and residual impacts are each less than significant (see Section 4.5).

Air Quality Element Policies		Applicability to Project
11.	Encourage contractors operating in the county to procure and to operate low-emission vehicles, and to seek low emission fleet status for their off-road equipment.	The Project is affected by various diesel engine rules that result in a low emission fleet.(Section 3.1.3.2)
12.	Minimize air pollutant emissions from Sacramento County facilities and operations.	Project emissions are minimized by SMAQMD rules, regulations, design features (Section 4.4.1), and mitigations (Section 4.5).
13.	Use CARB and SMAQMD guidelines for Sacramento County facilities and operations to comply with mandated measures to reduce emissions from fuel consumption, energy consumption, surface coating operations, and solvent usage.	CARB/SMAQMD guidelines were followed in preparing this report and mitigating significant impacts.
14.	Support SMAQMD's development of improved ambient air quality monitoring capabilities and the establishment of standards, thresholds and rules to more adequately address the air quality impacts of plans and proposals proposed by the County.	N/A. The Project does not affect the County's support for SMAQMD plans, programs and standards.
15.	Support intergovernmental efforts directed at stricter tailpipe emissions standards.	N/A. The Project does not affect intergovernmental efforts.
16.	Prohibit the idling of on-and off-road engines when the vehicle is not moving or when the off-road equipment is not performing work for a period of time greater than five minutes in any one-hour period.	The Project would comply with idling requirements and have a written policy. (Section 3.4.1)
17.	Promote optimal air quality benefits through energy conservation measures in new development.	The Project conserves energy as it is the most costly part of mining. (see Appendix B)
18.	Require the recovery of chlorofluorocarbons (CFC's) when older air conditioning and refrigeration units are serviced or disposed.	N/A. The Project excludes the affected equipment.
19.	Require all feasible reductions in emissions for the operation of construction vehicles and equipment on major land development and roadway construction projects.	The project would follow SMAQCD construction emission reductions requirements. (see Section 3.1.4.3)
20.	Promote Cool Community strategies to cool the urban heat island, reduce energy use and ozone formation, and maximize air quality benefits by encouraging four main strategies including, but not limited to: plant trees, selective use of vegetation for landscaping, install cool roofing, and install cool pavements.	The Project would plant trees and vegetation in buffer zones.
21.	Support SMAQMD's particulate matter control measures for residential wood burning and fugitive dust.	Project fugitive dust sources would comply with SMAQMD rules.
22.	Reduce greenhouse gas emissions from County operations as well as private development.	Project would not increase GHG emissions.

4.2 Environmental Setting

The environmental setting includes the physical setting against which is compared to reasonably expected conditions with the Project to determine the Project's impact. Besides emissions, the air quality environment is affected by terrain and meteorology (weather).

Terrain plays a role in air dispersion mechanics, and therefore the resulting levels of air pollutants in a given area. Mountains that surround valley areas tend to retain air within the valley and limit the dispersion of pollutants. Meteorology causes year-to-year changes in air quality trends that can mask the benefits of emission reductions. Unlike terrain, meteorology affects pollutant concentrations differntly depending upon the pollutant as discussed in the following examples:

- Ozone is formed in the atmosphere as sunlight initiates a complex set of chemical reactions. On hot sunny days, the abundant sunlight starts the ozone-forming processes and high temperatures promote fast chemical reactions. If the air is stagnant, the ozone formed is not dispersed or diluted by cleaner air. So, the highest ozone concentrations usually occur on hot and sunny days with light breezes or calm air. In some areas, high ozone levels may represent transport from upwind regions; local weather conditions associated with transport may differ from place to place. Since hot and sunny summer days typically lead to high ozone, it is not surprising that cold and cloudy winter days have much lower concentrations. (CARB, 2014).
- Ambient PM is comprised of primary PM that is directly emitted and secondary PM that forms in the atmosphere through chemical and physical processes. Primary PM includes dust and soot, while secondary PM includes particulate nitrates and sulfates. Some areas are subject to strong winds that lift dust into the air resulting in high concen-trations of primary PM. In other situations, cold, calm, and humid air can promote the buildup of secondary PM. Relatively high PM levels in valley areas usually occur in the winter under these meteorological conditions. The lowest PM concentrations often occur on rainy winter days when winds disperse PM and rain washes PM out of the air. (CARB, 2014).

4.2.1 Regional Setting

The Project site is located in the southernmost portion of the Sacramento Valley Air Basin (SVAB). The SVAB is comprised of nine air districts (Shasta County, Tehama County, Glenn County, Butte County, Colusa County, Feather River which spans Sutter and Yuba Counties, the wester portion of Placer County, Yolo-Solano which spans Yolo County and the easter portion of Solano County; and Sacramento Metro). The SVAB and County's jurisdictional areas are shown on Figure 1 (Appendix A). The National Weather Service describes the climate in the region of the Project as follows:

> *"The Southern Sacramento Valley, including the City of Sacramento, is blessed with a mild climate and an abundance of sunshine the year-round. The summers are virtually cloudless with warm, dry days and mild, pleasant nights. During the winter "rainy season" (November through February), over half the total annual precipitation falls, yet rain in measurable amounts occurs only about ten days monthly during the winter. Mountains surround the Sacramento Valley to the west, north and east. The Sierra Nevada snowfields are only 70 miles east of Sacramento and usually provide a plentiful supply of water to the valley streams during*

the dry season. Because of the shielding influence of the high mountains, winter storms reach the valley in a modified form. However, torrential rain and heavy snow frequently fall on the Western Sierra Slopes, the Southern Cascades, and to a lesser extent, the Coastal Range. As a result, flood conditions occasionally occur along the Sacramento River and its tributaries. Excessive rainfall and damaging wind storms occur infrequently." (NWS, 2010).

"The prevailing wind in Sacramento is southerly all year. This is due to the north-south orientation of the valley and the deflecting effects of the towering Sierra Nevada on the prevailing oceanic wind that moves through the Carquinez Strait near the Delta, at the junction of the Sacramento and San Joaquin Rivers. No other break exists in the Coastal Mountains to admit significant marine air into the Sacramento or the San Joaquin Valleys. Occasionally, a strong north or northeasterly pressure gradient develops, forcing air south and west from the high plateau of the Great Basin, over the Sierra Nevada and the Siskiyou Mountains, and down into the Sacramento Valley below, creating what is essentially a Foehn wind. This air is warmed by compression as it descends, reaching the valley floor as a hot and dry north wind. Heat waves in the summer can be produced by these winds and fortunately, are usually followed within two or three days by the normally cool southwest delta breezes, especially at night. The extremely low relative humidity that accompanies high temperatures in the valley during the summer should be considered when comparing temperatures with those of cities in more humid regions." (NWS, 2010).

"Summer nights in the Southern Sacramento Valley are usually pleasant. This is primarily the result of the refreshing breezes blowing up from the San Francisco Bay through the Delta. The exception is when the north or northeasterly wind develops during heat waves." (NWS, 2010).

"Thunderstorms in Sacramento are few in number and usually occur in the late fall or in the spring. Snow is so rare and falls in such small amounts that its occurrence may be disregarded as a climatic feature. Dense fog occurs mostly in mid-winter, seldom in the spring or autumn, and never in the summer. Light and moderate fog is more frequent and may happen anytime during the wet, cold season. Fog is usually of the radiational cooling type and is confined to the early morning hours. Under stagnant atmospheric conditions, winter fog can become very persistent and may continue for several days." (NWS, 2010).

"Sacramento is the geographical hub of the great Central Valley of California, which is the most roductive agricultural region in the United States. This region produces cotton, poultry, livestock and dairy products, plus a wide variety of fruits, cereals, vegetables and nuts, ranging from the semi-tropical to the hardier varieties." (NWS, 2010).

Table 4 Sacramento County Attainment Status

Pollutant	Federal Designation (attainment date)[a]	State Designation[b]
Ozone - One hour	Attainment (2009)[c]	Nonattainment
Ozone - Eight hour	Nonattainment – Severe 15[d]	Nonattainment
PM_{10}	Attainment (2013)	Nonattainment
$PM_{2.5}$	Nonattainment[e]	Nonattainment
Carbon Monoxide	Attainment (1998)	Attainment
Nitrogen Dioxide	Unclassifiable/Attainment (2012)[f]	Attainment (2012)
Sulfur Dioxide	Attainment[g]	Attainment
Lead (Particulate)	Attainment (2011)	Attainment
Hydrogen Sulfide	No Federal Standard	Unclassified
Sulfates	No Federal Standard	Attainment
Visibility Reducing Particles	No Federal Standard	Unclassified
Vinyl Chloride	No Federal Standard	Unclassified

Sources: (SMAQMD, 2017), (81 FR 81276), and (Green Book, 2017).

a. See also Code of Regulations (CFR) 40 CFR, Part 81.

b. See also CCR Title 17 Sections 60200-60210.

c. EPA revoked the 1979 1-hour ozone standard as well as the 1997 8-hour standard including associated designations and classifications.

d. The 8-hour ozone standard was lowered for the third time by the EPA final rule that became effective on December 28, 2015. The previous (2008) standard additionally remains in effect in some areas. Revocation of the 2008 standard and transitioning to the current (2015) standard will be addressed in the implementation rule for the 2015 standard. Severe 15 classification was recommended by CARB in a letter to EPA on October 3, 2016. EPA published proposed amendments to 40 CFR Parts 50 and 51 which included a severe designation for Sacramento County and has since been finalized. (81 FR 81276).

e. On May 10, 2017, U.S. EPA found that the Sacramento $PM_{2.5}$ Nonattainment Area attained the 2006 24-hour $PM_{2.5}$ NAAQS (15 µg/m^3) by the attainment date of December 31, 2015 (82 CFR 21711). However, in 2012 EPA adopted a more stringent NAAQS of 12 µg/m3 which has not been attained. The Regional Air Districts, which make up the nonattainment area, will be preparing an implementation/maintenance plan for the 2006 24-hr.

f. EPA designates areas as "unclassifiable/attainment" if they met the standard or are expected to meet the standard despite a lack of monitoring data.

g. EPA reports the SO_2 concentration at the Del Paso Manor station to be 3 ppb which indicates attainment with the 75 ppb 2010 NAAQS (Designation and NAAQS Information Related to the 2010 SO2 Standard, 2017).

"$PM_{2.5}$ exceedances most often occur in Sacramento during the winter months and speciation data suggest that residential wood burning and mobile source emissions are the most important sources. In fact, area source data for Sacramento and the surrounding counties, with the exception of Yolo County, show that residential wood burning is the dominant source of $PM_{2.5}$. With respect to mobile sources, Sacramento and the surrounding counties have significant mobile source emissions which, combined with the commuting patterns, suggest a link between exceedances in Sacramento and mobile source emissions from the surrounding counties." (SMAQMD, 2013).

The windrose in Figure 3, represents SMAQMD pre-processed meteorological data from the Mather Airport station (023206) located about four miles northwest of the Project site. The Mather Airport data was used for dispersion modeling performed as part of the HRA for the Project discussed in Sections 4.4.6 and 4.5.4.

According to Western Regional Climate Center (WRCC), the Sacramento 5 ESE Station (047633) located approximately 9.3 miles from the Project site, is the nearest climatological monitoring station. Based on the period of record (7/11/1877 to 6/9/2016), average monthly temperature has ranged from a minimum of 39.6°F to a maximum of 91.7°F. December and January are typically the coldest months with July and August the warmest (WRCC, 2017). The annual rainfall totals approximately 18.15 inches and mostly occurs between November and April (WRCC, 2017). Summer rainfall is minimal and generally limited to scattered thundershowers over the Sierra Nevada mountain range.

SMAQMD operates ten (10) air monitoring sites within Sacramento County with CARB operating an eleventh (Sacramento-T Street). Data collected at permanent monitoring stations are used by the US EPA and CARB to classify regions as "attainment" or "nonattainment," depending on whether concentrations of pollutants exceed the applicable AAQS. The attainment status in Sacramento County area is shown in Table 4.

4.2.2 Local Setting

The closest air monitoring stations to the Project are Del Paso Manor (9.3 miles WNW) and Sloughhouse (2 miles ESE) stations. The Del Paso Manor Station monitors a variety of pollutants and generally observes the highest pollutant concentrations in the region. Sloughhouse Station monitors $PM_{2.5}$ by a non-standard method (e-BAM). Data from the Del Paso Manor Station are reported in Table 6 and Table 5. Carbon monoxide and sulfur dioxide are not presented in these tables because the pollutants are not currently monitored within Sacramento County and concentrations measured at all monitoring stations within SVAB have been less than state or Federal standards over the past five years. A summary of all AAQS is presented in Table 2.

Table 5 Number of Days Exceeding Air Quality Standards

AAQS	2011	2012	2013	2014	2015	2016
State 1-Hour O_3	1	6	2	2	2	5
State 8-Hour O_3	9	21	7	18	8	11
Federal 8-Hour O_3	8	21	6	16	8	10
State 24-Hour PM_{10}[a]	12.2	0	12.3	0	0	0
Federal 24-Hour $PM_{2.5}$[a]	9.5	0	13	0	8.7	3.3

Source: Trends Summary (CARB, 2016).

[a] Measurements of PM_{10} and $PM_{2.5}$ are usually collected every 6 days and 3 days, respectively. "Numbers of days exceeding the standards" are mathematical estimates.

ND – insufficient data available to determine.

Table 6 Ambient Air Quality in the Project Area

Concentration and Averaging Period	Ambient Air Quality Standard	2011	2012	2013	2014	2015	2016
Ozone 1-hr	0.09 ppm (State, max.)	0.11	0.112	0.117	0.101	0.112	0.107
Ozone 8-hr	0.070 ppm (State, max.)	0.089	0.096	0.088	0.077	0.089	0.090
	0.070 ppm (Fed., 4th high)	0.081	0.078	0.077	0.077	0.076	0.077
NO_2 1-hr	0.18 ppm (State, max.)	0.047	0.051	0.045	0.043	0.052	0.041
	0.100 ppm (Fed., 98th %ile)	0.040	0.039	0.042	0.038	0.045	0.034
NO_2 Annual	0.030 ppm (State) 0.053 ppm (Fed.)	0.008	0.009	0.009	0.008	0.006	
PM_{10} 24-hr	50 µg/m^3 (State, max.)	66	43	63.5	42.8	51.4	42.2
	150 µg/m^3 (Fed., 2nd high)	62	41	56	40	42	31
PM_{10} Annual	20 µg/m^3 (State)	20.7	15.8	23.2	18.8	18	17.6
$PM_{2.5}$ 24-hr	35 µg/m^3 (Fed., 98th %ile)	39.8	27.1	39.7	28.1	37.8	28.2
$PM_{2.5}$ Annual	12 µg/m^3 (State, max.)	11.6	9.2	11.5	8.8	10.4	9.8
	12.0 µg/m^3 (Fed., 3 Yr Avg.)	10	9.5	10.4	9.8	10.2	9.3

Source: Trends Summary for O_3, PM_{10}, $PM_{2.5}$ and Top 4 Summary for NO_2. (CARB, 2016).
Max. = Maximum. Hr = Hour. Fed. = Federal. ppm = parts per million. µg/m3 = micrograms per cubic meter.
4th high = Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years.
2nd high = Not to be exceeded more than once per year on average over 3 years.
98th %ile = 98th percentile of: 1-hour daily maximum concentrations for the 1-hr NO_2 NAAQS; and of 24-hour average concentrations for PM_{10} and $PM_{2.5}$, averaged over 3 years.
ND – insufficient data available to determine. NA – data are not available from the listed sources.
Carbon monoxide and sulfur dioxide are not presented in these tables because the pollutants are not currently monitored within Sacramento County and concentrations measured at all monitoring stations within the Air Basin have been less than State or Federal standards over the past five years.

4.2.3 Health Effects Setting

NAAQS/CAAQS and Reference Exposure Levels (REL) that are used for health risk assessment are designated for each pollutant at a level where no “adverse health effect” would occur to sensitive populations. The OEHHA relies upon the definition of “adverse health effect” published by American Thoracic Society (ATS). ATS published a definition in 1985 and then amended the definition in 2000 to address issues not covered by the 1985 definition. From the 1985 definition, “adverse respiratory health effect” means:

Medically significant physiologic or pathologic changes generally evidenced by one or more of the following:

1. *Interference with the normal activity of the affected person or persons;*
2. *Episodic respiratory illness;*
3. *Incapacitating illness;*
4. *Permanent respiratory injury; and/or*
5. *Progressive respiratory dysfunction.* (OEHHA, 2004).

As discussed by OEHHA, the 2000 ATS publication (see copy in Appendix D) recommended that the following "dimensions" of adverse effects be considered when determining an adverse health effect:

1. *Biomarkers: These should be considered, however it must be kept in mind that few biomarkers have been validated sufficiently to establish their use for defining a point at which a response becomes adverse, consequently, not all changes in biomarkers should necessarily be considered adverse.*
2. *Quality of life: In recent years, decreased health-related quality of life has become widely accepted as an adverse health effect. The review committee concluded that reduction in quality of life, whether in healthy persons or persons with chronic respiratory disease, should be considered as an adverse effect.*
3. *Physiological impact: The committee recommended that small, transient reductions in pulmonary function should not necessarily be regarded as adverse, although permanent loss of lung function should be considered adverse. The committee also recommended that reversible loss of lung function in conjunction with symptoms should be considered adverse.*
4. *Symptoms: Air pollution-related symptoms associated with reduced quality of life or with a change in clinical status (i.e., requiring medical care or a change in medications) should be considered adverse at the individual level. At the population level, the committee suggested that any detectable increase in symptom frequency should be considered adverse.*
5. *Clinical outcomes: Detectable effects of air pollution on clinical measures should be considered adverse. More specifically, the ATS committee cited as examples increases in emergency department visits for asthma or hospitalizations for pneumonia, at the population level, or an increased need to use bronchodilator medication, at the individual level. The committee recommended that: "no level of effect of air pollution on population-level clinical indicators can be considered acceptable."*
6. *Mortality: Increased mortality should clearly be judged as adverse.*
7. *Population health versus individual risk: The committee concluded that a shift in risk factor distribution, and hence the risk profile of an exposed population, should be considered adverse when the relationship between the risk factor and the disease is causal, even if there is no immediate occurrence of obvious illness*. (OEHHA, 6/2004).

Based on these recommendations, many health outcomes found to be associated with criteria pollutants could be considered adverse, including pulmonary function changes accompanied by symptoms, pulmonary function changes and respiratory symptoms that reduce quality of life, large changes in pulmonary function, clinical outcomes such as emergency department visits for asthma, hospitalization for respiratory and cardiovascular disease, and mortality. In addition, outcomes such as increase in airway reactivity and inflammation may be considered adverse if they signify increases in the potential risk profile of the population.

With regard to sensitivity, the 1970 Clean Air Act recognized that some persons were so ill as to need controlled environments, e.g., persons in intensive care units or newborn infants in nurseries; the act stated that the standards might not necessarily protect such individuals. It further stated, however, *that the standards should protect "particularly sensitive citizens such as bronchial asthmatics and emphysematics who in the normal course of daily activity are exposed to the ambient environment.* (ATS, 2000).

Finally, according to ATS, research now shows that some highly susceptible individuals may respond to common exposures at or close to natural background pollutant levels that are often unavoidable. A copy of the relevant ATS document, "WHAT CONSTITUTES AN ADVERSE HEALTH EFFECT OF AIR POLLUTION?" is provided in Appendix D.

4.3 Significance Thresholds

The CEQA Guideline Appendix G checklist was used along with the SMAQMD CEQA Guidelines to determine whether the Project would result in a significant impact. Project emissions represent the change between baseline and the future emissions levels associated with the proposed operations, and are the metrics compared to thresholds to determine significance.

4.3.1 CEQA Guidelines Appendix G

The Environmental Checklist Form in Appendix G of the CEQA Guidelines presents questions about projects that, if true for a particular project, would be considered a significant impact. This document considers the following Environmental Checklist Form questions to be the Significance Thresholds against which Project air quality impacts are judged.

Would the project:

a) Conflict with or obstruct implementation of applicable air quality plan?

b) Violate any air quality standard or contribute substantially to an existing or projected air quality violation?

c) Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable Federal or State ambient air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors)?

d) Expose sensitive receptors to substantial pollutant concentrations?

e) Create objectionable odors affecting a substantial number of people?

4.3.2 SMAQMD CEQA Guidelines

The SMAQMD references the CEQA Checklist Form described above and presents significance determination methods based on whether the pollutant mass or concentration is being applied.

3.3.2.1 Assessing Mass Emissions

SMAQMD (the District) directs lead agencies to estimate and present a project's operational emissions for both the summer and winter seasons, and annually. Lead agencies shall compare the project's maximum daily operational emissions of precursors ROG, NO_X, PM_{10}, and $PM_{2.5}$ during both seasons and annual emissions of PM to the District's thresholds of significance. By exceeding the District's mass emission thresholds for operational emissions of ROG, NO_X, PM_{10} or $PM_{2.5}$, the project will be considered to conflict with or obstruct implementation of the District's air quality planning efforts (*CEQA Checklist Form Question a*). Furthermore, the project will result in a cumulatively considerable net increase in precursor and PM emissions, for which Sacramento County is nonattainment with respect to one or more of the AAQS (*CEQA Checklist Form Question c*).Quantities of pollutants above which SMAQMD believes would cause a significant impact on regional air quality and thus conflict with attainment planning efforts are presented in Table 7. Impacts from construction and operation phases of a project are evaluated independently from one another.

Table 7 Mass Emission Threshold Criteria for Assessing Impacts on Regional Air Quality

Pollutant/Precursor	Construction Emissions	Operational Emissions
NOx	85 lb/day	65 lb/day
ROG	None	65 lb/day
PM_{10}	Zero (0) - unless all feasible BACT/BMPs are applied, then 80 lb/day and 14.6 tons/yr applies to construction and operation phases.	
$PM_{2.5}$	Zero (0) - unless all feasible BACT/BMPs are applied, then 82 lb/day and 15 tons/yr applies to construction and operation phases.	

Source: (SMAQMD, 2016).

3.3.2.2 Assessing Local Concentrations

The significance of local impacts from criteria pollutants is based on the CAAQS and NAAQS. A project would be considered to have a significant impact if its emissions are predicted to cause or contribute to a violation of an ambient air quality standard by exceeding any CAAQS/NAAQS. The CAAQS/NAAQS are listed above in Table 2. The SMAQMD CEQA Guidelines include the criteria provided on Table 9 which can be used for both construction and operation phases of a project. If a project exceeds these thresholds criteria it is considered to cause or contribute to a violation of a CAAQS or NAAQS.

Table 8 Localized Significance Criteria

Pollutant	Criteria (Concentration and Averaging Period)
CO	20 ppm 1-hour, 9 ppm 8-hour
NO_2	0.18 ppm 1-hour, 0.03 ppm AAM
SO_2	0.25 ppm 1-hour, 0.04 ppm 24-hour
Lead	1.5 µg/m^3 30-day average
Visibility Reducing Particles	Extinction coefficient of 0.23 per kilometer - visibility of ten miles or more due to particles when relative humidity is less than 70 percent
Sulfates	0.25 µg/m^3 24-hour
H_2S	0.03 ppm 1-hour
Vinyl Chloride	0.01 ppm 24-hour

Source: (CEQA Guide, 2016).

CO Concentration Criteria

SMAQMD provides two-tiered screening criteria for CO. The screening criteria identify when site-specific CO dispersion modeling is unnecessary. If the first tier of screening criteria is not met then the second tier of screening criteria shall be examined. Because The Project would not result in an increase in off-site traffic, The

Project meets the first tier of the SMAQMD screening criteria and no further analysis is required for CO emissions.

Tier 1 CO Hot Spot Screening Method

"The proposed project will result in a less-than-significant impact to air quality for local CO if:

- Traffic generated by the proposed project will not result in deterioration of intersection level of service (LOS) to LOS E or F; and
- The project will not contribute additional traffic to an intersection that already operates at LOS of E or F." (CEQA Guide, 2016).

Because the Project would not result in an increase in offsite traffic, the Porject meets the first tier of the SMAQMD screening criteria and no further analysis is required for CO emissions.

PM_{10} and $PM_{2.5}$ Concentration Criteria

The SMAQMD criteria are vague on what the $PM_{10}/PM_{2.5}$ concentration criteria are for non-stationary source (i.e., units and activities do not require a permit) projects like this Project. The SMAQMD Guidelines state that substantial contribution means one that exceeds the mass emissions threshold levels in Table 7 and no other thresholds are provided for PM_{10} or $PM_{2.5}$. As discussed above, the SMAQMD Guidelines contemplate the need to model PM_{10} and $PM_{2.5}$ concentrations for large projects but no thresholds are provided to do so and the 5% of CAAQS cumulatively considerable threshold was explicitly rescinded when the PM_{10} and $PM_{2.5}$ mass based thresholds were adopted (Resolution AQM2015-022). Therefore, one is left with only the mass based thresholds to use for $PM_{10}/PM_{2.5}$ analysis.Nevertheless, the region is in attainment with PM_{10} NAAQS and has requested redesignation for the $PM_{2.5}$ NAAQS indicating attainment. Thus, a project could cause an exceedance of a NAAQS. This AQCCIA uses the PM_{10} and $PM_{2.5}$ NAAQS as thresholds of significance when compared to the project plus background concentration

Assessing Local Health Risk

SMAQMD recommends significance thresholds for TACs emitted from stationary sources to be based on the AB2588 Air Toxics Hot Spots Program notification thresholds. SMAQMD has not established thresholds of significance for mobile or indirect emission sources, which are source types the Project includes. Health risk impact significance criteria used to determine significance of the Project are presented in Table 9.

Table 9 Health Risk Significance Criteria for Assessing TAC Emissions Impacts

Exposure Type	Significance Criteria
Carcinogens	An incremental increase in cancer risk greater than 10 in one million at any off-site receptor
Non-Carcinogens	Ground-level concentration of project-generated TACs that would result in a Hazard Index greater than 1 at any off-site receptor.

Source: (SMAQMD, 2016)

Assessing Odors

Due to the subjective nature of odor impacts, the number of variables that can influence the potential for an odor impact, and the variety of odor sources, there are no quantitative or formulaic methodologies to determine if potential odors would have a significant impact. Rather, projects must be assessed on a case-by-case basis.

The intensity of an odor source's operations and its proximity to sensitive receptors influences the potential significance of odor emissions. SMAQMD has identified some common types of facilities that have been known to produce odors in the SVAB. These are discussed further in the impact analysis for odors (Section 3.5.5).

Cumulative Impacts

As a result of past, present, and future development projects within the SMAQMD's jurisdiction, and the current nonattainment status of the SVAB for ozone and particulate matter, a cumulatively significant air quality impact exists.

By its very nature, air pollution is largely a cumulative impact. Ambient air quality standards are violated or approach nonattainment levels due to past development that has formed the urban fabric, and attainment of standards can be jeopardized by increasing emissions generating activity in the region. The nonattainment status of regional pollutants is a result of past and present development within the SVAB. Thus, this regional impact is a cumulative impact, and projects would contribute to this impact on a cumulative basis. A project's emissions may be individually limited, but cumulatively considerable when taken in combination with past, present, and future development projects.

Consequently, the District's approach to thresholds of significance is relevant to whether a project's individual emissions would result in a cumulatively considerable adverse contribution to the SVAB's existing air quality conditions. If a project's emissions would be less than the District's thresholds, the project would not be expected to result in a cumulatively considerable contribution to the significant cumulative impact. However, an exceedance of the project-level thresholds does not necessarily constitute a significant cumulative impact.

Each new development in Sacramento County that results in an increase in air pollutant emissions above those assumed in regional air quality plans is considered to contribute to cumulative air quality impacts.

4.4 Methodology

This air quality impact assessment considered potential emissions from both the mining operations and the portable Recycle Plant. The Recycle Plant was conservatively assumed to be powered by a diesel generator (i.e., if grid power is used, then emissions would be less than the emissions considered in this assessment). Emissions for both processes (mining and Recycle Plant) are presented in this report for disclosure purposes.The maximum potential emissions from the combination producing approximately 1,000,000 tons/yr for offsite shipment was assessed. It was assumed that addition of the Recycle Plant would not affect the proposed annual production rate or on-road truck trips associated with the Sacramento Aggregates facility; regardless of individual process contribution the total amount of material produced will remain constant.

4.4.1 Project Design Features and Assumptions

The impact assessment incorporated the following general assumptions:

- The excavation and associated equipment would operate in compliance with applicable air quality regulations.
  - Diesel engines would comply with applicable state regulations (i.e. ATCM). This includes labeling of off-road equipment with registration numbers assigned by CARB, establishment of an idling policy, and limiting idle time to less than five minutes (13 CCR §2449).
  - Fugitive dust emissions would be controlled through implementation of the Basic Construction Emissions Control Practices and Rule 403 that apply, where applicable. See 3.1.4.3 SMAQMD CEQA Guidelines.
- The Project is located in Sacramento County, which is among the counties listed as containing serpentine and ultramafic rock (OPR, 2000). However, no serpentine or ultramafic rock has been found on the Project site or in the vicinity of the Project. In addition, the Asbestos ATCM for Construction, Grading, Quarrying, and Surface Mining Operations (17 CCR § 93105) allows the APCO from the local air district to exempt materials produced by facilities that mine alluvial deposits as would be the case for the Project. Therefore, asbestos was excluded from health risk assessment performed for the Project.
- The Project would not store hazardous substances or acutely hazardous substances in quantities that would be subject to chemical accident prevention provisions of the CAA or the implementing regulation (40 CFR Part 68).

The following assumptions are design features of the Project:

- Aggregate would be transported to the processing plant facility by a conveyor system originating at a feed hopper located on or adjacent to the Project site. Off-site truck travel would not increase and is not part of the Project.
- Production rates and equipment used would remain unchanged from existing conditions in Phase E which is currently being mined. Specifically, the daily excavation rate is unchanged from 6,300 tons/day and any change in emissions would be attributed to a difference in source characteristics rather than an increase in activity level of the source(s).
- Vehicle engine emissions characteristics reflect the statewide average characteristics which vary by calendar year, engine size and vehicle type as presented in Appendix D of the CalEEMod User Guide.
- Materials processed by the portable A&C and RMC plants would substitute for mined materials. Emissions from the diesel generator which powers the A&C Plant would meet Interim Tier 4 emissions standards as required by PERP for registration of new engines greater than 750 hp.

The following assumptions are mitigation measures from the 2008 FEIR and are incorporated as design features of the Project:

- Every effort shall be made to remove overburden during the period of the year when surface soils are moist. If overburden is removed when surface soils are dry, water spraying equipment shall be used to reduce dust emissions. Water spraying equipment shall likewise be used, as needed, when removing aggregate. Cover loads of all haul/dump trucks securely and/or maintain 2 feet of freeboard clearance.
- Moisture content of the material being conveyed to the off-site processing plant is sufficient to avoid visible dust emissions from the conveyor loading and unloading points.
- Unpaved access/haul roads shall regularly be watered or treated with chemical dust suppressants, as needed, to control wind erosion and dust created by vehicle travel.
- Material stockpiles shall be watered or treated with chemical dust suppressants, as needed, to control wind erosion.

4.4.2 Emissions Calculations Methodologies

Emissions from combustion sources associated with the Project primarily consist of non-road diesel engines in offroad vehicles. Exceptions may be the water truck and service truck which are assumed to have off-road engines for purposes of this analysis which is a conservative assumption because on-road engines generally emit less pollutants as compared to an offroad engine that was manufacturered in the same calendar year (i.e., an onroad 2010 model year engine is cleaner than a 2010 offroad engine). Emissions from dust sources associated with Project include those previously assessed for in the 2008 FEIR. Specifically, emissions from travel on unpaved surfaces and storage pile area activity emissions (e.g., loading and handling) are assessed. Emissions are calculated in Appendix D using the methods presented below.

Non-Road Engines

Non-road engine emissions in offroad vehicles and dewatering pumps were calculated using the CalEEMod default method and emissions factors. Engine emissions rates decrease over time as the fleet is turned over and controls are implemented to comply with CARB regulations (i.e., In-Use Off-Road). Appendix A of the CalEEMod User Manual contains the following equation for quantifying off-road engine emissions.

$$Emissions_{DieselEx} = \sum_{i} (EF_i \times Pop_i \times AvgHP_i \times Load_i \times Activity_i)$$

Where:

EF = Emission factor (g/bhp-hr) as processed from OFFROAD2011.
Pop = Population, or the number of pieces of equipment.
AvgHP = Maximum rated average horsepower.
Load = Load factor.
Activity = Hours of operation.
i = Equipment type.

Aggregates Handling and Storage Piles

Aggregate storage and handling dust emissions were calculated using methodology from the 2008 FEIR. Specifically, the following emissions factor equation from AP-42 Section 13.2.4.

$$EF = k(0.0032)\frac{\left(\frac{U}{5}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}$$

Where: EF = emission factor (lb/ton).
k = particle size multiplier (dimensionless: 0.35 for PM_{10}).
U = mean wind speed, (miles per hour [mph]).
M = material moisture content (%).

Material moisture content of 6% and mean wind speed of 6.93 mph that were reported in the 2008 FEIR (Appendix C) were retained.

Travel on Unpaved Surfaces

Road dust emissions are calculated using the CalEEMod and AP-42 emissions factor equations (Appendix E). AP-42 Section 13.2.2 (November 2006) contains the following emissions factor equation for vehicles traveling on unpaved roads at industrial sites:

$$E_{ext} = \left[k\left(\frac{s}{12}\right)^{0.9} \times \left(\frac{W}{3}\right)^{0.45}\right]$$

Where: Eext = annual particulate emission factor (having units matching the units of k),
k = particle size multiplier units of interest (e.g. 1.5 lb/VMT for PM_{10}),
s = surface material silt content (%),
W = average weight (tons) of the vehicles traveling the road,

The control efficiency for watering unpaved roads was assumed to be 68 percent based on the control efficiency found in the CalEEMod User Manual (CAPCOA, 2013). The silt content of the unpaved roads was assumed to be 8.3 percent (EPA, 2006). Offroad truck weight (40 tons empty, 90 tons full) was obtained for a representative 50 ton capacity truck from the Caterpillar Performance Handbook. Onroad trucks were assumed to be 34 tons full and 15 tons empty with a mean weight of 25 tons. Annual emissions were adjusted for rainfall, assuming 51 days a year exceeding 0.01 inch of rainfall (CAPCOA, 2013).

Asphalt and Concrete Processing Plant

Emissions are calculated using the AP-42 controlled factors presented in Table 10.

Table 10 A&C Processing Plant Emissions Factors

Source	PM_{10} (lb/ton)	$PM_{2.5}$ (lb/ton)
Crushing (controlled)	0.00054	0.00010
Screening (controlled)	0.00074	0.000050
Conveyor Transfer Point (controlled)	0.000046	0.000013

Source: (AP-42 Section 11.19.2, 2004).

Ready Mix Concrete Plant

Emissions are calculated using the AP-42 Factors Presented in Table 11. PM 2.5 is calculated as a function of PM10 emissions.

Table 11 Ready Mix Concrete Plant Emission Factors

Source	PM_{10} (lb/ton)	$PM_{2.5}$ (lb/ton)	Source
Truck Unloading of Aggregates	0.00054	0.00016	AP42, Table 11.19.2-2, 8/04
Transfer Points	0.00074	0.00025	AP42, Table 11.19.2-2, 8/04
Cement Unloading (filtered)	0.00034	0.00010	AP42 Table 11.12-2, 6/06
Cement Supplement Unloading	0.0049	0.0014	AP42 Table 11.12-2, 6/06
Weigh Hopper Loading (filtered)	0.000028	0.0000082	AP42 Table 11.12-2, 6/06
Truck Loading	0.0263	0.0077	AP42 Table 11.12-2, 6/06

[1]PM2.5 emission factor assumed to be 29.2% of PM10 for material drops based on SCAQMD's Updated CEIDARS

4.4.3 CEQA Baseline

The CEQA Baseline for this Project would be the project described in the 2008 FEIR for the Phase E expansion (south of Florin Road) because those activities would be moving to this new location. The certified EIR assesses emissions from equipment operating in the pit that loads the conveyor feeding the off-site processing plant and site stockpile areas. Specifically, emissions from the following sources were assessed:

- Mobile equipment (i.e., heavy-heavy-duty trucks [HHDTs] and off-road equipment).
- Fugitive dust from trucks and off-road equipment traveling on unpaved surfaces.
- Loading operations onto trucks and conveyors.

Table 12 presents the equipment and activity levels described in the certified 2008 FEIR which would remain unchanged with the Project. Table 13 presents the emissions described in the certified EIR that constitute the Baseline and are subtracted from the operations emissions calculated for Phase T to determine the Project emissions(the difference between the Baseline and the operations emissions associated with the Project). Project emissions are compared to the significance criteria later in this report.

The 2008 FEIR did not assess $PM_{2.5}$ because the pollutant category did not exist at the time. $PM_{2.5}$ is a subset of PM_{10} which was assessed in the 2008 FEIR. This report could derive baseline $PM_{2.5}$ emissions by applying the PM size profiles on the CARB website or from another resource (e.g., AP-42). However, as shown in Table 7, the $PM_{2.5}$ significance criteria (82 lb/day and 15 tons/yr) is greater than the PM_{10} significance criteria (80 lb/day and 14.6 tons/yr). Application of the PM_{10} significance criteria would limit the $PM_{2.5}$ emissions to less than the $PM_{2.5}$ significance criteria. Project $PM_{2.5}$ emissions are calculated in this report for purposes of disclosure.

Table 12 Excavation Equipment Operating Hours

Equipment	Horsepower	Operating Hours Per Day	Operating Hours Per Year
D9R CAT DOZER	450	4	1248
140H CAT MOTOR GRADER	165	2	312
EX1200 HITACHI EXCAVATOR	625	8	2496
988F CAT LOADER	425	8	2496
988F CAT LOADER	425	8	2496
R40-C EUCLID RIGID HAULER	525	8	2496
R40-C EUCLID RIGID HAULER	525	8	2496
357 PETERBILT WATER TRUCK	385	2	624
384 PETERBILT SERVICE TRUCK	190	1	312

Source: 2008 FEIR, Table AQ-3, p. 9-13.

Table 13 2008 FEIR Baseline Emissions

Source	ROG (lb/day)	ROG (lb/yr)	NOx (lb/day)	NOx (lb/yr)	PM_{10} (lb/day)	PM_{10} (lb/yr)
Mobile Equipment	13.93	4,297	214.75	66,531	9.03	2,789
On-road Trucks	0.11	34.54	1.33	416.45	0.06	19.02
Unpaved Surfaces	--	--	--	--	273.41	81,864
Loading/Handling	--	--	--	--	3.81	1,189
Total	14.04	4,332	216.08	66,947	286.31	85,861

Source: 2008 FEIR Table AQ-4, p. 9-13.

Note: SMAQMD PM_{10} thresholds did not exist at the time of the 2008 EIR.

The 2008 FEIR determined that the project analyzed would have significant and unavoidable impacts on NO_X and PM_{10} and summarized those impacts as follows:

- The project's particulate emissions would result in exceedance of CAAQS. Soil wetting, chemical dust suppressants and other managerment practices can help reduce particulate matter impacts; however, even with these practices impacts are significant and unavoidable.
- The project's NO_X emissions would exceed thresholds established by SMAQMD. 'The SMAQMD has suggested mitigation to reduce impacts; however, not below significant levels.

Concentration of PM_{10} was modeled for the 2008 FEIR and it was determined that the maximum 24-hour average concentration resulting from the project (93.4 $\mu g/m^3$) would cause an exceedance of the most stringent AAQS (50 $\mu g/m^3$) and when added to the background concentration (77.0 $\mu g/m^3$) would contribute to an existing exceedance. This impact would not change with the Project.

However, PM_{10} and $PM_{2.5}$ AAQS are established at concentrations chosen primarily to protect the health of individuals in urban areas where concentrations are greatest and the species of chemicals in the particulate is most toxic. Thus, in order to understand the true impact of the chemicals emitted by the Project on health of the surrounding residences and workers, PM_{10} modeling was performed by way of HRA for toxic constituents present in fugitive dust and diesel exhaust that would be emitted by the Project (i.e., the 2008 FEIR HRA evaluated only diesel exhaust particulates and did not include toxic constituents in fugitive dust). Given that the primary purpose of the AAQS is to protect human health and the wide ranging health effects associated with the variety of chemicals that are emitted as particles (i.e., this only excludes chemicals that are gaseous, every other emission is a particle); HRA is considered a more precise methodology and is used to evaluate this Project.

NO_X emissions were reported in the 2008 FEIR to exceed the mass-based threshold and yet the associated NO_2 concentrations were determined to be less than the corresponding AAQS. This impact has been reduced over time with the phase in of emissions controls on diesel engines. This impact is re-assessed in Section 4.5.3 based on values in Table 15.

4.4.4 Construction Phase Emissions

The topsoil on-site would be excavated and placed in berms along the property line to be used later in reclaiming the site. This reclamation activity is considered part of mining and therefore operation phase. The Project would also landscape the berms during the operation phase. Accordingly, the only temporary construction phase type impacts of the Project and construction phase are those that result from the erection of the Ready Mix and Recycle Plants. The California Emissions Estimator Model (CalEEMod) was utilized to determine construction phase emissions and impacts. Table 14 summarizes the impacts, and the full results can be found in Appendix F.

Table 14 Construction Phase Emissions

	ROG	NOx	CO	SO2	PM10	PM2.5
Maximum Tons/Year	0.00609	0.0645	0.0440	0.00008	0.0835	0.0115
Maximum lbs/day	1.2253	12.8426	8.8802	0.0166	19.6895	2.5945
Threshold Tons/Year	-	-	-	-	14.6	15
Threshold lbs/day	-	85	-	-	80	82
Threshold Exceeded?	**No**	**No**	**No**	**No**	**No**	**No**

Source: Table 7, Appendix F

4.4.5 Operation Phase Emissions

Operation phase emissions are quantified in Appendix F using the methodology and assumptions discussed above. Significance of the operation phase emissions is determined in Section 4.5.

Table 15 Operation Phase Hourly Emissions

Source	ROG (lb/hr)	NOx (lb/hr)	CO (lb/hr)	SOx (lb/hr)	PM10 (lb/hr)	PM2.5 (lb/hr)
Mining						
Engines	1.15	13.20	6.65	0.02	0.53	0.48
Travel on Unpaved Surfaces	-	-	-	-	15.11	1.51
Material Handling/Stockpiles	-	-	-	-	0.48	0.07
A&C Processing						
Engines	0.99	9.87	7.17	0.01	0.33	0.30
Travel on Unpaved Surfaces	-	-	-	-	3.23	0.40
Material Handling/Stockpiles	-	-	-	-	0.04	0.01
Plant Equipment	-	-	-	-	0.79	0.23
RMC						
Plant					2.38	0.70
Total	**2.14**	**23.08**	**13.81**	**0.03**	**22.88**	**3.71**

Note: Totals may differ slightly from Appendix calculation due to rounding.
Source: Appendix F.

Table 16 Operation Phase Daily Emissions

Source	ROG (lb/day)	NO_X (lb/day)	CO (lb/day)	SOx (lb/day)	PM_{10} (lb/day)	$PM_{2.5}$ (lb/day)
Mining						
Engines	6.80	78.23	39.90	0.10	3.02	2.78
Travel on Unpaved Surfaces	-	-	-	-	177.4	17.7
Material Handling/Storage Piles	-	-	-	-	5.7	0.87
A&C Processing						
Engines	11.87	118.48	86.02	0.18	3.9	3.60
Travel on Unpaved Surfaces	-	-	-	-	48.1	9.12
Material Handling/Storage Piles	-	-	-	-	0.5	1.1
Plant Equipment	-	-	-	-	9.5	1.23
RMC						
Ready Mix Concrete Plant					57.2	16.7
Total	**18.67**	**196.71**	**125.92**	**0.28**	**305.32**	**53.1**

Note: Totals may differ slightly from Appendix calculation due to rounding.
Source: Appendix F.

Table 17 Operation Phase Annual Emissions

Source	ROG (ton/yr)	NO_X (ton/yr)	CO (ton/yr)	SO_2 (ton/yr)	PM_{10} (ton/yr)	$PM_{2.5}$ (ton/yr)
Mining						
Engines	0.72	8.58	4.23	0.01	0.32	0.30
Travel on Unpaved Surfaces	-	-	-	-	15.24	1.52
Loading/Handling	-	-	-	-	0.59	0.09
A&C Processing						
Engines	0.72	8.58	4.23	0.01	0.32	0.30
Travel on Unpaved Surfaces	-	-	-	-	0.82	0.08
Material Handling/Stockpiles	-	-	-	-	0.01	0.002
Plant Equipment	-	-	-	-	0.12	0.03
RMC						
Plant					1.79	0.52
Total	**1.45**	**17.16**	**8.46**	**0.02**	**19.21**	**2.85**

Note: Totals may differ slightly from Appendix calculation due to rounding.
Source: Appendix F.

4.4.6 Health Risk Assessment

A HRA was performed using current best practices including methods from the HRA Guidelines (OEHHA, 2015). The four steps involved in the risk assessment process are: 1) hazard identification, 2) exposure assessment, 3) dose-response assessment, and 4) risk characterization. These four steps were used to assess health risk for the Project and each is discussed in the subchapters below.

Hazard Identification and Quantification

For air toxics sources, hazard identification involves the pollutant(s) of concern emitted by a facility, and the types of adverse health effects associated with exposure to the chemical(s), including whether a pollutant is a potential human carcinogen or is associated with other types of adverse health effects. Appendix A of the HRA Guidelines includes a list of TACs that are used for HRA in California.

DPM is the primary toxic constituent emitted by mining projects. DPM has an assigned cancer potency factor (CPF) and a non-cancer reference exposure level (REL) that are used to evaluate the health risk. Fugitive dust is generally inert but does contain trace metals and RCS which could result in substantial health risk if not controlled. CARB maintains chemical speciation and size profiles for various sources of particulate matter. Values in speciation Profile 470 (Table 18) associated with unpaved road dust, the largest source of dust on-site, were multiplied by the mass emission rates of PM_{10} to quantify the mass of each toxic chemical in the mixture of dust particulates. The resulting mass of each TAC was then used as input along with the dispersion coefficients to quatitatively predict the ground level concentration (GLC) of each TAC to which individuals may be exposed (see exposure assessment subsection below). The concentrations were then combined with exposure parameters to quantify the dose received by each receptor and for each exposure pathway. In the case of non-cancer risk, the exposures were then summed on a target organ by target organ basis using HARP2 to determine the maximum hazard index (HI) among the target organs in the human body. The maximum target organ HI was then compared to the non-cancer significance criteria (i.e., 1.0 HI) as discussed in the following subsections.

Table 18 Speciation Profiles for Fugitive Dust Sources

HARP2 Pollutant ID	Chemical Name	Fraction of TAC in PM Profile 470	Fraction of TAC Determined by Onsite Sampling
7440382	Arsenic	0.000015	0.000000038
7726956	Bromine	0.000018	ND
7440439	Cadmium	0.000013	ND
7782505	Chlorine	0.000844	ND
7440508	Copper	0.000158	ND
7439921	Lead	0.000130	ND
7439965	Manganese	0.000915	ND
7439976	Mercury	0.000014	ND
7440020	Nickel	0.000037	0.00000073
7782492	Selenium	0.000003	ND
7440622	vanadium (fume or dust)	0.000077	ND
1175	Silica, Crystln	0.056	ND

Sources: CARB Speciation Profiles (http://www.arb.ca.gov/ei/speciate/interoptvv10001.php) and the Journal of Air and Waste Management Association article in Appendix G for respirable crystalline silica (RCS) (Richards & Brozell, 2007).
Lab report and caluclations for sampled TACs can be found in Appendix G.

In addition to the TACs listed in the CARB PM profiles above (Table 18), the HRA assumed that 5.6% of fugitive dust is RCS (Richards & Brozell, 2007). The HRA considered whether health risk from asbestos should be quantified. It was determined based on review of available maps (California Department of Conservation, Division of Mines and Geology, 2000) and language in the Asbestos ATCM's (17CCR §93105 and §93106) that allows the APCO to exempt sand and gravel facilities operating in alluvial deposits, that asbestos is unlikely to exist within, or upstream from, the Project site. Therefore, asbestos was excluded from the HRA.

In order to increase the accuracy of the TAC speciation profile, soil sampling was conducted on the actively mined Vulcan Materials site and the Carli Expansion on 5/15/18. Six (6) samples were taken from each site, totaling twelve (12) samples taken. The samples were processed by a California certified analytical laboratory using USEPA method 6010B to determine Nickel (Ni) and Aresenic (As) levels. Lab reported TAC levels (Appendix G) were averaged to determine the fractions of Ni and AS (Table 18) utilized in the HRA.

Exposure Assessment

The purpose of exposure assessment is to estimate the extent of public exposure to emitted substances. For the Hot Spots program, in practice this means estimating exposures for those emitted substances for which potential cancer risk or noncancer health hazards for acute, repeated 8-hour, and chronic exposures will be evaluated. This involves emission quantification, modeling of environmental transport, evaluation of environmental fate, identification of exposure routes, identification of exposed populations, and estimation of short-term (e.g., 1-hour maximum), 8-hour average, and long-term (annual) exposure levels.

Hot Spots Analysis and Reporting Program (HARP2) software developed by CARB can be used to model ground level concentrations at specific off-site locations. HARP2 incorporates the US EPA-approved dispersion model, American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD). AERMOD is a steady-state plume model based on planetary boundary layer turbulence structure and scaling concepts, including treatment of both surface and elevated sources, and both simple and complex terrain. CARB recommends AERMOD for Hot Spots risk assessments (OEHHA, 2015).

In this HRA, the air dispersion modeling was performed separately from HARP2 using AERMOD View by Lakes Environmental, Version 9.4.0 running AERMOD executable Version 16216r. Pollutant specific ground level concentratrion (GLC) plotfiles were generated using the multi-chemical batcher function of AERMOD View. The HARP2 risk module was invoked by command line call to the HARP2 risk calculator (HRACalc.exe) to generate risk plotfiles as described in the Appendix E of the *User Manual for the Health Risk Assessment Standalone Tool* (CARB, 2015). The air dispersion modeling consisted of four steps:

1. Air dispersion modeling is used to estimate annual average and maximum one-hour GLCs. The air dispersion modeling results are expressed as an air concentration or in terms of (Chi over Q) for each receptor point. (Chi over Q) is the modeled downwind air concentration (Chi) based on an emission rate of one gram per second (Q). (Chi over Q) is expressed in units of micrograms per cubic meter per gram per second, or ($\mu g/m^3$)/(g/s). (Chi over Q) is sometimes written as (X/Q) and is sometimes referred to as the dilution factor.

2. When multiple substances are evaluated, the X/Q is normally utilized since it is based on an emission rate of one gram per second. The X/Q at the receptor point of interest is multiplied by the substance-specific emission rate (in g/s) to yield the substance-specific GLC in units of $\mu g/m^3$. The following equations illustrate this point.

$$GLC = \left(\frac{X}{Q}\right) \times Q_{Substance}$$

$$\frac{X}{Q} = (Chi\ over\ Q)\ in\ \left(\frac{\mu g/_{m^3}}{g/_s}\right), from\ model\ results\ with\ unit\ emission\ rate$$

$$Q_{Substance} = substance\ emission\ rate\ \left(g/_s\right)$$

3. The applicable exposure pathways (e.g., inhalation, soil contact, fish consumption) are identified for the emitted substances, and the receptor locations are identified. This determines which exposure algorithms are ultimately used to estimate dose. After the exposure pathways are identified, the fate and transport algorithms are used to estimate concentrations in the applicable exposure media (e.g., soil or water) and the exposure algorithms are used to determine the substance-specific dose.

4. The dose is used with cancer and noncancer health values to calculate the potential health impacts for the receptor. An example calculation using the high-end point-estimates for the inhalation (breathing) exposure pathway can be found in Appendix I of the HRA Guidelines (OEHHA, 2015).

AERMOD was used as described above to calculate a X/Q for each source-receptor combination by setting the emission rate for each source in the model to one gram per second (1 g/s). Other parameters used in AERMOD describe overall control of the model domain and functionality (e.g., coordinate system, terrain, non-default options, etc.), receptors (e.g., location, height), sources (e.g., size, location, exhaust velocity, temperature, operating schedule), meteorology (files provided by SMAQMD), and output file options.

The Control Pathway of AERMOD was set to provide output in units of concentration; and both wet and dry plume depletion were disabled. Terrain Options within AERMOD were set to "Flat & Eleveated" and digital terrain files were downloaded through AERMOD from "NED GEOTIFF". Pollutant/averaging options were set to HRA (i.e., other, not a criteria pollutant) with averaging times of 1-hour and the period of the meteorological data file (i.e., five years) as provided by SMAQMD. The ADJ_U* setting was used pursuant to current EPA Guidelines in Appendix W of 40CFR Part 51 (82 FR 5182, 1/17/2017). The rural dispersion coefficient was used. Algorithims to include deposition, exponential decay and low wind (beta) were not used.

Receptors were modeled at ground level. Four (4) discrete receptors (
Table **19**) and 275 fenceline receptors were modeled. The receptors, sources that existed in the Baseline, and sources proposed by the Project are illustrated on Figure 4 and Figure 5 (Appendix A). Additional receptors that were considered are identified in Table 20. Source parameters are summarized inTable 21. Project sources were assigned positive emissions values and Baseline sources were assigned negative values (i.e., to represent sink) so that the HRA results represent the change in health risk with the Project.

The model was segmented into two time intervals based on the age sensitivity factors (ASFs) established by OEHHA and used by HARP2 to attribute increased cancer risk to early life exposures. The segments were chosen to coincide with the ASFs and represent Project years 1-2; and Project years 3-16, each with a unique set of volume sources and source outputs. Theoretical project years 3 – 30 were also modeled for the sake of obtaining conservative data in line with SMAQMD requirements. Pollutant emissions were calculated for each year of the Project, averaged over each segment, and attributed among source objects (Table 21, Appendix G). To be conservative, source object locations and source emissions densities were chosen to achieve greatest potential exposure at off-site receptors.

However, emissions rates were weighted according to the area of the Project site that they cover. For instance, the 2017-2018 model includes perimeter volume sources that represent the sloped edge of the pit where it is assumed that no haul trucks would operate and emissions from mining would be half the amount compared to interior areas of the excavation because material left in the triangular cross-section of the slope is approximately half of what would be excavated if the sides of the excavation were vertical (Appendix G).

Output of the dispersion model in the form of plotfiles, one for each combination of source and averaging period, containing X/Q values were combined with pollutant emissions rate by the AERMOD View multichemical batcher. Exposure parameters discussed below were assigned to HRACalc.exe input file (HRAInput.hra) that was used along the GLC plotfiles to predict the cancer and non-cancer risk at each receptor. Modeling files are provided at https://bit.ly/2l5lzQM, or can be obtained by contacting Sespe Consulting.

Table 19 Discrete Receptors

ID Number	UTM Coordinates (meters E, meters N)	Description
1	651603, 4263124	Residence
2	651860, 4262315	Residence
3	653232, 4262237	Residence
4	651608, 4262055	Residence
5	651158, 4263965	Residence

Note: Project is in UTM Zone 10N.

Table 20 Other Receptors of Potential Concern

Receptor Name	Description	UTM Coordinates (m East, m North)	Aprox. Distance from Site (miles)
Country Kids	Daycare	656111.00, 4262680.00	2.5
Sunrise Elementary	Primary School	653564.00, 4268919.00	3.8
Arnold Adreani Elementary	Primary School	646242.00, 4259368.00	4.2
Mather Youth Academy	Secondary School	649147.00, 4267572.00	3.5
Mather Heights Elementary	Primary School	650116.00, 4267590.00	3.2
Slavic Missionary Church	Church	645662.00, 4265414.00	4.3
Carson Creek Jr./Sr. High	Secondary School	662541.00, 4268757.00	7.4
St. Vincent De Paul Catholic	Church	665214.00, 4261955.00	8.0

Source: Google Earth. See also the Vicinity Map (Figure 6, Appendix A).

Table 21 Model Source Object Parameters

AERMOD ID	Project Segment	Description	Type	Side Length (m)[a]	Sigma Y (m)	Sigma Z (m)
VOL001 – VOL053	2017 - 2018	Sloped Excavation Edge	Volume	11	2	1
VOL054 – VOL153	2017 - 2018	Excavation Center	Volume	25	6	1
VOL154 -VOL155	2017 - 2018	Pre-Project Sink	Volume	386	90	1
VOL156 – VOL159	2017 - 2018	RMC and Recycle Plants	Volume	28	7	
VOL160	2017 - 2018	Sink from Aggregates Plant[d]	Volume	181	42	1
VOL001-VOL440	2019 - 2032	Excavation Center	Volume	28	7	1
VOL441, VOL442	2017 - 2032	Pre-Project Sink	Volume	371	86	1
VOL443 – VOL446	2017 - 2032	RMC and Recycle Plants	Volume	28	7	1
VOL447	2017 - 2032	Sink from Aggregates Plant[d]	Volume	181	42	1

[a] Each volume source is a rectangular prism with a square top and bottom face, and a height of 1 meter. Sigma Y and Sigma Z represent the initial lateral and vertical dimensions of the plume generated by the volume source.

[b] Haul road parameters by EPA methods (EPA, 2012).

[c] Initial dimensions by EPA methods (EPA, 1995).

[d] Represents reduction in aggregates plant emissions due to diversion of materials to recycle and ready mix plants.

After emissions exit the source, the substances are dispersed in the air. In addition to being inhaled, particulates deposit on vegetation, on soil, and in water at a rate that is dependent on the particle size. A deposition rate of 0.02 m/s for emission sources that have controlls is recommended and was used for the Project HRA. Other parameters are used to estimate concentrations in environmental media including air, soil, water, vegetation, and animal products.

Determination of the concentration in air is made using X/Q and the emissions rate (g/s) as discussed above. The concentration of the substance in soil (Cs) is a function of the deposition, accumulation period, chemical specific soil half-life, mixing depth, and soil bulk density. The water pathway is evaluated as if a standing water body (e.g., pond or lake) is impacted by facility emissions and is used as a source for drinking water by food-producing animals or humans, or is a source of angler-caught fish. The average concentration of the substance in water (Cw) is a function of direct deposition (material carried in by surface run-off may occur as well but is not modeled). Concentrations in vegetation, animal products, angler caught fish, and mother's milk are predicated on the concentrations estimate to be in the air, water, and soil. The Project HRA includes air, soil ingestion, home grown produce, and mother's milk as pathways of exposure. Detailed discussion of the methodologies used to determine the concentrations in various media to which receptors may be exposed is located in Subchapter 5.3 of the HRA Guidelines.

Once the concentrations of substances are estimated in air, soil, water, plants, and animal products, they are used to evaluate estimated exposure to people. Exposure is evaluated by calculating the daily dose in milligrams per kilogram body weight per day (mg/kg/d). The HRA Guidelines describe the algorithms used by HARP2 to calculate this dose for exposure through inhalation, dermal absorption, and ingestion pathways. All chemicals are assessed for exposure through inhalation. Emissions of semi-or non-volatile multipathway substances (e.g., earth metals in fugitive dust), the soil ingestion pathway and the dermal soil exposure pathway are also assessed. The mother's milk pathway is used depending on the multipathway substance released. The Project HRA assessed each of these pathways. The other exposure pathways (e.g., ingestion of water, home-grown crops, home-raised animal products, and angler-caught fish) need to be assessed if a survey of the exposure site shows they are present. Except for home grown crops, these other exposure pathways were not assessed in the Project HRA because they are not present in this case.

Inhalation Dose

The dose through the inhalation route is estimated for cancer risk assessment and noncancer hazard assessment. Both residential and off-site worker exposures are considered. Since residential exposure includes near-continuous long-term exposure at a residence and workers are exposed only during working hours (i.e., 8 hours/day), different breathing rate distributions are used.

Exposure through inhalation is a function of the breathing rate, the exposure frequency, and the concentration of a substance in the air. For residential exposure, the breathing rates are determined for specific age groups, so inhalation dose (Dose-air) is typically calculated for each of these age groups: 3rd trimester, 0<2, 2<9, 2<16, 16<30 and 16-70 years though short projects may not affect all age groups. OEHHA used the mother's breathing rates to estimate dose for the 3rd trimester fetus assuming the dose to the fetus during the 3rd trimester is the same as the mother's dose. These age-specific groupings are needed in order to properly use the age sensitivity factors for cancer risk assessment. Tier 1 evaluations and the Project HRA use the high-end point estimate (i.e., the 95th percentiles) breathing rates for the inhalation pathway in order to avoid underestimating cancer risk to the public, including children. The following equation is used to determine dose for the inhalation pathway.

$$Dose_{Air} = C_{Air} \times \left\{\frac{BR}{BW}\right\} \times A \times EF \times 10^{-6}$$

Where:

$Dose_{Air}$ = Dose through inhalation (mg/kg/d)

C_{Air} = Concentration in air (µg/m^3)

{BR/BW} = Daily breathing rate normalized to body weight (L/kg body weight-day)

A = Inhalation absorption factor (unitless)

EF = Exposure frequency (unitless), days/365 days

10^{-6} = Micrograms to milligrams conversion, liters to cubic meters conversion

The breathing rate normalized to body weight term, {BR/BW}, has several values used to assess cancer risk for each age bins designated in the HRA Guidelines (i.e., third trimester, 0 to 2, 2 to 16 and 16 to 70 years). These values as well as parametric model distributions are provided in the HRA Guidelines. The inhalation absorbtion factor, A, is recommended to be assigned a value of one (i.e., 100% of dose is absorbed) but may also be assigned the value determined by the toxicological study upon which the REL for the substance is based.

Exposure frequency is recommended to be 350 days for residential exposures. Table 22 presents the mean and high end point estimates for residential intake rates that were assumed in the Project HRA.

For worker exposure, the HARP2 default assumes working age begins at 16 years, and that exposures to facility emissions occur during the work shift, typically up to 8 hours per day during work days. Breathing rates that occur over an 8-hour period vary depending on the intensity of the activity, and are used to estimate the inhalation dose. The 8-hour breathing rates may also be used for cancer risk assessment of children and teachers exposed at schools during school hours.

Table 22 Point Estimates of Residential Daily Breathing Rates by Age Group

Estimate	3rd Trimester[1] (L/kg BW-day)[2]	0<2 Years (L/kg BW-day)	2<16 Years (L/kg BW-day)	16<30 Years (L/kg BW-day)
Mean (65%ile)[3]	225	658	452	210
High-End (95%ile)	361	1090	745	335

Source: (OEHHA, 2015, pp. 5-25).

1 3rd trimester breathing rates based on breathing rate of pregnant women using the assumption that the dose to the fetus during the 3rd trimester is the same as that to the mother.

2 Values are in units of liters of air per kilogram of body weight per day.

3 Mean values were not used in the HRA and are provided for informational purposes only.

Exposed workers may be engaged in activities ranging from desk work, which would reflect breathing rates of sedentary/passive or light activities, to farm worker activities, which would reflect breathing rates of moderate intensity. OEHHA recommends default (Tier 1) point estimate 8-hour breathing rates in L/kg-8-hrs based on the mean and 95th percentile of moderate intensity activities, 170 and 230 L/kg-8-hrs, respectively, for adults 16-70 years old.

Many facilities operate non-continuously, as in only 8-10 hours per day, but the air dispersion modeling is performed as if the emissions were uniformly emitted over 24 hours a day, 7 days per week. The air dispersion computer model used, including AERMOD and other models, typically calculate an annual average air concentration based on actual operating conditions but also include the hours of nonoperation in the average concentration. This is conservative because the most stable atmospheric conditions occur in the early morning and late night hours and are when the highest concentrations occur. This approach necessitates consideration of overlap between the worker's schedule and the actual operating period for the facility. One approach is to use a worker adjustment factor (WAF) to approximate what the worker is breathing based on the modeling run used for residential receptors. The second approach uses a special modeling run with the hourly raw results from an air dispersion analysis and is described in Appendix M of the HRA Guidelines.

Non-cancer health risks were determined in HARP2 by dividing the GLC of each pollutant at each receptor by the corresponding reference exposure level (REL, units of $\mu g/m^3$) resulting in a hazard index (HI). The HIs for pollutants affecting each target organ were then summed to determine the total HI for each target organ. The target organ with the greatest HI is reported as the non-cancer health risk at each receptor. Worker chronic non-cancer health risk results were multiplied by a WAF of 4.2 which represents the amount overlap between the Project operating schedule and the worker's work schedule; both of which are assumed to be 8 hr/day, 5 days/wk. The mean and high-end intake rates for workers were 170 and 230 liters per kilogram per 8-hours

(L/kg-8-hrs). Workers were assumed to be exposed for 25 years as recommended in the HRA Guidelines (OEHHA, 2015, pp. 5-26).

Annual residential dose was calculated by HARP2 using the GLC (mg/m^3), the intake rate (L/kg-day), 350 days/yr exposure frequency, and an assumption that the entire mass of pollutants inhaled is absorbed into the body of the individual exposed (i.e., no pollutants are exhaled). A fraction of time at home (FAH) of 85% was applied for individuals of any age. Annual worker dose was calculated the same way and adjusted to 250 days/yr exposure frequency by multiplying the result by 0.68.

Inhalation dose of each pollutant at each receptor for each year was then multiplied in HARP2 by the inhalation cancer slope factor for the pollutant to estimate annual cancer risk in units of excess cancer cases per million individuals exposed. The total cancer risk from inhalation was then calculated by summing the annual risk from each pollutant and year of exposure. Residential cancer risk assumed exposure duration of 10 years and exposure was assessed using OEHHA Derived Method.

In cancer risk assessments, the Derived Method uses the high-end point estimate (i.e., 95th percentile) for the two driving (dominant) exposure pathways (e.g., soil and breast milk) and the mean (65th percentile) point estimate for the remaining pathways. In non-cancer chronic assessments, the inhalation pathway is always considered a driving pathway, the next two risk driving pathways will use the 95th percentile, and the remaining pathways will use the mean intake rate.

Ingestion Pathway

The average concentration of pollutants in soil is a function of the deposition, accumulation period, chemical specific half-life, mixing depth, and soil bulk density. Due to the limited duration of the Project and even shorter durations of the segments into which the Project was divided (i.e., two and eight years for a total of ten years), the HARP2 default 70-year accumulation period for soil deposition was refined from 25,550 days (i.e., 70 years) to 822 days (i.e., third trimester to age two) and 3,560 days (i.e., ten years which is the expected Project duration. As discussed above, the controlled deposition rate (0.02 m/s) was applied. Equations and parameters used to estimate the concentration of pollutant in the soil from the GLC can be found in the HRA Guidelines (p. 5-6 to 5-8).

The exposure dose through residential soil ingestion varies by age and was calculated for each age group. The dose is calculated by HARP2 based on the concentration in soil, pollutant specific gastrointestinal relative absorption fraction (GRAF, unitless), soil ingestion rate (mg/kg-day), and exposure frequency using the equation presented in the HRA Guidelines (p. 5-43). For simplicity, GRAF was assigned a value of one which represents the entire mass of pollutant being absorbed. Soil ingestion rates vary by age and the high-end point estimates shown in Table 23 were used.

Table 23 Soil Ingestion Rate Point Estimates by Age Group

Estimate	3rd Trimester[1] (mg/kg BW-yr)[2]	0<2 Years (mg/kg BW-yr)	2<16 Years (mg/kg BW-yr)	16<30 Years (mg/kg BW-yr)
Mean (65%ile)[3]	0.7	20	3	0.7
High-End (95%ile)	3	40	10	3

Source: (OEHHA, 2015, pp. 5-44).

1 3rd trimester is assumed to be the mother's soil ingestion rate.

2 Values are in units of milligrams of pollutant ingested per kilogram of body weight per year.

3 Geometric mean (GM) values were not used in the HRA and are provided for informational purposes only.

Dermal Pathway

Exposure through dermal absorption (dose-dermal) is a function of the soil or dust loading of the exposed skin surface, the amount of skin surface area exposed, and the concentration and availability of the pollutant. The annual dermal load (ADL) is a composite of the body surface area per kg body weight, exposure frequency, and soil adherence to the skin. High-end point estimates of ADL for individuals located in a mixed climate were used.

Table 24 Annual Dermal Loading Point Estimates by Age Group

Estimate	3rd Trimester[1] (mg/kg BW-yr)[2]	0<2 Years (mg/kg BW-yr)	2<16 Years (mg/kg BW-yr)	16<30 Years (mg/kg BW-yr)
Mean (65%ile)[3]	1,100	2,200	5,700	1,100
High-End (95%ile)	2,400	2,900	8,100	2,400

Source: (OEHHA, 2015, pp. 5-37).

1 3rd trimester based on ADL of mother normalized to body weight assuming exposure to the mother and feus are the same.

2 Values are in units of milligrams of pollutant on skin per kilogram of body weight per year.

3 Mean values were not used in the HRA and are provided for informational purposes only.

High-end ADL was combined with the concentration of pollutant in soil, the fraction absorbed across skin (pollutant-specific factor), the exposure duration (i.e., 70 years) and the averaging time (i.e., 70 year lifetime) using equations presented in the HRA Guidelines (p. 5-41) to estimate the dermal dose for each residential receptor. Worker receptors used the adult ADL and omitted exposure duration and averaging time from the calculation.

Mother's Milk Pathway

Estimates of the concentration of pollutants in a mother's milk require the use of the air, water, and soil environmental fate evaluations. Infants would be exposed to the pollutants in concentrations equal to the concentrations at which the mother is exposed from birth up to 25 years of age when the infant is born. The exposed infant is assumed to be fully breastfed for the first year of life. The summed average dose daily dose (mg/kg-day) from all pathways is calculated for the nursing mother using equations in the HRA Guidelines (p. 5-59). Breast milk intake rates of 101 and 139 g/kg-day are used by HARP2.

Dose-Response Assessment

Dose-response assessment is the process of characterizing the relationship between exposure to an agent and incidence of an adverse health effect in exposed populations. In quantitative carcinogenic risk assessment, the dose-response relationship is expressed in terms of a potency slope that is used to calculate the probability or risk of cancer associated with an estimated exposure. Cancer potency factors (CPF) are expressed as the 95th percent upper confidence limit of the slope of the dose response curve estimated assuming continuous lifetime exposure to a substance. Typically, potency factors are expressed as units of inverse dose (e.g., (mg/kg BW/day)$^{-1}$) or inverse concentration (e.g., (µg/m3)$^{-1}$). It is assumed in cancer risk assessments that risk is directly proportional to dose and that there is no threshold for carcinogenesis. (OEHHA, 2015).

For noncarcinogenic effects, dose-response data developed from animal or human studies are used to develop acute, 8-hour, and chronic noncancer Reference Exposure Levels (RELs). The acute, 8-hour and chronic RELs are defined as the concentration at which no adverse noncancer health effects are anticipated even in sensitive members of the general population, with infrequent one hour exposures, repeated 8-hour exposures over a significant fraction of a lifetime, or continuous exposure over a significant fraction of a lifetime, respectively. The most sensitive health effect is chosen to develop the REL if the chemical affects multiple organ systems. Unlike cancer health effects, noncancer health effects are generally assumed to have thresholds for adverse effects. In other words, injury from a pollutant will not occur until exposure to that pollutant has reached or exceeded a certain concentration (i.e., threshold) and/or dose. The acute, 8-hour, and chronic RELs are air concentrations intended to be below the threshold for health effects for the general population. (OEHHA, 2015).

The actual threshold for health effects in the general population is generally not known with any precision. Uncertainty factors are applied to the Lowest Observed Adverse Effects Level (LOAEL) or No Observed Adverse Effects Level (NOAEL) or Benchmark Concentration values from animal or human studies to help ensure that the chronic, 8-hour and acute REL values are below the threshold for human health for nearly all individuals. Table 25 summarizes the health values that were used in the dose-response assessment.

Table 25 Health Values for TACs Emitted by Project

CAS	TAC Name	Inh. Cancer URF (µg/m³)⁻¹	Inh. Cancer Slope Factor (mg/kg-d)⁻¹	Oral Cancer Slope Factor (mg/kg-d)⁻¹	Acute REL (µg/m³)	Inh. Chronic REL (µg/m³)	Inh. Chronic REL 8HR (µg/m³)	Oral Chronic REL (µg/m³)
9901	DieselExhPM	3.00E-04	1.10E+00	--	--	5.00E+00	--	--
85101	PM_{10}	(No health values for non-TACS like PM_{10} so risk from speciates of PM_{10} was assessed.)						
7440382	Arsenic	3.30E-03	1.20E+01	1.50E+00	2.00E-01	1.50E-02	1.50E-02	3.50E-06
7726956	Bromine	--	--	--	--	--	--	--
7440439	Cadmium	4.20E-03	1.50E+01	--	--	2.00E-02	--	5.00E-04
7782505	Chlorine	--	--	--	2.10E+02	2.00E-01	--	--
7440508	Copper	--	--	--	1.00E+02	--	--	--
7439921	Lead	1.20E-05	4.20E-02	8.50E-03	--	--	--	--
7439965	Manganese	--	--	--	--	9.00E-02	1.70E-01	--
7439976	Mercury	--	--	--	6.00E-01	3.00E-02	6.00E-02	1.60E-04
7440020	Nickel	2.60E-04	9.10E-01	--	2.00E-01	1.40E-02	6.00E-02	1.10E-02
7782492	Selenium	--	--	--	--	2.00E+01	--	5.00E-03
7440622	Vanadium	--	--	--	3.00E+01	--	--	--
1175	Silica, Crystln	--	--	--		3.00E+00	--	--

Source: HARP2 output file type PolDB.csv from non-cancer (NC) runs in Appendix I..

Note: greyed cells contain values that were not used in the HRA. Specifically, DPM was used to assess chronic/cancer risk from exposure to diesel exhaust. Speciates of orgaqnics in diesel exhaust were added to facilitate acute risk assessment.

Risk Characterization

Risk characterization is the final step of the HRA. In this step, information developed through the exposure assessment is combined with information from the dose-response assessment to characterize risks to the general public from emissions. In the California, OEHHA conducts the dose-response assessment during the development of cancer potency factors and Reference Exposure Levels. These are used in conjunction with the exposure estimates to estimate cancer risk and evaluate hazard from noncancer toxicity of emitted chemicals. Under AB2588, risk characterizations present both individual and population-wide health risks.

A general summary of the risk characterization components includes the following items and information.

- The locations of the point of maximum impact (PMI), the maximum exposed individual receptor (MEIR), and the maximum exposed individual worker (MEIW) are to be identified. The PMI, MEIW, and MEIR for cancer risk and for noncancer hazard indices (averaging times for acute 1-hour, repeated 8-hour, and chronic hazard indices) may not be the same location; all should be identified.
- The location of any specified sensitive receptors (e.g., schools, hospitals, daycare, or eldercare facilities - contact the District or reviewing authority for more information) should be identified.
- Estimates of population-wide cancer risk and noncancer hazard.

Cancer Risk

Cancer risk is calculated by multiplying the daily inhalation or oral dose, by a cancer potency factor, the age sensitivity factor, the frequency of time spent at home (for residents only), and the exposure duration divided by averaging time, to yield the excess cancer risk. As described below, the excess cancer risk is calculated separately for each age grouping and then summed to yield cancer risk at the receptor location. A brief description of the age sensitivity factors, exposure duration, and frequency of time spent at home are included below. These factors are discussed in various technical support documents to the HRA Guidelines.

OEHHA has determined that young animals are more sensitive than adult animals to exposure to many carcinogens. Therefore, OEHHA developed age sensitivity factors (ASFs) to take into account the increased sensitivity to carcinogens during early-in-life exposure. In the absence of chemical-specific data, OEHHA recommends a default ASF of 10 for the third trimester to age 2 years, and an ASF of 3 for ages 2 through 15 years to account for potential increased sensitivity to carcinogens during childhood. These values manifest in the intake parameters presented below.

FAH during the day can be used to adjust exposure duration and cancer risk from a specific facility's emissions, based on the assumption that exposure to the facility's emissions are not occurring away from home. From the third trimester to age <2 years, 85% of time is spent at home. From age 2 through <16 years, 72% of time is spent at home. From age 16 years and greater, 73% of time is spent at home. Facilities with a school within the 1×10^{-6} (or greater) isopleth are directed to use FAH = 1 for the child age groups (3rd Trimester, 0<2 years, and 2<16 years).

For residential inhalation exposure, cancer risk must be separately calculated for specified age groups because of age differences in sensitivity to carcinogens and age differences in intake rates (per kg body weight). Separate risk estimates for these age groups provide a health-protective estimate of cancer risk by accounting for greater susceptibility in early life, including both age-related sensitivity and amount of exposure. The following equation illustrates the formula for calculating residential inhalation cancer risk.

$$RISK_{inh-res} = DOSE_{air} \times CPF \times ASF \times \frac{ED}{AT} \times FAH$$

Where:

$RISK_{inh-res}$	= Residential inhalation cancer risk
$DOSE_{air}$	= Daily inhalation dose (mg/kg-day)
CPF	= Cancer potency factor $(mg/kg\text{-}day)^{-1}$
ASF	= Age sensitivity factor for a specified age group (unitless)
ED	= Exposure duration (in years) for a specified age group
AT	= Averaging time for lifetime cancer risk (years)
FAH	= Fraction of time spent at home (unitless)

Cancer risks calculated for individual age groups are summed to estimate the total cancer risk over the period of interest and/or lifetime. Cancer risk is typically expressed in "chances per million" (cancer risk × 10^6) but may also be expressed in other ways, such as "chances per 100,000" or "chances per 10 million" (cancer risk × 10^7).

For assessment of off-site worker cancer risk at the MEIW, the default assumes working age begins at 16 years. The daily inhalation dose ($DOSE_{air}$) is based on the adjusted 8-hour concentration at the MEIW (for noncontinuous sources) and amount of time the off-site worker's schedule overlaps with the facility's emission schedule. The duration of exposure at the MEIW receptor is 10 years due to the length of the Project. Additional consideration for off-site worker cancer risk assessment is whether there are women of child bearing age at the MEIW location and whether the MEIW has a daycare center. Under most circumstances, cancer risk accumulated by inhalation is calculated using the following equation:

$$RISK_{inh-work} = DOSE_{air} \times CPF \times ASF \times \frac{ED}{AT}$$

Where:

$RISK_{inh-work}$	= Woker inhalation cancer risk
$DOSE_{air}$	= Daily inhalation dose (mg/kg-day)
CPF	= Cancer potency factor $(mg/kg\text{-}day)^{-1}$
ASF	= Age sensitivity factor for a specified age group (one for working age 16 to 70)
ED	= Exposure duration (in years) for a specified age group (25 years)
AT	= Averaging time for lifetime cancer risk (70 years)

As discussed previously, some substances (e.g., semi-volatile organics and metals) are carcinogenic regardless of how they enter the body. Exposures to these substances are called multipathway. HRA for a facility that emits a multipathway pollutant must, at a minimum, evaluate doses from soil ingestion and dermal exposure. If polycyclic aromatic hydrocarbons, lead, dioxins, furans, or polychlorinated biphenyls are emitted, then the breast-milk consumption pathway becomes mandatory for residential receptors. OEHHA has developed transfer coefficients for these chemicals from the mother to breast milk. The other exposure pathways (e.g., ingestion of homegrown produce or fish) are only evaluated for residential receptors if the facility impacts that exposure medium and the receptor under evaluation can be exposed to that medium or pathway. For example, if the facility does not impact a fishable body of water within the isopleth of the facility, or the impacted water body does not sustain fish that are consumed by fishers, then the fish pathway will not be considered for that facility or receptor.

Noninhalation residential cancer risk is calculated using the same steps as inhalation cancer risk. The pathway under evaluation (e.g., soil ingestion) is multiplied by the substance-specific oral slope factor, expressed in units of inverse dose (i.e., $(mg/kg/day)^{-1}$), the appropriate ASF, and exposure duration divided by averaging time to yield the cancer risk for a specified age grouping. Cancer risk for each age group is summed as appropriate for the exposure duration.

If multiple substances are emitted, the substance-specific cancer risks for all exposure pathways are summed to give the (total) multipathway cancer risk at the receptor location. HARP2 displays the multipathway risk for each carcinogenic substance and a breakdown of the cancer risk from each exposure pathway.

This HRA evaluates mother's milk due to presence of lead in fugitive dust. The default assumption inherent in the intake rate is that the infant's only source of food is breast for the first year (e.g., is fully breastfed), which is one-half of the 0<2 year age group used in the Hot Spots program. Thus, the cancer risk by the mother's milk pathway is calculated with a slightly modified equation using a different exposure duration. Once the cancer risk is determined for the mother's milk pathway then it is summed with the other risks to calculate the total cancer risk for the receptor.

For facilities with large emission footprints (e.g., refineries, ports, or rail yards, etc.), population-based health impacts are critical to provide a better illustration of the potential impacts of emissions since large numbers of people may be exposed to the emissions. The individual cancer risk approach discussed up to this point has some inherent limitations in terms of protecting public health. A small facility with a single stack can impact a few individuals with an individual cancer risk that is unacceptable, whereas a large facility may have an individual cancer risk that is less than the acceptable limit for individual risk but exposes many more people. Thus, the population-wide impacts are larger for the large facility. Population-wide risk is independent of individual risk, and assumes that a population (not necessarily the same individuals) will live in the impacted zone over a 70-year period.

To evaluate population risk, one method that regulatory agencies have used is the cancer burden method to account for the number of excess cancer cases that could occur in a population. The cancer burden can be calculated by multiplying the cancer risk at a census block centroid by the number of people who live in the census block, and adding up the estimated number of potential cancer cases across the zone of impact. The result of this calculation is a single number that is intended to estimate of the number of potential cancer cases within the population that was exposed to the emissions for a lifetime.

Cancer burden is independent of how many people move in or out of the vicinity of an individual facility. For example, if 10,000 people are exposed to a carcinogen at a concentration with a 1×10^{-5} cancer risk for a lifetime the cancer burden is 0.1, and if 100,000 people are exposed to a 1×10^{-5} risk the cancer burden is 1.

OEHHA recommends that exposure from projects longer than 2 months but less than 6 months be assumed to last 6 months (e.g., a 2-month project would be evaluated as if it lasted 6 months). Exposure from projects lasting more than 6 months should be evaluated for the duration of the project. In all cases, for assessing risk to residential receptors, the exposure should be assumed to start in the third trimester to allow for the use of the ASFs. Thus, for example, if one is evaluating a proposed 10-year project, the cancer risks for the residents would be calculated based on exposures starting in the third trimester through the first ten years of life.

HRA performed for the Project follows the short project methodology described above for the Operation Phase which would last approximately ten years. Thus, the Project HRA assesses the emissions/risk for ten years starting in 2017. Emissions calculated for the Baseline (see Section 4.4.3) and Project (see Section 4.4.5) were determined for each time segment during the Project's life corresponding to cancer risk age bins third trimester to age two and age two through age nine. Cancer risk results for each time segment were then summed to determine the Project cancer risk impact at each receptor.

Non-Cancer Risk

Estimates of noncancer inhalation health impacts are determined by dividing an airborne concentration at the receptor by the appropriate REL. This is termed the Hazard Index (HI) Approach. A REL is used as an indicator of potential noncancer health impacts and is defined as the concentration at which no adverse noncancer health effects are anticipated. When a health impact calculation is performed for a single substance, then it is called the hazard quotient (HQ). Each REL for a substance will have one or more target organ systems (e.g., respiratory system, nervous system, etc.) where the substance can have a noncancer health impact. Thus, all HQs have specified target organ systems associated with them. The sum of the Hazard HQs of all chemicals emitted that impact the same target organ is the HI. Inhalation RELs for noncancer health impacts have been developed for acute, 8-hour, and chronic exposures to a number of substances.

Acute RELs are designed to protect against the maximum 1-hour ground level concentration at the receptor. Chronic RELs protect against long-term exposure to the annual average air concentration spread over 24 hours/day, 7 days/week. 8-hour RELs are designed to protect people with daily 8-hour schedules, such as off-site workers, in an impacted zone. The 8-hour RELs are used for typical daily work shifts of 8-9 hours and represent concentrations at or below which health impacts would not be expected even for sensitive subpopulations in the general population with repeated daily 8-hour exposures over a significant fraction of a lifetime. The 8-hour RELs can be used to evaluate the potential for health impacts (including effects of repeated exposures) in off-site workers, and to children and teachers exposed during school hours.

Acute, 8-hour, and chronic RELs are needed because the dose metrics and even the health impact endpoints may be different with the different exposure durations of acute, daily 8-hour, and chronic exposures. Also, although chronic REL values are lower or set the same as 8-hour RELs, there are some cases such as special meteorological situations (e.g., significant diurnal-nocturnal meteorological differences) or intermittent exposures where the 8-hour REL may be more protective than the chronic REL.

As discussed above, in order to calculate the acute, 8-hour, or chronic HQ, the maximum ground-level concentration (in µg/m^3) during the appropriate period of time (i.e., 1-hour acute, 8-hour, and 1-year chronic) is divided by the corresponding REL (in µg/m^3) for the substance. If a receptor is exposed to multiple substances that target the same organ system, then the HQs for the individual substances are summed to obtain a Hazard Index (HI) for that target organ as shown in the following equations.

$$HI_{\ Organ1} = \frac{C_{air,1}}{REL_1} + \frac{C_{air,2}}{REL_2} + \cdots + \frac{C_{air,n,}}{REL_n}$$

or

$$HI_{Organ1} = HQ_1 + HQ_2 + \cdots + HQ_n$$

A HI of 1.0 or less indicates that adverse health effects are not expected to result from exposure to emissions of that substance. As the HI increases above one, the probability of human health effects increases by an undefined amount. However, HI above one is not necessarily indicative of health impacts due to the application of uncertainty factors in deriving the RELs.

There are non-cancer multipathway pollutants that are assessed for inhalation, ingestion, and other non-inhalation pathways. Nickel and arsenic are two that are found in fugitive dust and so the non-inhalation exposures to these metals are assessed for the corresponding target organs. Specifically, nickel effects the respiratory, hematologic, and alimentary systems while arsenic affects development; the nervous and cardiovascular systems; and the skin.

4.5 Project-Level Impacts and Mitigation Measures

Project impact associated with each threshold of significance (Section 4.3) is evaluated in the following subsections. Mitigation measures are proposed for impacts where a threshold would potentially be exceeded. Mitigated impact is then assessed to evaluate the effect of the mitigation and determine if additional mitigation is necessary.

4.5.1 Conflict With or Obstruction to the Implementation of an Air Quality Plan

Impact Statement

Impact AQ-1: *Would the Project conflict with or obstruct implementation of the applicable air quality plan?* **(Appendix G Threshold Criteria (a))**

Impact Analysis

The SMAQMD is tasked with implementing programs and regulations required by the CAA and the CCAA. In that capacity, the SMAQMD has prepared plans to attain Federal and State ambient air quality standards. The SMAQMD has established thresholds of significance for criteria pollutant emissions. Projects with emissions below the thresholds of significance for criteria pollutants would be determined not to conflict or obstruct implementation of the SMAQMD's air quality plans. Table 26 presents the operation phase emissions (see Section 4.4.5), Baseline emissions (see Section 4.4.3 and 2008 FEIR excerpt in Appendix C), and calculates the change in emissions that may occur if the Project were approved. The change in emissions is the impact of the Project and those values are compared to the SMAQMD significance thresholds. It is important to note that Table 26 includes mitigation measures that were present in the 2008 FEIR, such as 68% control on fugitive dust sources.

Table 26 Criteria Pollutant Emissions Impacts

	ROG (lb/day)	NO_X (lb/day)	PM_{10} (lb/day)	$PM_{2.5}$ (lb/day)	PM_{10} (ton/yr)	$PM_{2.5}$ (ton/yr)
Operation	18.67	196.71	305.32	53.1	19.21	2.85
Baseline	14.0	216.1	286.3	33.7	42.9	4.7*
Project	4.67	-19.39	19.02	19.4	-23.69	-2.35
Threshold	65	65	80	82	14.6	15
Significant?	No	No	No	No	No	No

Source: 2008 FEIR Table AQ-4, p. 9-13 and Appendix A of the Air Quality Impact Analysis located in Appendix A of the FEIR.

Notes: SMAQMD $PM_{2.5}$ thresholds did not exist at the time of the 2008 EIR. $PM_{2.5}$ is a subset of PM_{10} and the significance criteria for PM_{10} is lower than the criteria for $PM_{2.5}$. Thus, evaluation of $PM_{2.5}$ is unnecessary and $PM_{2.5}$ values are presented for disclosure purposes only. $PM_{2.5}$ fractions are from AP-42 Table 13.2.2-2 and Equation 1 in Section 13.2.4.

Level of Significance Before Mitigation

Less than significant.

Mitigation Measures

None required.

Level of Significance After Mitigation

Not applicable.

4.5.2 Violation of any Air Quality Standard or Contribution to an Existing or Projected Air Quality Violation

Impact Statement

Impact AQ-2: *Would the Project Violate any air quality standard or contribute substantially to an existing or projected air quality violation?* **(Appendix G Threshold Criteria (b))**

Impact Analysis

Determination of whether project emissions would violate an ambient air quality standard is normally determined by dispersion modeling for projects that are unable to screen-out of modelling at the project's property boundary. Projects would be considered to not violate an air quality standard or contribute substantially to an existing or projected violation are those that, when added to background concentrations, do not exceed the AAQS. Where background concentrations already exceed the AAQS, a project's concentration is typically compared to the applicable Significant Impact Level (SIL, 40 CFR Section 51).

The Project would not increase emissions of ROG, NOx or PM_{10} from what has occurred in the past on annual, daily and hourly bases. These criteria pollutants would decrease from the amounts already approved in the certified 2008 FEIR and thus no impact would result.

Regarding CO and SOx, the Sacramento Metropolitan area is in attainment for both of these criteria pollutants. These pollutants were not quantified in the FEIR, but diesel engine requirements and fuel standards that have been passed since the FEIR indicate that emissions would decrease given constant activity levels. As truck trips for the Project remain unchanged, there is no reason to believe either of these criteria pollutants would increase from the previous analysis or cause the exceedance of an ambient air quality standard.

Level of Significance Before Mitigation

Less than significant.

Mitigation Measures

None required.

Level of Significance After Mitigation

Not applicable

4.5.3 Net Increase of any Criteria Pollutant

Impact Statement

Impact AQ-3: *Would the Project result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable Federal or State ambient air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors)?* **(Appendix G Threshold Criteria (c))**

Impact Analysis

CEQA defines cumulative impacts as two or more individual effects which, when considered together, are either significant or "cumulatively considerable", meaning they add considerably to a significant environmental impact. An adequate cumulative impact analysis considers a project over time and in conjunction with other past, present, and reasonably foreseeable future projects whose impacts might compound those of the project being assessed.

By its very nature, air pollution is largely a cumulative impact. The nonattainment status of regional pollutants is a result of past and present development. Future attainment of State and Federal ambient air quality standards is a function of successful implementation of the SMAQMD's attainment plans. Consequently, the SMAQMD's application of thresholds of significance for criteria pollutants is relevant to the determination of whether a project's individual emissions would have a cumulatively significant impact on air quality.

A Lead Agency may determine that a project's incremental contribution to a cumulative effect is not cumulatively considerable if the project will comply with the requirements in a previously approved plan or mitigation program, including, but not limited to an air quality attainment or maintenance plan that provides specific requirements that will avoid or substantially lessen the cumulative problem within the geographic area in which the project is located (CCR §15064(h)(3)).

Thus, if project emissions (change from baseline) exceed thresholds for NOx, ROG, PM_{10} or $PM_{2.5}$, then the project would result in a cumulatively considerable net increase of a criteria pollutant for which the SMAQMD is in non-attainment under applicable Federal or State ambient air quality standards. This does not imply that if the project impact is less than those significance criteria, it cannot be cumulatively significant. The significance criteria are presented in Table 7 and include a single set of emissions levels that are applied separately to construction and operation phases, both of which have been found to be less than significant.

Level of Significance Before Mitigation

Less than significant.

Mitigation Measures

None required.

Level of Significance After Mitigation

Not applicable.

4.5.4 Exposure of Sensitive Receptors to Substantial Pollutant Concentrations

Impact Statement

Impact AQ-4: *Would the Project expose sensitive receptors to substantial pollutant concentrations?* **(Appendix G Threshold Criteria (d))**

Impact Analysis

Determination of whether project emissions would expose sensitive receptors to substantial pollutant concentrations is a function of assessing potential health risks. Sensitive receptors are facilities that house or attract children, the elderly, people with illnesses, or others who are especially sensitive to the effects of air pollutants. Hospitals, schools, convalescent facilities, and residential areas are examples of sensitive receptors. When evaluating whether a development proposal has the potential to result in localized impacts, the nature of the air pollutant emissions, the proximity between the emitting facility and sensitive receptors, the direction of prevailing winds, and local topography must be considered.

A Health Risk Assessment was performed as discussed in Section 4.4.6 to evaluate the effects of TACs including DPM from vehicles and various substances found in fugitive dust emissions (i.e., metals and crystalline silica). Health risks from operation of the Project are presented in Table 27. A conservative 30 year cancer risk analysis was included in addition to the 16 year project timeline.

Table 27 Project Health Risk Impacts Before Mitigation

Model Receptor # – Type	16 Year Excess Cancer Cases per Million People Exposed	30 Year Excess Cancer Cases per Million People Exposed	Chronic Hazard Index	Acute Hazard Index
1 - Residence	127	134	0.34	0.76
2 - Residence	71	85	0.15	0.44
3 - Residence	61	77	0.12	0.19
4 - Residence	29	35	0.060	0.28
5 - Residence	17	20	0.061	0.21
33 - Fencline	N/A	N/A	N/A	1.2
Significance Threshold	10	10	1	1
Threshold Exceeded?	**Yes**	**Yes**	**No**	**Yes**

Source: Appendix F

N/A means not applicable because this method of analysis applies only to worker receptors, or because this method does not apply to the receptor. Fencline receptor 33 was chosen as it had the highest acute hazard index, and has UTM Coordinates 651653, 4262932.

Level of Significance Before Mitigation

Cancer risk and Acute Hazard impacts are potentially significant.

Mitigation Measures

Mitigation Measure Air Quality -1 and 2 (MM AQ-1, MM AQ-2) are recommended to reduce diesel particulate and fugitive dust emissions.

MM AQ-1 Maintain offroad mining vehicle fleet engines at EPA certified Teir 4 Interim or cleaner.

MM AQ-2 Implement Enhanced Dust Control Methods to increase overall control efficiency from 68% to 80%. See Appendix F.

By combining these mitigation measures, health risk attributed to engine emissions and TACs in fugitive dust can be reduced. Mitigation measure MM AQ-1 would decrease health risk impacts related to cancer by limiting the diesel particulate matter emissions of engines in the fleet. The EPA Nonroad Compression-Ignition Engines: Exhaust Emission Standards (Appendix I) details the requirements for Teir 4I certification. MM AQ-2 would involve implementing a series of practices (Appendix I) to control emissions of fugitive dust, resulting in lower potential for both cancer and acute hazard exposure.

Table 28 Project Health Risk Impacts After Mitigation

Model Receptor # – Type	16 Year Excess Cancer Cases per Million People Exposed	30 Year Excess Cancer Cases per Million People Exposed	Chronic Hazard Index	Acute Hazard Index
1 - Residence	-22	-25	0.19	0.68
2 - Residence	-90	-99	0.033	0.43
3 - Residence	-157	-173	0.031	0.17
4 - Residence	-53	-58	0.017	0.27
5 - Residence	-16	-18	0.040	0.20
33 - Fencline	N/A	N/A	N/A	0.92
Significance Threshold	10	10	1	1
Threshold Exceeded?	**No**	**No**	**No**	**No**

Source: Appendix F

N/A means not applicable because this method of analysis applies only to worker receptors, or because this method does not apply to the receptor. Fencline receptor 33 was chosen as it had the highest acute hazard index, and has UTM Coordinates 651653, 4262932.

In the case of a stack, which releases pollutants above ground level, it is conceivable that a receptor close to the base of the stack would receive lower exposure than a further receptor, as the pollutant plume might travel before reaching ground level. In the modeling method employed however, emissions sources were placed at ground level. Concentration and risk therefore decrease with distance. For this reason, the results shown in Table 28 were considered to be sufficient evidence that the receptors of potential concern in Table 20 will not be exposed to significant risk; the closest receptor in Table 20 is more than 2 miles away from the project site.

4.5.5 Odors Affecting a Substantial Number of People

Impact Statement

Impact AQ-5: *Would the Project create objectionable odors affecting a substantial number of people?* **(Appendix G Threshold Criteria (e))**

Impact Analysis

Due to the subjective nature of odor impacts, the number of variables that can influence the potential for an odor impact, and the variety of odor sources, there are no quantitative or formulaic methodologies to determine the presence of a significant odor impact. Rather, the SJVAPCD recommends that odor analyses strive to fully disclose all pertinent information.

The intensity of an odor source's operations and its proximity to sensitive receptors influences the potential significance of odor emissions. The SJVAPCD has identified some common types of facilities that have been known to produce odors in the San Joaquin Valley. These are presented in Table 29 below along with a reasonable distance from the source within which, the degree of odors could possibly be significant. If the proposed project would result in sensitive receptors being located closer than the screening level distances, a more detailed analysis should be provided and include information regarding odor complaints.

Table 29 Odor Screening Distances

Type of Facility	Odor Screening Distance (miles)
Wastewater Treatment Facilities	2
Sanitary Landfill	1
Transfer Station	1
Composting Facility	1
Petroleum Refinery	2
Asphalt Batch Plant	1
Chemical Manufacturing	1
Fiberglass Manufacturing	1
Painting/Coating Operations (e.g., auto body shops)	1
Food Processing Facility	1
Feed Lot/Dairy	1
Rendering Plant	1

Source: (CEQA Guidance and Tools, 2016, p. 7.Appendix).

Diesel exhaust from mobile equipment/vehicles has a slight odor. Odor intensity would decrease rapidly with distance and is not expected to be frequently (or at all) detectable at locations outside of the Project site boundary. In addition, given the subjective nature of odors, such odors are generally only considered to be objectionable by residential receptors (i.e., not by occupational workers). Given the rural nature of the Project vicinity, there are few residences located within 1 mile of the Project. Therefore, it is not anticipated that objectionable odors affecting a substantial number of people could result from the Project.

Level of Significance Before Mitigation

Less than significant.

Mitigation Measures

None required.

Level of Significance After Mitigation

Not applicable.

5.0 GREENHOUSE GASES

This section of the AQCCIA assesses GHG impacts of the Project. The methodologies used and the information provided in this section are supported by calculations in Appendix H

5.1 Regulatory Setting

5.1.1 Characteristics of Climate Pollutants

The accumulation of GHGs in the atmosphere contributes to the regulation of the earth's temperature. Some GHGs can remain in the atmosphere for long periods of time (i.e., long-lived). The following six GHGs are recognized under the Kyoto Protocol and have been found by the International Panel on Climate Change (IPCC) to have an effect on global climate change. In addition, California has identified "short-lived" climate pollutants.

Long-Lived Climate Pollutants

In general, there are six (6) compounds/classes of GHGs that are counted when emissions are inventoried. Each GHG exhibits a different global warming potential (GWP). The mass of emissions of each GHG is multiplied by its GWP to determine the carbon dioxide equivalent (CO_2e) potential for global warming. GWPs have changed over time by the Intergovernmental Panel on Climate Change (IPCC) which is considered an authority on GHGs and their effects. The CAP and CARB emissions inventories and plans use GWPs that are an iteration or two behind and the most recent IPCC publication. Characteristics of each long-lived GHG and the associated GWP is presented below.

Carbon Dioxide (CO_2) is an odorless, colorless natural GHG. CO_2 is emitted from natural and anthropogenic sources. Natural sources include the following: decomposition of dead organic matter; respiration of bacteria, plants, animals, and fungus; evaporation from oceans; and volcanic outgassing. Anthropogenic sources include burning coal, oil, natural gas, and wood. By definition, CO_2 has a GWP equal to one (1).

Methane (CH_4) is a flammable GHG. A natural source of CH_4 is from the anaerobic decay of organic matter. Geological deposits, known as natural gas fields, also contain CH_4, which is extracted for fuel. Other sources include landfills, fermentation of manure, and ruminants such as cattle. CH_4 has a GWP equal to 25.

Nitrous Oxide (N_2O) is a colorless GHG. N_2O is produced by microbial processes in soil and water, including those reactions that occur in fertilizer containing nitrogen. In addition to agricultural sources, some industrial processes (fossil fuel-fired power plants, nylon production, nitric acid production, and vehicle emissions) also contribute to its atmospheric load. N_2O has a GWP equal to 298.

Hydrofluorocarbons (HFCs) are synthetic chemicals that are used as a substitute for chlorofluorocarbons (CFCs). Of all the GHGs, they are one of three groups with the highest global warming potential. HFCs are human made for applications such as air conditioners and refrigerants. HFCs have GWPs that range from 124 (HFC 125a) to 14,300 (HFC 23).

Perfluorocarbons (PFCs) have stable molecular structures and do not break down through the chemical processes in the lower atmosphere; therefore, PFCs have long atmospheric lifetimes, between 10,000 and 50,000 years. The two main sources of PFCs are primary aluminum production and semiconductor manufacturing. PFCs have GWPs that range from 7,390 (PFC 14) to 12,200 (PFC 116).

Sulfur Hexafluoride (SF_6) is an inorganic, odorless, colorless, nontoxic, nonflammable gas. SF_6 is used for insulation in electric power transmission and distribution equipment, in the magnesium industry, in semiconductor manufacturing, and as a tracer gas for leak detection. SF_6 has a GWP equal to 22,800.

Short-Lived Climate Pollutants

Short-lived climate pollutants are climate forcers that remain in the atmosphere for a much shorter period of time than longer-lived climate pollutants, such as carbon dioxide (CO_2). Their relative potency, when measured in terms of how they heat the atmosphere, can be tens, hundreds, or even thousands of times greater than that of CO_2. The impacts of short-lived climate pollutants are especially strong over the short term. Reducing these emissions can make an immediate beneficial impact on climate change.

Black carbon is a component of fine particulate matter, which has been identified as a leading environmental risk factor for premature death. It is produced from the incomplete combustion of fossil fuels and biomass burning, particularly from older diesel engines and forest fires. Black carbon warms the atmosphere by absorbing solar radiation, influences cloud formation, and darkens the surface of snow and ice, which accelerates heat absorption and melting. Diesel particulate matter emissions are a major source of black carbon and are also toxic air contaminants that have been regulated and controlled in California for several decades in order to protect public health.

Fluorinated gases (F-gases) are the fastest growing source of greenhouse gas emissions in California and globally. They include ozone-depleting substances that are being phased out globally under the Montreal Protocol, and their primary substitute, hydrofluorocarbons (HFCs). Most F-gas emissions come from leaks of these gases in refrigeration and air-conditioning systems. Emissions also come from aerosol propellants, fire suppressants, and foam-expansion agents.

Methane (CH_4) is the principal component of natural gas. Its emissions contribute to background ozone in the lower atmosphere (troposphere), which itself is a powerful greenhouse gas and contributes to ground level air pollution. The atmospheric concentration of methane is growing as a result of human activities in the agricultural, waste treatment, and oil and gas sectors. Capturing methane from these sources can improve pipeline safety, and provide fuel for vehicles and industrial operations that displaces fossil natural gas use.

5.1.2 Federal

Federal actions on GHG are summarized in Table 30.

Table 30 Federal GHG Actions

Date	Action	Description
April 2, 2007	*Massachusetts v. EPA*, 549 U.S. 497	Supreme Court found that GHGs are air pollutants covered by the Clean Air Act. (528-29.)
September 22, 2009	Mandatory Reporting Rule	This rule and subsequent rules which amend 40 CFR Part 98 require and govern the collection accurate and timely data on GHG emissions that can be used to inform future policy decisions.
December 7, 2009	EPA Endangerment Findings	• Elevated concentrations of GHGs—CO_2, CH_4, N_2O, HFCs, PFCs, and SF_6—in the atmosphere threaten the public health and welfare of current and future generations. This is referred to as the "endangerment finding." • Combined emissions of GHGs—CO_2, CH_4, N_2O, and HFCs—from new motor vehicles and new motor vehicle engines contribute to the GHG air pollution that endangers public health and welfare. This is referred to as the "cause or contribute finding." (*Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act* (Dec. 15, 2009) 74 Fed. Reg. 66496, 546.)
December 19, 2007	Energy Independence and Security Act (EISA)	• Increase the supply of alternative fuel sources by requiring fuel producers to use at least 36 billion gallons of biofuel in 2022. • Set a target of 35 miles per gallon (mpg) for the combined fleet of cars and light trucks by model year 2020 and establish a fuel economy program for medium and heavy duty vehicles. • Prescribe or revise standards affecting regional efficiency for heating and cooling products.
April 2010, September 2011, and August 2012	EPA and NHTSA Joint Final Rules for Vehicle Standards	• In 2010, established a National program consisting of new standards for light-duty vehicles model years 2012 through 2016 which achieve the 250 g CO_2/mile (35 mpg) target in the EISA beginning with the 2016 model year fleet. • In 2011, approved GHG emissions standards for medium and heavy duty trucks model years 2014 through 2018. • In 2012, approved standards for model year 2017 and beyond light duty vehicles to 163 g CO_2/mile (i.e., 54.5 mpg if achieved only by fuel efficiency) for model year 2025.

Date	Action	Description
January 2, 2011	Clean Air Act Permitting for GHGs	On June 23, 2014, the U.S. Supreme Court issued its decision in Utility Air Regulatory Group v. EPA, 134 S. Ct. 2427 (2014) ("UARG"). The Court held that EPA may not treat GHGs as an air pollutant for purposes of determining whether a source is a major source required to obtain a PSD or title V permit. The Court also held that PSD permits that are otherwise required (based on emissions of other pollutants) may continue to require limitations on GHG emissions based on the application of Best Available Control Technology (BACT).
August 3, 2015	Clean Power Plan	The Plan provides standards for power plants, customized goals for states to cut the carbon pollution from power plants, national consistency, accountability and a level playing field while reflecting each state's energy mix. On February 9, 2016, the Supreme Court stayed implementation of the Clean Power Plan pending judicial review. EPA claims "The Court's decision was not on the merits of the rule. EPA firmly believes the Clean Power Plan will be upheld when the merits are considered because the rule rests on strong scientific and legal foundations."

5.1.3 State

The following tables were copied from the California government website for climate change (climatechange.ca.gov) and list the California legislation (Table 31), regulations, (Table 32), and executive orders (Table 33) through the end of 2015. More recent developments are discussed immendiately following the tables.

Table 31 California Climate Change Legislation

Date	Legislation	Description
October 7, 2015	Senate Bill 350 (De León, Chapter 547, Statutes of 2015)	Clean Energy and Pollution Reduction Act of 2015 Establishes targets to increase retail sales of renewable electricity to 50 percent by 2030 and double the energy efficiency savings in electricity and natural gas end uses by 2030.
September 21, 2014	Senate Bill 605 (Lara, Chapter 523, Statutes of 2014)	Short-lived climate pollutants Requires the State Air Resources Board to complete a comprehensive strategy to reduce emissions of short-lived climate pollutants by January 1, 2016.
September 21, 2014	Senate Bill 1275, (De León, Chapter 530, Statutes of 2014)	Charge Ahead California Initiative Establishes a State goal of 1 million zero-emission and near-zero-emission vehicles in service by 2020. Amends the enhanced fleet modernization program to provide a mobility option. Establishes the Charge Ahead California Initiative requiring planning and reporting on vehicle incentive programs, and increasing access to and benefits from zero-emission vehicles for disadvantaged, low-income, and moderate-income communities and consumers.

Date	Legislation	Description
September 21, 2014	Senate Bill1204 (Lara, Chapter 524, Statutes of 2014)	California Clean Truck, Bus, and Off-Road Vehicle and Equipment Technology Program Creates the California Clean Truck, Bus, and Off-Road Vehicle and Equipment Technology Program funded by the Greenhouse Gas Reduction Fund for development, demonstration, precommercial pilot, and early commercial deployment of zero- and near-zero emission truck, bus, and off-road vehicle and equipment technologies, with priority given to projects benefiting disadvantaged communities.
September 28, 2013	Assembly Bill 8 (Perea, Chapter 401, Statutes of 2013)	Alternative fuel and vehicle technologies: funding programs Extends until January 1, 2024, extra fees on vehicle registrations, boat registrations, and tire sales in order to fund the AB 118, Carl Moyer, and AB 923 programs that support the production, distribution, and sale of alternative fuels and vehicle technologies and air emissions reduction efforts. The bill suspends until 2024 ARB's regulation requiring gasoline refiners to provide hydrogen fueling stations and appropriates up to $220 million, of AB 118 money to create a hydrogen fueling infrastructure in the State.
September 28, 2013	Assembly Bill 1092 (Levine, Chapter 410, Statutes of 2013)	Building standards: electric vehicle charging infrastructure Requires the Building Standards Commission to adopt mandatory building standards for the installation of future electric vehicle charging infrastructure for parking spaces in multifamily dwellings and nonresidential development.
September 30, 2012	Senate Bill 535 (De León, Chapter 830, Statutes of 2012)	Greenhouse Gas Reduction Fund and Disadvantaged Communities Requires the California Environmental Protection Agency to identify disadvantaged communities; requires that 25% of all funds allocated pursuant to an investment plan for the use of moneys collected through a cap-and-trade program be allocated to projects that benefit disadvantaged communities and 10 those 25% be use within disadvantaged communities; and requires the Department of Finance to include a description of how these requirements are fulfilled in an annual report.
September 30, 2012	Assembly Bill 1532 (J. Perez, Chapter 807, Statutes of 2012)	Greenhouse Gas Reduction Fund in the Budget Requires the Department of Finance to develop and submit to the Legislature an investment plan every three years for the use of the Greenhouse Gas Reduction Fund; requires revenue collected pursuant to a market-based compliance mechanism to be appropriated in the Annual Budget Act; requires the department to report annually to the Legislature on the status of projects funded; and specifies that findings issued by the Governor related to "linkage" as part of a market-base compliance mechanism are not subject to judicial review.
April 12, 2011	Senate Bill X1-2 (Simitian, Chapter 1, Statutes of 2011)	Governor Edmund G. Brown, Jr. signed Senate Bill X1-2 into law to codify the ambitious 33 percent by 2020 goal. SBX1-2 directs California Public Utilities Commission's Renewable Energy Resources Program to increase the amount of electricity generated from eligible renewable energy resources per year to an amount that equals at least 20% of the total electricity sold to retail customers in California per year by December 31, 2013, 25% by December 31, 2016 and 33% by December 31, 2020. The new RPS goals applies to all electricity retailers in the State including publicly owned utilities (POUs), investor-owned utilities, electricity service providers, and community choice aggregators. This new RPS preempts the California Air Resources Boards' 33 percent Renewable Electricity Standard.

Date	Legislation	Description
September 29, 2011	Assembly Bill 1504 (Skinner, Chapter 534, Statutes of 2010)	Forest resources and carbon sequestration. Bill requires Department of Forestry and Fire Protection and Air Resources Board to assess the capacity of its forest and rangeland regulations to meet or exceed the State's greenhouse goals, pursuant to AB 32.
September 30, 2008	Senate Bill 375 (Steinberg, Chapter 728, Statutes of 2008)	Sustainable Communities & Climate Protection Act of 2008 requires Air Resources Board to develop regional greenhouse gas emission reduction targets for passenger vehicles. ARB is to establish targets for 2020 and 2035 for each region covered by one of the State's 18 metropolitan planning organizations. For more information on SB 375, see the ARB Sustainable Communities page.
October 14, 2007	Assembly Bill 118 (Núñez, Chapter 750, Statutes of 2007)	Alternative Fuels and Vehicles Technologies The bill would create the Alternative and Renewable Fuel and Vehicle Technology Program, to be administered by the Energy Commission, to provide funding to public projects to develop and deploy innovative technologies that transform California's fuel and vehicle types to help attain the State's climate change policies.
August 24, 2007	Senate Bill 97 (Dutton, Chapter 187, Statutes of 2007)	Directs Governor's Office of Planning and Research to develop CEQA guidelines "for the mitigation of greenhouse gas emissions or the effects of greenhouse gas emissions." For more information see the OPR CEQA and Climate Changepage.
July 18. 2006	Assembly Bill 1803 (Committee on Budget, Chapter 77, Statutes of 2006)	Greenhouse gas inventory transferred to Air Resources Board from the Energy Commission.
August 21, 2006	Senate Bill 1 (Murray, Chapter 132, Statutes of 2006)	California's Million Solar Roofs plan is enhanced by PUC and CEC's adoption of the California Solar Initiative. SB1 directs PUC and CEC to expand this program to more customers, and requiring the State's municipal utilities to create their own solar rebate programs. This bill would require beginning January 1, 2011, a seller of new homes to offer the option of a solar energy system to all customers negotiating to purchase a new home constructed on land meeting certain criteria and to disclose certain information.
September 26, 2006	Senate Bill 107 (Simitian, Chapter 464, Statutes of 2006)	SB 107 directs California Public Utilities Commission's Renewable Energy Resources Program to increase the amount of renewable electricity (Renewable Portfolio Standard) generated per year, from 17% to an amount that equals at least 20% of the total electricity sold to retail customers in California per year by December 31, 2010.
September 27, 2006	Assembly Bill 32 (Núñez, Chapter 488, Statutes of 2006)	California Global Warming Solutions Act of 2006. This bill would require Air Resources Board (ARB) to adopt a statewide greenhouse gas emissions limit equivalent to the statewide greenhouse gas emissions levels in 1990 to be achieved by 2020. ARB shall adopt regulations to require the reporting and verification of statewide greenhouse gas emissions and to monitor and enforce compliance with this program. AB 32 directs Climate Action Team established by the Governor to coordinate the efforts set forth under Executive Order S-3-05 to continue its role in coordinating overall climate policy. See more information on AB 32 at ARB.

Date	Legislation	Description
September 12, 2002	Senate Bill 1078 (Sher, Chapter 516, Statutes of 2002)	This bill establishes the California Renewables Portfolio Standard Program, which requires electric utilities and other entities under the jurisdiction of the California Public Utilities Commission to meet 20% of their renewable power by December 31, 2017 for the purposes of increasing the diversity, reliability, public health and environmental benefits of the energy mix.
September 7, 2002	Senate Bill 812 (Sher, Chapter 423, Statutes of 2002)	This bill added forest management practices to the California Climate Action Registry members' reportable emissions actions and directed the Registry to adopt forestry procedures and protocols to monitor, estimate, calculate, report and certify carbon stores and carbon dioxide emissions that resulted from the conservation-based management of forests in California.
July 22, 2002	Assembly Bill 1493 (Pavley, Chapter 200, Statutes of 2002)	The "Pavley" bill requires the registry, in consultation with ARB, to adopt procedures and protocols for the reporting and certification of reductions in greenhouse gas emissions from mobile sources for use by the ARB in granting the emission reduction credits. This bill requires the ARB to develop and adopt, by January 1, 2005, regulations that achieve the maximum feasible reduction of greenhouse gases emitted by passenger vehicles and light-duty trucks. For more information on AB 1493 Pavley I, see the ARB Clean Car Standards page.
October 11, 2001	Senate Bill 527 (Sher, Chapter 769, Statutes of 2001)	This bill revises the functions and duties of the California Climate Action Registry and requires the Registry, in coordination with CEC to adopt third-party verification metrics, developing GHG emissions protocols and qualifying third-party organizations to provide technical assistance and certification of emissions baselines and inventories. SB 527 amended SB 1771 to emphasize third-party verification.
September 30, 2000	Senate Bill 1771 (Sher, Chapter 1018, Statutes of 2000)	SB 1771 establishes the creation of the non-profit organization, the California Climate Action Registry and specifies functions and responsibilities to develop a process to identify and qualify third-party organizations approved to provide technical assistance and advice in monitoring greenhouse gas emissions, and setting greenhouse gas (GHG) emissions baselines in coordination with CEC. Also, the bill directs the Registry to enable participating entities to voluntarily record their annual GHG emissions inventories. Also, SB 1771 directs CEC to update the State's greenhouse gas inventory from an existing 1998 report and continuing to update it every five years.
September 28, 1988	Assembly Bill 4420 (Sher, Chapter 1506, Statutes of 1988)	The California Energy Commission (CEC) was statutorily directed to prepare and maintain the inventory of greenhouse gas emissions (GHG) and to study the effects of GHGs and the climate change impacts on the State's energy supply and demand, economy, environment, agriculture, and water supplies. The study also required recommendations for avoiding, reducing, and addressing related impacts - and required the CEC to coordinate the study and any research with federal, state, academic, and industry research projects.

Source: (climatechange.ca.gov, 2017)

Table 32 California Climate Change Regulations

Regulations	Description
Low Carbon Fuel Standard	In September 2015, the Air Resources Board re-adopted the Low Carbon Fuel Standard, to settle issues arising from lawsuits. The requirement is still a 10 percent reduction in the carbon intensity of transportation fuels.
Cap & Trade Offset Protocols	The Air Resources Board has adopted five protocols for offset compliance projects. In addition to the original four protocols adopted in 2011, ARB has adopted: Mine Methane Capture (MMC) Projects Compliance Offset Protocol, adopted April 2014
Cap & Trade Link with Quebec	California linked its cap-and-trade program with Quebec's program in January 2014. Linkage allows for the use of compliance instruments from Quebec's greenhouse gas emission trading system to meet compliance obligations pursuant to the California Cap-and-Trade Regulation, and the reciprocal approval of compliance instruments issued by California to meet compliance obligations in the external trading program.
Building Energy Efficiency Standards	The Energy Commission's 2013 Building Energy Efficiency Standards are 25 percent more efficient than previous standards for residential construction and 30 percent better for nonresidential construction. The Standards, which took effect on January 1, 2014, offer builders better windows, insulation, lighting, ventilation systems and other features that reduce energy consumption in homes and businesses.
Advanced Clean Cars Standard	The Advanced Clean Cars Program, approved in January 2012, will achieve additional GHG reductions from passenger vehicles for model years 2017-2025. This Program represents a new approach to passenger vehicles – cars and light trucks -- by combining the control of smog-causing pollutants and GHG emissions into a single coordinated package of standards known as Low Emission Vehicles (LEV) III. The new approach also includes efforts under the Zero-Emission Vehicle Program to support and accelerate the numbers of plug-in hybrids and zero-emission vehicles in California.
Water Appliance Standards	The Energy Commission's 2015 Water Appliance Standards are projected to save 10 billion gallons in the first year, increasing over time to 100 billion gallons of water per year. The energy efficiency and water standards require water appliances to consume less water thereby using less energy while performing the same function. The standards apply to: toilets and urinals; residential lavatory faucets; kitchen faucets; public lavatory faucets.
Cap & Trade Rulemaking Activities	A proposed California cap on greenhouse gas emissions and a market-based compliance mechanisms, including compliance offset protocols. OAL approved the rulemaking and filed it with the Secretary of State on December 13, 2011. The regulation will become effective on the January 1, 2012.
Low Carbon Fuel Standards (LCFS)	The regulations are designed to reduce the carbon intensity (CI) of transportation fuels used in California by at least 10 percent by the year 2020. The Air Resources Board approved the LCFS regulation for adoption on April 23, 2009. The regulation entered into full effect on April 15, 2010. Based upon feedback from stakeholders, amendments to the regulations were proposed by the Board in December 2011.
33% Renewable Portfolio Standard	On May 5, 2011, the Commission adopted the Order Instituting Rulemaking (R.) 11-05-005 to open a new proceeding for the implementation and administration of the 33% RPS Program. The primary focus of the R.11-05-005 proceeding was the implementation of the new 33% RPS law, Senate Bill (SB) 2 (1X) (Simitian), stats. 2011.

Regulations	Description
Mandatory Commercial Recycling	This regulation addresses recycling requirements for businesses that generate 4 or more cubic yards of commercial solid waste per week and multifamily residential dwellings with 5 or more units, regardless of the amount of waste generated; local jurisdiction requirements for education, outreach, monitoring and reporting; and CalAsphalt and concrete recycling review. The regulations were approved on May 7, 2012.

Table 33 California Climate Change Executive Orders

Date	Executive Order	Description
April 29, 2015	B-30-15	EO-B-30-15 sets a greenhouse gas (GHG) emissions target for 2030 at 40 percent below 1990 levels.
April 25, 2012	B-18-12	EO-B-18-12 calls for significant reductions in State agencies' energy purchases and GHG emissions. The Executive Order included a Green Building Action Plan, which provided additional details and specific requirements for the implementation of the Executive Order
March 23, 2012	B-16-12	EO-B-16-12 orders State agencies to facilitate the rapid commercialization of zero-emission vehicles (ZEVs). The Executive Order sets a target for the number of 1.5 million ZEVs in California by 2025. Also the Executive Order sets as a target for 2050 a reduction of GHG emissions from the transportation sector equaling 80 percent less than 1990 levels.
November 14, 2008	S-13-08	EO-S-13-08 directs State agencies to plan for sea level rise and climate impacts through coordination of the State Climate Adaptation Strategy.
January 18, 2007	S-01-07	EO-S-01-07 establishes the 2020 target and Low Carbon Fuel Standard. The EO directs the Secretary of Cal/EPA as coordinator of 2020 target activities and requires the Secretary to report back to the Governor and Legislature biannually on progress toward meeting the 2020 target.
October 18, 2006	S-20-06	EO-S-20-06 establishes responsibilities and roles of the Secretary of Cal/EPA and State agencies in climate change.
April 25, 2006	S-06-06	EO-S-06-06 directs Secretary of Cal/EPA to participate in the Bio-Energy Interagency Working Group and addresses biofuels and bioenergy from renewable resources.
June 1, 2005	S-03-05	EO-S-3-05 establishes greenhouse gas emission reduction targets, creates the Climate Action Team and directs the Secretary of Cal/EPA to coordinate efforts with meeting the targets with the heads of other State agencies. The EO requires the Secretary to report back to the Governor and Legislature biannually on progress toward meeting the GHG targets, GHG impacts to California, Mitigation and Adaptation Plans.
December 14, 2004	S-20-04	EO-S-20-04 (Green Buildings) directs State agencies to reduce energy use in State owned buildings by 20% by 2015 and increase energy efficiency.

Source: (climatechange.ca.gov, 2017)

On October 1, 2015, CARB held the Kickoff Public Workshop for the next Scoping Plan update that will reflect the 2030 Target of reducing GHG emissions to 40% below 1990 levels by 2030. Achieving the 2030 target will be done by the continuation of programs established to reach the previously set 2020 GHG emissions reduction target. At the Workshop CARB staff gave slide presentation that indicates achieving the 2030 Target will be accomplished by "continuation of programs established to reach the 2020 GHG emissions reduction target" including:

- Cap-and-Trade Program;
- Low Carbon Fuel Standard;
- Renewable Portfolio Standard;
- Advanced Clean Cars Program;
- Zero Emission Vehicles (ZEV) Program;
- Sustainable Freight Strategy;
- Short-Lived Climate Pollutant Strategy; and
- SB 375 Sustainable Communities Strategy.

Measures that will be developed to reduce GHG emissions are planned for development as follows:

- Governor's Office pillars framework including:
  - Reduce petroleum use;
  - Increase renewable electricity;
  - Increase building energy efficiency;
  - Reduce short-lived climate pollutants; and
  - Ensure natural/working lands are carbon sink.
- Sector oriented measures.
- Maximize GHG reductions across all areas and realize co-benefits at large industrial sources.
- Multi-agency collaborative process.
- Stakeholder input through public workshops with formal and informal comment periods.

On March 23, 2017, CARB adopted the Short-Lived Climate Pollutant Reduction Strategy. The Strategy states:

> *The only practical way to rapidly reduce the impacts of climate change is to employ strategies built on the tremendous body of science. The science unequivocally underscores the need to immediately reduce emissions of Short-Lived Climate Pollutants (SLCPs), which include black carbon (soot), methane (CH_4), and fluorinated gases (F-gases, including hydrofluorocarbons, or HFCs). They are powerful climate forcers and dangerous air pollutants that remain in the atmosphere for a much shorter period of time than longer-lived climate pollutants, such as CO_2, and are estimated to be responsible for about 40 percent of current net climate forcing. While the climate impacts of CO_2 reductions take decades or more to materialize, cutting*

emissions of SLCPs can immediately slow global warming and reduce the impacts of climate change.

Control measures included in the SLCP Reduction Strategy are as follows:

- Carbon black (non-forest) measures:
  - Residential fireplace and woodstove conversion.
  - Sustainable freight strategy State Implementation Plans clean energy goals.
- Methane reduction measures:
  - Dairy manure management.
  - Dairy and livestock enteric fermentation.
  - Landfill gas management.
  - Oil and gas production, processing and storage.
  - Wastewater, industrial and other sources.
- Fluorinated gas reduction measures:
  - Financial incentive for low-GWP refrigeration early adoption.
  - HFC supply phasedown.
  - Sales ban of very-high GWP refrigerants.
  - Prohibition on new equipment with high-GWP compounds.

5.1.4 Sacramento Metropolitan Air Quality Management District

A review of the SMAQMD rules and regulations relating to greenhouse gas emissions revealed Rule 250 – Sacramento Carbon Exchange Program (Adopted 3/25/2010) which provides an administrative mechanism for quantifying, certifying, issuing, and tracking high quality carbon credits from emission reduction activities that occur in the SMAQMD. Rule 250 applies to persons who submit a project plan to voluntarily reduce GHG emissions within Sacramento County; or who may own, purchase, sell, trade, or retire carbon credits created under the rule. Rule 350 provides a mechanism for SMAQMD to collect Program fees for reviewing project plans and other administrative tasks that are required by the Program.

In addition, the SMAQMD Climate Change Protection Program was adopted in 2006 to provide outreach and education, data analysis and research, and support for local, regional, state, and federal initiatives to address climate change. Efforts focus on both reducing greenhouse gas emissions as well as helping the Sacramento region to prepare for the effects of climate change.

Lastly, the GHG section of the SMAQMD CEQA Guide was updated December 2016 and used in preparing this impact assessment.

5.1.5 Sacramento County

In 2011, the Board of Supervisors adopted an updated General Plan (2030 General Plan, 2011). Key changes from the previous General Plan include a new growth management strategy, a stronger focus on addressing existing communities and revitalizing aging commercial corridors, a new Economic Development Element, and strategies to reduce greenhouse gas emissions consistent with State law.

Concurrently, the Board of Supervisors adopted a Climate Action Plan - Strategy and Framework Document (CAP, 2011) which presents a framework for reducing GHG emissions and an overall strategy to address climate change. Additionally, it provids direction for developing the second phase of the CAP.

2030 General Plan

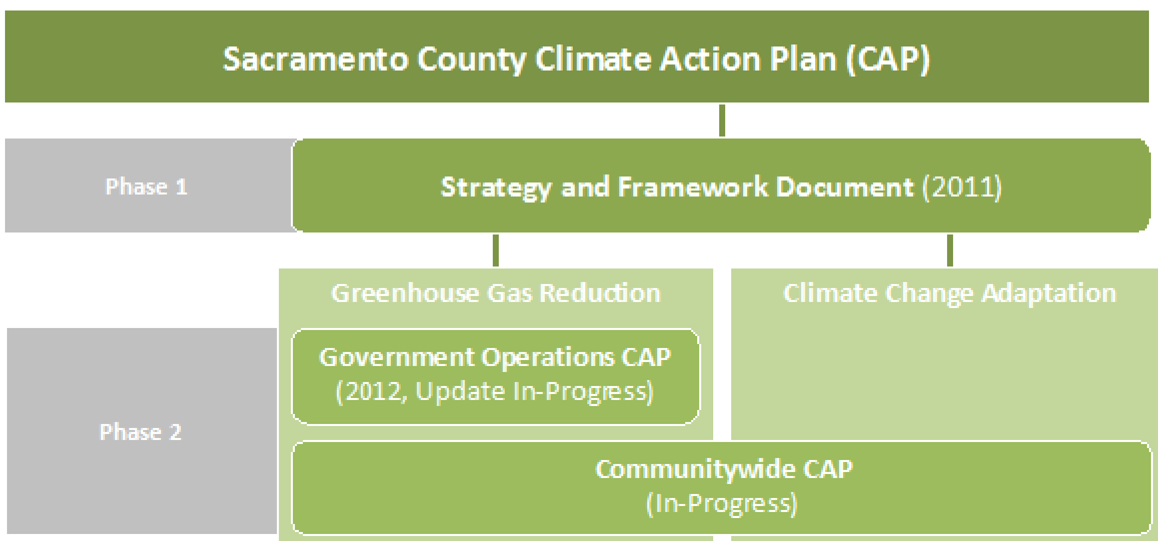
The 2030 General Plan contains climate change related policies and implementation measures within each element of the Plan (i.e., as opposed to creating a separate climate change element).

General Plan Element	Strategy (S) / Policy (P) / Implementation Measure (IM)
Air Quality	P-AQ-22. Reduce greenhouse gas emissions from County operations as well as private development. IM-22J. Implement a program that will reduce greenhouse gas emissions from County operations, the current built environment and future development in compliance with the California Global Warming Solutions Act of 2006. IM-22K. Participate in research that examines the effects of climate change on human and natural systems in Sacramento County.
Conservation	P-CO-22. Support water management practices that are responsive to the impacts of Global Climate Change such as groundwater banking and other water storage projects.
Housing	S-I-C: Use of Infill and Underutilized Sites
Land Use	P-LU-28. Encourage the development of energy-efficient buildings and communities. P-LU-29. Promote voluntary participation in incentive programs to increase the use of solar photovoltaic systems in new and existing residential, commercial, institutional, and public buildings. P-LU-30. Whenever feasible, incorporate energy-efficient site design, such as proper orientation to benefit from passive solar heating and cooling, into master planning efforts. P-LU-115 It is the goal of the County to reduce greenhouse gas emissions to 1990 levels by the year 2020. This shall be achieved through a mix of State and local action. IM-115F. Adopt by resolution a first-phase Climate Action Plan, concurrent with approval of the General Plan update. IM-115G. Complete a GHG emissions inventory every three years to track progress with meeting emission reduction targets. IM-115H. Prepare for the Board of Supervisors' consideration a second-phase Climate Action Plan as soon as possible, but no longer than three years after adoption of the General Plan update that includes economic analysis and detailed programs and performance measures, including timelines and the estimated amount of reduction expected from each measure. IM-115I. Enact and fund a Sustainability Program to provide ongoing oversight, monitoring and maintenance of the Climate Action Plan, including: preparation of the second-phase Climate Action Plan, updates to the GHG emissions inventory, and future updates to the first

General Plan Element	Strategy (S) / Policy (P) / Implementation Measure (IM)
	and second-phase Climate Action Plan as necessary. The County shall develop sustainable funding sources for this Program and associated activities, which may include a fee assessed for development projects. IM-115J. Update the Energy Element and/or the Public Facilities Element of the General Plan to include policies related to alternative energy production within the County, which may include a General Plan Land Use Diagram overlay designation reflecting prime or allowable areas for alternative energy production (such as solar or wind farms).

Climate Action Plans

The State has passed legislation, including the Global Warming Solutions Act of 2006 (AB 32), requiring GHG emissions to be reduced. In 2009, Sacramento County began a multi-phase Climate Action Plan (CAP) to meet the State's targets for GHG reductions. The components of the multi-phase CAP are illustrated below.



Phase 1

The CAP describes actions that the County has already taken or could take in the future to reduce GHG emissions and adapt to a changing climate, while being more resource efficient, saving energy and money, and creating jobs. In addition, most of the actions provide important co-benefits such as improved air and water quality and public health. Actions are presented for five sectors, shown in below with corresponding goals for each sector.

Table 34 2011 CAP Actions to Address Climate Change

Transportation and Land Use	• Increase the average fuel efficiency of County-owned vehicles powered by gasoline and diesel and encourage increased fuel efficiency in community vehicles. • Increase use of alternative and lower carbon fuels in the County vehicle fleet and facilitate their use in the community. • Reduce total vehicle miles traveled per capita in the community and the region.
Energy	• Improve energy efficiency of existing and new buildings in the unincorporated County. • Improve energy efficiency of County infrastructure operation (roads, water, waste, buildings, etc). • Decrease use of fossil fuels by transitioning to renewable energy sources.
Water	• Achieve 20% reduction in per capita water use levels by 2020. • Emphasize water use efficiency as a way to reduce energy consumption. • Increase energy efficiency related to water system management. • Strive to reduce uncertainties in water reliability and quality by increasing the flexibility of the water allocation and distribution system to respond to drought conditions and encouraging redundancy in water storage, supply, and treatment systems. • Elevate the importance of floodplain and open space protection as a means of protecting water quality and habitat, sequestering carbon, and providing groundwater recharge opportunities.
Waste Management and Recycling	• Promote reduction in consumption. • Maximize waste diversion, composting, and recycling through expanding residential and commercial programs. • Reduce methane emissions at Kiefer Landfill.
Agriculture and Open Space	• Protect important farmlands, rangelands and open space from conversion and encroachment and maintain connectivity of protected areas. • Educate the local agricultural community about the impacts of climate change and support efforts to promote sustainable practices. • Promote water conservation to ensure reliable and sufficient water supplies for crop irrigation and livestock needs. • Implement policies and programs which increase demand for locally grown and processed agricultural commodities. • Achieve a net gain in the size, health, and diversity of protected open space and the local urban forest, encouraging native species wherever practical. • Ensure community understanding of and appreciation for open space, parks, and trees both as a vital part of the region's character and as a greenhouse gas-reduction strategy.

Phase 2

Government Operations

In 2012, the Board of Supervisors adopted the Climate Action Plan – Government Operations (GO-CAP, 2012) on September 11, 2012. The GO-CAP identifies the GHG emissions from the County's operations (i.e. County-owned facilities, vehicles, and equipment) and measures to reduce those GHG emissions. As part of the current Communitywide CAP project, the County will update the inventory of GHG emission from the County's operations, review the status of the measures identified in the current GO-CAP; and revise the measures, or propose new measures, as needed.

Communitywide

The County is currently working on the Climate Action Plan – Communitywide Greenhouse Gas Reduction and Climate Change Adaptation (Communitywide CAP) project which will complete the second phase of the County's multi-phase CAP process. The Communitywide CAP will use the process recommended by Cool California, in order to update the unincorporated County's GHG inventory and forecasts; determine the GHG reduction targets which are required; and propose measures to achieve the required GHG reductions for the entire County.

Additionally, to prepare for climate change impacts (e.g. impacts related to precipitation, flooding, heat waves, wildfires, air quality, water supply, water quality, natural ecosystems, and agriculture), the Communitywide CAP will use the process identified by California Climate Adaptation Planning Guide including preparation of the Climate Change Vulnerability Assessment (2017) and development of an adaptation strategy which has yet to be completed.

5.2 Environmental Setting

Climate change refers to global changes in the average weather of the Earth measured by changes in wind patterns, storms, precipitation, and temperature. While climate change is global in scale, California-specific impacts to the climate may result in a loss of snow-pack, increased risk of large wildfires, and a potential reduction in the quality and quantity of certain agricultural products.

Gases that trap heat in the atmosphere are GHGs, analogous to the way a greenhouse retains heat. Consequently, these GHG emissions are believed to directly affect the global climate.

5.2.1 Effects Attributed to GHG Emissions

The most recent GHG policy document issued by CARB is the next Scoping Plan update published in draft on January 20, 2017 (The 2017 Climate Change Scoping Plan Update). This document reports updates findings in the field of climate science since the last Scoping Plan update and is the source of the quoted text below (footnotes omitted, see https://www.arb.ca.gov/cc/scopingplan/2030sp_pp_final.pdf for a complete copy).

> *"Climate scientists agree that global warming trends and other shifts in the climate system observed over the past century are caused by human activities. These changes are proceeding at an unprecedented rate when compared with climate change that human society has lived through to date. According to new research, unabated GHG emissions could allow sea levels to*

rise close to two meters in total (more than six feet) by the end of this century—nearly twice as much as previously predicted—an outcome that could devastate coastal communities in California and around the globe.

California is already feeling the effects of climate change, and projections show that these effects will continue and worsen over the coming centuries. The impacts of climate change have been reported by the Office of Environmental Health Hazard Assessment (OEHHA) in the climate change indicators report, which reports the following changes occurring already:

- *A recorded increase in annual average temperatures, as well as increases in daily minimum and maximum temperatures,*
- *An increase in the occurrence of extreme events, including wildfire and heat waves,*
- *A reduction in spring runoff volumes, as a result of declining snowpack,*
- *A decrease in winter chill hours, necessary for the production of high-value fruit and nut crops, and*
- *Changes in the timing and location of species sightings, including migration upslope of flora and fauna, and earlier appearance of Central Valley butterflies.*

In addition to these trends, the State's current conditions point to a changing climate. California is in the middle of an historic drought. Recent scientific studies show that such extreme drought conditions are more likely to occur under a changing climate. The total statewide economic cost of the 2013–2014 drought was estimated at $2.2 billion, with a total loss of 17,100 jobs. In the Central Valley, the current drought has cost California agriculture about $2.7 billion and more than 20,000 jobs in 2015, which highlights the critical need for developing drought resilience, even if wet conditions mitigate the current drought. Drought affects other sectors as well. An analysis of the amount of water consumed in meeting California's energy needs between 1990 and 2012 shows that while California's energy policies have supported climate mitigation efforts, they have increased vulnerability to climate impacts, especially greater hydrologic uncertainty.

California has always been drought-prone, but the severity of this current drought (2013 was the driest year on record for the State, 2014 was the fourth driest, while 2015 was the warmest year on record) have led many to wonder whether global warming may be a contributing factor. Hence, several recent publications carefully examined the potential role of climate change in the California drought. One study examined both precipitation and runoff in the Sacramento and San Joaquin River basins, and found that 10 of the past 14 years have been below normal, and the past three years have been the driest and hottest in the full instrumental record from 1895 through November 2014. In another study, the authors show that the increasing co-occurrence of dry years with warm years raises the risk of drought, highlighting the critical role of elevated temperatures in altering water availability and increasing overall drought intensity and impact. Generally, there is growing risk of unprecedented drought in the western United States driven primarily by rising temperatures, regardless of whether or not there is a clear precipitation trend.

According to the U.S. Forest Service report, National Insect and Disease Forest Risk Assessment, 2013–2027 (Krist et al. 2012), California is at risk of losing at least 25 percent of standing live forest due to insects and disease over 5.7 million acres, or 12 percent of the total forested area in the State. Some species are expected to lose significant amounts of their total basal area (i.e., whitebark pine is projected to lose 60 percent of its basal area; lodgepole pine, 40 percent). While future climate change is not modeled within the risk assessment, and current drought conditions are not accounted for in these estimates, the projected climate changes over the next 15 years are expected to increase significantly the number of acres at risk, and will increase the risk from already highly destructive pests such as the mountain pine beetle. Extensive tree mortality is already prevalent in California. The western pine beetle and other bark beetles have killed a majority of the ponderosa pine in the foothills of the central and southern Sierra Nevada Mountains. A recent aerial survey by the U.S. Forest Service identified more than 100 million dead trees in California. As there is usually a lag time between drought years and tree mortality, we are now beginning to see a sharp rise in mortality from the past four years of drought. In response to the very high levels of tree mortality, Governor Brown issued an Emergency Proclamation on October 30, 2015.

A warming climate also causes sea level to rise; first, by warming the oceans which causes the water to expand, and second, by melting land ice which transfers water to the ocean. Even if storms do not become more intense and/or frequent, sea level rise itself will magnify the adverse impact of any storm surge and high waves on the California coast. Some observational studies report that the largest waves are already getting higher and winds are getting stronger. The ocean is also changing as temperatures warm and GHG concentrations increase. Carbon dioxide is dissolving in the ocean, making it more acidic. More acidic ocean water affects a wide variety of marine species, including species that people use for food. This fundamental change is likely to have substantial ecological and economic consequences in California and worldwide.

A growing body of scientific evidence also shows that healthy tropical forests are central to solving climate change, as tropical forests exchange large amounts of water and energy with the atmosphere (affecting atmospheric rivers), controlling regional and global climate. Atmospheric rivers are relatively narrow regions in the atmosphere that are responsible for most of the horizontal transport of water vapor outside of the tropics. Deforestation and climate change have the capacity to alter rainfall regimes, water availability, and surface-atmosphere flux of water and energy of tropical forests. Between 2010 and 2015, despite some successful efforts at reducing the global rate of deforestation, trends continued to show losses of upwards of 6.6 million hectares per year, mainly from loss of natural forests in the tropics. Tropical deforestation accounts for about 15 percent of global GHG emissions—larger than the entire global transportation sector. Preserving tropical forests will help meet the aggressive global emissions reduction targets necessary to avoid catastrophic climate change and may help to preserve California's historical rainfall patterns.

While more intense dry periods are anticipated under warmer conditions, extremes on the wet end of the spectrum are also expected to increase, due to more frequent warm, wet atmospheric river events and a higher proportion of precipitation falling as rain instead of snow. In recent years, atmospheric rivers have also been recognized as the cause of the large majority of major floods in rivers all along the U.S. West Coast and as the source of 30–50 percent of all precipitation in the same region. These extreme precipitation events, together with the rising snowline, often cause devastating floods in major river basins (e.g., California's Russian River). It was estimated that the top 50 observed floods in the U.S. Pacific Northwest were due to atmospheric rivers. Looking ahead, computer models predict that climate change will cause the very worst atmospheric river storms hitting California to become much more frequent and larger.

Sea level rise, droughts, floods, and forest impacts are just some of the environmental systems disrupted by climate change. As GHG emissions continue to accumulate and climate disruption grows, such destructive events will become more frequent. The historical record, which once set our expectations for the traditional range of weather and other natural events, is becoming an increasingly unreliable predictor of the conditions we will face in the future. Climate disruption can drive extreme weather events such as coastal storm surges, drought, wildfires, floods, and heat waves….

Together, current conditions and future projections provide a picture of California's changing climate, with two important messages:

- *Change is already being experienced and documented across California, and some of these changes have been directly linked to changing climatic conditions.*
- *Even with the uncertainty in future climate conditions, every scenario estimates further change in future conditions." (CARB, 2017)*.

5.2.2 Emissions Inventories

CARB and the County each have emissions inventories of GHG for their respective jurisdictions. Each is discussed below followed by Table 35 which presents a side-by-side summary of emissions by source category for both inventories.

CARB's most recent GHG emission inventory, the 2016 Edition, tracks the emissions of seven GHGs identified in the California Health and Safety Code for years 2000 to 2014. In 2014, total GHG emissions were 441.5 $MMTCO_2e$, a decrease of 2.8 $MMTCO_2e$ compared to 2013. This represents an overall decrease of 9.4% since peak levels in 2004. During the 2000 to 2014 period, per capita GHG emissions in California dropped from a peak in 2001 of 13.9 tonnes per person to 11.4 tonnes per person in 2014; an 18% decrease. Overall trends in the inventory also demonstrate that the carbon intensity of California's economy (the amount of carbon pollution per million dollars of gross domestic product (GDP)) is declining, representing a 28% decline since the 2001 peak, while the State's GDP has grown 28% during this period (Trend Report, 2016, p. 1).

The transportation sector remains the largest source of GHG emissions in the State, accounting for 36% of the inventory, and shows a small increase in emissions in 2014. Emissions from the electricity sector continue to decline due to growing zero-GHG energy generation sources. Emissions from the remaining sectors have remained relatively constant, although emissions from high-GWP gases have continued to climb as they replace ozone depleting substances banned under the Montreal Protocol (Trend Report, 2016, p. 2).

The County has prepared GHG inventories for 2005 and 2015 for sources within the unincorporated areas as well as it's own operations. Table 35 presents the most recent GHG emissions inventories and BAU projections published by CARB and the County.

Table 35 State and County GHG Inventories

Sector/Activity	2014 Statewide ($MMTCO_2e$ / yr)	2020 Statewide BAU ($MMTCO_2e$ / yr)	2030 Statewide Proposed BAU Ranges ($MMTCO_2e$ / yr)	2015 Sacramento County ($MMTCO_2e$ / yr)	2020 Sacramento County BAU ($MMTCO_2e$ / yr)	2030 Sacramento County BAU ($MMTCO_2e$ / yr)
Electricity	88.24	57.3	42 – 62	1.394658	1.479479	1.667427
Transportation	159.53	185.3	103 – 111	1.868365	1.981996	2.233783
Industrial (fuel, water)	93.32	93.7	77 – 87	0.046068	0.048870	0.055078
Commercial (fuel)	14.61	17.9	38 – 40	0.208479	0.221158	0.249254
Residential (fuel)	23.73	31.7		0.477183	0.506204	0.570511
Agriculture & Forestry	36.11	36.2	24 – 25	0.254899	0.270401	0.304753
High GWP	17.15	31.5	8 – 11	0.251085	0.266356	0.300193
Recycling and Waste	8.85	9.4	8 – 9	0.352909	0.374372	0.421932
Total	441.54	509.4	300 – 345	4.853646	5.148836	5.802930
Cap-and-Trade	n/d	n/d	40 – 85	n/d	n/d	n/d
Goal	n/d	431	260	n/d	4.337103[c]	3.252827[c]

Sources: (CARB, 2016), (CARB, 2014), (Ascent Environmental, 2016).

Notes: n/d = not determined.

[a] Electricity and natural gas related GHG emissions for industrial, commercial and residential are summed in the County inventory and presented for each type of land use accordingly.

[b] Water and wastewater related emissions are attributed to the industrial sector for comparison to the statewide inventory.

[c] Countywide 2020 and 2030 targets are estimated based on information in the Strategy and Framework Document (CAP, 2011).

5.3 Significance Thresholds

Determination of whether an impact is significant usually involves the comparison of Project impact levels to threshold criteria set by the lead agency. For air quality and GHG impacts, lead agencies often rely on guidance from a responsible agency (e.g., in this case, SMAQMD as discussed in Section 5.3.2).

5.3.1 CEQA Guidelines Appendix G

The Environmental Checklist Form in Appendix G of the CEQA Guidelines presents questions about projects that, if true for a particular project, would be considered a significant impact. This document considers the following Environmental Checklist Form questions to be the Significance Thresholds for GHG emissions from this Project.

Would the project:

a) *Generate GHG emissions, either directly or indirectly, that may have a significant impact on the environment?*

b) *Conflict with an applicable plan, policy or regulation adopted for the purpose of reducing the emissions of GHGs?*

5.3.2 Additional Threshold Criteria

Sacramento County

The CAP has yet to address community wide sources and currently does not apply to Project sources.

Sacramento Metropollitan AQMD

The SMAQMD CEQA Guidelines contain screening thresholds for construction and operation phase of a project and also differentiate between development and stationary source projects. Specifically the construction phase and development project operation screening levels are both 1,100 MTCO2e/yr. Stationary source facility operation phase screening level is 10,000 MTCO2e/yr. (CEQA Guide, 2016, p. 6.10).

If a project's emissions exceed the thresholds of significance, then the project emissions may have a cumulatively considerable contribution to a significant cumulative environmental impact, answering Appendix G's first GHG-related question on whether the project would generate GHG emissions, either directly or indirectly, that may have a significant impact on the environment. For projects that exceed the District's threshold of significance, lead agencies shall implement all feasible mitigation to reduce GHG emissions.

The second GHG-related question in Appendix G asks if the project will conflict with an applicable plan, policy or regulation adopted for the purpose of reducing the emissions of GHGs. In order to answer this question, project emissions should be evaluated with respect to consistency with the following plans and policies that have been adopted to reduce GHG emissions:

- A local jurisdiction's qualified climate action plan or GHG reduction plan,
- AB 32, SB 32 and the Scoping Plan,
- The Metropolitan Transportation Plan/Sustainable Communities Strategy (MTP/SCS), and
- Executive Order B-30-15 goals.

5.4 Methodology

5.4.1 CEQA Baseline

The Baseline condition includes excavation of materials at the Phase E site. The annual CO_2e emissions is calculated to be 2041 MT/yr as calculated in the 2008 FEIR (p. 16-16 and Appendix K-4).

5.4.2 Operation Phase

Equipment and activity levels for excavation in the Baseline and for the Project are presented in Section 4.4 above and the associated GHG emissions are summarized in Table 36 below. The activity level does not change but the OFFROAD model load factors were updated between the 2007 version used in the 2008 FEIR and the current 2011 version that is used in this report and results in lower GHG emissions. The Recycle Plant and RMC emissions were not included in the table as the overall production will be constant; an increase in emissions from these plants will mean a decrease in emissions from mining operations. Production of Recycled materials or RMC results in less emissions than mining (see Appendix H) so Table 36 represents a conservative scenario.

Table 36 Project Operation GHG Emissions

Equipment	Horsepower	Load Factor	Operating (hr/yr)	Activity (hp-hr/yr)	Fuell Use (gal/ yr)	CO_2e (MT/yr)
D9R CAT DOZER	450	0.43	1,248	241,488	12,571	129
140H CAT MOTOR GRADER	165	0.41	312	42,214	2,198	23
EX1200 HITACHI EXCAVATOR	625	0.38	2,496	592,800	30,859	316
988F CAT LOADER	425	0.36	2,496	381,888	19,880	204
988F CAT LOADER	425	0.36	2,496	381,888	19,880	204
R40-C EUCLID RIGID HAULER	525	0.38	2,097	418,352	21,778	223
R40-C EUCLID RIGID HAULER	525	0.38	2,097	418,352	21,778	223
357 PETERBILT WATER TRUCK	385	0.38	624	91,291	4,752	49
384 PETERBILT SERVICE TRUCK	190	0.38	312	22,526	1,173	12
TOTAL	n/a	n/a	n/a	2,590,798	134,869	1,381

Sources: 2008 FEIR Table AQ-3, p. 9-13 for equipment types, sizes, and hours of operation.
OFFROAD2011 for load factors, and brake specific fuel consumption (BSFC) of 0.367 lb fuel/hp-hr.
AP-42 for diesel fuel density of 7.05 lb/gal.
ARB 2014 GHG emissions inventory sector 1a2m_manufacturing_fuelcombustion_distillate for CO_2, CH_4, and N2O emissions factors and GWP.
Although the Project is continuation of operations described in the 2008 FEIR, the offroad haul truck activity is lower (2,097 hr/yr) than it was in the 2008 FEIR (2,496 hr/yr) because distance traveled is lower for the given Carli site geometry and Project features. The values presented reflect the maximum annual emissions from the haul trucks.
See also Appendix H for complete calculation details.

5.5 Project-Level Impacts and Mitigation Measures

5.5.1 Generate GHG Emissions That May Have a Significant Impact on the Environment

Impact Statement

Impact GHG-1: *Would the Project generate GHG emissions, either directly or indirectly, that may have a significant impact on the environment?* **(Appendix G Threshold Criteria (a)).**

Impact Analysis

Operational GHG emissions from a project should be calculated for the first full year of operations to compare to the GHG operational threshold of 1,100 metric tons per year. As shown above in Section 5.4 the 2008 FEIR calculated emissions of 2041.4 $MTCO_2e$/yr and the current methodology predicts emissions of 1,381 $MTCO_2e$/yr, which is a decrease of approximately 660 $MTCO_2e$/yr. This decrease in emissions of 32% is due to the updated load and emissions factors in CalEEMOD, as well as shorter trips than were previously assessed as determined by Carli site geometry and Project features. The 32% reduction is greater than the 25% "hard" mitigation that was required for the previous expansion (p.16-17, 2008 FEIR).

Level of Significance Before Mitigation

Less than significant.

Mitigation Measures

None required.

Level of Significance After Mitigation

Not applicable.

5.5.2 Conflict With an Applicable Plan, Policy or Regulation that Reduces GHGs

Impact Statement

Impact GHG-1: *Would the Project conflict with an applicable plan, policy or regulation adopted for the purpose of reducing the emissions of GHGs?* **(Appendix G Threshold Criteria (b)).**

Impact Analysis

Project emissions are evaluated with respect to consistency with the following plans and policies that have been adopted to reduce GHG emissions:

Plan/Policy	Consistent?
A local jurisdiction's qualified climate action plan or GHG reduction plan,	The community wide Climate Action Plan has yet to be adoped and there is no local plan with which to evaluate consistency. Therefore, the emissions from this Project can not conflict with a local plan and are determined to be consistent.
AB 32, SB 32 and the Scoping Plan,	The emissions are reduced by 32% from those calculated previously and in excess of the amount of "hard" mitigation that was required of 2008 FEIR in 2008 (i.e., 25%). Thus, the emissions are consistent with the current Scoping Plan and AB32.

Plan/Policy	Consistent?
The Metropolitan Transportation Plan/Sustainable Communities Strategy (MTP/SCS), and	The Project does not include off-site trips of light duty cars and trucks which are subject to the SCS. In addition, without the Project the SCS would likely result in greater emissions from infill development requiring construction materials to be delivered from mines farther from where construction is occurring. Thus, the Project is consistent with the MTP/SCS.
Executive Order B-30-15 goals.	The Project is consistent with the Executive Order B-30-15 goals which apply to the fuel and electricity sectors as a whole. The fuels and electricity used by the Project would be subject to the cap-and-trade program as well as other Scoping Plan and related control measures (e.g., renewable energy portfolio, low carbon fuel standard) that are applied higher up in the supply chain. There is no plan, policy or regulation adopted for the purpose of reducing emissions of GHGs specifically from mining projects. Thus, the sources that are affected by such plans and policies would be consistent with those plans, policies, and/or regulations by virtue of using fuels and electricity that has been produced for consumption within California.

Level of Significance Before Mitigation

Less than significant.

Mitigation Measures

None required.

Level of Significance After Mitigation

Not applicable.

6.0 ACRONYMS

AADT	average annual daily trips
AAQS	Ambient Air Quality Standards
AB	Assembly Bill
ADJ_U*	adjusted friction velocity
ADL	annual dermal load
AERMET	AERMOD Meteorological Processor
AERMOD	American Meteorological Society/Environmental Protection Agency Regulatory Model
APCO	Air Pollution Control Officer
AQCCIA	Air Quality and Climate Change Impact Assessment
ASF	age sensitivity factors
ATCM	airborne toxic control measure
ATS	American Thoracic Society
BACM	best available control measure
BACT	best available control technology
BAU	business-as-usual
BPS	best performance standard
BR	breathing rate
BW	body weight
CAAA	Clean Air Act Amendments
CAAQS	California ambient air quality standards
CAFE	corporate average fuel economy
CalEPA	California Environmental Protection Agency
CAP	climate action plan
CAPCOA	California Air Pollution Control Officers Association
CAT	Climate Action Team
CBE	Communities for a Better Environment
CCAA	California Clean Air Act
CDFW	California Department of Fish and Wildlife
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
CPF	cancer potentcy factor
CPUC	California Public Utility Commission
CUPA	Certified Unified Permitting Agency
DPM	Diesel particulate matter
DWR	Department of Water Resources
FAH	fraction of time at home
FED	functionally equivalent document
FPMP	fugitive PM_{10} management plan
g/dscm	grams per dry standard cubic meter
GAMAQI	Guidance for Assessing and Mitigating Air Quality Impacts
GLC	ground level concentration

GM	geometric mean
GRAF	gastrointestinal relative absorption fraction
gr/dscf	grains per dry standard cubic feet
GWP	global warming potential
HARP2	Hot Spots Analysis and Reporting Program
HFC	hydrofluorocarbon
HI	hazard index
hp	horsepower
HQ	hazard quotient
IPCC	International Panel on Climate Change
LNG	liquefied natural gas
LPG	liquefied petroleum gas
LOAEL	lowest observed adverse effects level
MACT	maximum achievable control technology
MEIR	maximum exposed individual receptor
MEIW	maximum exposed individual worker
MPO	metropolitan planning organizations
MT	metric tonnes
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NMHC	non-methane hydrocarbons
N_2O	nitrous oxide
NO_2	nitrogen dioxide
NO_X	oxides of nitrogen
NOAEL	no observerd adverse effects level
NSPS	New Source Performance Standards
NSR	New Source Review
NHTSA	National Highway Traffic Safety Administration
O_3	Ozone
OEHHA	Office of Environmental Health Hazard Assessment
OPR	Governor's Office of Planning and Research
Pb	Lead
PCC	Portland cement concrete
PERP	Portable Equipment Registration Program
PFC	perfluorocarbon
PM	Particulate matter
PM_{10}	PM with aerodynamic diameter less than 10 microns
$PM_{2.5}$	PM with aerodynamic diameter less than 2.5 microns
PMI	point of maximum impact
RACM	reasonably available control measure
RCS	respirable crystalline silica
REL	reference exposure level
RICE	reciprocating internal combustion engine
SB	Senate Bill
SF_6	sulfur hexafluoride
SIP	state implementation plan
SMAQMD	Sacramento Metropolitan Air Quality Management District
SO_2	sulfur dioxide
SVAB	Sacramento Valley Air Basin

TAC	toxic air contaminant
TCAG	Sacramento County Association of Governments
tpy	tons per year
TVP	true vapor pressure
U.S.	United States
US EPA	United States Environmental Protection Agency
VDE	visible dust emissions
VMT	vehicle miles traveled
VOC	volatile organic compounds
WAF	worker adjustment factor
WRCC	Western Regional Climate Center

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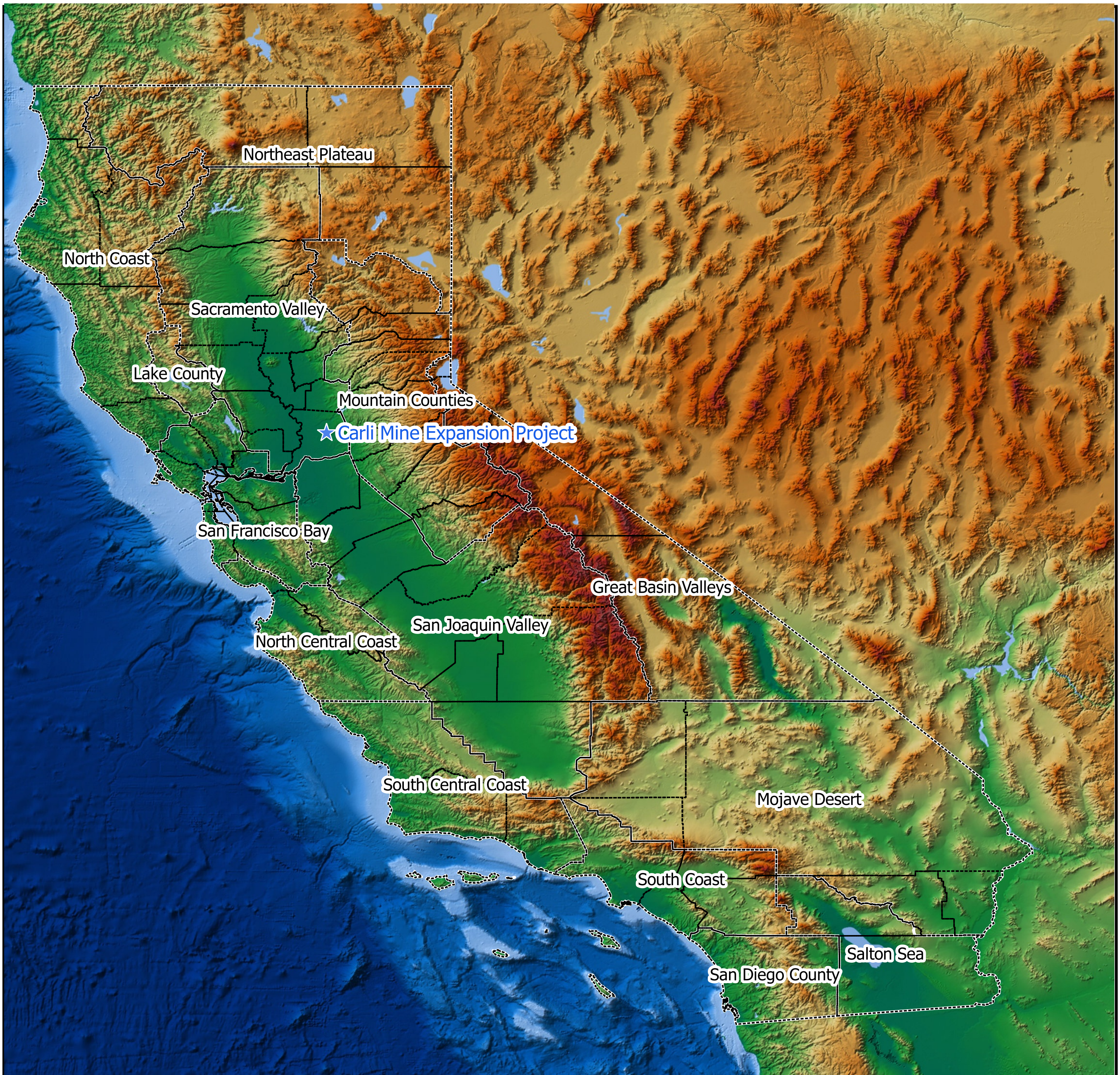
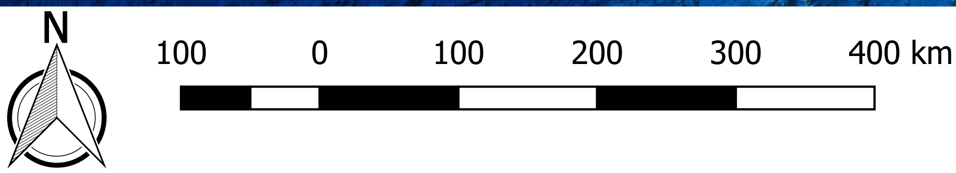
APPENDIX A

FIGURES





SESPE CONSULTING, INC.

FIGURE 1	Site Location, Air Basin, and County Boundaries Map Sacramento Aggregates Carli Expansion 11501 Florin Road Sacramento County, CA 95830		
PROJECT #:	VU01.16.68	DATE:	3/17/2017
SCALE:	as shown	DRAWN BY:	SDC

N

SESPE CONSULTING, INC.

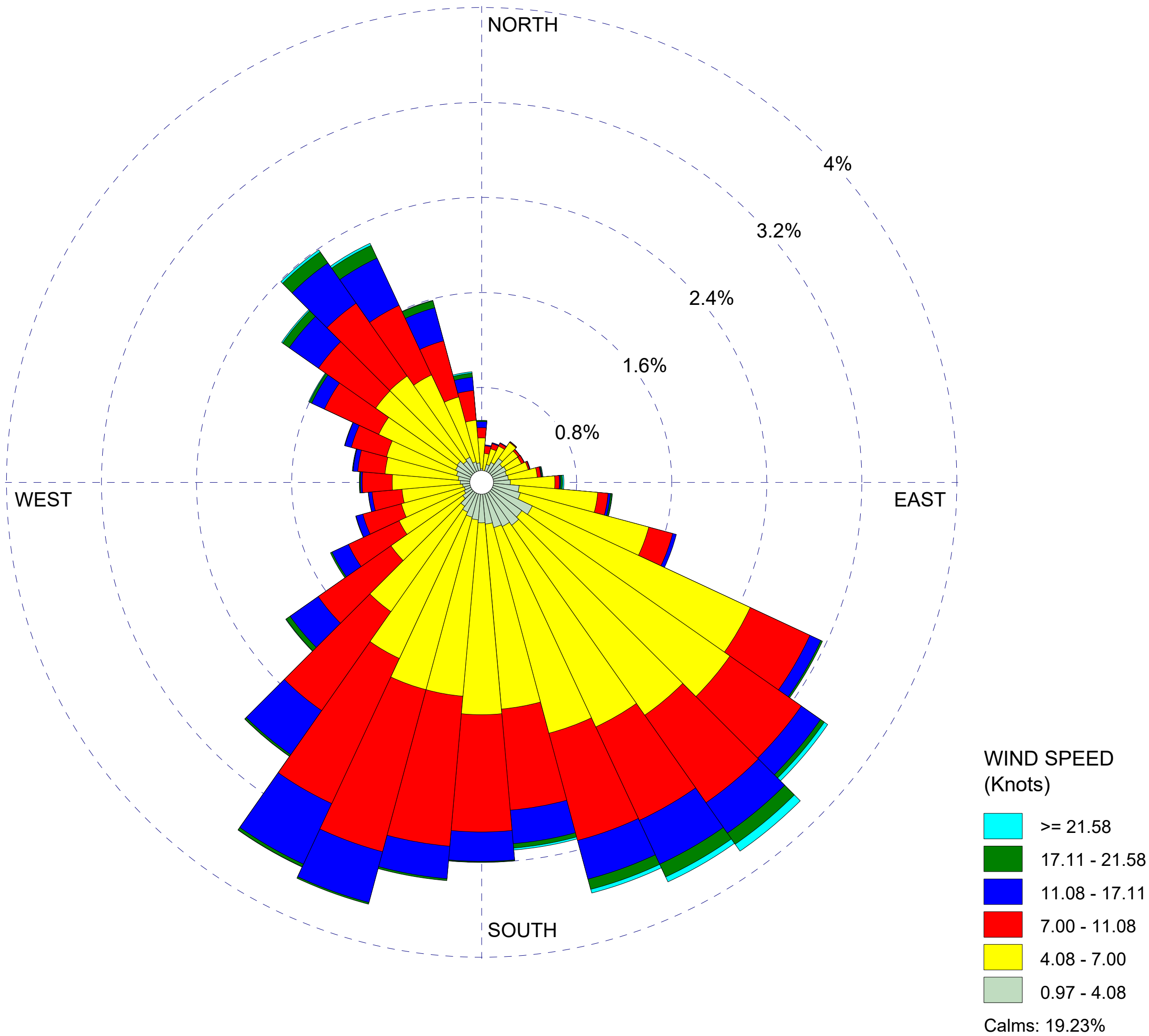
FIGURE	Site Plan Sacramento Aggregates Carli 11501 Florin Road Sacramento County, CA 95830		
2			
PROJECT #:	VU01.16.68	DATE:	3/13/17
SCALE:	not determined	DRAWN BY:	SDC

WIND ROSE PLOT:

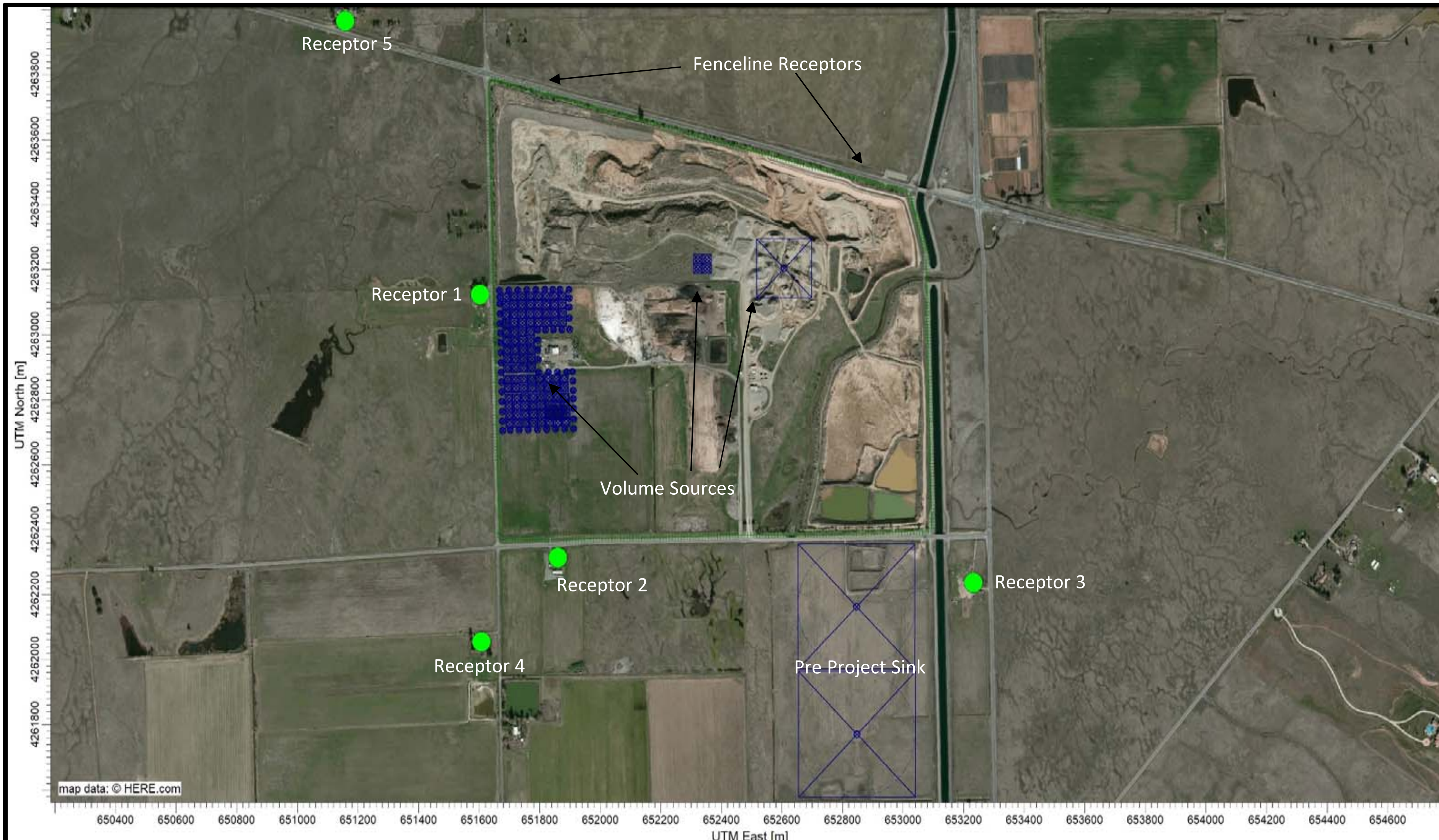
Station #23206

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 1/1/2009 - 00:00 **End Date: 1/2/2014 - 23:59**	SESPE CONSULTING INC.	
		MODELER: ADA	Figure 3
	CALM WINDS: **19.23%**	TOTAL COUNT: **36606 hrs.**	
	AVG. WIND SPEED: **5.48 Knots**	DATE: **3/2/2017**	PROJECT NO.: VU01.16.68



N

SESPE CONSULTING, INC.

FIGURE 4	Sources, Receptors: Project Year 0 - 2 Carli Expansion Project 11501 Florin Road, Sacramento CA		
PROJECT #:	VU01.16.68	DATE:	6/11/18
SCALE:	Shown	DRAWN BY:	ADA

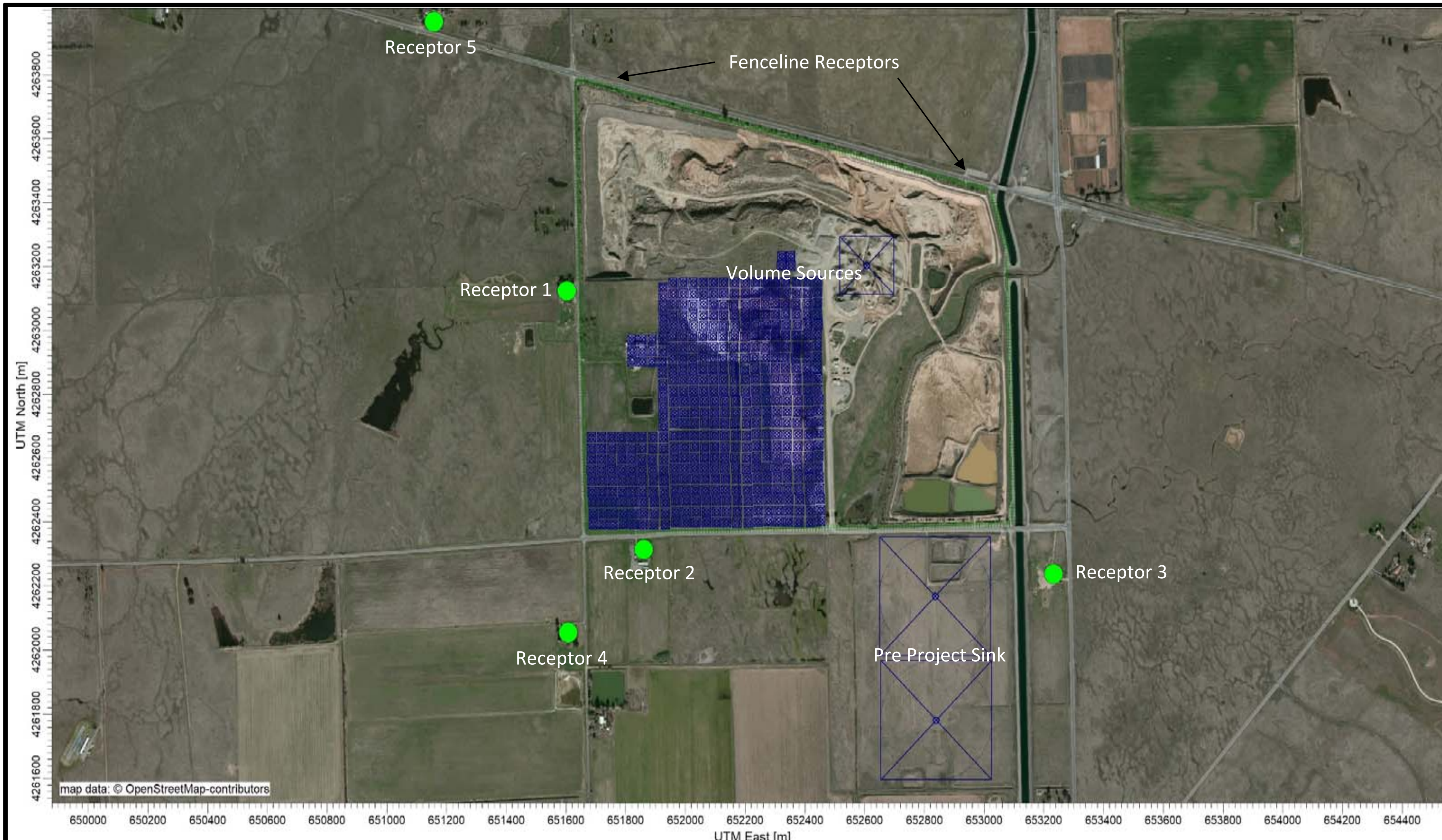
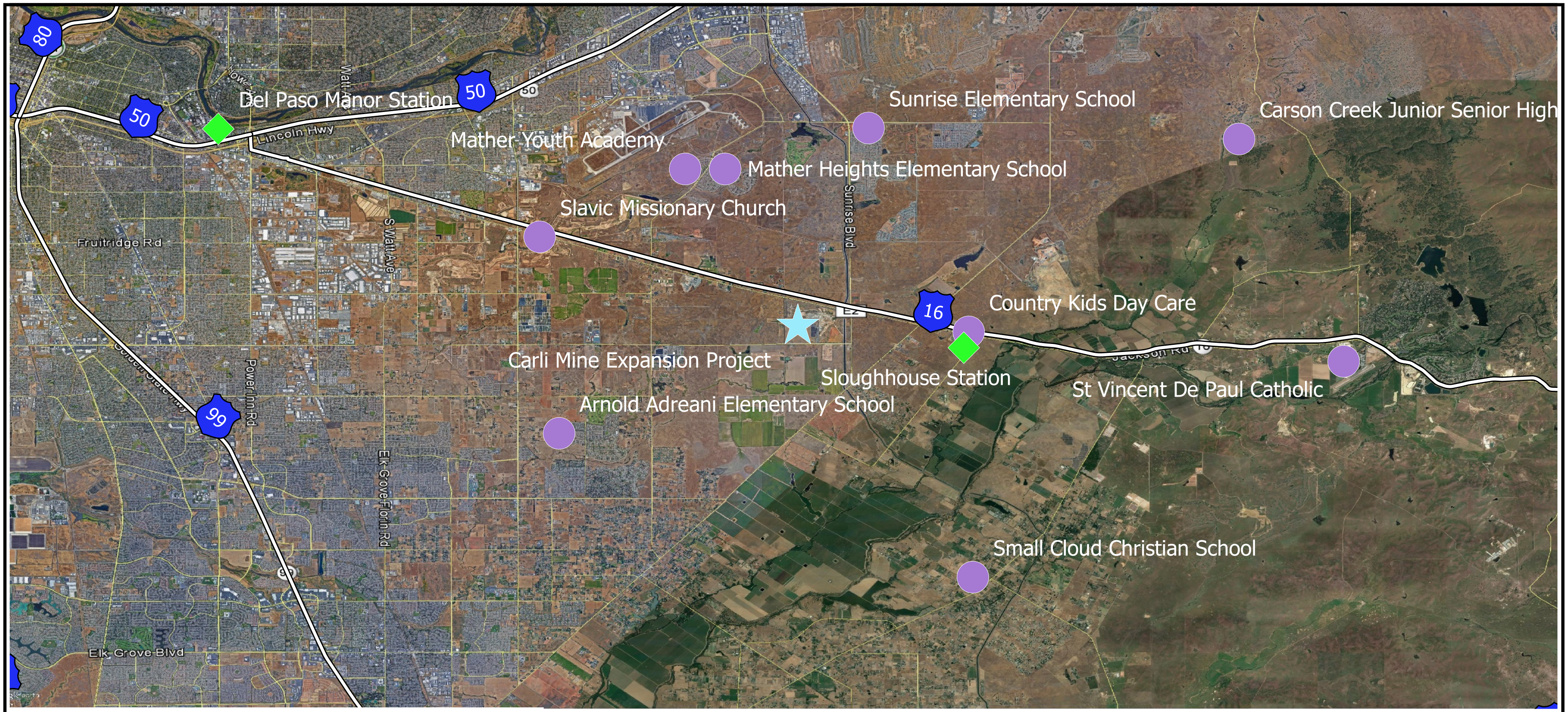


FIGURE	**Sources, Receptors: Project Year 3+**		
5	Carli Expansion Project 11501 Florin Road, Sacramento CA		
PROJECT #:	VU01.16.68	DATE:	6/11/18
SCALE:	Shown	DRAWN BY:	ADA

SESPE CONSULTING, INC.



Legend

- Sunrise Elementary School
- St Vincent De Paul Catholic
- Small Cloud Christian School
- Sloughhouse Station
- Slavic Missionary Church
- Mather Youth Academy
- Mather Heights Elementary School
- Del Paso Manor Station
- Country Kids Day Care
- Carson Creek Junior Senior High School
- Carli Mine Expansion Project
- Arnold Adreani Elementary School

2.5 0 2.5 5 7.5 10 km

N

SESPE CONSULTING, INC.

FIGURE 6	Vicinity Map Sacramento Aggregates Carli Expansion 11501 Florin Road Sacramento County, CA 95830		
PROJECT #:	VU01.16.68	DATE:	3/17/2017
SCALE:	as shown	DRAWN BY:	SDC

APPENDIX B

ECONOMICS OF CONSTRUCTION AGGREGATES

DEPARTMENT OF AGRICULTURAL AND RESOURCE ECONOMICS AND POLICY
DIVISION OF AGRICULTURE AND NATURAL RESOURCES
UNIVERSITY OF CALIFORNIA AT BERKELEY

WORKING PAPER NO. 994

A NOTE ON THE ENVIRONMENTAL COSTS OF AGGREGATES

by

Peter Berck

California Agricultural Experiment Station
Giannini Foundation of Agricultural Economics
January 2005

A Note on the Environmental Costs of Aggregates

by Peter Berck*
January 10, 2005

Abstract:

The opening of a new site for the production of aggregates has both direct and indirect impacts on the environment. The indirect impacts include changes in the environmental costs of hauling aggregates and possible changes in the level of construction activity. In this note, we show that the most likely effect of a new aggregate site is to reduce the truck miles used for aggregate hauling, which is an environmental benefit. We also show that the change in construction activity induced by a new site is likely to be extremely small.

* Peter Berck is Professor of Agricultural and Resource Economics. I would like to thank Atanu Dey for able research assistance. The remaining errors are mine.

A Note on the Environmental Costs of Aggregates

The opening of a new quarry for aggregates will change the pattern of transportation of aggregates in the area served by the quarry. In this note, we will show that, so long as aggregate producers are cost minimizing, the new pattern of transportation requires less truck transport than the pattern of transportation that existed before the opening of the new quarry. Since the costs of providing aggregates falls, it is reasonable to assume that the price of delivered aggregates also will fall. This note also shows that the demand expansion effect is of very small magnitude. Since the demand increase from a new quarry is quite small, the dominant effect is that the quarries are on average closer to the users of aggregates and, as a result, the truck mileage for aggregate hauling decreases. To summarize the effects of a new quarry project:

> a) The project in itself will not significantly increase the demand for construction materials in the region through market forces, which include the downward pressure on pricing.
>
> b) Truck traffic (i.e. vehicle miles traveled) in the region will not increase and may decrease as a result of the project.

As a result, the effect of a new quarry project will be to reduce the air emissions from aggregate trucking. The reduction in emissions should be included as a positive impact of a quarry project in any analysis of the environmental consequences of a new quarry.

The remainder of this note provides a brief description of the economics of construction materials and explains why these points must be true.

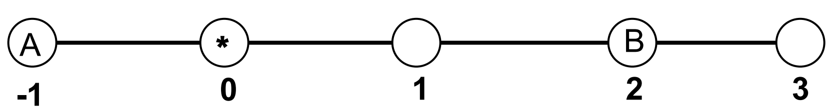
Based upon the available evidence, a project would decrease haul distances for aggregates and would therefore decrease emissions from trucks, rather than increase them.

There are two economic facts that are important to understand in evaluating the likely addition or subtraction to truck traffic from a new quarry. One is the economics of location. The second is the demand for aggregates, which is the quantity of aggregates used as a function of price.

That a new site leads to smaller haul distance is a matter of geometry and economics. Transportation is a major element in the cost of delivered aggregate, so new sites are chosen, within the limits placed by the natural availability of aggregates, to minimize transport costs.

An example should make this fact clear. Consider diagram 1. Circles represent aggregate-using projects of equal size. The five projects shown are located at miles marked –1, 0, 1, 2, and 3. Two of the project sites are marked with the letters A and B, and they are potential locations for aggregate production. The location at mile 0 is an existing aggregate production site and it is marked by an asterisk (*). The scale is in miles. For simplicity, each project uses one unit of aggregate.

Diagram 1



With only one aggregate production site at mile 0, the miles traveled to supply the five projects is seven: zero miles for project at mile 0, one mile for each for the projects at mile –1 and 1, two miles for the project at 2 and three miles for the project at 3 for a total of 7 miles. If an additional aggregate production site is started at A, the miles traveled decreases to six, because there is no transportation required for the aggregate-using project at A and all other projects are served by the original site. However, if the new site is placed at B instead of being placed at A, transport distance falls to three miles because then two projects have aggregate production at their location and thus have zero transportation requirements, and the three remaining sites each require a one-mile transport. Each aggregate production site supplies 2.5 units of aggregates, that is, half the total required by the five projects. Since cost depends on distance and, markets minimize costs, the free market system always will choose a point like B, the one with the lowest cost. In this case it is also the lowest transport distance.

Other forms of industrial organization lead to higher prices being charged for aggregates, but the effect of additional suppliers is to lower prices and haul distances. Appendix A elucidates the case where the price depends upon the delivered costs of the second most efficient producer.

The second issue for the siting of aggregate production is the possibility that lower delivered costs lead to more projects or more use of aggregates in existing projects. The degree to which decrease in the price of a good, in this case construction material, leads to an increase in the quantity of that material used is described by the elasticity of demand. The elasticity of demand is the percent increase in use caused by a one percent decrease in price.

A search of the economic literature found no articles estimating a positive elasticity of demand for aggregates. A review by the Susan Kohler[†] finds that only population and not price is correlated with aggregate usage. In other words, a reduction in the price of aggregate does not lead to an increase in demand for it.

While it is a theoretical possibility that the quantity of aggregates demanded (that is, the quantity used in projects) is responsive to price, two facts about construction make this unlikely. First, the cost of aggregates is usually a tenth or less of the cost of a project. Second, the building of projects -- housing, roads, and commercial construction -- is not very sensitive to the costs of producing them.

[†] *Map Sheet 52. Aggregate Availability in California.* by Susan L. Kohler. California Department of Conservation. California Geological Survey. Sacramento. 2002.

Although we have not found literature on the elasticity of demand for either public projects or contract construction, there is an empirical literature on the elasticity of demand for housing[‡]. In these studies, a one percent change in the price leads to about a half percent change in the quantity of housing consumed. Public projects, like roads, are budgeted, often from specials funds, like road taxes. In that case, a one percent decrease in the costs of *all* projects in a taxing jurisdiction would lead to a one percent increase in the quantity of roads built. Since aggregates are very expensive to ship, the quarry being considered likely would only change the costs of nearby road construction, perhaps for just one county.

For example, Monterey County has a population of 400,000 while the state population is 33.9 million people.[§] Assuming that road construction is roughly proportional to population, about 1.2 percent of road construction would be in Monterey. So, if a new quarry in Monterrey decreased the price of aggregates in Monterrey by 1 percent and left the price the same in the rest of the state, then the average price in the whole state would fall by about 0.01 percent, which is negligible. A project that affects only a small part of a taxing jurisdiction has only a small effect on that jurisdiction's costs and can have no major affect on the quantity of services supplied by that jurisdiction.

We know of no evidence of elasticities for construction work as high as one. We estimate the elasticity of demand for projects using aggregates to be much less than one, likely under a half in the private sector and near zero in the public sector.

Given that projects will be built, there is some possibility of substituting of other structural materials for aggregates in buildings. However these substitute materials too would be trucked. The realistic possibility for roads is that there are no materials to substitute for aggregates. I do not believe this pathway to greater use of aggregates in building would be triggered by the transport savings from a new aggregate source or that it would result in an increase in net truck miles.

[‡] Hanushek, Eric A., John Quigley. "What is the price elasticity of housing demand?" *Review of Economics and Statistics.* August, 1980.

[§] Population figures are for the year 2000.

Since a change in price of aggregates does not lead to either a substantial substitution of other materials for aggregates or a substantial increase in the quantity of projects, the demand for aggregates is very inelastic. This inelasticity of demand is exactly the reason that the State of California can use a fixed per-capita consumption rate for forecasting the need for construction materials.

An example will make clear how the transport advantage and elasticity of demand arguments fit together. Let us consider a new quarry that, through its transportation advantage over existing quarries, would save 12.5 miles of trucking on each and every project in the study area. We shall assume that the average truck haul pre-project was 25 miles.

According to the *Map Sheet 52: Aggregate Availability in California,* the cost of construction aggregate doubles every 25-35 miles from the point of production. The following calculations are carried out assuming that a 25 mile haul doubles the cost. Assuming that a unit of aggregate costs $1 at the production site, then its delivered cost at a project site 25 miles away is $2. If the haul distance were to be reduced to 12.5 miles due to a new quarry, then half of the transportation costs – or $0.50 – would be saved. This represents a cost savings of 25 percent in the delivered cost of aggregate and is entirely due to a 50 percent decrease in miles traveled.

The only way for a new quarry to influence the quantity of construction is through the price of aggregates. This example presents the competitive case, where the delivered price decreases by the full amount of the transport cost savings. In the competitive case, the effect on the quantity of construction will be extremely moderate, as demonstrated below. (Appendix A presents a less than perfectly competitive example.)

In keeping with the fact that the cost of aggregate accounts for less than 10 percent of the total cost of a construction project, a price reduction of 25 percent on aggregate is a cost saving of 2.5 percent or less on the project. Let us assume a very liberal price elasticity of demand for construction of 0.5. In other words, 2.5 percent reduction in the cost of construction would lead to 1.25 percent increase in the quantity of construction demanded. This increased quantity of delivered aggregate leads to additional truck haul miles. The number of increased miles from the increased aggregate sales is 1.25 percent of the original quantity times the new haul distance which is 50% of the original distance. Therefore, the percentage increase in truck haul miles occasioned by a decrease in aggregate price will be 0.625 percent because the new aggregate location is only half as far away.

In this example, the new quarry saves 50 percent of truck trip miles through location and contributes 0.625 percent of new truck trip miles from demand increase. This leads to a net decrease of 49.375 percent in truck miles. The following Table 1 summarizes the net reduction of truck haul miles for three different scenarios – the new aggregate project site located at 12.5, 6.25, and 2.5 miles from a construction site.

Table 1

Distance to New Quarry (miles)	Decrease in haul miles (%)[**]	Decrease in delivered aggregate cost (%)	Decrease in construction cost (%)	Increase in construction quantity (%)	Increase in haul miles from additional construction(%)[††]	Net decrease in miles hauled (%)
12.5	50	25	2.5	1.25	0.62	**49.4**
6.25	25	37.5	3.75	1.85	0.46	**74.5**
2.5 miles	90	45	4.5	2.25	0.22	**89.8**

There is a general rule to be deduced from the example: The percent decrease in cost for the delivery of aggregates equals the percent decrease in miles driven, while the increase in the use of aggregates equals the elasticity of demand for a final product (such as roads) times the cost share of aggregates in making the product times the decrease in cost. Since the elasticity of demand for a final product is much less than one, and the cost

[**] This decrease is with respect to the pre-project haul miles.
[††] This increase is with respect to the pre-project haul miles.

share of aggregates in making the product is about 8 percent, a new quarry must decrease truck miles and decrease NOX and other emissions from trucks.

Appendix A

Spatial Models with Imperfect Competition

When a producer has a price advantage over other producers because of lower transport costs, the producer can exploit that advantage by charging consumers a price greater than its marginal cost. Marginal cost is the cost of producing one incremental unit.
In this appendix, I will briefly investigate one model of spatial competition that is derived from a classical model of Hotelling [‡‡]

In Hotelling's model, two stores (which are analogous to production sites) can relocate at no cost and then compete based on price. Since consumers are some distance from the store, they see the price of a product as the amount they pay for the product plus the cost of travel. They go to the store with the least total cost (cost of product plus cost of travel). The stores seek to make the most money they can make. The price the consumer will pay is the largest price that the store the consumer goes to can charge without losing the customer to the other store.[§§] In Hotelling's model, the two stores will locate next to each other, split the market in half, and charge the competitive price. While the pricing rule of the Hotelling model may well apply to aggregates, the assumption of complete location flexibility is not applicable.

Returning to the model of diagram 1, shown above., I now consider the effects on pricing of adding one aggregate production site with competition in prices. Consider the case where both aggregate production sites and aggregate-using projects exist at location A and *. The production site at * would be willing to supply the project at location A at its marginal cost of production (mc) plus the cost of transport for one mile, for a total of mc + 1 c. This is higher than the marginal plus transport costs that production site A has for

[5] Hotelling, Harold. 1929. "Stability in Competition." Economic Journal 39:41-57
[6] Salop, Steven C. 1979. "Monopolistic Competition with Outside Goods." *The Bell Journal of Economics.* Salop models the competition between stores in terms of quantity, so that the price for consumers near a store is determined as a monopolist would determine price. With a very low elasticity of demand as is true for aggregates, the price competition model of Hotelling seems more appropriate.

supplying the project at A. However, the site at A can charge up to mc+c without losing the customer. The site charges mc+c while its costs are mc and makes c units of pure profit. The site at * prices in the same way—a price just high enough to avoid the site at A from taking the customer. For the sites to the right of *, the prices are mc+2, mc+3, and mc+ 4. In each case, this is the highest price site * can charge without losing the customer to site A.

In this model, one of the best places for a new site would be at B. The new site would sell ½ unit to the project between it and * at a price of mc + c, a whole unit to the project located at B at a price of mc + 2c (the price at which the site at * would be willing to supply aggregate), and a whole unit to the project located to its right at a price of mc + 3c. The result of adding the new site would be that the price for each project to the right of the project at * fell by c.

With competitive (marginal cost) pricing as described in the body of the note, the addition of the new site at B would result in the prices paid by projects decreasing by four, while with imperfect competition as described in this appendix, the new site would result in the prices paid by projects decreasing only by three. Compared to the competitive case cited above, the imperfect competition example results in smaller changes in prices and therefore a larger decrease in truck traffic.

MAP SHEET 52

(UPDATED 2012)

AGGREGATE SUSTAINABILITY IN CALIFORNIA

2012

CALIFORNIA GEOLOGICAL SURVEY
Department of Conservation

THE NATURAL RESOURCES AGENCY
JOHN LAIRD
SECRETARY FOR RESOURCES

STATE OF CALIFORNIA
EDMUND G. BROWN, JR.
GOVERNOR

DEPARTMENT OF CONSERVATION
MARK NECHODOM
DIRECTOR

CALIFORNIA GEOLOGICAL SURVEY
JOHN G. PARRISH, PH.D., *STATE GEOLOGIST*

MAP SHEET 52

(UPDATED 2012)

AGGREGATE SUSTAINABILITY IN CALIFORNIA

By

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2012

CALIFORNIA GEOLOGICAL SURVEY

DEPARTMENT OF CONSERVATION

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INTRODUCTION

Sand, gravel, and crushed stone are “construction materials.” These commodities, collectively referred to as aggregate, provide the bulk and strength to Portland Cement Concrete (PCC), Asphaltic Concrete (AC, commonly called “black top”), plaster, and stucco. Aggregate is also used as road base, subbase, railroad ballast, and fill. Aggregate normally provides from 80 to 100 percent of the material volume in the above uses.

The building and paving industries consume large quantities of aggregate and future demand for this commodity is expected to increase throughout California. Aggregate materials are essential to modern society, both to maintain the existing infrastructure and to provide for new construction. Therefore, aggregate materials are a resource of great importance to the economy of any area. Because aggregate is a low unit-value, high bulk weight commodity, it must be obtained from nearby sources to minimize economic and environmental costs associated with transportation. If nearby sources do not exist, then transportation costs can quickly exceed the value of the aggregate. Transporting aggregate from distant sources results in increased construction costs, fuel consumption, greenhouse gas emissions, air pollution, traffic congestion, and road maintenance.

To give an idea of the scale of these impacts, from 1981 to 2010, California consumed an average of about 180 million tons of construction aggregate (all grades) per year. Moving in 25 ton truckloads that is over 7.2 million truck trips per year. With an average 25 mile haul (50 mile round trip) that amounts to more than 360 million truck miles traveled, almost 47 million gallons of diesel fuel used, and more than 520,000 tons of carbon dioxide emissions produced annually. If the haul distance is doubled to 50 miles (100 mile round trip) the numbers double to 721 million truck miles traveled, almost 94 million gallons of diesel fuel used, and over 1 million tons of carbon dioxide emissions produced.

Land-use planners and decision makers in California are faced with balancing a wide variety of needs. Increasingly, as existing permitted aggregate supplies are depleted, local land-use decisions regarding aggregate resources can have regional impacts that go beyond local jurisdictional boundaries.

These factors, universal need, increasing demand, the economic and environmental costs of transportation, and multiple land-use pressures make information about the availability and demand for aggregate valuable to land-use planners and decision makers charged with planning for a sustainable future for California’s citizens.

California Geological Survey (CGS) Map Sheet 52, 1:1,100,000-scale, and this accompanying report provide general information about the current availability of, and future demand for, California’s permitted aggregate reserves. Map Sheet 52 was originally published in 2002 (Kohler 2002) and subsequently updated in 2006 (Kohler 2006). Map Sheet 52 (2012) is an update of the version published in 2006.

Map Sheet 52 updates data from reports compiled by the CGS for 31 aggregate study areas throughout the state. These study areas cover about 30 percent of the state and provide aggregate for about 85 percent of California’s population. This report is divided into three parts: Part I provides data sources and methods used to derive the information presented; Part II compares the updated 2012 Map Sheet 52 to the prior (2006) map; and, Part III is an overview of construction aggregate. All aggregate data and any reference to “aggregate” in this report and on the map pertain to “construction aggregate,” defined for this report as alluvial sand and gravel or crushed stone that meets standard specifications for use in PCC or AC unless otherwise noted.

The estimates of permitted resources, aggregate demand, and years of permitted reserves remaining presented on Map Sheet 52 (2012) and in this report are based on conditions as of January 1, 2011 and do not reflect changes, such as production, mine closures, or new or expanded permits, that may have occurred since that time. Although the statewide and regional information presented on the map and in this report may be useful to decision-makers, it should not be used as a basis for local land-use decisions. The more detailed information on the location and estimated amounts of permitted and non-permitted resources, and future regional demands contained in each of the aggregate studies employed in the compilation of Map Sheet 52 should be used for local land-use and decision making purposes.

PART I: DESCRIPTION OF MAP SHEET 52, AGGREGATE SUSTAINABILITY IN CALIFORNIA

Map Sheet 52 is a statewide map showing a compilation of data about aggregate availability collected over a period of about 33 years and updated to January 1, 2011. The purpose of the map is to compare projected aggregate demand for the next 50 years with currently permitted aggregate reserves in 31 regions of the state. The map also shows the projected years of permitted reserves remaining and highlights regions where there is less than 10 years of permitted aggregate supply remaining. The following sections describe data sources and methodology that were used in the development of the map.

Mineral Land Classification Reports and Aggregate Studies

Data regarding aggregate reserves and projected aggregate demand shown on Map Sheet 52 are updated from a series of mineral land classification reports published by CGS between 1981 and 2010 (see Appendix). They were prepared in response to California's Surface Mining and Reclamation Act of 1975 (SMARA) that requires the State Geologist to classify land based on the known or inferred mineral resource potential of that land. SMARA, its regulations and guidelines, are described in Special Publication 51(Division of Mines and Geology, 2000).

The Mineral Land Classification process identifies lands that contain economically significant mineral deposits. The primary goal of mineral land classification is to ensure that the mineral resource potential of lands is recognized and considered in land-use planning. The classification process includes an assessment of the quantity, quality, and extent of aggregate deposits in a study area.

Mineral land classification reports may be specific to aggregate resources, may contain information about both aggregate and other mineral resources, or they may only contain information on minerals other than aggregate. Reports that focus on aggregate include aggregate resource classification and mapping, estimates of permitted and non-permitted aggregate resources, projected 50-year demand for aggregate resources, and an estimate of when the permitted reserves will be depleted. Map Sheet 52 is a statewide updated summary of 50-year demands and permitted resource calculations for all SMARA classification reports pertaining to construction aggregate.

Mineral land classification studies for aggregate may use either a Production-Consumption (P-C) region or a County as the study area boundary. A P-C region is one or more aggregate production districts (a group of producing aggregate mines) and the market area they serve. P-C Regions sometimes cross county boundaries. Mineral land classification reports include information from one or more P-C regions, or from a county. For ease in discussion, the area covered by each P-C region or county aggregate study is referred to as an "aggregate study area". These areas are shown at the lower left-hand corner of the map along with their respective report number and publication date. It should be noted that a report may include more than one aggregate study area.

SMARA guidelines recommend that the State Geologist periodically review the mineral land classification in defined study regions to determine if new classifications are necessary. The projected 50-year forecast of aggregate demand in the region may also be revised. Fourteen updated classification studies have been completed since the program began. Updated studies were completed by county:

- Los Angeles,
- Orange, and
- Ventura

or by P-C region

- South San Francisco Bay,
- Monterey Bay,
- Western San Diego County,
- Fresno, Palm Springs,
- Stockton-Lodi,
- Claremont-Upland,
- North San Francisco Bay (in progress) ,
- San Bernardino,
- San Gabriel Valley,
- Bakersfield, and
- San Luis Obispo-Santa Barbara.

Since Los Angeles and Ventura counties had more than one P-C region, separate updated 50-year forecasts were made for each region. The Los Angeles County update (OFR 94-14) includes the San Fernando Valley, San Gabriel Valley, Saugus-Newhall, and the Palmdale P-C regions. The San Gabriel Valley P-C Region has since been updated separately. The Ventura County update (OFR 93-10) included the Western Ventura and the Simi Valley P-C regions. The index map of aggregate studies shown in the lower left hand corner of Map Sheet 52 shows the latest reports that cover an aggregate study area. Earlier reports covering the same areas or portions of areas are referenced in the Appendix with an asterisk ("*").

Fifty-Year Aggregate Demand Forecast

The fifty-year aggregate demand forecast for each of the aggregate study areas is presented on Map Sheet 52 as a pie chart (See *Fifty-Year Aggregate Demand Compared to Permitted Aggregate Reserves* section), and also is presented in Table 1of this report. The demand information may be new, or updated from previously published mineral land classification reports. The demand forecast information depicted on Map Sheet 52 is for the period January 1, 2011 through December 2060.

The aggregate study areas with the greatest projected future need for aggregate are South San Francisco Bay, Temescal Valley-Orange County, and Western San Diego County. Each is expected to require more than a billion tons of aggregate by the end of 2060. Other areas with projected high demands are San Gabriel Valley, and San Bernardino. Each of these areas is projected to need more than 800 million tons of aggregate in the next 50 years. Aggregate study areas having smaller demands generally are located in rural, less populated areas. The aggregate study areas of El Dorado County, Glenn County, Nevada County, Shasta County, Southern Tulare

County, Tehama County, and Western Merced County are all projected to require 100 million tons of aggregate or less over the next 50 years.

Methodology

Before selecting a method for predicting a 50-year aggregate demand, historical aggregate use was compared to such factors as housing starts, gross national product, population, and several other economic factors. It was found that the only factor showing a strong correlation to historical aggregate use was population change. Consequently, a per capita aggregate consumption forecast model is used for most of the aggregate study projections. This method of forecasting aggregate consumption benefits from its simplicity and the availability of population forecast data. The California's Department of Finance (DOF) makes 50-year county population forecasts using U.S. census data.

The steps used for forecasting California's 50-year aggregate needs using the per capita consumption model are: 1) collecting yearly historical production and population data for a period of years ranging from the 1960s through 2010; 2) dividing yearly aggregate production by the population for that same year to determine annual historical per capita consumption; 3) projecting yearly population for a 50-year period from the beginning of 2011 through 2060; and, 4) multiplying each year of projected population by the average historical per capita consumption and adding the results for each year to obtain the 50-year aggregate demand. It should be noted that the years chosen to determine an average historical per capita consumption may differ depending upon historical aggregate use for that specific region.

Effectiveness of the Per Capita Consumption Model

The assumption that each person will use a certain amount of aggregate every year is a simplification of actual usage patterns, but overall, an increase in the population leads to the use of more aggregate. Over long enough periods, perhaps 20 to 30 years or more, the random impacts of major public construction projects and economic recessions tend to be smoothed and consumption trends become similar to historic per capita consumption rates. Per capita consumption is a commonly used and accepted national, state, and regional measure for purposes of forecasting.

The per capita consumption model has proved to be effective for projecting aggregate demand in major metropolitan areas. The Western San Diego and the San Gabriel Valley P-C regions are examples of how well the model works, having only a two percent (over 14 years) and an eight percent (over 29 years) difference, respectively, in actual versus projected aggregate demand (Miller, 1996, Kohler, 2010). However, the per capita model may not work well in county aggregate studies or in P-C regions that import or export a large percentage of aggregate resulting in a low correlation between P-C region production and population. In such areas, projections may be made based on historical production or multiple projections based on differing assumptions may be used to better characterize a range of future demand. For regions that export large amounts of aggregate to neighboring P-C regions, projections are based on an historical production model where 50-year aggregate demand is determined by extending a best-fit line of historical aggregate production data for a county or region. This model was used to project Yuba City-Marysville's 50-year demand because the region exports about 70 percent its aggregate into neighboring areas such as Sacramento County and Placer County. In addition, the 50-year demand for Glenn and Tehama counties, the Palmdale P-C region, and the Temescal Valley-Orange County area was also projected using this method.

Permitted Aggregate Reserves

Approximately 4 billion tons of permitted aggregate reserves lie within the 31 aggregate study areas shown on Map Sheet 52. Permitted aggregate reserves are aggregate deposits that have been determined to be acceptable for commercial use, exist within properties owned or leased by aggregate producing companies, and have permits allowing mining of aggregate material. A "permit" is a legal authorization or approval by a lead agency, the absence of which would preclude mining operations. Although some permitted reserves face legal challenges, these reserves are included in this study pending resolution of those challenges. In California, mining permits usually are issued by local lead agencies (county or city governments). Map Sheet 52 shows permitted aggregate reserves as a percentage of the 50-year demand on each pie chart (See *Fifty-Year Aggregate Demand Compared to Permitted Aggregate Reserves* section). Beneath the study area name located next to its corresponding pie chart is the amount of permitted resource in tons along with the amount of 50-year demand. These figures are also given in Table 1. Tonnages are not given for Western Merced County and for the southern Tulare County to preserve proprietary company data.

Permitted aggregate resource calculations shown on the map and in Table 1 initially were determined from information provided in reclamation plans, mining plans and use permits issued by the lead agencies. When information was inadequate to make reliable independent calculations, CGS staff used resource estimates provided by mine operators or owners. These data were checked against rough calculations made by CGS staff, and any major discrepancies were discussed with the mine operators or owners. Permitted resource calculations have been updated to account for production from 2006-2010 and are current as of the beginning of 2011.

Fifty-year Aggregate Demand Compared to Permitted Aggregate Reserves

Fifty-year aggregate demand compared to the currently permitted aggregate reserves is represented by a pie chart for each of the 31 aggregate study areas shown on Map Sheet 52. Each pie chart is located in the approximate center of the aggregate study area it represents. There are four different sizes of charts, each size representing a 50-year demand range. The smallest pie chart represents 50-year demands ranging from 25 million to 200 million tons, while the largest chart represents demands of over 800 million tons. The amount of 50-year demand in tons is shown on the map along with the amount of permitted reserves beneath the study area name located next to its corresponding pie chart (permitted reserves, left / 50-year demand, right). The whole pie represents the total 50-year aggregate demand for a particular aggregate study area. The blue portion of the pie represents the permitted aggregate resource (shown as a percentage of the 50-year demand) while the purple-colored portion of the pie represents that portion of the 50-year demand that will not be met by the currently permitted reserves. For example, if the blue portion is 25 percent and the purple portion is 75 percent of a pie chart that represents a total demand of 400 million tons, the permitted reserves are 100 million tons, and the region will need an additional 300 million tons of aggregate to supply the area for the next 50 years. The pie representing the Placer County aggregate study area (north-central California) is completely colored blue showing permitted aggregate reserves are equal to or greater than the area's 50-year aggregate demand.

AGGREGATE STUDY AREA [1]	**50-Year Demand** (million tons)	**Permitted Aggregate Reserves** (million tons)	**Permitted Aggregate Reserves Compared to 50-Year Demand** (percent)	**Projected Years Remaining**
Bakersfield P-C Region	438	143	33	21 to 30
Barstow-Victorville P-C Region	159	124	78	31 to 40
Claremont-Upland P-C Region	203	109	54	21 to 30
El Dorado County	76	18	24	11 to 20
Fresno P-C Region	435	46	11	**10 or fewer**
Glenn County	59	33	56	21 to 30
Merced County[2]				
Eastern Merced County	100	50	50	21 to 30
Western Merced County	28	Proprietary	>50	31 to 40
Monterey Bay P-C Region	346	323	93	41 to 50
Nevada County	100	26	26	11 to 20
Palmdale P-C Region	577	152	26	11 to 20
Palm Springs P-C Region	295	152	52	21 to 30
Placer County	151	152	101	More than 50
North San Francisco Bay P-C Region	521	110	21	11 to 20
Sacramento County	670	42	6	**10 or fewer**
Sacramento-Fairfield P-C Region	196	128	65	11 to 20
San Bernardino P-C Region	993	241	24	11 to 20
San Fernando Valley / Saugus-Newhall [3]	476	77	16	**10 or fewer**
San Gabriel Valley P-C Region	809	322	40	11 to 20
San Luis Obispo-Santa Barbara P-C Region	240	75	31	11 to 20
Shasta County	93	52	56	21 to 30
South San Francisco Bay P-C Region	1,381	404	29	11 to 20
Stanislaus County	214	45	21	11 to 20
Stockton-Lodi P-C Region	436	232	53	31 to 40
Tehama County	62	32	52	21 to 30
Temescal Valley-Orange County [3]	1,077	297	28	11 to 20
Tulare County[2]				
Northern Tulare County	124	27	22	11 to 20
Southern Tulare County	73	Proprietary	<50	21 to 30
Ventura County [3]	298	96	32	11 to 20
Western San Diego County P-C Region	1,014	167	16	**10 or fewer**
Yuba City-Marysville P-C Region	403	392	97	41 to 50
Total	**12,047**	**4,067**	**34**	

[1] Aggregate study areas follow either a Production-Consumption (P-C) region boundary or a county boundary. A P-C region includes one or more aggregate production districts and the market area that those districts serve. Aggregate resources are evaluated within the boundaries of the P-C Region. County studies evaluate all aggregate resources within the county boundary.
[2] The County study has been divided into two areas, each having its own production and market area. A separate permitted resource calculation and 50-year forecast is made for each area.
[3] Two P-C regions have been combined into one study area.

Table 1. Comparison of 50-year demand to permitted aggregate reserves for aggregate study areas as of January 1, 2011. (Study areas with ten or fewer years of permitted reserves are in bold type).

Except for Placer County, all of the aggregate study areas have less permitted aggregate reserves than they are projected to need for the next 50-years. Nineteen of the 31 aggregate study areas have less than half of the permitted reserves they are projected to need in the next 50 years.

Estimates of Years of Permitted Reserves Remaining

New to the 2012 update, the right hand column of Table 1 indicates the projected years of permitted reserves remaining for the various aggregate study areas. Calculations of depletion years are made by comparing the currently permitted reserves to the projected annual aggregate consumption in the study area on a year-by-year basis. This is not the same as dividing the total projected 50-year demand for aggregate by 50 because, as population increases, so does the projected annual consumption of aggregate for a study area. Data are presented as ranges; 10 or fewer, 11-20, 21-30, 31-40, 41-50, and more than 50 years. This information is included on the map beneath the study area name along with the permitted reserves and the projected 50-year demand. These estimates are based on conditions as of January 1, 2011 and do not reflect changes, such as new or expanded permits, that may have occurred since that time.

Four of the 31 aggregate study areas – Western San Diego County, Sacramento County, Fresno County, and the San Fernando Valley-Saugus Newhall area – are projected to have less than 10 years of permitted aggregate reserves remaining as of January 1, 2011. They are highlighted by red halos around the pie charts on Map Sheet 52 and appear in bold type in Table 1.

Thirteen of the 31 aggregate study areas have between 11 and 20 years of permitted aggregate reserves remaining. Several of these including the North and South San Francisco Bay study areas and the Palmdale, San Bernardino, San Gabriel Valley, Temescal Valley-Orange County and Ventura County study areas are in or adjacent to urban areas with high aggregate demands.

Eight of the 31 aggregate study areas have between 21 and 30 years of permitted aggregate reserves remaining, three have more than 31 years remaining, two have more than 41 years and one (Placer County) has more than 50 years of permitted reserves remaining.

These numbers are estimates and the actual lifespan of existing permitted reserves in a study area can be influenced by many factors. In periods of high economic growth, demand may increase, shortening the life of permitted reserves. Large projects, such as the construction or maintenance of major infrastructure, or rebuilding after a disaster such as an earthquake could also deplete permitted reserves more rapidly. Increased demand from neighboring regions with dwindling or depleted permitted reserves may also accelerate the depletion of permitted reserves in a study area. Conversely, a slow economy may reduce demand for a period of time, extending the life of permitted reserves, or new or expanded permits may be granted in a study area increasing the permitted reserves and the lifespan of permitted reserves in that area.

Non-Permitted Aggregate Resources

Non-permitted aggregate resources are deposits that may meet specifications for construction aggregate, are recoverable with existing technology, have no land use overlying them that is incompatible with mining, and currently are not permitted for mining. While not shown on Map Sheet 52, non-permitted aggregate resources are identified and discussed in each of the mineral land classification reports used to compile the map (See Appendix). There are currently an estimated 74 billion tons of non-permitted construction aggregate resources in the 31 aggregate study areas shown on the map. While this number seems large, it is unlikely that all of these resources will ever be mined because of social, environmental, or economic factors. The location of aggregate resources too close to urban or environmentally sensitive areas can limit or prevent their development. Resources may also be located too far from a potential market to be economic. In spite of such possible constraints, non-permitted aggregate resources are the most likely future sources of construction aggregate potentially available to meet California's continuing demand. Factors used to calculate non-permitted resource amounts and to determine the aerial extent of these resources, are given in each of the aggregate classification reports listed in the Appendix.

Aggregate Production Areas and Districts

Aggregate production areas are shown on the map by five different sizes of triangle. A triangle may represent one or more active aggregate mines. The relative size of each symbol corresponds to the amount of yearly production for each mine or group of mines. Yearly production was based on data from the Department of Conservation's Office of Mine Reclamation (OMR) records for the calendar year 2010. The smallest triangle represents a production area that produces less than 0.5 million tons of aggregate in 2010. These triangles represent a single mine operation. About 90 percent of the production areas on the map fall into this category, and many are located in rural parts of the state. The largest triangle represents aggregate mining districts with production of more than 5 million tons in 2010. Only two aggregate production districts fall into this category – the Temescal Valley District in western Riverside County and the San Gabriel Valley District in Los Angeles County. It should be noted that, because of the economic slowdown from 2007 to 2010, the tonnages represented by the triangles on the 2012 map are different from those on the 2006 map.

PART II COMPARISONS BETWEEN THE PRIOR (2006) AND THE UPDATED (2012) MAP SHEET 52

The prior version of Map Sheet 52 was completed and published in 2006. Permitted aggregate resource data for that map were current as of January 1, 2006. Work conducted for that study took place during 2006. The latest aggregate production and location data available for the prior map were from 2005 records. The aggregate demand projections for the prior map were based on DOF county population projections from the 2000 U.S. census. Fifty-year aggregate demand from January 1, 2006 through the year 2055 was determined for 31 study areas.

This updated Map Sheet 52 was completed and published in 2012. **Permitted aggregate resource data for the updated map is current as of January 1, 2011.** All work conducted for the updated study also took place during 2012. The latest aggregate production and location data available for the updated map are from 2010 records. The aggregate demand projections for the updated map were based on DOF county population projections from the 2010 U.S. census. Fifty-year aggregate demand from January 1, 2011 through the year 2060 was determined for 31 study areas.

Changes have occurred in both aggregate supplies (permitted aggregate reserves) and in 50-year aggregate demand in the five years since the prior Map Sheet 52 update was completed. Changes in permitted aggregate reserves between the prior Map Sheet 52 (2006) and updated Map Sheet 52 (2012) are shown in Table 2. Table 3 compares the changes in 50-year demand between Map Sheet 52 (2006) and the updated 2012 map.

Aggregate Study Area Changes

Six aggregate study areas on the original (2002) Map Sheet 52 were modified for the 2006 map, resulting in three fewer study areas. They included the Southern California P-C regions of Orange County, Temescal Valley, San Fernando Valley, Saugus-Newhall, Western Ventura County, and Simi Valley. These regions were combined into three regions when they began to run out of permitted reserves and became dependant on aggregate sources from neighboring regions. The importation of aggregate from neighboring regions typically results in longer haul distances, higher costs, and increased carbon dioxide emissions, air pollution, traffic congestion, and highway maintenance. The shift in supply area also results in more rapid depletion of permitted reserves in neighboring regions.

No additional study areas have been combined in this update. It is likely that in some future update the San Fernando Valley-Saugus Newhall aggregate study area and the Palmdale study area may be combined as permitted reserves in the San Fernando Valley-Saugus Newhall aggregate study area are depleted.

Changes in Permitted Aggregate Reserves

Twenty-four of the 31 study areas shown on the updated map experienced a decrease in permitted aggregate reserves since the 2006 map was completed (See Table 2). Included in these 24 areas are Western Merced County and Southern Tulare County. Permitted reserves for both of these county study areas cannot be shown because they are proprietary.

AGGREGATE STUDY AREA	**Permitted Aggregate Reserves as of 1/1/06** (million tons) **Map Sheet 52, 2006**	**Permitted Aggregate Reserves as of 1/1/11** (million tons) **Map Sheet 52, 2012**	**Percent Difference (%)**
Bakersfield P-C Region	115	143	24
Barstow Victorville P-C Region	133	124	-7
Claremont-Upland P-C Region	147	109	-26
Eastern Merced County	53	50	-6
El Dorado County	19	18	-5
Fresno P-C Region	71	46	-35
Glenn County	17	33	94
Monterey Bay P-C Region	347	323	-7
Nevada County	31	26	-16
Northern Tulare County	12	27	125
North San Francisco Bay P-C Region	49	110	124
Palmdale P-C Region	181	152	-16
Palm Springs P-C Region	176	152	-14
Placer County	45	152	238
Sacramento County	67	42	-37
Sacramento-Fairfield P-C Region	164	128	-22
San Bernardino P-C Region	262	241	-8
San Fernando Valley-Saugus Newhall *	88	77	-13
San Gabriel Valley P-C Region	370	322	-13
San Luis Obispo-Santa Barbara P-C Region	77	75	-3
Shasta County	51	52	2
Southern Tulare County	Proprietary	Proprietary	Proprietary
South San Francisco Bay P-C Region	458	404	-12
Stanislaus County	51	45	-12
Stockton Lodi P-C Region	196	232	18
Tehama County	36	32	-11
Temescal Valley-Orange County*	355	297	-16
Ventura County (combined Western Ventura County and Simi Valley P-C Region)*	106	96	-9
Western Merced County	Proprietary	Proprietary	Proprietary
Western San Diego County P-C Region	198	167	-16
Yuba City-Marysville P-C Region	409	392	-4
Total	**4,343**	**4,067**	**-6**

* Two P-C Regions have been combined into one study area

Table 2. Comparison of permitted aggregate reserves between Map Sheet 52, 2006 and Map Sheet 52, 2012.

AGGREGATE STUDY AREA	50-Year Demand as of 1/1/06 (million tons) Map Sheet 52, 2006	50-Year Demand as of 1/1/11 (million tons) Map Sheet 52, 2012	Percent Difference (%)
Bakersfield P-C Region	252	438	74
Barstow-Victorville P-C Region	179	159	-11
Claremont-Upland P-C Region	300	203	-32
Eastern Merced County	106	100	-6
El Dorado County	91	76	-16
Fresno P-C Region	629	435	-31
Glenn County	83	59	-29
Monterey Bay P-C Region	383	346	-10
Nevada County	122	100	-18
Northern Tulare County	117	124	6
North San Francisco Bay P-C Region	647	521	-19
Palmdale P-C Region	665	577	-13
Placer County	171	151	-12
Palm Springs P-C Region	295	295	0
Sacramento County	733	670	-9
Sacramento-Fairfield P-C Region	235	196	-17
San Bernardino P-C Region	1,074	993	-8
San Fernando Valley/Saugus Newhall *	457	476	4
San Gabriel Valley P-C Region	1,148	809	-30
San Luis Obispo-Santa Barbara P-C Region	243	240	-1
Shasta County	122	93	-24
Southern Tulare County	88	73	-17
Stanislaus County	344	214	-38
Stockton Lodi P-C Region	728	436	-40
South San Francisco Bay P-C Region	1,244	1381	11
Tehama County	72	62	-14
Temescal Valley-Orange County *	1,122	1,077	-4
Ventura County (combined Western Ventura County and Simi Valley P-C Regions) *	309	298	-4
Western Merced County	53	28	-47
Western San Diego County P-C Region	1,164	1014	-13
Yuba City-Marysville P-C Region	360	403	12
Total	**13,536**	**12,047**	**-11**

* Two P-C Regions have been combined into one study area

Table 3. Comparison of 50-year demand between Map Sheet 52, 2006 and Map Sheet 52, 2012.

Seven of the study areas shown on the updated map had increases in permitted aggregate reserves. Most of these increases are because of newly permitted or expanded mining operations. An expansion may increase the footprint of the mine or increase permitted mining depth. Significant increases exceeding 50 percent occurred in the Placer County, Glenn County, Northern Tulare County, and the North San Francisco Bay aggregate study areas (See Table 2).

Total permitted reserves for all 31 areas decreased from 4,343 million tons to 4,067 million tons – an apparent reduction of 276 million tons. Most of this reduction was because of aggregate consumption. Other potential reasons for reductions in permitted aggregate reserves include social and economic conditions leading to mine closures, regulatory changes, or natural variations in the quality of aggregate deposits. Actual production was greater but was offset in part by increases in permitted reserves in some study areas.

Changes in Fifty-Year Demand

Of the 31 study areas shown on the updated Map Sheet 52 five had increases in 50-year demand, one remained constant, and 25 showed decreases in projected 50-year demand (See Table 3). The large number of study areas with decreasing 50-year demand is due in large part to the new population projections used in forecasting. The new county population projections (State of California Department of Finance, 2012) are based on the 2010 U.S. census and project lower growth rates for much of California compared to the projections used in the previous versions of this study. Newly updated per capita consumption numbers may also have contributed to changes in projected 50-year demand.

The large increase (74 percent) in the 50-year demand for the Bakersfield study area is due to the use of newer population projections than were used in the original study and previous versions of this study.

Changes in Permitted Aggregate Reserves and Demand

Table 4 shows the percentages of permitted reserves compared to the 50-year demand for the 2006 and updated 2012 Map Sheet 52. These percentages are represented on both maps as pie charts – the blue portion of the pie depicting percentage of the 50-year demand met with current permitted reserves. Increases occurred in 14 of the 29 study areas that can be compared and no change or decreases occurred in 15 study areas.

The large increases in some of these study areas (Glenn County, North San Francisco Bay, Northern Tulare County, Placer County, Shasta County, and Stockton-Lodi) were because of new or expanded permits resulting in additional permitted aggregate reserves. Many of the small increases are not due to new or modified permits, but are a result of low production rates during the economic slowdown from 2007 to 2010 and the lower projected 50-year demand in many study areas based on updated population forecasts used in the 2012 update. Similarly those study areas with no change or small decreases may also have been influenced by these factors.

Comparison of Areas with Less than 10-Years of Permitted Aggregate Reserves

The 2012 Map Sheet 52 shows four aggregate study areas with less than a 10-year supply of permitted aggregate reserves – Sacramento County, Fresno County, San Fernando Valley-Saugus Newhall, and the Western San Diego County P-C Regions. The map shows these areas with red halos around the pie charts. Compared to the 2006 version of the map, the San Fernando Valley-Saugus Newhall study area is a new addition to this group while the North San Francisco Bay and Northern Tulare County study areas have been removed.

AGGREGATE STUDY AREA	Percentage of Permitted Aggregate Reserves as Compared to 50-Year Demand as of 1/1/06 Map Sheet 52, 2006	Percentage of Permitted Aggregate Reserves as Compared to 50-Year Demand as of 1/1/11 Map Sheet 52, 2012	Difference
Bakersfield P-C Region	46	33	-13
Barstow-Victorville P-C Region	74	78	4
Claremont-Upland P-C Region	49	54	5
Eastern Merced County	50	50	0
El Dorado County	21	24	3
Fresno P-C Region	11	11	0
Glenn County	21	56	35
Monterey Bay P-C Region	91	93	2
Nevada County	25	26	1
Northern Tulare County	10	22	12
North San Francisco Bay P-C Region	8	21	13
Palmdale P-C Region	27	26	-1
Palm Springs P-C Region	60	52	-8
Placer County	26	101	75
Sacramento County	9	6	-3
Sacramento-Fairfield P-C Region	70	65	-5
San Bernardino P-C Region	24	24	0
San Fernando Valley/Saugus Newhall *	19	16	-3
San Gabriel Valley P-C Region	32	40	8
San Luis Obispo-Santa Barbara P-C Region	32	31	-1
Shasta County	42	56	14
Southern Tulare County	Proprietary	Proprietary	
Stanislaus County	15	21	6
Stockton Lodi P-C Region	27	53	26
South San Francisco Bay P-C Region	37	29	-8
Tehama County	49	52	3
Temescal Valley-Orange County *	32	28	-4
Ventura County (combined Western Ventura County and Simi Valley P-C Regions) *	34	32	-2
Western Merced County	Proprietary	Proprietary	
Western San Diego County P-C Region	17	16	-1
Yuba City-Marysville P-C Region	100	97	-3

* Two P-C Regions have been combined into one study area

Table 4. Percentage of permitted aggregate reserves as compared to 50-year demand for Map Sheet 52, 2006 and Map Sheet 52, 2012.

PART III: OVERVIEW OF CONSTRUCTION AGGREGATE

Construction aggregate was the leading non-fuel mineral commodity produced in California in 2010. Valued at $1.19 billion, aggregate made up about 41 percent of California's $2.9 billion non-fuel mineral production in 2010.

Aggregate Quality and Use

Aggregate normally makes up 80 to 100 percent of the material volume in PCC and AC and provides the bulk and strength to these materials. Rarely, even from the highest-grade deposits, is in-place aggregate physically or chemically suited for every type of aggregate use. Every potential deposit must be tested to determine how much of the material can meet specifications for a particular use, and what processing is required. Specifications for PCC, AC, and various other uses of aggregate have been established by several agencies, such as the U.S. Bureau of Reclamation, the U.S. Army Corps of Engineers, and the California Department of Transportation to ensure that aggregate is satisfactory for specific uses. These agencies and other major consumers test aggregate using standard test procedures of the American Society for Testing Materials (ASTM), the American Association of State Highway Officials, and other organizations.

Most PCC and AC aggregate specifications have been established to ensure the manufacture of strong, durable structures capable of withstanding the physical and chemical effects of weathering and use. For example, specifications for PCC and concrete products prohibit or limit the use of rock materials containing mineral substances such as gypsum, pyrite, zeolite, opal, chalcedony, chert, siliceous shale, volcanic glass, and some high-silica volcanic rocks. Gypsum retards the setting time of portland cement; pyrite dissociates to yield sulfuric acid and an iron oxide stain; and other substances contain silica in a form that reacts with alkali substances in the cement, resulting in cracks and "pop-outs." Alkali reactions in PCC can be minimized by the addition of pozzolanic admixtures such as fly ash or naturally occurring pozzolanic materials. Pozzolans are siliceous or siliceous and aluminous material of natural or artificial origin that, in the presence of moisture, reacts with calcium hydroxide to form cementitious compounds.

Specifications also call for precise particle-size distribution for the various uses of aggregate that is commonly classified into two general sizes: coarse and fine. Coarse aggregate is rock retained on a 3/8-inch or a #4 U.S. sieve. Fine aggregate passes a 3/8-inch sieve and is retained on a #200 U.S. sieve (a sieve with 200 weaves per inch). For some uses, such as asphalt paving, particle shape is specified. Aggregate material used with bituminous binder (asphalt) to form sealing coats on road surfaces shall consist of at least 90% by weight of crushed particles. Crushed stone is preferable to natural gravel in asphaltic concrete (AC) because asphalt adheres better to broken surfaces than to rounded surfaces and the interlocking of angular particles strengthens the AC and road base.

The material specifications for PCC and AC aggregate are more restrictive than specifications for other applications such as Class II base, subbase, and fill. These restrictive specifications make deposits acceptable for use as PCC or AC aggregate, the scarcest and most valuable aggregate resources. Aggregate produced from such deposits can be, and commonly is, used in applications other than concrete. PCC- and AC-grade aggregate deposits are of major importance when planning for future availability of aggregate commodities because of their versatility, value, and relative scarcity.

Factors Affecting Aggregate Deposit Quality

The major factors that affect the quality of construction aggregate are the rock type and the degree of weathering of the deposit. Rock type determines the hardness, durability, and potential chemical reactivity of the rock when mixed with cement to make concrete. In alluvial sand and gravel deposits, rock type is variable and reflects the rocks present in the drainage basin of the stream or river. In crushed stone deposits, rock type is typically less variable, although in some types of deposits, such as sandstones or volcanic rocks, there may be significant variability of rock type within a deposit. Rock type may also influence aggregate shape. For example, some metamorphic rocks such as slates tend to break into thin platy fragments that are unsuitable for many aggregate uses, while many volcanic and granitic rocks break into blocky fragments more suited to a wide variety of aggregate uses. Deposit type also affects aggregate shape. For example, in alluvial sand and gravel deposits, the natural abrasive action of the stream rounds the edges of rock particles, in contrast to the sharp edges of particles from crushed stone deposits.

Weathering is the in-place physical or chemical decay of rock materials at or near the Earth's surface. Weathering commonly decreases the physical strength of the rock and may make the material unsuitable for high strength and durability uses. Weathering may also alter the chemical composition of the aggregate, making it less suitable for some aggregate uses. If weathering is severe enough, the material may not be suitable for use as PCC or AC aggregate. Typically, the older a deposit is, the more likely it has been subjected to weathering. The severity of weathering commonly increases with increasing age of the deposit.

Comparison of Alluvial Sand and Gravel to Crushed Stone Aggregate

The preferred use of one aggregate material over another in construction practices depends not only on specification standards, but also on economic considerations. Alluvial gravel is typically preferred to crushed stone for PCC aggregate because the rounded particles of alluvial sand and gravel result in a wet mix that is easier to work than a mix made of angular fragments. Also, crushed stone is less desirable in applications where the concrete is placed by pumping because sharp edges will increase wear and damage to the pumping equipment. The workability of a mix consisting of portland cement with crushed stone aggregate can be improved by adding more sand and water, but more cement must then be added to the mix to meet concrete durability standards. This results in a more expensive concrete mix and a higher cost to the consumer. In addition, aggregate from a crushed stone deposit is typically more expensive than that from an alluvial deposit due to the additional costs associated with the ripping, drilling and blasting necessary to remove material from most quarries and the additional crushing required to produce the various sizes of aggregate. Manufacturing sand by crushing is more costly than mining and processing naturally occurring sand. Although more care is required in pouring and placing a wet mix containing crushed stone, PCC made with this aggregate is as satisfactory as that made with alluvial sand and gravel of comparable rock quality. Owing to environmental concerns and regulatory constraints in many areas of the state, it is likely that extraction of sand and gravel resources from instream and floodplain areas will become less common in the future. If this trend continues, crushed stone may become increasingly important to the California market.

Aggregate Price

The price of aggregate throughout California varies considerably depending on location, quality, and supply and demand. The highest quality aggregate, and typically most costly, is that which meets the California Department of Transportation's specifications for use in Portland Cement Concrete (PCC). All prices discussed in this section are for PCC-grade aggregate at the plant site or FOB (freight on board). Transportation cost, which adds to the final cost of aggregate, is discussed in the next section.

Regional variations make it difficult to estimate the average price of PCC-grade aggregate for the state. Over the last decade, prices have varied from $20 per ton or more in areas with depleting or depleted aggregate supplies and high demands to $7 to $8 per ton in areas with abundant aggregate supplies and low to moderate demands.

In the last decade, the highest prices aggregate in the state have been in the San Diego area, where PCC-grade sand is in short supply, causing prices to range up to $20-$22 per ton and in parts of the San Francisco Bay area where sand has also been in short supply and prices have ranged from $15 to $19 per ton.

In the Los Angeles metropolitan areas prices have been in the $13 to $16 per ton range with aggregate from the sparsely populated Palmdale area at about $10 per ton. Aggregate from Palmdale is also transported to Ventura County – a haul distance of about 60 miles, and into the San Fernando Valley-Saugus Newhall area. The cost of transportation in these cases adds significantly to the final cost of the aggregate.

In the Central Valley, prices have ranged from $7 to $8 per ton in the Yuba City-Marysville area where aggregate supplies are abundant to $10 to $11 per ton in the Sacramento and Stockton-Lodi areas. In the Southern Valley, prices have been somewhat higher, about $12 per ton in the Bakersfield region and $14 to $18 per ton in the Fresno and northern Tulare areas.

Transportation and Increasing Haul Distances

Transportation plays a major role in the cost of aggregate to the consumer. Aggregate is a low-unit-value, high-bulk-weight commodity, and it must be obtained from nearby sources to minimize both the dollar cost to the aggregate consumer and other environmental and economic costs associated with transportation. If nearby sources do not exist, then transportation costs may significantly increase the cost of the aggregate by the time it reaches the consumer. For straight hauls with minimal traffic, the price of aggregate increases about 15 cents per ton for every mile that it is hauled from the plant according to industry sources. Currently, transporting aggregate a distance of 30 miles will increase the FOB price by about $4.50 per ton. For example, to construct one mile of six-lane interstate highway requires about 113,500 tons of aggregate. Transporting this amount of aggregate 30 miles adds $510,000 to the base cost of the material at the mine. In major metropolitan areas, this rate is often greater because of heavy traffic that increases the haul time. Other factors that affect hauling rates include toll bridges and toll roads, road conditions, and routes in hilly or mountainous areas. Transportation cost is the principal constraint defining the market area for an aggregate mining operation.

Throughout California, aggregate haul distances have been gradually increasing as more local sources of aggregate diminish. Consequently, older P-C regions, most of which were established in the late 1970s have changed considerably since their boundaries were drawn. This is especially evident in Los Angeles, Orange, and Ventura counties where aggregate shortages have led to the merging of six P-C regions shown on the original (2002) map into three regions for the updated maps.

Increased aggregate haul distances not only increase the cost of aggregate to the consumer, but also increase environmental and societal impacts such as increased fuel consumption, carbon dioxide emissions, air pollution, traffic congestion and road maintenance.

Factors Affecting Aggregate Demand

Several factors may influence aggregate demand. In periods of high economic growth, demand may increase, depleting permitted reserves more rapidly than expected. Large projects, such as the construction or maintenance of major infrastructure, or rebuilding after a disaster such as an earthquake could also deplete permitted reserves more rapidly. Increased demand from neighboring regions with dwindling or depleted permitted reserves may also accelerate the depletion of permitted reserves in a study area. Conversely, a period of declining economy or of low economic growth, such as that during the recession of 2007 to 2009 and the subsequent slow economic recovery, can reduce demand for a period of time, extending the life of permitted reserves. In some cases, importation of aggregate from other areas may extend the life of a region's permitted reserves.

SUMMARY AND CONCLUSIONS

Aggregate is essential to the needs of modern society, providing material for the construction and maintenance of roadways, dams, canals, buildings and other parts of California's infrastructure. Aggregate is also found in homes, schools, hospitals and shopping centers. In the 30-year period from 1981 to 2010, Californians consumed an average of more than 180 million tons of construction aggregate (all grades) per year or about 5.7 ton per person per year. Demand for aggregate is expected to increase as the state's population continues to grow and infrastructure is maintained, improved, and expanded. Because aggregate is a low unit-value, high bulk weight commodity, it must be obtained from nearby sources to minimize the dollar cost to the aggregate consumer and other environmental and economic costs associated with transportation.

For the last 33 years, under the Surface Mining and Reclamation Act, CGS has conducted on-going studies that identify and evaluate aggregate resources throughout the state. Map Sheet 52 (2012) is an updated summary of supply and demand data from these studies. The map presents a statewide overview of future aggregate needs and currently permitted reserves.

The following conclusions can be drawn from Map Sheet 52 (2012) and this accompanying report:

- In the next 50 years, the 31 study areas identified on Map sheet 52 (2012) will need approximately 12 billion tons of aggregate.
- The 31 study areas currently have about 4 billion tons of permitted reserves, which is about one third of the total projected 50-year aggregate demand identified for these study areas. This is about 5.5 percent of the total aggregate resources located within the 31 study areas.
- Four of the aggregate study areas are projected to have 10 or fewer years of permitted aggregate reserves remaining as of January 2011 (pie charts highlighted with red borders).
- Thirteen of the 31 aggregate study areas have between 11 and 20 years of aggregate reserves remaining.
- Eight of the 31 aggregate study areas have between 21 and 30 years of aggregate reserves remaining.
- Three of the 31 aggregate study areas have between 31 and 40 years of aggregate reserves remaining.
- Two of the 31 aggregate study areas have between 41 and 50 years of aggregate reserves remaining
- One of the 31 aggregate study areas (Placer County) has more than 50 years of aggregate reserves remaining.

The information presented on Map Sheet 52 (2012) and in the referenced reports is provided to assist land use planners and decision makers in identifying those areas containing construction aggregate resources, and to quantify potential future demand for these resources in different regions of the state. This information is intended to help planners and decision makers balance the need for construction aggregate with the many other competing land use issues in their jurisdictions, and to provide for adequate supplies of construction aggregate to meet future needs.

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State of California, Department of Finance, *Interim Population Projections for California and Its Counties 2010-2050,* Sacramento, California, May 2012.

APPENDIX: MINERAL LAND CLASSIFICATION REPORTS BY THE CALIFORNIA GEOLOGICAL SURVEY (Special Reports and Open-File Reports, with information on aggregate resources)

SPECIAL REPORTS

SR 132: Mineral Land Classification: Portland Cement Concrete-Grade Aggregate in the Yuba City-Marysville Production-Consumption Region.
By Habel, R.S., and Campion, L.F., 1986.

*SR 143: Part I: Mineral Land Classification of the Greater Los Angeles Area: Description of the Mineral Land Classification Project of the Greater Los Angeles Area.
By Anderson T. P., Loyd, R.C., Clark, W.B., Miller, R.M., Corbaley, R., Kohler, S.L., and Bushnell, M.M., 1979.

*SR 143: Part II: Mineral Land Classification of the Greater Los Angeles Area: Classification of Sand and Gravel Resource Areas, San Fernando Valley Production-Consumption Region.
By Anderson T.P., Loyd, R.C., Clark, W.B., Miller, R.M., Corbaley, R., Kohler, S.L., and Bushnell, M.M., 1979.

*SR 143: Part III: Mineral Land Classification of the Greater Los Angeles Area: Classification of Sand and Gravel Resource Areas, Orange County-Temescal Valley Production-Consumption Region.
By Miller, R.V., and Corbaley, R., 1981.

*SR 143: Part IV: Mineral Land Classification of the Greater Los Angeles Area: Classification of Sand and Gravel Resource Areas, San Gabriel Valley Production-Consumption Region.
By Kohler, S.L., 1982.

*SR 143: Part V: Mineral Land Classification of the Greater Los Angeles Area: Classification of Sand and Gravel Resource Areas, Saugus-Newhall Production-Consumption Region and Palmdale Production-Consumption Region.
By Joseph, S.E, Miller, R.V., Tan, S.S., and Goodman, R.W., 1987.

*SR 143: Part VI: Mineral Land Classification of the Greater Los Angeles Area: Classification of Sand and Gravel Resource Areas, Claremont-Upland Production-Consumption Region.
By Cole, J.W., 1987.

*SR 143: Part VII: Mineral Land Classification of the Greater Los Angeles Area: Classification of Sand and Gravel Resource Areas, San Bernardino Production-Consumption Region.
By Miller, R.V., 1987.

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CALIFORNIA DEPARTMENT OF CONSERVATION
DIVISION OF MINES AND GEOLOGY

DMG OPEN-FILE REPORT 99-09

MINERAL LAND CLASSIFICATION: PORTLAND CEMENT CONCRETE-GRADE AGGREGATE AND KAOLIN CLAY RESOURCES IN SACRAMENTO COUNTY, CALIFORNIA

EDITOR'S NOTES:
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ftp://ftp.consrv.ca.gov/pub/dmg/pubs/ofr/OFR_99-09/

DISCUSSION OF ECONOMICS BEGINS ON PAGE 13.
THE PROJECT IS IN AGGREGATE RESOURCE AREA 15

1999

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Division of Mines and Geology

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MINERAL LAND CLASSIFICATION: PORTLAND CEMENT CONCRETE-GRADE AGGREGATE AND KAOLIN CLAY RESOURCES IN SACRAMENTO COUNTY, CALIFORNIA

By

Don Dupras

DMG OPEN-FILE REPORT 99-09

1999

CALIFORNIA DEPARTMENT OF CONSERVATION
DIVISION OF MINES AND GEOLOGY
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EXECUTIVE SUMMARY

Aggregate (sand and gravel and crushed stone) is the number one non-fuel commodity in California as well as the nation. Valued at $1.26 billion, aggregate made up almost 40% of California's non-fuel mineral production in 1999. Transportation plays a major role in the cost of aggregate to the consumer. Because much of California's aggregate is used in urban and urbanizing areas, it is extremely important that an adequate supply be available close to those areas.

The California Department of Conservation's Division of Mines and Geology (DMG) classifies mineral resources in compliance with the Surface Mining and Reclamation Act (SMARA) of 1975. The purpose of such classification is to identify mineral resources for land use planning and conservation. Under SMARA guidelines, classification studies are to be periodically reviewed for updating.

This report updates information presented in a classification study of portland cement concrete-grade (PCC-grade) aggregate resources in Sacramento County completed in 1984. Results of that investigation were published by DMG as Special Report 156 (SR 156) titled "Mineral Land Classification: Portland Cement Concrete-Grade Aggregate in the Sacramento-Fairfield Production Consumption Region" (Dupras, 1988). Special Report 156 included urban and urbanizing portions of Solano, Yolo, Placer, El Dorado, and Sacramento counties. Only the northern third of Sacramento County was included in SR 156. All of Sacramento County is classified in this report. Those parts of the adjacent counties that were included in SR 156 are not included in this report because of recent classification and permitting activities in those areas.

Special emphasis is given aggregate that meets PCC-grade specifications in this investigation. Data contained within this report were current as of August 1999, with the exception of the figures related to annual aggregate production, which are complete up to December 1998.

The actions required of local lead agencies by this report are that Sacramento County and the cities of Folsom and Sacramento must incorporate the classification information on Plate 4 into the Mineral Resource Element of their General Plans. Additionally, Sacramento County must incorporate the information on Plate 6 and Plate 7 into the Mineral Resource Element of its General Plan.

Based on this study and assuming that the aggregate consumption forecast is accurate, the following conclusions were reached:

- The anticipated consumption of all aggregate in Sacramento County for the next 50 years (through the year 2049) is estimated to be 688 million tons, of which approximately 65 percent or about 447 million tons must be of PCC-grade quality.

Current PCC-grade aggregate resources in Sacramento County total 202 million tons.

- Over the next 50 years, Sacramento County will have to develop new aggregate resources in areas classified MRZ-3 for PCC-grade material, or it will have to rely on imported aggregate from outside the county.

- At historic rates of consumption, the 52.8 million tons of presently permitted PCC-grade aggregate reserves (as of 01/1999) within Sacramento County are enough to continue to supply the county for about four more years, or until the year 2004. In 1984, the county had about 57 million tons of PCC-grade aggregate reserves which was enough to satisfy demand until 1991. Several new mining permits and permit-additions were granted in Sacramento County since 1984 extending that original forecast.

- In the past few years Sacramento County exported an estimated 8% to 13% of its annual aggregate production to Placer, Amador, Yolo, and El Dorado counties. An estimated 6% to 10% of the aggregate consumed in Sacramento County is annually imported from aggregate resource areas outside the county.

- In 1984, 7.1 square miles of land containing 158.5 million tons of PCC-grade aggregate resources were identified in northern Sacramento County. Since 1984, much of these identified resources have been precluded from mining by intensive urbanization and riparian restoration projects. In other areas to the south of Highway 50 in northern Sacramento County, approximately 2.1 square miles containing an estimated 66.2 million tons of identified PCC-grade aggregate resources have been lost due to urbanization or were mined out since it was classified in 1984.

- Two areas within Sacramento County have been newly classified in this report; (1) an area within the Mather Air Force Conversion Project, and (2) an area at the intersection of Sunrise Boulevard and Highway 16. These two areas cover 1.94 square miles and contain an estimated 65.2 million tons of PCC-grade aggregate resources (these figures exclude the active Grech Ranch Pit).

- As of August 1999, 15 aggregate mines operated by 8 different mining companies were producing construction-grade aggregate in Sacramento County, and there are 6 active PCC-grade aggregate mines operated by 4 mining companies. In 1984, 13 mines operated by 7 companies were producing construction-grade aggregate in Sacramento County, and there were 7 PCC-grade aggregate mines operated by 4 mining companies.

- The average annual per capita consumption rate of construction aggregate from 1960 to the end of 1998 was 7.7 tons. That rate was derived by correlating aggregate production and population in the county for those years. This per capita consumption rate (7.7 tons) was used to determine the years until depletion (four years) assuming aggregate exportation (8% to 13%) and importation (6% to 10%) remain about equal.

- Portions of thirteen ARAs covering a total area of 1,022 acres are within the identified 100-year FEMA flood zone. The portions of these thirteen ARAs within the 100-year FEMA flood zone contain 43,138,000 tons of PCC-grade aggregate resources.

- Two types of clays are mined in Sacramento County; common clay and kaolin clay. Because common clay is so pervasive throughout the county, only those identified deposits of kaolin clay have been classified. Much of the current common clay production within the county occurs as a by-product of aggregate mining operations.

- Significant deposits of kaolin clay, also called "fire clay," occur in eastern Sacramento County. Approximately 10.6 square miles of fire clay deposits have been classified in this report; 7.1 square miles of which are classified as MRZ-2 for fire clay. At historic rates of production and consumption, there are enough existing resources of fire clay to last for many decades.

- There are 5 active clay pits operated by 3 producers in Sacramento County.

Changes in PCC-Grade Aggregate Mineral Land Classification of Sacramento County Since 1984

Six new Aggregate Resource Areas (ARAs) classified MRZ-2 have been added to the mineral land classification of Sacramento County since SR 156 was published in 1988. These changes include the active Grech Ranch Pit (ARA 19), the area at the intersection of Sunrise Boulevard and Highway 16 (ARAs 13-16), and an area in the Mather Air Force Base Conversion Project (ARA 2). These ARAs are shown on Plate 6.

The following table compares 1984 data (from SR 156) with 1999 data (included in this study) for population, area classified, aggregate production, PCC-grade aggregate reserves, projected year of depletion for identified reserves and PCC-grade aggregate resources, the number of permitted aggregate mines, the number of companies producing construction aggregate, and the number of companies producing PCC-grade aggregate.

EXECUTIVE SUMMARY TABLE

COMPARISON OF:	1984	January 1999
SACRAMENTO COUNTY POPULATION	852,600	1,189,056
AREA OF SACRAMENTO COUNTY CLASSIFIED	351.8 SQUARE MILES	995.7 SQUARE MILES
REPORTED AGGREGATE PRODUCTION	5.0 MILLION TONS (For 1982)	8.1 MILLION TONS (For 1998)
TOTAL PERMITTED PCC-GRADE AGGREGATE RESERVES	57.0 MILLION TONS	52.8 MILLION TONS
CALCULATED YEAR OF DEPLETION OF PCC-GRADE AGGREGATE RESERVES	1991	2004
IDENTIFIED PCC-GRADE AGGREGATE RESOURCES	349 MILLION TONS	202 MILLION TONS
TOTAL PERMITTED CONSTRUCTION AGGREGATE MINES	13	15
NUMBER OF COMPANIES PRODUCING CONSTRUCTION AGGREGATE	7	8
PERMITTED PCC-GRADE AGGREGATE MINES	7	6
NUMBER OFCOMPANIES PRODUCING PCC-GRADE AGGREGATE	4	4

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PART I—MINERAL LAND CLASSIFICATION PROJECT DESCRIPTION

INTRODUCTION

Sacramento County is in the southern end of the Sacramento Valley and lies entirely within the Great Valley Province. The western two-thirds of Sacramento County is characterized by low rolling hills interrupted by meandering stream and river channels such as the Sacramento, American and Cosumnes river systems. The eastern third of Sacramento County is adjacent to the Sierran foothills and has more pronounced hills and more pronounced incised river and stream channels. The county overlies an alluvial plain consisting of gravel, sand, silt, and clay that range in age from Cretaceous to Holocene. These sedimentary rock units increase in thickness to the west and south, and are thickest under the southwestern tip of Sacramento County where they reach several tens of thousands of feet. Exposures of Sierra Nevadan granite and Paleozoic bedrock occur along the northeastern and eastern margins of the county (Plate 1).

Sacramento County has a total area of about 996 square miles of which about 13 square miles are covered with water. The county varies from about 27 miles wide across its northern boundary, to about 45 miles in width along its southernmost boundary. It varies in length from about 50 miles on its western flank to about 30 miles along its eastern boundary (Figure 1). The estimated population of Sacramento County in 1999 is 1,189,056, and the projected population growth of Sacramento County to the year 2049 is 2,337,948, an increase of about 97% (California Department of Finance, 1993, 1998). As in any urbanizing region of California, it is hoped that land-use decisions within Sacramento County be made with the full recognition of the natural resources in that region. This study provides information about two economically important industrial mineral resources within Sacramento County: (1) portland cement concrete-grade alluvial sand and gravel in Parts III and IV, and (2) kaolin clay resources in Part V.

Aggregate Resources

In this study, special emphasis is given to aggregate that meets the specifications used in making portland cement concrete (PCC) and asphaltic concrete (AC). In this report portland cement concrete-grade aggregate (PCC-grade aggregate) includes PCC as well as AC because of their similar engineering specifications and because these two products come from the same source areas. Engineering specifications for PCC and AC aggregates are more rigorous and more restrictive than specifications for aggregate used in other applications (such as for base, subbase, P.G.& E. sand, or riprap). Deposits that are acceptable for use as PCC or AC aggregate are the rarest and most valuable of aggregate resources. Suitable PCC and AC aggregate deposits in Sacramento County include high quality and durable alluvial sand and gravel resources. This classification report describes three sets of databases

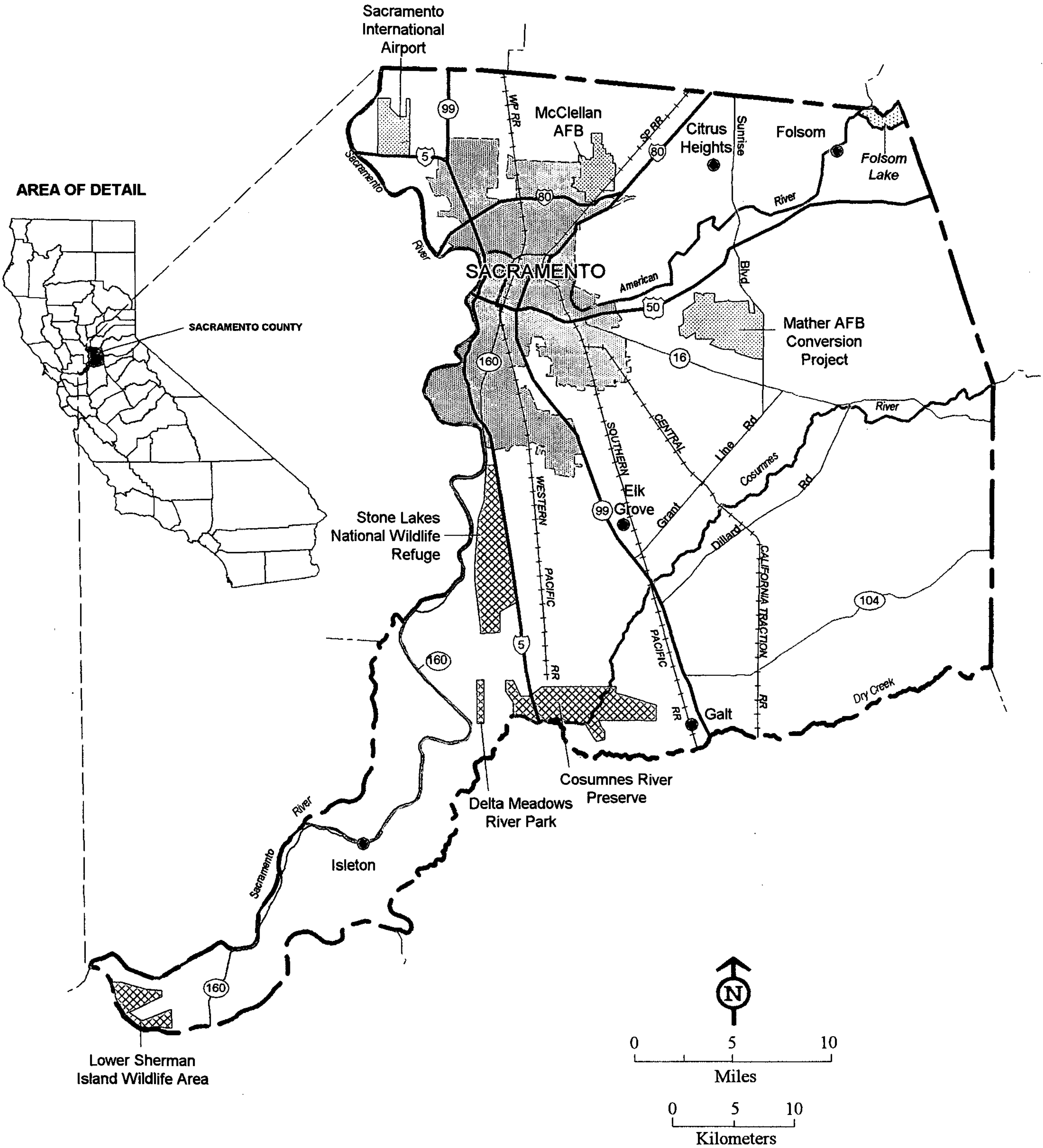

Figure 1. Location map of Sacramento County showing major geographic and urban features.

about PCC-grade aggregate in Sacramento County: (1) the location of known PCC-grade aggregate resources, (2) the quantity of PCC-grade aggregate within those deposits, and (3) the demand for PCC-grade aggregate within Sacramento County for the next 50 years.

Kaolin Clay Resources

Kaolin clay has been mined from several sites in the Michigan Bar area of eastern Sacramento County since the 1860s, and has continued to the present day. This commodity is extracted from the Ione Formation and has been widely used in a variety of applications. Because of its value, occurrence, and the rapid rate of urbanization within Sacramento County, kaolin clay resources are classified in this report.

Report Background

This study was conducted as specified by the Surface Mining and Reclamation Act (SMARA) of 1975. SMARA was passed by the California State Legislature in response to the loss of significant mineral resources due to urban expansion, the need for current information concerning the location and quantity of essential mineral deposits, and to ensure adequate mined-land reclamation. To address mineral resource conservation, SMARA mandated a two-phase process called classification-designation. The objective of the classification-designation process is to ensure, through appropriate local lead agency policies and procedures, that construction materials be available when needed and do not become inaccessible as a result of inadequate information during land-use decision-making actions.

SMARA mandates that guidelines for classification be developed by the State Mining and Geology Board (SMGB). The SMGB originally adopted formal SMARA guidelines on June 30, 1978. Section I.1.a of those guidelines requires the State Geologist to classify specified areas into Mineral Resource Zones (MRZ). Classification is the process of identifying lands containing significant mineral deposits, based solely on geologic factors, and without regard to present land use or ownership. The SMGB recognizes that construction materials (sand, gravel, crushed stone, and clay) are produced regionally, are used in every urban area of the state, and require special classification data.

Section I.3 of the guidelines requires that classification reports pertaining to deposits of construction aggregate materials include the following information: (1) the location and estimated total quantity of construction aggregate available for mining; (2) limits of the market area that these potential resources would supply; and (3) an estimate of the total quantity of aggregate material that will be needed to supply the area for the next 50 years. A copy of the guidelines is printed in California Department of Conservation, Division of Mines and Geology (DMG) Special Publication 51 (third revision January, 2000) and can be obtained for $25 from the following address:

Division of Mines and Geology
801 K Street MS 14-34
Sacramento CA 95814-3532
(Telephone: 916-445-5716)

This report includes a partial update of the PCC-grade aggregate resources in Sacramento County originally published in the DMG Special Report 156 (SR 156) (Dupras, 1988). SR 156 included an inventory of PCC-grade aggregate resources in the Cache Creek and American River aggregate production regions located in Yolo and Sacramento counties, respectively. The area of Sacramento County included in SR 156 is shown in Figure 2. Special Report 156 also included portions of Placerville, Solano, and El Dorado counties. All of Sacramento County is classified in this report. Those parts of the adjacent counties that were included in SR 156 are not included in this report because of recent classification or permitting activities in those areas.

Overview of Classification

The DMG is responsible under SMARA for carrying out the classification phase of the classification-designation process. Classification for PCC-grade aggregate entails seven distinct but interrelated steps:

(1) Determination of Study Boundary: Sacramento County was chosen for study because the SMGB determined that it is an expanding urban area and contains important industrial minerals that represent economically valuable present and future resources.

(2) Establishment of Mineral Resource Zones (MRZ): Based on geologic appraisals, lands within Sacramento County recognized as significant are classified as MRZ-2a or MRZ-2b. This classification system is defined in Part II of this report titled "California Mineral Land Classification System." This mineral land classification is presented on Plates 3-7; Plate 4 is an index map showing the coverage of the plates of the MRZ-2a and MRZ-2b areas. This appraisal includes a study of pertinent geologic reports and maps, field investigations at outcrops and at active and inactive pits and quarries.

(3) Identification of Aggregate Resource Areas (ARA): Lands known to contain significant PCC-grade aggregate resources (areas classified as MRZ-2a or MRZ-2b in Step 2 above) are evaluated to determine whether or not current uses of these lands preclude possible future mining. Areas currently permitted for mining and areas found to have land uses compatible with possible future mining are considered available for mining. MRZ-2a and MRZ-2b areas which are not yet developed, but which have Specific Plans approved by local governments, were not

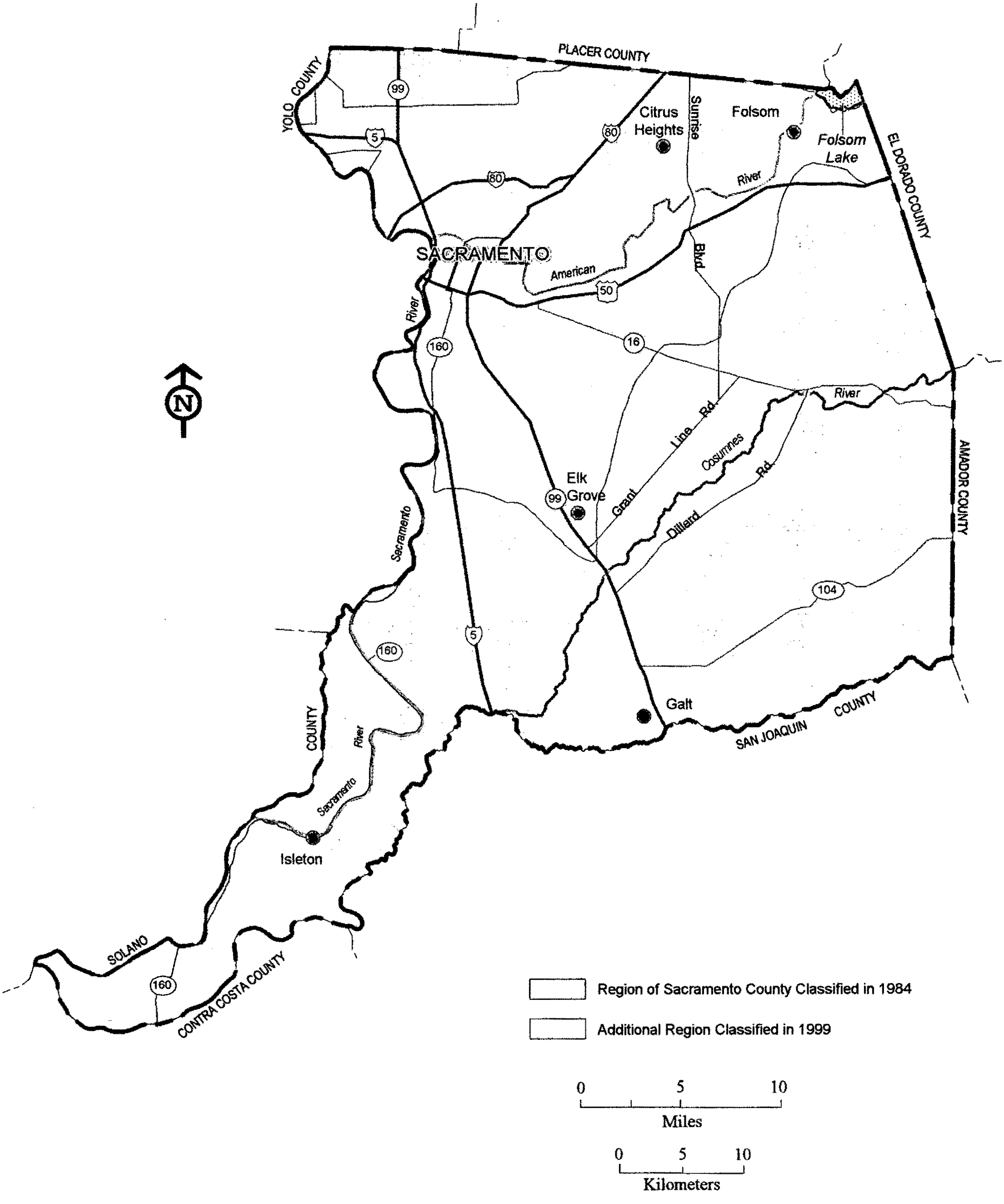

Figure 2. Region classified in Special Report 156, and expanded area classified in this report.

considered to be available for mining. ARAs which identify available land are delineated on Plate 6 and described in detail in this report.

(4) Calculation of Resource Tonnages within ARAs: Investigation and analysis of on-site conditions, measurement of the area extent of deposits, drill-hole information, waste-material percentages, and deposit densities are used to calculate total tonnages of PCC-grade aggregate reserves (deposits in land owned by an aggregate producer and permitted for mining by local governments as of January 1, 1998) and resources (all deposits of PCC-grade aggregate, including the reserves) within each ARA. Calculations reflect conditions of the deposits as of July 1, 1999 and do not include resource depletion since that date.

(5) Forecast of 50-Year Needs and the Life Expectancy of Current Reserves: The total tonnage of aggregate needed to satisfy the demand in Sacramento County over the next 50 years (until 2049) is based on multiplying the projected population over that period with the average annual per capita rate of total aggregate consumption from 1960-1998. Results of this forecast are used to determine the life expectancy of the county's current reserves.

(6) Identification of Alternative Resources: Alternative sources of aggregate to meet the forecasted 50-year demand are identified and briefly considered.

Lead Agency Response to Classification

The SMGB, upon receipt of the classification information from the State Geologist, transmits the classification report to the appropriate lead agencies and makes it available to other interested parties. Within twelve months of receipt of the classification report, each lead agency must develop and adopt mineral resource management policies to be incorporated in its general plan. These policies will:

(1) Recognize the mineral classification information, including the classification maps, transmitted to the lead agency by the SMGB, and

(2) Emphasize the conservation and development of identified mineral deposits.

This report encompasses all of Sacramento County, and lead agencies with jurisdiction within the report area are shown in Table 1.

Table 1. Lead agencies that include counties and incorporated city governments within this report study area.

City of Citrus Heights
+ City of Folsom
City of Galt
City of Isleton
+ City of Sacramento
*+ County of Sacramento

+Agencies that have land classified as MRZ-2a or MRZ-2b for PCC-grade aggregate within their jurisdiction.

*Agencies that have active aggregate operations within their jurisdiction.

Agencies with ARAs within their jurisdiction are underlined.

PART II—CALIFORNIA MINERAL LAND CLASSIFICATION SYSTEM MINERAL RESOURCE ZONE (MRZ) CATEGORIES

The DMG has classified 995.7 square miles of land within Sacramento County. Lands classified are presented in the form of Mineral Resource Zones, or MRZs. Directions for the identification of MRZs are set forth in DMG's Special Publication 51 (SP 51) in the section "Guidelines for Classification and Designation of Mineral Lands" (Division of Mines and Geology, January, 2000).

The guidelines for establishing MRZs are as follows:

MRZ-1: Areas where available geologic information indicates that little likelihood exists for the presence of significant mineral resources.

MRZ-2a: Areas underlain by mineral deposits where geologic data indicate that significant measured or indicated resources are present. As shown on the California Mineral Land Classification System Diagram (Figure 3), MRZ-2 is divided on the basis of both degree of knowledge and economic factors. Areas classified MRZ-2a contain discovered mineral deposits that are either measured or indicated reserves as determined by such evidence as drilling records, sample analysis, surface exposure, and mine information. Land included in the MRZ-2a category is of prime importance because it contains known economic mineral deposits.

MRZ-2b: Areas underlain by mineral deposits where geologic information indicates that significant inferred resources are present. For this report, areas classified MRZ-2b contain discovered mineral deposits that are significant inferred resources as determined by their lateral extension from proven deposits or their similarity to proven deposits. Further exploration work could result in upgrading areas classified MRZ-2b to MRZ-2a.

MRZ-3a: Areas containing known mineral occurrences of undetermined mineral resource significance. Further exploration work within these areas could result in the reclassification of specific localities into MRZ-2a or MRZ-2b categories. As shown on the California Mineral Land Classification System Diagram, MRZ-3 is divided on the basis of knowledge of economic characteristics of the resources.

MRZ-3b: Areas containing inferred mineral occurrences of undetermined mineral resource significance. Land classified MRZ-3b represents areas in geologic settings that appear to be favorable environments for the occurrence of specific mineral deposits. Further exploration

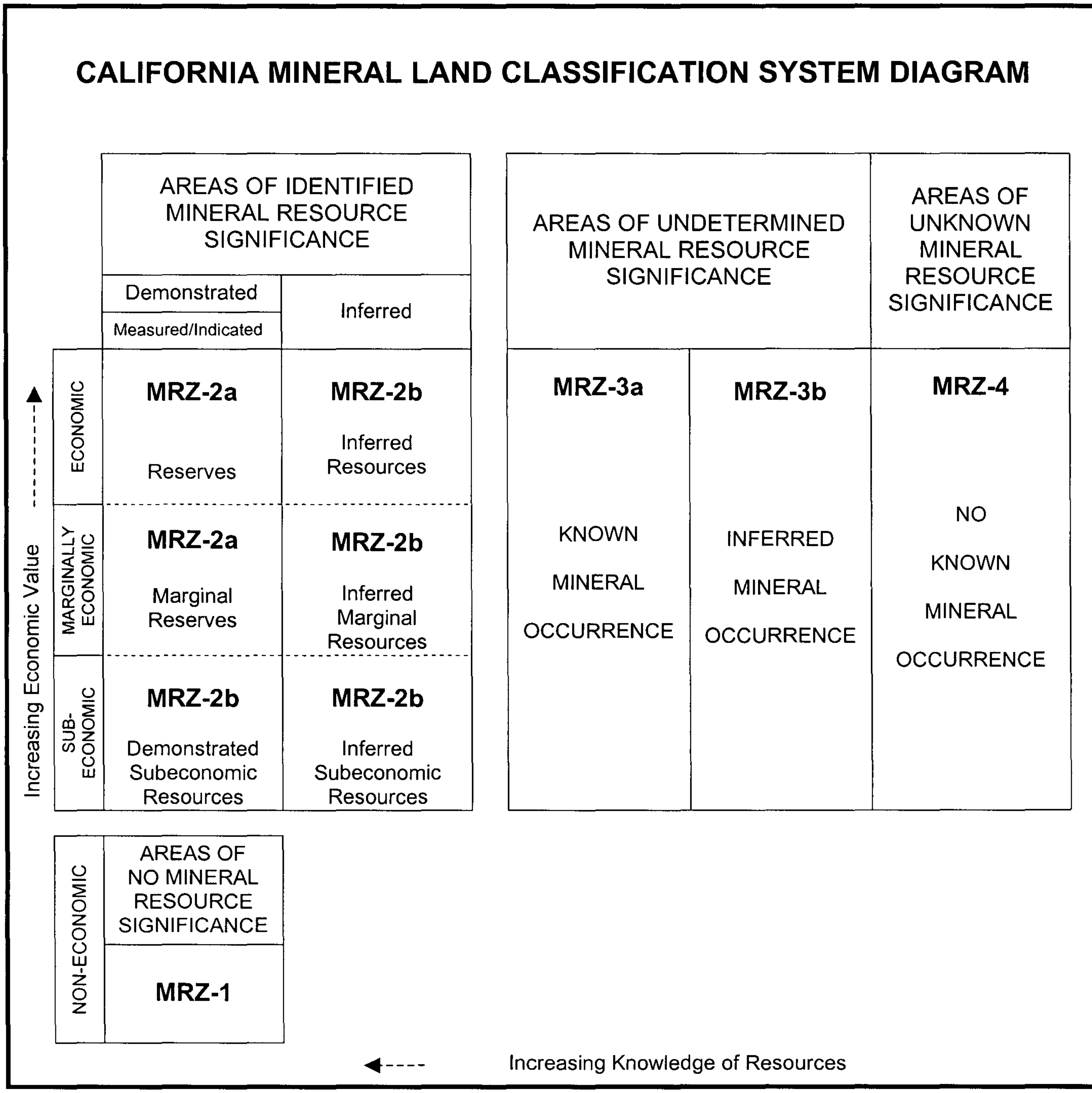

Figure 3. California Mineral Land Classification System Diagram: Diagrammatic relationship of Mineral Resource Zone (MRZ) categories to the resource/reserve classification system. Adapted from U.S. Bureau of Mines and the U.S. Geological Survey (1980).

work could result in the reclassification of all or part of these areas into the MRZ-2a or MRZ-2b categories.

MRZ-4: Areas of no known mineral occurrences where geologic information does not rule out either the presence or absence of significant mineral resources.

The distinction between the MRZ-1 and the MRZ-4 categories is important for land-use considerations. It must be emphasized that MRZ-4 classification does not imply that there is little likelihood for the presence of mineral resources, but rather there is a lack of knowledge regarding mineral occurrence. Further exploration work could well result in the reclassification of land in MRZ-4 areas to MRZ-3 or MRZ-2 categories.

MINERAL RESOURCE/RESERVE CLASSIFICATION NOMENCLATURE

Following are definitions of the nomenclature associated with the California Mineral Land Classification System Diagram (Figure 3). It is important to refer to these definitions when studying the different resource categories shown on the California Mineral Land Classification System Diagram. Particular attention should be given to the distinction between a mineral deposit and a resource and to how a mineral deposit may relate to resources.

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Mineral Deposit: A mass of natural occurring mineral material, e.g. metal ores or nonmetallic minerals, usually of economic value, without regard to mode of origin. The mineral material may be of value for its chemical and/or physical characteristics.

Mineral Occurrence: Any ore or economic mineral in any concentration found in bedrock or as float; especially a valuable mineral in sufficient concentration to suggest further exploration.

Economic: This term implies that profitable extraction or production under defined investment assumptions has been established, analytically demonstrated, or assumed with reasonable certainty. Adapted from: U.S. Bureau of Mines and the U.S. Geological Survey (1980).

Reserves: That part of the resource base which could be economically extracted or produced at the time of determination. For the purposes of this report, the term reserves, as applied to aggregate resources, has been further restricted to include only those deposits for which a valid mining permit has been granted by the appropriate lead agency.

Identified Mineral Resources: Resources whose location, grade, quality, and quantity are known or estimated from specific geologic evidence. Identified mineral resources include economic, marginally economic, and subeconomic components. To reflect varying degrees of geologic certainty, these economic divisions can be subdivided into demonstrated and inferred.

Demonstrated: A term for the sum of measured plus indicated.

Measured: Quantity is computed from dimensions reveled in outcrops, trench workings, or drill holes; grade and/or quality are computed from the results of detailed sampling. The sites for inspection, sampling, and measurement are spaced so closely and the geologic character is so well defined that size, shape, depth, and mineral content of the resource are well established.

Indicated: Quantity and grade and/or quality are computed from information similar to that used for measured resources, but the sites for inspection, sampling, and measurement are further apart or otherwise less adequately spaced. The degree of assurance, although lower than that for measured resources, is high enough to assume continuity between points of observation.

Inferred: Estimates are based on an assumed continuity beyond measured and/or indicated resources, for which there is geologic evidence. Inferred resources may or may not be supported by samples or measurements.

Marginal Reserves: That part of the demonstrated reserve base that, at the time of determination, borders on being economically producible. The essential characteristic of this term is economic uncertainty. Included are resources that would be producible, given postulated changes in economic or technologic factors.

Marginal Resources: That part of the inferred resource base that, at the time of determination, would be economically producible, given postulated changes in economic or technologic factors.

Subeconomic Resources: The part of identified resources that does not meet the economic criteria of marginal reserves and marginal resources.

MINERAL RESOURCE/RESERVE CLASSIFICATION CRITERIA

To be considered **significant** for the purpose of Mineral Land Classification, a mineral deposit, or a group of mineral deposits that can be mined as a unit, must meet marketability and threshold value criteria adopted by SMGB (Division of Mines and Geology, January, 2000). The criteria vary for different minerals depending on (1) their uniqueness or rarity, and (2) their commodity-type category (metallic minerals, industrial minerals, or construction minerals). For example, to be considered significant, the threshold value of the first marketable product for a metallic ore deposit (such as a gold deposit) is $1,250,000 1998-dollars, $2,500,000 1998-dollars for an industrial mineral deposit (such as a diatomite or clay deposit), and $12,500,000 1998-dollars for a construction aggregate deposit (such as a sand and gravel or crushed stone deposit). To adjust for inflation since 1998, each of these values is multiplied by 1.022 (California Department of Finance, Demographic Research Unit, personal communication, 1999) to calculate the threshold values in 1999 dollars. The results are:

Metallic Deposits	$ 1,278,000
Industrial Minerals	$ 2,555,000
Construction Aggregate	$12,776,000

PART III—AGGREGATE ECONOMICS, PROCESSING TECHNOLOGY, GOLD VALUES, GEOLOGY, AND AGGREGATE RESOURCE MINERAL LAND CLASSIFICATION

This section of the report assesses aggregate resources in Sacramento County.

AGGREGATE ECONOMICS

Overview of Construction Aggregate

Sand, gravel, and crushed stone used as aggregate are termed 'construction aggregate.' These commodities provide bulk and strength to PCC, hot mix asphalt, plaster, mortar, and stucco. Construction aggregate is also used as road base, subbase, fill, and a host of other similar products used throughout the construction industry. It provides from 80-100% of the material volume in these products.

An affordable source of construction aggregate is essential to the needs of our modern society. The economic well-being of urban areas throughout California is directly linked to the availability of basic construction materials; aggregate is the preferred infrastructure construction material in Sacramento County and is used in myriad construction projects. Sand, gravel, and crushed rock are used in two forms: either loose, or combined with binding agents such as cement or asphaltum. In its loose form different sizes of aggregate are used for riprap and in foundations such as for roads, structures, backfill, pipe bedding, and leach fields. Sand and gravel combined with portland cement to make PCC are employed in a host of construction applications such as for all-weather freeways, building foundations, aqueducts, dams, and airport runways. When crushed and coated with heated asphaltum, construction aggregate is used as hot mix asphalt to make durable all-weather road and highway surfaces. Hot mix asphalt is more commonly referred to as either 'blacktop' or AC.

Society—the consumers of aggregate—generally understands the important need for construction materials; however, many people do not appreciate the essential conditions required to develop a potential aggregate mine site. Five general criteria are needed to establish an aggregate quarry; the first two are controlled by geology, the next two by physical site conditions, and the final criterion is controlled by societal values (Banino, 1994):

<u>Quality</u>: The material must have the necessary physical and chemical characteristics to meet the engineering specifications of its end use.

<u>Quantity</u>: There must be enough material to economically justify the costs of start-up and operating the mine.

<u>Mineability</u>: The deposit must be economical to mine. The deposit should be configured and located so that it will not require excessive excavation, permitting,

reclamation, or processing costs. If a notable deposit of high-grade aggregate has been built over with houses, freeways, or other structures, it is generally regarded as being precluded from mining.

Accessibility: Adequate access to the regional transportation network and to markets must be available.

Permitability: The site must qualify for all necessary governmental permits.

Rarely is in-place aggregate (the raw material) physically or chemically suited for every type of aggregate use. Every potential deposit must be sampled and tested to determine how much of the material can meet specifications for specific products, and what processing is required for marketing. Specifications for various uses of aggregate material have been established by several agencies, such as the U.S. Bureau of Reclamation, the U.S. Army Corps of Engineers, and the California Department of Transportation (CalTrans). These agencies and aggregate operators test construction aggregate for acceptance by standard test procedures defined by such organizations as the American Society for Testing Materials, CalTrans, and the American Association of State Highway Officials.

Most aggregate specifications have been established to ensure the manufacture of strong, durable materials capable of withstanding the long-term effects of physical and chemical attack from weathering and use. For example, specifications for PCC and concrete products limit the use of aggregate materials containing gypsum, pyrite, zeolite, opal, chalcedony, chert, siliceous shale, volcanic glass, and highly siliceous volcanic rocks. Gypsum lengthens the setting time of portland cement, pyrite dissociates to yield sulfuric acid and iron oxide stain, and other substances containing hydrous silica react with alkali substances in the cement, resulting in deleterious cracks and 'pop-outs.' Alkali-silica reactions in PCC can be minimized by the addition of pozzolanic admixtures such as fly ash.

Aggregate specifications also call for precise particle-size distributions for the various uses of aggregate. Aggregate is commonly classified into two general sizes, coarse and fine. Coarse aggregate is rock retained on a 3/8-inch sieve also called a "#4 U.S. sieve." Fine aggregate passes a 3/8-inch sieve and is retained on a #200 U.S. sieve (a sieve with 200 weaves per inch.) Particles smaller than a #200 mesh sieve are silt- and clay-sized clasts referred to as 'plastic fines.' For some uses, such as asphalt paving, the particle shape and texture are specified. Standard specifications used by CalTrans require that at least 90% by weight of coarse aggregate (1/4-inch to 3/4-inch diameter) used as asphalt aggregate has to be crushed particles. Crushed stone is commonly preferable to alluvial gravel in hot mix asphalt because asphalt adheres better to broken surfaces, and the interlocking arrangement of angular particles in crushed stone strengthens the asphalt (California Department of Transportation, 1988).

Unique Importance of PCC-Grade Aggregate

In this aggregate resource classification study, special emphasis is given to aggregate that meets the specifications used in making PCC. PCC-grade aggregate often can be used for AC because of its similar engineering specifications. The material specifications for PCC and AC aggregates are more rigorous and therefore are more restrictive than aggregate specifications used in other applications. Deposits that are acceptable for use as PCC or AC aggregate are the rarest and most valuable of aggregate resources. Aggregate produced from concrete-grade aggregate deposits can be, and is commonly, used in other lower quality products. Because of this versatility, value, importance in construction, and relative scarcity, concrete-grade aggregate deposits are of major concern when planning for future availability of aggregate commodities.

Aggregate Demand and Price in Sacramento County

California leads the nation in the production of construction aggregate and has some of the largest sand and gravel operations in the world. In 1998 it produced sand and gravel valued at $801 million, and crushed stone valued at $344 million (Kohler-Antablin, 1999). To illustrate our dependence on aggregate, in California, about 35% of all processed aggregate is used in building construction, and nearly half of all mined aggregate is used in road construction and maintenance. California has a network of about 130,000 miles of roadways. An average of 105,000 tons of PCC-grade aggregate is needed in the construction of a mile of six-lane concrete freeway, and an average of 24,000 tons of PCC-grade aggregate is needed in the construction of a mile of a 2-lane asphalt concrete highway (Schenk and Torries, 1975).

The current aggregate demand in Sacramento County is enormous and has increased over the years with population growth. The demand for aggregate over the past 50 years has been chiefly determined by the level of construction activity. From the late 1930s through the 1970s the demand for construction aggregate in Sacramento County was particularly high because, in addition to the intense construction of residential housing and related structures in urbanizing areas, there was several very large local projects that included Interstates 5, 50, and 80, Folsom Dam, the Folsom South Canal, Mather and McClellan Air Force bases, and the Sacramento Airport.

Future aggregate demand in Sacramento County will primarily depend on population growth and its related construction activity. As a result of the continued high population growth rate, the accompanied urbanization is anticipated to place heightened importance on competitive land uses. Such competitive land-use concerns will place an emphasis on successfully exploiting existing PCC-grade sand and gravel resources within Sacramento County. Mining these resources will in turn depend on being able to obtain all the varied governmental permits as well as on several important economic considerations such as distance to market, quality, quantity, rates of urbanization, ease of mining and processing, reclamation costs, and profit.

Even, when adjusted for inflation and despite rising costs associated with permitting, labor, competitive land uses, transport, electrical energy, reclamation, and governmental regulation, the unit price of a ton of concrete-blended aggregate has remained reasonably priced in Sacramento County over the past 20 years. For example, a ton of concrete-blended aggregate in 1978 ran around $2.75 per-ton at the plant; at the time this report was published, it ran about $9.50 per-ton F.O.B. (an old, although common mining acronym for 'Freight-On-Board' meaning 'at the plant site'). When adjusted for an inflation factor of 2.639 calculated from 1978 to July 1999, the 1978 per-ton price equates to $7.25 today. This relative price stability is primarily the result of increased processing efficiency through automation (Rapp, 1975; Dupras, 1988; California Department of Finance oral comm., 1999).

Since the mid 1800s the majority of readily available high-grade sand and gravel resources in Sacramento County have been lost by urbanization, dredging, aggregate mining, and riparian habitat restoration. Throughout the 19th and 20th centuries, most of Sacramento County's aggregate has been supplied by the American River channel and its associated terraces. Most of these resources are no longer viable for mining operations (Plates 3 through 6). As a result of the reduced availability of nearby aggregate resources, it can be anticipated that future prices of aggregate can be expected to rise. Other factors may also raise the future price of aggregate in Sacramento County. Notwithstanding the trend of increasing processing efficiency, the price of aggregate in Sacramento County can be expected to rise due to diminished aggregate quality, and a corresponding increase in aggregate beneficiation costs, and increased transport distances from more distant sources.

Mining and Processing Costs

In comparison with other mined minerals, such as crushed stone and metallic ores, alluvial sand and gravel resources are more cost effective to mine and process. Sand and gravel are extracted by front loader, washed, sized or "classified," and stockpiled by conveyor belts and radial stackers. Small operations often employ portable processing plants. The large aggregate processing plants in Sacramento County are mechanized, very cost efficient, are designed to be adaptable, and can accommodate rapid changes in their processing circuit to meet the demand for a wide diversity of aggregate sizes and products.

In order to amortize the costs of plant construction, permitting, aggregate extraction, processing, reclamation, taxes, as well as employee and company remuneration, the average price of concrete-blend alluvial aggregate in Sacramento County runs about $9.00 to $10.00 per-ton F.O.B. Aggregate transport to the consumer, however, is commonly as expensive as the F.O.B. cost.

Transport Costs

There are several reasons why it is preferable to obtain aggregate from sources near large urbanizing regions, such as the Sacramento metropolitan region. An important consideration is the minimization of transport costs. The farther aggregate is transported the more expensive it becomes. Sand, gravel, and crushed stone are low-value high-bulk volume materials, and the cost of moving such construction aggregate from the plant to the consumer may exceed the sales price of the product at the plant site. When compared with the costs of extracting, processing, marketing, and reclaiming extracted aggregate lands, transport cost is often the decisive factor in determining if a potential aggregate mine is economically feasible.

The preferred mode of aggregate transport in Sacramento County is by trucks because they are efficient, versatile, and economical. Trucks can be quickly loaded with varied aggregate products, and driven to their destination where they can rapidly dump their loads. Standard three-axle aggregate dump trucks haul between 9 and 12.5 tons (18,000 to 25,000 pounds). Larger tandem-trailer five-axle tractors can haul about 24 to 25 tons (48,000 to 50,000 pounds).

Aside from transport costs, other important considerations that limit trucking aggregate from distant sources include: increased wear-and-tear on road surfaces, increased air pollution, added dust, increased noise, and increased traffic congestion. Generally, the marketing range of a permitted aggregate deposit is often confined by competition from other aggregate production sites located nearer the consumer. As a consequence of these transport parameters, the aggregate industry throughout California is characterized as being highly competitive with operators serving localized markets. This is especially noticeable in rapidly urbanizing areas such as Sacramento County.

The following is an example how transport costs affect the final delivered price of aggregate that takes about 1 hour to deliver. In Sacramento County, a 24-ton load of blended concrete-mix aggregate at the plant site generally costs between $9.00 to $10.00 per ton. Hauling a 24-ton aggregate load to a job site at a distance of about 25-30 miles from the plant—or a round trip of about 50-60 miles—can be assumed to take 5-10 minutes to load the aggregate, 5-10 minutes to dump the aggregate at the job site, and 35-45 minutes to make the return trip (an average haul time of about 1 hour). When the remuneration of the truck driver, the costs of the truck amortization, fuel, truck permits, and insurance are factored in, the final delivered price of a 24-ton PCC-grade aggregate load hauled one way for 25 to 30 miles will nearly double the final delivered price, or will commonly run between $350 to $375 when it is delivered to the consumer.

Trucking significant tonnages of PCC-grade sand and gravel from the dredged tailings east of Marysville into the Sacramento metropolitan area, a distance of about 45 miles along Highway 99, would also significantly add to the final delivered price. Similarly, transporting PCC-grade crushed greenstone sources in western Amador

County into the Sacramento metropolitan area, a distance of about 30-40 miles along either Highway 104 or Highway 16, would also significantly increase the final delivered cost. Another problem with these truck transport routes is that they are all relatively narrow 2-lane highways that are commonly choked with commuter traffic during most workdays. Significant escalation in transport costs, dust, noise, air pollution, and traffic congestion from exploiting distant aggregate resources can be avoided by developing deposits nearest to urbanizing centers.

In sharp contrast with trucking aggregate, the economical marketing range of transporting cement is very different. Compared with aggregate, cement is a much higher unit-cost product and can be trucked 250 to 300 miles before the delivered price doubles. Moreover, cement is quite profitable to ship by sea, and many producers in developing countries routinely ship cement great distances to industrialized countries. For example, Thai and South Korean cement costs $10.50 - $14.00 a ton to produce, and $27.50 per ton to ship it across the Pacific Ocean to the west coast of California where it can sell for up to $63.50 per ton: a $22 per ton profit margin (*The Economist*, 1999, p. 66).

AGGREGATE PROCESSING

Future sources of marginal aggregate located in older perched terrace deposits at considerable distances away from active channels will first need to be extensively analyzed for use as PCC-grade aggregate. A grid-spaced drilling program combined with aggregate sampling and industry accepted engineering testing will be needed to determine the suitability of a proposed aggregate source for PCC-grade aggregate. Two promising examples of marginal aggregate deposits in Sacramento County include the extensive dredge tailings in and near Aerojet, and elevated terraces associated with the Cosumnes River.

Washing, crushing, sizing, stockpiling, and blending of alluvial aggregate are processes needed to market it. The more processing alluvial aggregate undergoes, the more valuable it becomes. Similarly, the more processing alluvial aggregate undergoes the more costly it is to sell at a profit. For example, professional mineral appraisers rarely value untested in-place alluvial aggregate resources at more than $0.15 to $0.20 per ton. However, once the aggregate has been proven to be of PCC-grade quality, and processed for concrete-mix it can then be sold for nearly $9.00 to $10.00 per ton F.O.B. in Sacramento County.

Processing Technology and Its Effect on Aggregate Quality and Costs

California's mining industry has greatly benefited from advances in aggregate mining technology, automation, improved mining equipment reliability, and skilled mining personnel. Innovative technological solutions to mining problems are embraced as increased pressures are placed on operators to mine marginal alluvial sand and gravel deposits with minimum impact on the environment. As a consequence, technological advances have enhanced mining performance, efficiency, and profitability. The mining industry has met the combined challenges of rising demand for high-quality alluvial sand and gravel, while at the same time ensuring enhanced beneficiation of more-and-more marginal alluvial aggregate resources. During the past two decades technological advances in aggregate processing, crushing, blasting, computer automation, equipment reliability, as well as a more technologically savvy work force have done much to ensure aggregate quality while optimizing production within rigid cost constraints (Phillips, 1997).

Aggregate mining technology has advanced considerably since the 1970s with such innovative equipment as automated logic control systems, speed sensors, alarms, remote shut-off switches, conveyor belt scales, and flowmeters. Satellites, computers, microprocessors, lasers and a host of other high-tech advances make it more efficient and economical to mine aggregate despite increased costs of transport, reclamation, and environmental regulations. Most large aggregate plants in California today are 100% automated and have advanced methods of aggregate extraction and benefication. The widespread application of computers to aid in extraction, processing, marketing, and even reclamation design prior to commencing mining have streamlined all large-scale aggregate operations in Sacramento County. Automated processes such as conveyor belt tracking, automated aggregate classifying, and concrete and asphalt loading have dramatically improved the efficiency of many aggregate operations.

Of continued concern is the demand for high-performance aggregate products that will meet rigorous engineering specifications—such as gradation, soundness, and shape parameters—while at the same time confronting the problem of mining more-and-more marginal alluvial aggregate resources. To resolve this problem, operators employ a variety of specialized mining equipment such as cone crushers and vertical shaft impact crushers for cost efficiency purposes.

Vertical Shaft Impact Crushers and Cone Crushers

Many types of alluvial aggregate rock types processed in Sacramento County contain hard and brittle igneous and metamorphic rocks that tend to shatter when crushed, producing high percentages of elongated and flat particles. In past years, particle shape was not an issue when aggregate operators manufactured AC. Current AC specifications, however, often require a reduction in rounded natural alluvium and require more cubical-shaped crushed aggregate because it forms a stronger, interlocking asphaltic texture that resists rutting in pavements. Another significant factor is that cubical-shaped aggregate particles are less susceptible to degradation than flat or elongated particles, which have sharp narrow points that can break off during handling and compaction. Laboratory data show that when the same rock type is used, flat or elongated aggregate clasts often have significantly higher losses in Los Angeles abrasion tests than do cubical-shaped clasts.

Because cubical-shaped coarse and fine crushed aggregate have improved durability performance when compared with flat or elongated coarse aggregate and rounded sand, recent engineering requirements, especially for AC, specify that sand-sized aggregate be more cubical shaped. Additionally, the high costs of manufacturing sand from more-and-more marginal alluvial aggregate resources are challenges commonly faced by northern California aggregate operators. In response to this challenge, industry has designed a variety of rock crusher types to manufacture sand: cone crushers, vertical shaft impact crushers, cage mills, hammer mills, and ball mills. The two primary types of crushers preferred by alluvial aggregate operators in northern California are traditional cone crushers and the newer vertical shaft impact crushers. In some cases vertical shaft impact crushers are used in conjunction with cone crushers to produce the desired aggregate products.

The marginal alluvial deposits being mined in Sacramento County have varying percentages of friable clasts, and are deficient in pea-gravel sized and sand sized aggregate needed by the construction industry. Vertical shaft impact crushers are sometimes used by operators to meet the demand for these sizes and to pulverize friable aggregate clasts into various aggregate products. Vertical shaft impact crushers reduce stone by propelling rock clasts into one another and into a piece of very hard and durable "wear iron." Because the force generated for crushing is related to the speed and mass of the rock clast, larger cobble-sized clasts are crushed more easily than smaller gravel-sized clasts. It has a "shattering effect" similar to breaking rock on an anvil. Vertical shaft impact crushers are capable of producing large percentages of crushed rock in the size range between ½-inch and 1/8-inch. Another important advantage of vertical shaft impact crushers is that they produce more cubical-shaped aggregate clasts, a desired texture for AC applications.

The more traditional cone crushers use a different mechanism than vertical shaft impact crushers to break rock. In a cone crusher the introduced rock is compressed in a crushing chamber of wear iron. The chamber consists of an iron bowl and mantle; these act together in a fashion similar to that of a 'mortar and pestle.' As it spins, a cone crusher delivers a consistent crushing pressure to the introduced rock. Comparisons between the tried-and-true cone crushers and the newer vertical shaft impact crushers generally hinge on three variables; (1) the desired aggregate product, (2) the percentage of waste material generated, and (3) the lowest costs to own, operate, and maintain a crusher that is commonly measured by per-ton of product. Impact crushers that process out undesirable soft or friable aggregate are an example of how once marginal aggregate are currently economically processed and upgraded to PCC-grade.

Alluvial Sand and Gravel Versus Crushed Stone Aggregate

The preferred use of one aggregate material over another in construction practices depends not only on specification standards, but also on economic considerations. Alluvial gravel is preferred to crushed stone for concrete aggregate because of important economic considerations. In comparison laboratory tests, however, it is found that concrete strength and durability are similar with concrete made of alluvial sand and gravel as compared with concrete made of crushed stone. Crushed stone can readily replace rounded alluvial sand and gravel for concrete applications in regards to strength and durability when both are of concrete-quality. Nevertheless, there are four reasons why alluvial aggregate is preferred over crushed aggregate for use in PCC:

(1) Concrete flatwork that entails trowling—such as in the finished construction of driveways, sidewalks, and swimming pools—is much easier when rounded alluvial sand and gravel are used to provide the desired smooth-textured finish. The use of crushed stone in flatwork entails finishability problems and is more tedious because it requires more care and time (and in the construction business "time is money").

(2) Compared with alluvial sand and gravel, crushed stone tends to have a rougher surface texture, and the clasts are more angular in shape. As a result when crushed rock is used, the concrete mix requires more cement and water, and is more difficult to mix, pour, and place. Additional cement amounts to a quarter of a 94-pound sack per-cubic-yard of concrete and adds an additional cost of about $1.25 per yard of mix. In some large concrete projects, engineers must make sure all of the air pockets within the concrete are eliminated, and it takes more effort to eliminate air pockets in concrete when crushed stone is used. Customary placement of concrete is accomplished with pumper trucks, however, crushed-rock concrete tends to increase the abrasion on the cylinders, hoses, and tubes.

(3) Crushed stone costs more, as much as $1 per-ton or more F.O.B. in some northern California marketing regions, than comparable alluvial sand and gravel aggregate because of the additional stages of extraction and processing.

(4) Crushed stone entails additional processing problems and undesirable environmental parameters such as blasting, increased fugitive dust, and increased noise resulting in additional governmental permits.

Manufactured Sand

There are basic acceptance requirements for sand sizes whenever aggregate is used in construction projects. High-quality durable sand-sized aggregate is a necessary ingredient for producing PCC (usually with a 25-30% sand fraction), and hot-mix AC (usually containing a 15-20% sand fraction). Sand sizes used in PCC and AC commonly range from coarse sand (3/8-inch) to very fine sand retained on a No. 100 mesh sieve (sand sizes of about the diameter of a sentence period). There are two sources for obtaining sand-sized aggregate—from alluvial deposits and from manufactured sand. Because mining operations are currently occurring in older channel terraces that have undergone extensive in-place weathering, the deposits are generally deficient in useable sand sizes and must manufacture sand to meet demand.

Crushing rock to manufacture sand is much more expensive than separating sand from alluvium. Reducing rock to sand sizes, particularly hard or abrasive rock—such as granite, diorite, or quartzite—dramatically increases crusher wear and maintenance costs. Within Sacramento County, manufactured sand is commonly obtained from reducing boulder- and cobble-sized rocks. As rocks, these clasts are most often combinations of several minerals. However, by the time such rocks are crushed down into sand-sized fractions, each sand grain is composed of a single mineral. For example, in naturally occurring alluvial deposits within Sacramento County the sand-sized fraction commonly contains grains of pure quartz, feldspar, hornblende, augite, magnetite, biotite, and garnet.

Manufactured sand is quite expensive to produce and requires costly equipment; manufactured sand is often the single most expensive factor in processing aggregate for PCC and AC. Estimates of manufactured sand are as much as $1.50 per ton more than processing equivalent sizes of alluvial sand. Moreover, it is more expensive to produce sand-sized aggregate than it is to produce more course-sized clasts. For example, it is commonly more than twice as expensive to manufacture PCC-grade coarse sand and pea-gravel (3/8-inch) sizes than it is to make a 2-inch diameter cobble product from crushed rock. Additionally, to manufacture sand, there is increased associated fugitive dust and noise concerns. For these reasons sand-sized and pea-gravel aggregate from naturally occurring alluvial deposits are much preferred over similar-sized manufactured aggregate from crushed rock resources.

Sand-sized aggregate, generally referred to as 'fine aggregate', is defined as particles that are about 3/16-inch in diameter and smaller. Particles greater than 3/16-inch in diameter are referred to as 'coarse aggregate.' Sand is an essential ingredient in PCC and AC. Historically, there has been a deficiency of sand sizes and pea gravel sized aggregate in the alluvial terrace deposits of Sacramento County. However, there has been an increased demand for high-quality sand-sized gradations due to the rapid growth of PCC and AC products that require rigid sand-sized engineering specifications. Additionally, AC engineering specifications are also requiring more angular sand. These factors are increasing the demand for manufactured sand.

In future years, it may become expedient for operators in Sacramento County to process crushed stone at increased distances from urban areas for use as aggregate. New processing technologies for crushed stone quarries have also become more mechanized and cost efficient during the past decade. The application of global positioning systems (GPS) has improved the accuracy and efficiency of placing blasting grids at quarries. New drilling rigs equipped with GPS now enable miners to sink blast holes in rock without manually marking the hole sites. Geographic information system

(GIS) map displays are increasingly being used to illustrate current mine layout and to propose future mining operations and final reclamation design in operating crushed rock quarries. Additionally, GIS maps can be rapidly and efficiently customized to suit a variety of different formats depending on the interest or demand. In-tandem uses of GPS and GIS enable operators to mine and reclaim areas with more precision than previously. For example, surveyors create mine maps by walking the site while wearing computers in backpacks that incorporate a global positioning system and a geographic information system. The survey electronically records and stores coordinate data from orbiting satellites. The final product is an accurate map that can then be used to calculate reserve and resource tonnages.

FACTORS RELATED TO AGGREGATE ECONOMICS

Recycled Asphalt and Concrete

Recycling PCC and AC have become common practice within Sacramento County and the uses of these recycled materials are expected to grow. It is often more efficient and cost effective to recycle these materials rather than paying expensive tipping fees at land-fills. The increased use of recycled asphalt and demolition concrete during the past 20 years has helped to extend the life of virgin aggregate reserves and resources.

All large aggregate producers in Sacramento County recycle asphalt and concrete to a limited extent and have successfully done so for several years. Currently, recycled materials make up less than an estimated 6% of the annual aggregate production in Sacramento County. Most large consumers of PCC, such as CalTrans, specify that no recycled material will be accepted for use in such common projects as concrete-surfaced roads or bridge abutments. However, recycled AC and PCC materials are gaining popularity and are increasingly being accepted as base, subbase, and fill construction materials. Recycled PCC and AC in Sacramento County are used primarily as subbase and base aggregate. Generally, AC is primarily recycled for use as subbase and base materials because increased air pollution would result if significant amounts of recycled asphalt were used to make new hot-mix AC. Often, portable plants are moved to where old concrete structures are being demolished, the rebar is separated out, the concrete rubble is crushed to the appropriate sizes, mixed with conventional aggregates, and successfully used in base or even in new concrete mixtures.

Engineering tests on concrete made with recycled aggregate show that it can be useful for limited concrete applications. Concrete made with 100% recycled aggregate, however, does not have the compressive strength or the desired mix control when compared with concrete made with conventional aggregates. Concrete made with 100% recycled aggregate requires strict mix design specifications (often determined by trial-and-error), often requires about 5% more cement in the mix, and is of lower density because of the lower specific gravity of the old cement mortar attached to the aggregates. Additionally, there is up to a 20% reduction in tensile strength and the water requirements are unpredictable; the resultant mix is commonly hard to pour and finish. Nevertheless, additives of conventional aggregates mixed with lesser percentages of recycled concrete have been proven quite acceptable for such projects as sidewalks and concrete pads for housing (Hansen, 1992).

Vernal Pools

Vernal pools are small ephemeral ponds that fill with winter rain, bloom in the spring, then dry out and remain dormant throughout the summer and fall. Prior to the 1970s, vernal pools were called 'hog wallows.' Both Teichert Aggregates and Granite Construction are spending considerable time and effort reclaiming mined aggregate sites back into vernal pool habitats in north-central Sacramento County. Increasingly, vernal pool areas in Sacramento County have become a source of tension between environmentalists, who want to preserve them, and developers, growers, and miners, who want to develop them. Some vernal pool animal species are listed by the federal government as endangered and are protected.

By-Product Gold from Construction Aggregate

The placer gold deposits that occur in alluvial gravels in Sacramento County originated from hydrothermally emplaced gold-bearing lode quartz veins that formed during the Jurassic in various Paleozoic and Mesozoic metamorphic and granitic rock types within the Sierran Foothills Belt (Curtis and others, 1958). Over the intervening 150 million years since its emplacement, the rising Sierra Nevada in combination with weathering processes eroded these lode gold-bearing rocks, and streams transported the placer gold downstream to where it was redeposited within alluvial gravels. Massive amounts of gold-bearing alluvial sediments gradually accumulated in the eastern margins of the Sacramento Valley.

Undredged alluvial sand and gravel deposits in eastern and central Sacramento County contain placer gold. However, current mining and reclamation costs make it uneconomical to recover the placer gold from these alluvial deposits unless the gold is recovered as a by-product of sand and gravel mining. When alluvial sand and gravel are processed for aggregate, it is often economical to extract placer gold. Most aggregate operations in Sacramento County that extract sand and gravel from undredged deposits also recover by-product placer gold values that generally range from $0.35 to $0.75 per cubic yard of processed aggregate when gold is at $300 per ounce (Thompson, 1992). In the current competitive economic environment, placer gold recovery has become an important source of revenue for aggregate mining operations. In addition to the inherent value that high-quality alluvial resources have, operators often find it economically viable to consider a by-product gold recovery circuit when planning on extracting undredged alluvial materials for aggregate. The procedures to determine the gold content, recovery methods, necessary equipment and

State of California
DEPARTMENT OF TRANSPORTATION

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: DISTRICT DIRECTORS

Date: November 18, 2011

From: MALCOLM DOUGHERTY
Acting Director

Subject: **Aggregate Resource Policy Statement and Tools**

This memo is in response to multiple requests from resource developers, planning departments, and California Department of Transportation (Caltrans) staff about our policy toward mining projects. It clarifies the policy and provides tools for districts to encourage an increased supply of aggregate materials statewide.

Our policy is that Caltrans will continue to work with local and State agencies to help gain approval of new aggregate mining sites throughout the state, acknowledging the need for an increased aggregate supply. As a responsible agency under the California Environmental Quality Act, however, we do not endorse specific mining projects. In light of this, Caltrans will provide the technical assessment and information pertaining to availability locally as well as infrastructure needs of aggregate projects in your region, including education of local stakeholders and early public engagement regarding long-term aggregate issues.

The following tools are attached to aid you in this regard:

- A sample letter that can be addressed to our local and regional transportation planning partners. This letter outlines our policy toward mineral resource development in general.
- The 2011 update of the Construction Aggregate Supply Limitations Fact Sheet.
- The 2006 Department of Conservation Map Sheet 52, which shows the permitted aggregate materials supply in relation to projected demand over 50 years.

The above tools were developed in support of an ongoing consortium known as the Aggregate Availability Group. This group, as per its 2009 charter, includes management and staff-level representatives from the Caltrans Divisions of Planning, Design, and Construction, the California Business, Transportation and Housing Agency, the California Department of Conservation, the California Construction and Industrial Materials Association, and the Governor's Office of Planning and Research. One of the main goals of this effort has been to produce maps and other tools to engage the public, legislators, and local jurisdictions. These staff will apprise you of new materials as they become available.

Please take the time to review the attached tools. This issue is as important as ever, and it is my hope that ongoing collaboration will help us secure the resources that we need to provide world-class transportation options for years to come.

Attachments:
(1) Sample Policy Statement Letter
(2) Construction Aggregate Supply Limitations Fact Sheet
(3) Department of Conservation Map Sheet 52, Aggregate Availability in California

STATE OF CALIFORNIA—BUSINESS, TRANSPORTATION AND HOUSING AGENCY nor

DEPARTMENT OF TRANSPORTATION
<DISTRICT>
<ADDRESS>
<CITY, STATE, ZIP>
<PHONE>
<FAX >
<WEB URL>

Flex your power!
Be energy efficient!

<DATE>

<Name>
<Title>
<Organization>
<Street Address>
<City, State, Zip Code>

Dear<RECIPIENT>:

As you are aware, aggregate resources play a vital role in our efforts to build and improve our State's infrastructure. Indeed, our State's mineral resource development is essential to our economic well-being, as well as our intentions to grow more responsibly and provide the safest, fastest, and most efficient transportation options possible. While it is important that we find ways to meet our current needs for construction materials, we must also anticipate future demand and expand our aggregate supply in an environmentally appropriate and culturally circumspect manner. In doing so, we prepare our future generations to navigate the challenges that our State will face as population increases and accessible resources grow scarce.

Throughout the State, attention is being given to what is increasingly seen as an urgent resource issue. The recently enrolled Assembly Bill 566 (Galgiani, 2011) codified several legislative findings, among them that mineral extraction is essential to the needs of society, and that the development of local mineral resources is vital in reducing truck emissions in our State.

The California Department of Transportation (Caltrans) continues to coordinate with public decision-makers, the construction industry, and government officials in exploring opportunities to improve the reclamation and permitting processes and increase California's aggregate supply. While the pressure for resources has eased for the last three years due to a sharp decline in residential construction, the transportation sector continues to build projects and the housing market is showing signs of regaining strength. This is not a time to relax our efforts, but to redouble them in anticipation of full economic recovery.

In the last five years, Caltrans has delivered approximately 1,700 highway projects worth $19 billion that were moved into construction. There are currently 825 construction contracts underway with a contract value that exceeds $10 billion. Highway projects are only one part of the story, however, as local and regional agencies continue to maintain and improve the roads in their jurisdictions.

In addition to the outlay of the traditional transportation agencies, the California High Speed Rail Authority expects to break ground on the first 179 mile stretch of its high-speed railway in fall 2012. This section, from Merced to Bakersfield, will require over five million tons of sand, gravel, and crushed stone, which is about four percent of the total production that the State saw in 2009.

With the passage of SB 391 (Liu, 2009) and SB 375 (Steinberg, 2008), Caltrans and local transportation agencies were challenged to conceive of new ways to reduce greenhouse gas (GHG) emissions while providing world class transportation facilities for our constituents. The statewide modal plans and Regional Transportation Plans, which shape California's transportation future, outline extensive improvements to the current system. Yet, between long truck hauls averaging 50 miles and international importing of materials, the GHG impact of aggregate delivery continues to mount. An increased aggregate reserve that is closer to construction sites is key to addressing our dire air quality and climate change concerns.

While we are continuing to work with local and State agencies to help gain approval of new aggregate mining sites throughout the state, there is still much to be done to ensure that these essential resources will be available for development in the far reaches of our long-range plans. I would like to encourage you to explore new strategies to increase aggregate reserves in your region, including education of local stakeholders, early public engagement, and willingness to collaborate in the mitigation of environmental and transportation system impacts from aggregate production and distribution.

The attached Fact Sheet provides information on the potential economic, social, air quality, and environmental factors that are affected by local aggregate supply. This is a good starting point for collaborative discussions that aim to find solutions to issues regarding aggregate availability. Also attached is a map that shows statewide aggregate supply and demand.

Finally, I would like to invite you to contact <CALTRANS DISTRICT REPRESENTATIVES> (http://www.dot.ca.gov/localoffice.htm), who are available upon request to speak at public meetings in your area regarding the importance of increasing California's aggregate supply in an environmentally sustainable manner. While the permitting of new mining facilities must be done with attention to all of the possible impacts to surrounding areas, Caltrans encourages the development of new sources for construction aggregate. Our economy and our environment depend on it.

Please share this information with your planning commissions, city councils, and county boards of supervisors.

Thank you in advance for helping to improve mobility across California.

Sincerely,

<Signature Block Name>
District Director

Attachments:
(1) 2011 Construction Aggregate Supply Limitations Fact Sheet
(2) Department of Conservation Map Sheet 52, *Aggregate Availability in California*

Construction Aggregate Supply Limitations
Some Estimates of Economic Impact–November 2011

- Aggregates are low-value, heavy-weight building materials used in construction, including sand, gravel, crushed stone, and recycled concrete. Aggregates are mined and either used as raw material (for example, as foundations) or serve as composite materials in the production of concrete and asphalt. The main end markets for aggregates include private residential construction (34 percent), commercial construction (17 percent), and public infrastructure projects (43 percent, including 26 percent for public highways, streets and transit).

- Aggregates are usually shipped from quarries or production sites close to their end market because transportation is a major element in the cost of delivered aggregates and the cost depends on the distance of the delivery. According to the industry, shipping costs for aggregates can outweigh production costs if the material is trucked more than 20 miles.[1] Permitting new aggregate sites would lead to shorter haul distance to minimize transport/shipping cost.

- According to the California Geological Survey (CGS), California has an estimated 74 billion tons of aggregate resources underlying mineral lands classified by the State Geologist. However, only about six to seven percent have actually been permitted by local agencies for mining activities. Permitting of mining sites is difficult and time consuming due to environmental, land development, and zoning laws, and could take between five and ten years. At the current rate of production, available aggregate supply in some areas in the State could be depleted in a decade.

- According to the California Department of Finance, housing construction activity in California more than doubled between 1996-2005, the longest sustained growth period in recent history; but experienced more than 80 percent decline during 2006-2009 (from 209 to 36 thousand units). Despite a 23 percent rebound in housing construction spending in 2010, overall construction industry in California remains depressed. This has contributed to a significant reduction in both production and value of construction aggregate in recent years.

- According to the CGS, California produced 133.5 million tons (valued at $1.4 billion) of construction sand, gravel, and crushed stone in 2009, compared to 237.3 million tons (valued at $1.9 billion) in 2006, an almost 44 percent drop since 2006. The transportation of 133.5 million tons of construction aggregates generates about 5.3 million truckloads (@ 25 tons per truck), or a total of 10.7 million truck trips a year (including empty trucks returning to the aggregate sites) related to the transportation of construction aggregates in the State.

- According to the Teichert Construction and West Coast Aggregates, Inc. the average hauling distance for aggregates in California may be as high as 50 miles. Truck transportation accounts for about 99 percent of shipping aggregates for 40 miles or less.[2] At an average 50-mile distance, the total aggregate-truck VMT would be 535 million miles per year (10.7 million trucks x 50 miles).

- Let us assume that permitting additional mining facilities would reduce the average hauling distance from 50 to 35 miles statewide. Using an average hauling distance of 35 miles, the total annual aggregate-truck miles of travel would be 375 million miles (10.7 million trucks x 35 miles). The 15-mile shorter hauling distance would reduce aggregate-truck miles of travel by 160 million miles per year (535-375), and annual diesel fuel consumption by 20 million gallons [using California Air Resources Board (CARB) diesel fuel consumption rate of 0.13 gallons per vehicle-mile at 55-60 mph speed].

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[1] Therese Dunphy, "Evening the Playing Field," *Aggregates Manager*, August 2006.
[2] Tina Grady Barbaccia, "Off-highway Transportation," *Aggregates Manager*, July 2006.

- A recent University of California, Berkeley study[3] confirms that the most likely, and dominant, effect of the opening of new sites for the production of construction aggregates would be a reduction in truck miles of travel for hauling aggregates (i.e., new quarry will be located closer to the users to minimize transportation costs), thus a reduction in emissions from trucks.

- Based on the CARB emission factors estimates, and assuming an average 55-60 miles per hour speed, a reduction of 160 million miles of truck travel (or 20 million gallons of diesel fuel consumption) would reduce truck emissions (CO, NOx, PM10, SOx, VOC, and CO2) by about 22,436 tons a year.

- The total transportation cost of aggregates (at $0.10 per ton per mile) shipped 35-miles average distance throughout California would be $936 million (10.7 million trucks x 25 tons x 35 miles x $0.1), and over $1.3 billion if shipped an average distance of 50 miles. The statewide transportation cost savings of reduced hauling distance would amount to $376 million a year (or a 30 percent cost savings).

- The California Department of Transportation (Caltrans) estimates that on average, about $2.5 billion is spent on State and local capital outlay projects each year, and on average, aggregates account for 8-10 percent of total project costs, or about $250 million annually. A 30 percent increase/decrease in shipping cost of aggregates would increase/decrease the total annual project costs by $75 million per year.

- The reduction in aggregate-related truck miles of travel would also reduce traffic congestion and traffic accidents on roads, but these impacts would be difficult to estimate. An additional benefit from truck trip reduction would be reduced pavement deterioration. Caltrans expects to spend about $700 million annually on pavement rehabilitation projects. Assuming trucks account for 60 percent of the pavement damage on the State highways, and aggregate-trucks on average account for 5 percent of all heavy truck travel on the State highways, the trucks shipping aggregates would account for about $20 million of cost savings in the pavement rehabilitation each year.

- Project delays due to lack of aggregate supply in the area, would also result in project cost escalation and reduced user benefits (reduced travel time and accidents) that would have otherwise been generated. A delay of 10 percent of the projects (or $250 million in capital outlay expenditures) for one year would increase the cost of the State and local capital outlay program by $13 million a year (at 5 percent average cost escalation factor).

- Generalizing, and pro rating, the user benefits estimated for the 2008 Interregional Transportation Improvement Program projects, a delay of ten percent of the capital outlay program for one year could also cost California about $97 million in increased roadway congestion and traffic accidents.

In conclusion, the overall picture may indicate that the concerns over the limited supply of construction aggregates may have eased for now due to the severe housing decline and economic slowdown. However, over the long run, with the eventual housing and economic rebound, the supply-demand imbalance will continue for many areas. Meanwhile, for some specific localities and construction projects, the challenge of adequate and cost-effective supply of construction aggregates persists.

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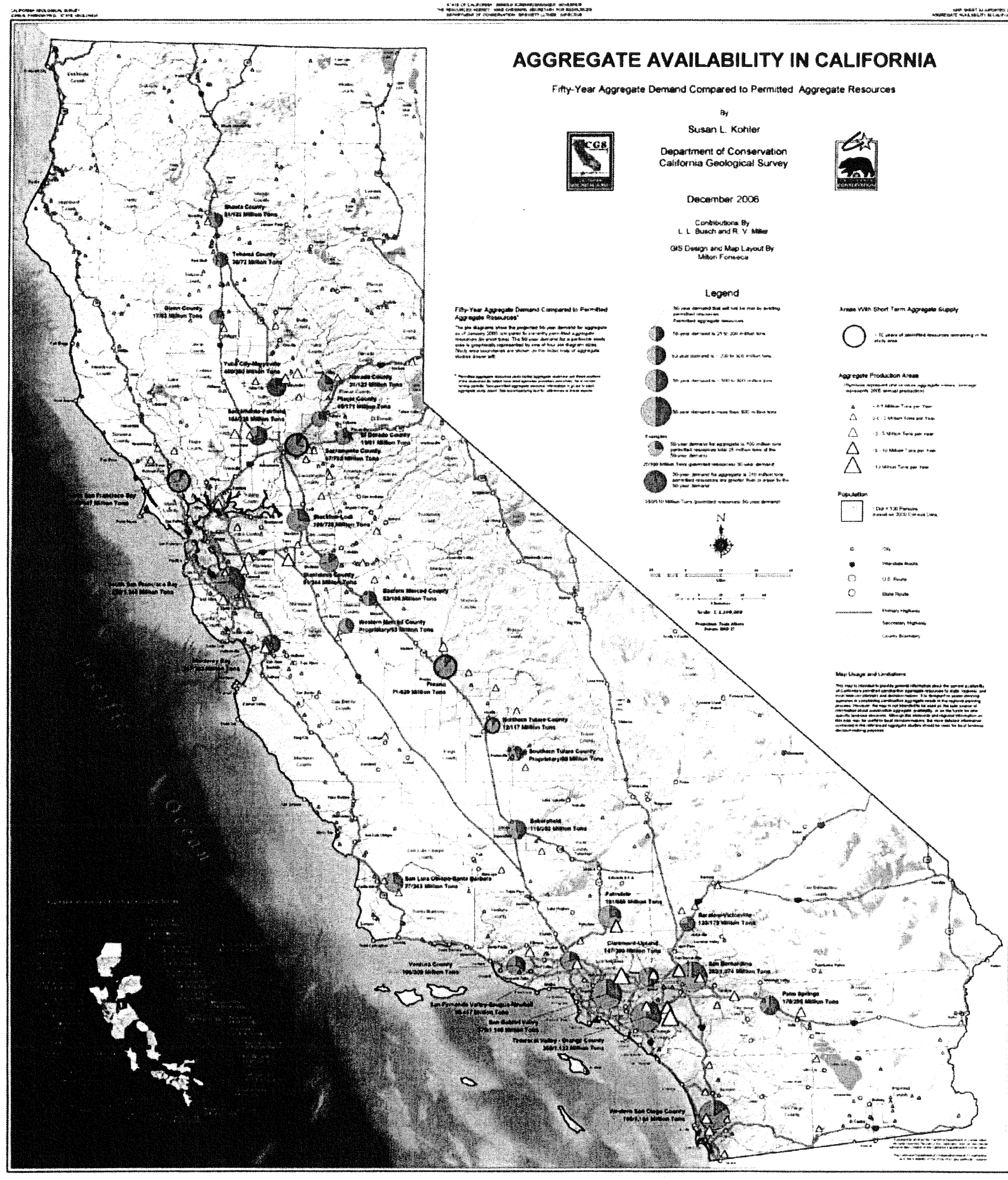
[3] Peter Berck, "A Note on the Environmental Costs of Aggregates," *Working Paper No. 994*, Dept. of Agricultural and Resource Economics and Policy, University of California, Berkeley, January 2005.

Attachment 3



APPENDIX C

TECHNICAL REPORTS FROM THE CERTIFIED 2008 FEIR

17 SUMMARY OF IMPACTS AND THEIR DISPOSITION

SIGNIFICANT EFFECTS WHICH CANNOT BE AVOIDED

Approval of the project will result in several significant effects in the areas of aesthetics, air quality and climate change that cannot be avoided. These effects are as follows:

AESTHETICS (CHANGES TO THE LANDFORM)

- The project will irreversibly change the landform from gently rolling to a 70-75 foot deep mining pit. There is no feasible mitigation to reduce this significant aesthetic impact.

AIR QUALITY

- The project's particulate emissions would ~~exceed~~ *result in exceedance* of California ambient air quality standards. Soil wetting, chemical dust suppressants, and other management practices can help reduce particulate matter impacts; however, even with these practices impacts are significant and unavoidable.

- The project's NOx emissions would exceed thresholds established by the Sacramento Metropolitan Air Quality Management District (SMAQMD). The SMAQMD has suggested mitigation to reduce impacts; however, not below significant levels.

CLIMATE CHANGE

- The project is expected to annually contribute 2041.4 metric tons of CO_2 to the atmosphere during its expected 12 year lifetime. Mitigation to reduce the project's greenhouse gas emissions is proposed consisting of 75% "soft" and 25% "hard" mitigation and will result in both qualitative and quantitative reductions and offsets. However, even with the described mitigation, this project's cumulative climate change impacts are considered significant and unavoidable.

SIGNIFICANT EFFECTS WHICH COULD BE AVOIDED WITH IMPLEMENTATION OF MITIGATION MEASURES

Approval of the project will result in the following significant effects in the areas of land use, aesthetics, public services, public safety, traffic, noise, geology and soils, ground water hydrology, surface water hydrology, biological resources and cultural resources, which could be avoided with implementation of mitigation measures:

LAND USE

- The project has the potential to create significant nuisance impacts upon three nearby residences. While mitigation measures will reduce nuisance impacts to a less than significant level, the proposed mining activities will nonetheless remain noticeable to surrounding residents and it is acknowledged that these impacts are perceived differently by various individuals.

AESTHETICS (OVERALL VISUAL IMPACT)

- The overall visual impact of surface mining can result in potentially significant aesthetic impacts due to removal of vegetation and soil, and due to the visibility of mining equipment. Mitigation has been included to reduce impacts to less than significant including implementation of the proposed reclamation and mining plans or substantially similar plans that contain elements that assure the at-grade protection of Laguna Creek, the continuation of the Laguna Creek Corridor Preserve, and the enhancement and revegetation of the preserve area through creek meandering and native revegetation.

PUBLIC SERVICES

- Mining could eliminate the functionality of the planned alignment of the future Laguna Creek Interceptor, Section 4 (LC-4) for gravity sewer service. Mitigation to reduce impacts to less than significant includes site reclamation performed in a manner that will accommodate future gravity construction of the Laguna Creek Interceptor through the project site.

- Mining in the vicinity of Laguna Creek could result in the loss of this resource for use as a planned off street pedestrian/bicycle/equestrian trail. Mitigation to reduce impacts to less than significant includes dedication of land to the Southgate Recreation and Parks District for the planned Laguna Creek bicycle, pedestrian and equestrian trail system in cooperation with the Sacramento Valley Open Space Conservancy (SVOSC) to determine areas that will provide limited public access from the trail to the surrounding Laguna Creek Corridor preserve, consistent with the needs of species..

PUBLIC SAFETY

- Mining can result in unstable slopes resulting in slope failures. This can damage property and harm people. With mitigation, stable slopes will be achieved and no public safety impacts are expected from slope instability. Further, required fencing and warning signs will prevent the inadvertent entry of the public into the mining areas. The required reclamation plan and financial bonding assurances will ensure that the site is returned to a stable landform even if the mining company were to abandon the site.

TRAFFIC

- The concentration of heavy haul trucks utilizing the site may impact nearby structural paving materials and reduce pavement life and serviceability. This potentially significant impacts can be reduced to less than significant levels with mitigation requiring the applicant to make repairs caused by the mining trucks.

- Mining can result in slope failures with the potentially significant impacts of reducing the structural integrity of the roadway or causing roadway failures. As discussed in the Geology and Soils chapter, a 30 foot setback is considered sufficient to minimize the risk of slope failure to surrounding uses and would reduce impacts to less than significant. .

NOISE

- The noise generated by overburden removal and normal mining activities at the site would be expected to exceed the nighttime median noise level standard at the nearest residences. Mitigation for both of the above conditions will reduce impacts to less than significant and specifies that both overburden removal and mining operations shall be limited to the daytime hours (7 a.m. – 10 p.m.).

GEOLOGY AND SOILS

- During and after mining the project could result in unstable slopes that pose a hazard to people, roadways or property. Mitigation has been included requiring a minimum of 1.5:1, horizontal:vertical, reclaimed pit side slopes, proper compaction and erosion protection.

- The project may impact paleontological resources by uncovering and disturbing fossils. Mitigation requiring an action plan, in the event of discovery, to assess and/or preserve the fossils will reduce impacts to less than significant.

- Post reclamation, the project may not support agriculture as proposed unless the site is restored for agricultural purposes. Therefore mitigation has been included to require that mining and reclamation activities are conducted in a manner which, at a minimum, maintains the existing agricultural value of site soils.

GROUND WATER HYDROLOGY

- The travel distance for infiltrating surface water and any associated pollutants will be lessened as a result of the mining operation, increasing the risk of groundwater contamination. Mitigation regulating the application of toxics and pollutants to the pit floor and the requirement for an Agricultural Management Plan for any agriculture other than non-irrigated pasture has been included and will reduce this impact to less than significant.

SURFACE WATER HYDROLOGY

- Laguna Creek floodwaters could enter the mining pit, resulting in headcut erosion that could breach the banks of Laguna Creek. Therefore a temporary flood control berm is proposed along the east bank of the creek and the southern property line. However, this confinement of the creek would increase the floodplain to the west of the creek and therefore a temporary detention basin is proposed on the existing mining site north of Florin Road. Mitigation requiring this design would reduce impacts to less than significant.

- Post mining Laguna Creek’s flows and floodplains could be altered if the flow of water into the abandoned pit is not controlled and the restored creek may not have a stable stream bed, bank or meander belt. Mitigation that would reduce these impacts to less than significant includes implementation of the proposed reclamation plan and installation of a side channel weir as described in the Drainage Study in order to provide flood storage similar to the pre-project conditions such that creek levels are equal to pre project condition and design of the low-flow meander belt such that it maintains a natural stability of the stream bed and bank relative to width, depth and meander.
- The project proposes a temporary detention basin that could potentially attract wildlife hazardous to aircraft operations within five miles of Mather Airport. Potential bird air strike impacts would be reduced to less than significant levels with mitigation that includes building a steep sided basin, controlling vegetation around the basin, monitoring for wildlife attraction and actively discouraging wildlife (birds) from utilizing the basin if it proves to be an attractant.

BIOLOGICAL RESOURCES

- Foraging habitat for a variety of raptors and birds, including but not limited to, the short eared owl, tricolored blackbird, Swainson’s hawk and burrowing owl, would be removed as active mining progresses. With mitigation requiring, phased mining, concurrent reclamation, and the restoration and enhancement of the Laguna Creek Corridor this impact is reduced to less than significant.

- The project will result in impacts to 8.93 acres of seasonal wetlands, 2.58 acres of man-made ponds and 0.15 acres of vernal pools. The vernal pools are presumed to contain federally protected branchiopods. With mitigation this potentially significant impact can be reduced to less than significant.

- Mining will destroy potential nesting habitat for tricolored blackbirds. Mitigation requiring pre construction surveys and avoidance of active colonies will reduce this impact to less than significant

- Mining the site could result in direct take of an active burrowing owl burrow. This is a potentially significant impact which can be reduced to less than significant with mitigation requiring pre-construction surveys and adherence with CDFG guidelines.

- The site contains habitat suitable for ground nesting raptors and other migratory birds that would be destroyed in the course of mining. Mitigation requiring pre construction surveys and avoidance of active nests will reduce this impact to less than significant

- Mining will occur within 30 feet of an elderberry bush (habitat for the valley elderberry longhorn beetle) which may result in potentially significant indirect impacts. These impacts can be reduced to less than significant levels by mitigation consistent with the 1999 USFWS guidelines including avoidance areas, fencing, employee training and signage.

- The project would result in the loss of pond and marshy habitats suitable for pond turtles. In addition, there is a potential for the direct loss of pond turtles during mining. This impact can be reduced to less than significant levels by mitigation requiring pre-construction surveys and capture and relocation as necessary.

- There is a potential that stream enhancement activities in Laguna Creek could impact Sanford's arrowhead. Mitigation for Sanford's arrowhead, including avoidance and/or transplanting would reduce potential impacts to less than significant.

CULTURAL RESOURCES

- The possibility exists for potentially significant unidentified cultural materials to be encountered on or below the surface during the course of future mining activities. Mitigation has been added to ensure that impacts to potential subsurface cultural resources by ground disturbance from future mining are less than significant.

EFFECTS FOUND NOT TO BE SIGNIFICANT

Impacts associated with traffic, toxic air contaminants, groundwater consumption and service providers are considered less than significant. They are as follows:

TRAFFIC

- The proposed project does not seek to increase the existing plant capacity or to extend the operating permit timeline beyond what is already permitted nor is it expected to increase truck traffic over current levels. Truck access and hauling routes are not proposed to change.

TOXIC AIR CONTAMINANTS

- A health risk assessment determined that the expected cancer risk from the project is 2.2 in one million and not a significant impact.

GROUND WATER CONSUMPTION

- The project's groundwater consumption in the context of the Central Groundwater Basin is less than significant and already included in the baseline condition.

SERVICE PROVIDERS

- With the exception of sewer service and parks and recreation as discussed under the Public Services heading above, no impacts to public service providers such as the sheriff's department, fire department, schools etc. are expected.

IRREVERSIBLE ENVIRONMENTAL CHANGES

An irretrievable commitment of natural resources, including aggregates harvested for urban uses, the use of petrochemicals during mining, and the overall change of the landform are considered irreversible changes.

CUMULATIVE IMPACTS

The project has significant and unavoidable air quality impacts related to emissions of ozone precursors and particulate matter. These emissions will add cumulatively to the air quality problem in the region. The project also results in the emissions of green house gases which may not be entirely offset by mitigation; this will cumulatively add to the climate change problem.

Approval of this project will facilitate a County detention basin project that may have additional environmental impacts. Both the expansion site and original mining site have been proposed for utilization as detention basins by the Sacramento County Department of Water Resources for purposes of flood control and ground water recharge. This has been discussed in the Surface Water Hydrology Chapter. The Sacramento Aggregates mine expansion project is separate and independent from the County's potential detention basin project and is not reliant on, nor proposed for the purposes of facilitating the county detention basin project. However, under CEQA, cumulative impacts are defined to include closely related reasonably foreseeable future projects (14 CCR Sections 15130(b)(1) and 15355). The County's detention basin use of the site is considered reasonably foreseeable. The County's detention basin project would be a use of a portion of the same site but later in time, by a different project proponent, and under separate environmental review. However, to the extent that this project may facilitate the County detention project and that the County detention project may result in additional environmental impacts; this project is considered to cause a potential cumulative impact.

GROWTH INDUCING IMPACTS

The project site is located in close proximity to urban growth areas and resources harvested from the site would be used to supply development consistent with adopted land use plans and policies within Sacramento County, adjacent cities, and possibly beyond. The contribution to growth-inducing impacts resulting from the project is minimal and no extension of urban infrastructure is necessary to facilitate the project. Therefore, growth-inducing impacts are considered less than significant.

AIR QUALITY IMPACT ANALYSIS

FOR

TRIANGLE ROCK PRODUCTS, INC.
EXPANSION OF
SACRAMENTO AGGREGATES OPERATIONS

Prepared for:

Triangle Rock Products, Inc.
11501 Florin Road
Sacramento, California 95830

Prepared by:

Impact Sciences, Inc.
Air Quality Technical Services Group
3256 Penryn Road, Suite 220
Loomis, California 95650

April 2007

SUMMARY

Triangle Rock Products, Inc. currently operates an aggregate (sand and gravel) mining and processing facility in Sacramento in an undeveloped region of Sacramento County. Triangle Rock Products is proposing an expansion of its mining operations and has requested an air quality assessment in accordance with the Sacramento Metropolitan Air Quality Management District's (SMAQMD) *Guide to Air Quality Assessment in Sacramento County* (District Guide) for preparation of environmental review documents under the California Environmental Quality Act (CEQA).

The SMAQMD recommends that the District Guide be used for projects that are likely to result in air quality impacts in Sacramento County. The District Guide recommends the following significance criteria for air quality impact assessments in environmental review documents:

- The project will result in operational emissions of either of the two primary precursors of ozone, reactive organic gases (ROG) and oxides of nitrogen (NO_X), in excess of 65 pounds per day (lbs/day); and

- The project will cause an exceedance of an air quality standard, or may make a substantial contribution to an existing exceedance of an air quality standard. "Substantial" is defined as making measurably worse, which is 5 percent or more of an existing exceedance of an ambient air quality standard.

This study evaluates air quality impacts of NO_X and nitrogen dioxide (NO_2), ROG, and respirable particulate matter less than 10 microns (PM_{10}). The sources of NO_X, ROG, and PM_{10} at the facility include:

- Mobile equipment (i.e., heavy-heavy-duty trucks [HHDTs] and off-road equipment);

- Fugitive dust from trucks and off-road equipment traveling on unpaved surfaces; and

- Loading operations onto trucks and conveyors.

The proposed expansion will provide a source of new aggregate materials. The equipment used at the existing site will be transferred to the proposed expansion site; therefore, the production rate and operating hours will remain the same as the current rate and hours. The number of workers and worker commutes will also remain unchanged. Thus, one operating scenario representing potential operating conditions at the proposed expansion site was evaluated. The production rates used in this assessment are based on the best estimate of the current and anticipated future peak production rates.

Using these thresholds of significance, this air quality impact analysis predicts that the net change in emissions of ROG and NO_X would not exceed the 65 lbs/day threshold for each pollutant. However, emissions of PM_{10} are expected to result in net changes in ambient concentrations, relative to existing

conditions, in excess of the 5 percent threshold for both the 24-hour and annual California ambient air quality standards near the boundary of Triangle Rock Products' property. These exceedances are predicted to occur at the residential receptors located directly east and south of the project site.

While the modeled 24-hour and annual net PM_{10} impacts are predicted to exceed the significance thresholds, such exceedances would occur only if (1) the actual background concentrations were as high as those used in this analysis, (2) the amount of activity (e.g., number and types of equipment, hours of operation, process rates) assumed in this analysis actually occurred, and (3) the meteorological conditions in the data set used in the dispersion modeling analysis occurred in the vicinity of the project site during the peak operating periods.

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1.0 INTRODUCTION

Triangle Rock Products, Inc. currently operates an aggregate (sand and gravel) mining and processing facility in Sacramento in an undeveloped region of Sacramento County. The current operations are located at 11501 Florin Road in the County of Sacramento, just west of Sunrise Boulevard and the Folsom South Canal and south of the Jackson Highway in Section 6 of Township 7N, Range 7E. Aggregate mining and processing operations are currently permitted on approximately 249 acres under Sacramento County Use Permit (01-ZGB-UPB-0107). This existing site is currently being mined in Phases VII and VIII. Triangle Rock Products is proposing an expansion of its mining operations and has requested an air quality assessment in accordance with the Sacramento Metropolitan Air Quality Management District's (SMAQMD) *Guide to Air Quality Assessment in Sacramento County*[1] (District Guide) for preparation of environmental review documents under the California Environmental Quality Act (CEQA).

The proposed expansion site includes approximately 100 acres of a 125-acre parcel of open grazing land located immediately south of Florin Road. The expansion site's eastern boundary is the Folsom South Canal and the western boundary is 50 feet east of the eastern top bank of Laguna Creek. Triangle Rock Products proposes to transfer its existing mining equipment to the expansion site, although use of the equipment for reclamation activities will continue in the existing mining site. Material mined from the proposed site will be transferred to the existing processing plant by electric-powered conveyor via a conveyor tunnel under Florin Road.

Triangle Rock Products' proposed expansion will emit criteria pollutants, including oxides of nitrogen (NO_X), reactive organic gases (ROG), and respirable particulate matter (PM_{10}) from mobile equipment and trucks associated with these operations. Carbon monoxide (CO) and sulfur oxides (SO_X) are also emitted from the proposed mine expansion. This analysis evaluates the net emissions and net change in ambient levels of criteria pollutants that would result from the proposed project, and compares these levels to the thresholds of significance identified in **Section 1.1, Thresholds of Significance**.

1.1 Thresholds of Significance

For this analysis, air quality impacts were considered significant if the project would result in any of the following, which are based on *CEQA Guidelines* Appendix G (Title 14, California Code of Regulations, Section 15000 et seq.):

- Violate any air quality standard or contribute substantially to an existing or projected air quality violation; or

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1 Sacramento Metropolitan Air Quality Management District, *Guide to Air Quality Assessment in Sacramento County*, July 2004.

- Expose sensitive receptors to substantial pollutant concentrations.

In addition, the SMAQMD recommends that the District Guide be used for projects that are likely to result in air quality impacts in Sacramento County. The District Guide recommends that project impacts should be considered significant if certain conditions are met. Applicable conditions include the following:

> *The project will result in operational emissions of either of the two primary precursors of ozone, ROG and NOx, in excess of 65 pounds per day (lbs/day).*
>
> *The project will cause an exceedance of an air quality standard, or may make a substantial contribution to an existing exceedance of an air quality standard. "Substantial" is defined as making measurably worse, which is 5 percent or more of an existing exceedance of an ambient air quality standard.*

Criteria pollutants are air pollutants for which the U.S. Environmental Protection Agency (U.S. EPA) or the California Air Resources Board (ARB) has established ambient air quality standards. For purposes of this assessment, project emissions of the ozone precursors ROG and NO_X and of PM_{10} and impacts on ambient levels of nitrogen dioxide (NO_2) and PM_{10} were evaluated. The impacts on ambient ozone levels due to a single project cannot be assessed with existing air quality models. The impacts on carbon monoxide (CO) and sulfur dioxide (SO_2) levels are anticipated to be minor and less than significant due to the following reasons: (1) existing background concentrations, as measured through representative monitoring stations closest to the project site, are well below ambient air quality standards; (2) the allowable sulfur content of diesel fuel, which is used in mobile equipment and trucks associated with the project operation, was reduced substantially commencing in mid-2006; and (3) high localized CO concentration are generally associated with congested intersections in urban areas.

The District Guide indicates that a project would have a significant air quality impact if it would exceed any air quality standard or contribute substantially to an existing air quality exceedance. Projected emissions of NO_X and PM_{10} were modeled to determine if any applicable state or federal AAQS could be exceeded or if a substantial contribution to an existing exeedance could occur. A substantial contribution is equal to 5 percent of the standard, according to the SMAQMD. The modeled impacts were added to the background concentrations at the nearest monitoring station in Sacramento County to determine if the impacts would exceed ambient air quality standards for NO_2 or PM_{10}. While California and National Ambient Air Quality Standards have been established for PM_{10}, the more stringent California standards were used in this analysis. Due to the reasons listed above, modeled impacts from CO and SO_X emissions were not evaluated as they are highly unlikely to exceed applicable ambient air quality standards.

1.2 Existing Air Quality

1.2.1 Regional Air Quality

The proposed project is located in Sacramento County in the southern portion of the Sacramento Valley Air Basin (SVAB). The Sacramento Metropolitan area, which includes all or portions of Yolo, Solano, Sutter, Placer, El Dorado, and Sacramento Counties, is classified as a serious nonattainment area for the federal 8-hour ozone standard and is classified as a serious nonattainment area for the state 1-hour ozone standard. Sacramento County is designated as an unclassifiable/attainment area for the federal 1-hour and 8-hour CO standards, and designated as an attainment area for the state 1-hour and 8-hour CO standards. Also, it is designated as an unclassifiable/attainment area for the federal NO_2 standard and as an attainment area for the state NO_2 standard. The County has been designated as a moderate nonattainment area for the federal 24-hour and annual PM_{10} standards (although PM_{10} levels in the region have been less than the federal standards for several years) and as a nonattainment area for the state 24-hour and annual PM_{10} standards.[2,3] Sacramento County is designated as an unclassifiable/attainment area for the federal 3-hour, 24-hour, and annual SO_2 standards, and designated as an attainment area for the state 1-hour and 24-hour SO_2 standards.

1.2.2 Local Air Quality

Table 2, Peak Background Concentrations for Sacramento County for the Period of 2003 to 2005, shows the peak background concentrations of NO_2 and PM_{10} at the nearest monitoring stations located in Sacramento County. While the closest monitoring station is in Sloughhouse, this station does not monitor these pollutants. The closest stations that monitor NO_2 and PM_{10} are located 13th and T Streets and on Branch Center Road, respectively, in Sacramento. These stations are approximately 13 miles northwest and 6 miles northwest of the project site, respectively. These are the values on which the ambient air quality analyses for NO_2 and PM_{10} are based for the purpose of determining if the project would result in or contribute substantially to an exceedance of ambient air quality standards. For background concentrations of PM_{10}, the California samplers and test methods were used as they result in more conservative measurements than samplers using federal reference or equivalent methods.

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2 California Air Resources Board. "Area Designations (Activities and Maps)." [Online] [September 29, 2006]. http://www.arb.ca.gov/desig/desig.htm.

3 U.S. Environmental Protection Agency. "Region 9: Air Programs, Air Quality Maps." [Online] [August 15, 2006]. http://www.epa.gov/region9/air/maps/maps_top.html.

Table 1
Peak Background Concentrations for the Period of 2003 to 2005

Pollutant	Averaging Period	Unit	2003	2004	2005
Nitrogen Dioxide (NO_2)	1 hour	ppm	0.084	0.072	0.071
	Annual	ppm	0.017	0.017	0.016
Respirable Particulate Matter (PM_{10})	24 hours[1]	µg/m³	77.0	45.0	64.0
	Annual[1]	µg/m³	28.8	25.4	25.3

Source: California Air Resource Board Air Quality Database http://www.arb.ca.gov/adam/welcome.html.
[1] *Values reported using the California test method.*

2.0 SOURCE DESCRIPTION

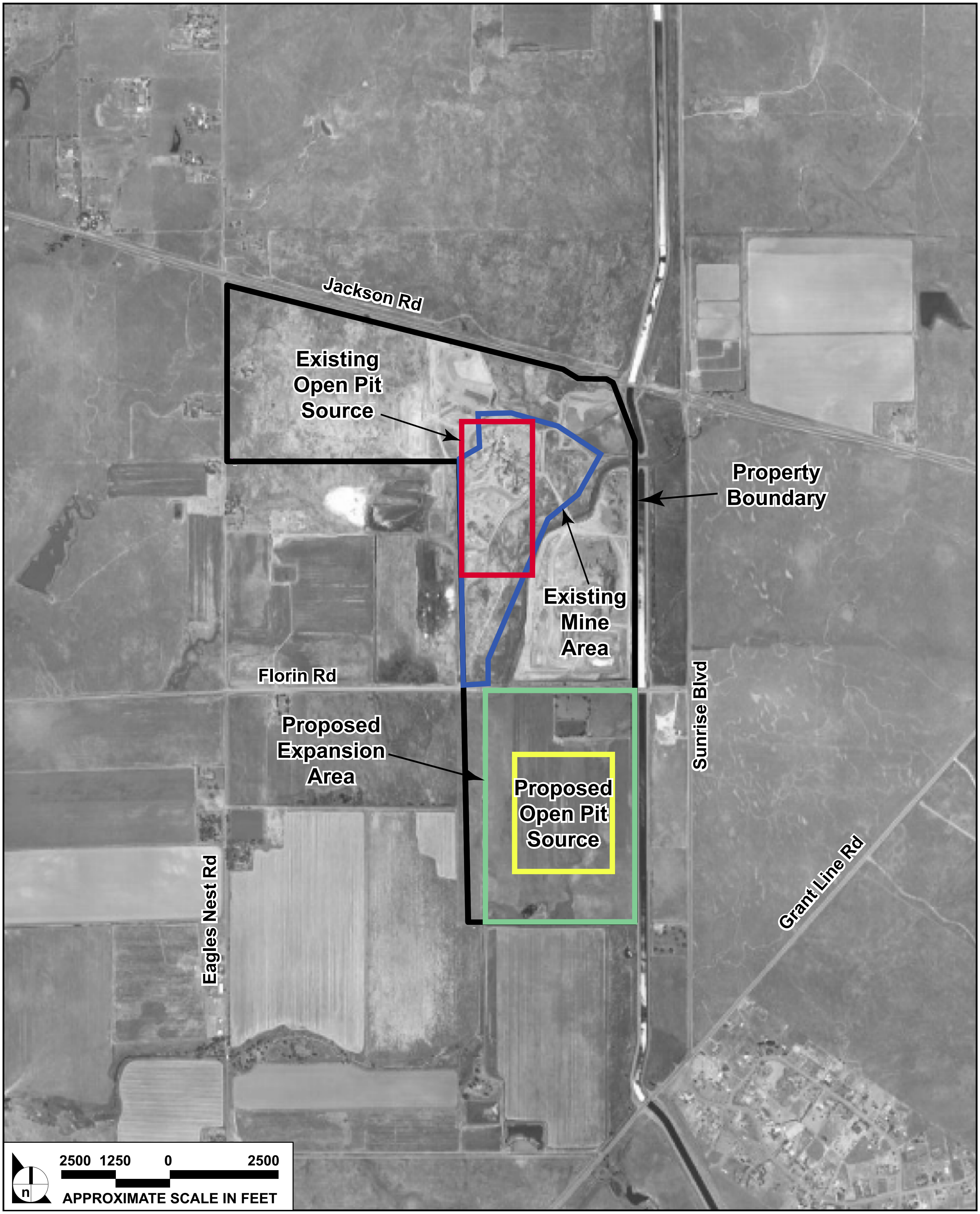
Figure 1, Source Locations – Mine Operations, shows the location of the existing mine area and the proposed expansion area of the Triangle Rock Products mine in Sacramento County.[4] Three sources were identified for analysis of the mine expansion as sources of NO_X, ROG, and PM_{10} emissions:

- General activity areas for mobile mine equipment (i.e., heavy-heavy-duty trucks [HHDTs] and off-road equipment);
- Unpaved surfaces generating fugitive PM_{10} emissions from mobile mine equipment; and
- General activity areas for loading of aggregate haul trucks and conveyor.

3.0 ACTIVITY DATA

Triangle Rock Products currently conducts operations at its mine located in Sacramento County. Since the majority of the existing equipment, if not all, will be moved to the proposed mine expansion site, for the purpose of this assessment, the emissions from mobile equipment and trucks are estimated at the anticipated capacity levels of the expansion area. Reclamation activities will still be going on during the initial operation of the expansion site; however, the operations would not be concurrent for the most part. The mine equipment and their annual operating hours are shown in **Table 3, Mine Equipment Operating Hours**. The mine is assumed to operate six days per week during the hours of 7 AM to 4 PM with a one-hour break period. All equipment would operate six days per week except the motorgrader, which would operate up to three times per week.

4 Some of the areas depicted in the figure are the volume and open pit sources used in the dispersion model. See **Section 5.0, Modeling Methodology**, for a further description of these sources.



SOURCE: Google Earth – 2006, Impact Sciences, Inc. – January 2007

FIGURE 1

Source Locations – Mine Operations

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Table 2
Mine Equipment Operating Hours

Equipment	Model	Hours/Day	Hours/Year
Dozer	Caterpillar D9R	4	1,248
Motorgrader	Caterpillar 140H	2	312
Excavator	Hitachi EX1200	8	2,496
Loader	Caterpillar 988F	8	2,496
Loader	Caterpillar 988F	8	2,496
Water Truck	Peterbilt 357	2	624
Service Truck	Peterbilt 384	1	312
Haul Truck	Euclid R40-C	8	2,496
Haul Truck	Euclid R40-C	8	2,496

Source: Triangle Rock Products, Inc.

4.0 CALCULATION OF EMISSIONS

4.1 Mobile and Stationary Engine Exhaust Emissions

The NO_X, ROG, and PM_{10} emission sources at the mine consist of off-road mobile equipment (e.g., front-end loaders) and on-road heavy-heavy-duty diesel trucks (HHDTs) used for watering the unpaved surfaces and providing miscellaneous services. These sources emit NO_X, ROG, and PM_{10} as a part of their exhaust emissions.

To determine whether the project exceeds the daily SMAQMD thresholds for ROG and NO_X, this analysis calculates the net emissions increase from the existing mine site to the proposed mine expansion site. As the existing equipment will be transferred to the proposed expansion site, using a net emissions approach is appropriate. The baseline year for this type of analysis is determined by the year in which the project Notice of Preparation (NOP) is submitted. It is anticipated that the NOP will be submitted in 2007; thus, the baseline emissions will be calculated in this year. The proposed expansion site emissions were calculated in year 2013, which is the end of the first phase of the proposed mine. This provides a conservative estimate for project emissions since the location of the nearest residential receptor is adjacent to the first phase of the proposed expansion.

The NO_X, ROG, and PM_{10} emissions from off-road mobile equipment were calculated using the emission factors (grams per brake-horsepower-hour) from the ARB OFFROAD emissions inventory model. The emission factors include an initial emission factor based on the equipment model year and a deterioration rate that accounts for increased emissions as the equipment is used. For this analysis, deterioration rates for each of the off-road equipment applicable to calendar years 2007 and 2013 were used. Model years and horsepower ratings for the off-road equipment were provided by Triangle Rock Products. The emissions for the off-road mobile equipment were calculated using the following equation:

Emission Factor (g/BHP-hr) × Engine Rating (BHP) × Load Factor ÷ 453.6 g/lb = Pounds/hour

Pounds/hour × Hours/year = Pounds/year

The NO_X, ROG, and PM_{10} emission factors for on-road HHDTs were determined from the ARB's motor vehicle emission inventory program, EMFAC2002.[5] These trucks are diesel-fueled HHDTs. EMFAC2002 can generate emission factors for different classes of motor vehicles and model years within a county for a particular study year. For this analysis, Sacramento County and calendar years 2007 and 2013 were selected in EMFAC2002. Model years for the HHDTs were provided by Triangle Rock Products. An inventory of PM_{10} emissions corresponding to a vehicle speed of 15 miles per hour was used to generate emission factors for on-site travel by the trucks. This vehicle speed was assumed to be the average speed at which trucks would travel in and around the expansion site. The EMFAC2002 emission factors, expressed in grams per mile, were extracted from the program based on an ambient temperature of 60 degrees Fahrenheit and a relative humidity of 50 percent. The emission factors include exhaust emissions while trucks are starting, running, and idling.

The daily miles traveled for each on-site truck were estimated from the average vehicle speed and daily operating hours. The emission factors were then multiplied by the daily miles traveled to obtain daily emission rates and annual emission rates in units of pounds per day and pounds per year, respectively. In summary, the hourly and annual on-site truck emissions were calculated using the following equations:

Daily Distance Traveled (miles) × Emission Factor (g/mi) ÷ 453.6 g/lb = Pounds/hour

Annual Distance Traveled (miles) × Emission Factor (g/mi) ÷ 453.6 g/lb = Pounds/year

The resulting calculated emissions from the mobile equipment and trucks associated with the existing mine and the mine expansion are summarized below in **Table 3, Summary of Criteria Air Pollutant Emissions from Mine Operations**. Detailed emission calculations are provided in **Appendix A** to this air quality impact analysis.

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5 California Air Resources Board. *EMFAC2001 Version 2.08/EMFAC2002 Version 2.20 – Calculating Emission Inventories for Vehicles in California, User's Guide*, undated.

4.2 Fugitive Dust Emissions from Travel on "Unpaved Roads"

The emission factors for fugitive dust from equipment traveling on unpaved surfaces at the mine were determined using calculations in Section 13.2.2 (Unpaved Roads) of the U.S. EPA's *Compilation of Air Pollutant Emission Factors* (AP-42).[6] The silt content of the unpaved surfaces was assumed to be 8.3 percent.[7] The emissions were calculated for each of the equipment listed in Table 3 above. Information on mean vehicle weights (i.e., an average of fully loaded vehicle weight and empty vehicle weight) was obtained from manufacturer's data or other publicly accessible data and ranged from 15 tons to over 120 tons.

To control fugitive dust emissions, SMAQMD Rule 403 (Fugitive Dust) requires:

> *"A person shall take every reasonable precaution not to cause or allow the emissions of fugitive dust from being airborne beyond the property line from which the emission originates, from any construction, handling or storage activity, or any wrecking, excavation, grading, clearing of land or solid waste disposal operation. Reasonable precautions shall include, but are not limited to:*
>
> 1. *Use, where possible, of water or chemicals for control of dust in the demolition of existing buildings or structures, construction operations, the construction of roadways or the clearing of land.*
> 2. *Application of asphalt, oil, water, or suitable chemicals on dirt roads, materials stockpiles, and other surfaces which can give rise to airborne dusts; or*
> 3. *Other means approved by the Air Pollution Control Officer."*

To comply with Rule 403, Triangle Rock Products waters unpaved surfaces regularly throughout the day during dry weather. The control efficiency for watering disturbed areas three to four times per day was assumed to be 68 percent.[8] In summary, the hourly and annual emissions for unpaved surfaces were calculated using the following equations:

$$\text{Daily Distance Traveled (miles)} \times \text{Emission Factor (lb/mi)} = \text{Pounds/hour}$$

$$\text{Annual Distance Traveled (miles)} \times \text{Emission Factor (lb/mi)} \times (1\text{- Control Efficiency}) = \text{Pounds/year}$$

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6 U.S. Environmental Protection Agency. *Compilation of Air Pollutant Emission Factors*, Section 13.2.2 (Unpaved Roads), December 2003.

7 U.S. Environmental Protection Agency. *Compilation of Air Pollutant Emission Factors*, Section 13.2.2, Table 13.2.2-1 (Haul Road), December 2003.

8 South Coast Air Quality Management District control efficiency for watering disturbed areas at construction sites three times per day [Online] [September 2, 2005]. http://www.aqmd.gov/ceqa/urbemis.html.

Triangle Rock Products does not anticipate any changes in personnel, operating schedule, maximum daily miles traveled, or maximum capacity; therefore, it is assumed that the net change in maximum daily fugitive dust emissions due to travel on unpaved roads is zero (i.e., there would be no change in emissions between the baseline and proposed project cases).

The resulting calculated emissions from the mobile equipment and trucks associated with existing mine and the mine expansion are summarized in **Table 3, Summary of Criteria Air Pollutant Emissions from Mine Operations**. Detailed emission calculations are provided in **Appendix A** to this air quality impact analysis.

4.3 Fugitive Dust Emissions from Loading/Handling Operations

The emission factors for fugitive dust from handling operations at the mine were determined using calculations in Section 13.2.4 (Aggregate Handling and Storage Piles) of the U.S. EPA's *Compilation of Air Pollutant Emission Factors* (AP-42).[9] The emissions were calculated for the loading of aggregate onto a conveyor from off-road loaders and unloading of soil/overburden from haul trucks. The emission factor takes into account mean wind speed, material moisture content, and a dimensionless particle size multiplier. The mean wind speed, based on 1985 data from the Sacramento Executive Airport, is 6.93 miles per hour. The moisture content is 6 percent, as indicated by Triangle Rock Products. The particle size multiplier is 0.35.[10] According to data received from Triangle Rock Products, the facility handles approximately 6,300 tons of aggregate per day. In summary, the hourly and annual emissions for loading and handling operations were calculated using the following equations:

Daily Material Handled (ton/day) × Emission Factor (lb/ton) = Pounds/day

Annual Material Handled (ton/year) × Emission Factor (lb/ton) = Pounds/year

Triangle Rock Products does not anticipate any changes in the maximum amount of material handled; therefore, it is assumed that the net change in maximum daily fugitive dust emissions due to material handling is zero (i.e., there would be no change in emissions between the baseline and proposed project cases).

The resulting calculated emissions from the mobile equipment and trucks associated with the existing mine and the mine expansion are summarized below in **Table 3, Summary of Criteria Air Pollutant**

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9 U.S. Environmental Protection Agency. *Compilation of Air Pollutant Emission Factors*, Section 13.2.4 (Aggregate Handling and Storage Piles), January 1995.

10 U.S. Environmental Protection Agency. *Compilation of Air Pollutant Emission Factors*, Section 13.2.2, Table 13.2.2-1 (Haul Road), December 2003.

Emissions from Mine Operations. Detailed emission calculations are provided in **Appendix A** to this air quality impact analysis.

Table 3
Summary of Criteria Air Pollutant Emissions from Mine Operations

	Pounds/Day			Pounds/Year		
Source	**ROG**	**NO_X**	**PM_{10}**	**ROG**	**NO_X**	**PM_{10}**
Project Emissions (2013):						
Off-road Mobile Equipment	13.93	214.75	9.03	4,297	66,531	2,789
On-road Trucks	0.11	1.33	0.06	34.54	416.45	19.02
Unpaved Surfaces	—	—	273.41	—	—	81,864
Loading/Handling	—	—	3.81	—	—	1,189
Subtotal	14.04	216.08	286.31	4,332	66,947	85,861
Baseline Emissions (2007):						
Off-road Mobile Equipment	10.64	181.10	6.41	3,275	56,042	1,974
On-road Trucks	0.09	1.31	0.06	29.34	409.58	18.77
Unpaved Surfaces	—	—	273.41	—	—	81,864
Loading/Handling	—	—	3.81	—	—	1,189
Subtotal	10.73	182.41	283.69	3,304	56,452	85,046
Net Change (Project less Baseline)	**3.31**	**33.67**	**2.62**	**1,028**	**10,495**	**815**
SMAQMD Thresholds:	65	65	—	—	—	—
Exceeds Threshold?	No	No	—	—	—	—

*Source: Impact Sciences, Inc. (**Appendix A**).*

5.0 MODELING METHODOLOGY

The USEPA-approved dispersion model AMS/EPA Regulatory Model (AERMOD)[11] was used for the analysis to model the dispersion of the criteria pollutants (AERMOD input and output files are included in **Appendix B**). AERMOD can estimate the air quality impacts of single or multiple sources using actual meteorological conditions. The model was configured with the following control parameters:

- Modeling switches: regulatory defaults, except for TOXICS option;
- Averaging periods: 1-hour (NO_2), 24-hour (PM_{10}), and annual (NO_2 and PM_{10});
- Choice of dispersion coefficients based upon land-use type: rural; and
- Particle Deposition: dry.

Meteorological data from a monitoring station located at the Sacramento Executive Airport for January 1, 1985, to December 31, 1985, were used for the surface conditions while data from a monitoring station

11 Lakes Environmental Software, ISC-AERMOD View (Version 5.6.0).

located at Oakland International Airport for the same time period were used for the upper air conditions in AERMOD. The District Guide specifically recommends calendar year 1985 for dispersion modeling analyses because the 1985 meteorological data tend to produce the most conservative results of the recent meteorological data sets. Both monitoring stations were operated in accordance with U.S. EPA and ARB protocols during the given time frame. The AERMOD Meteorological Preprocessor (AERMET) was used to organize and process the meteorological data into a format suitable for use by AERMOD. The meteorological data were extracted by AERMET and the data quality was assessed through a series of quality assessment checks. AERMET then merged the meteorological data and estimated the necessary boundary layer parameters for dispersion calculations. Two files were produced by AERMET which included (1) a surface file of hourly boundary layer parameter estimates and (2) a profile file of multiple-level observations of wind speed and direction, temperature, and standard deviation of the fluctuating components of the wind.

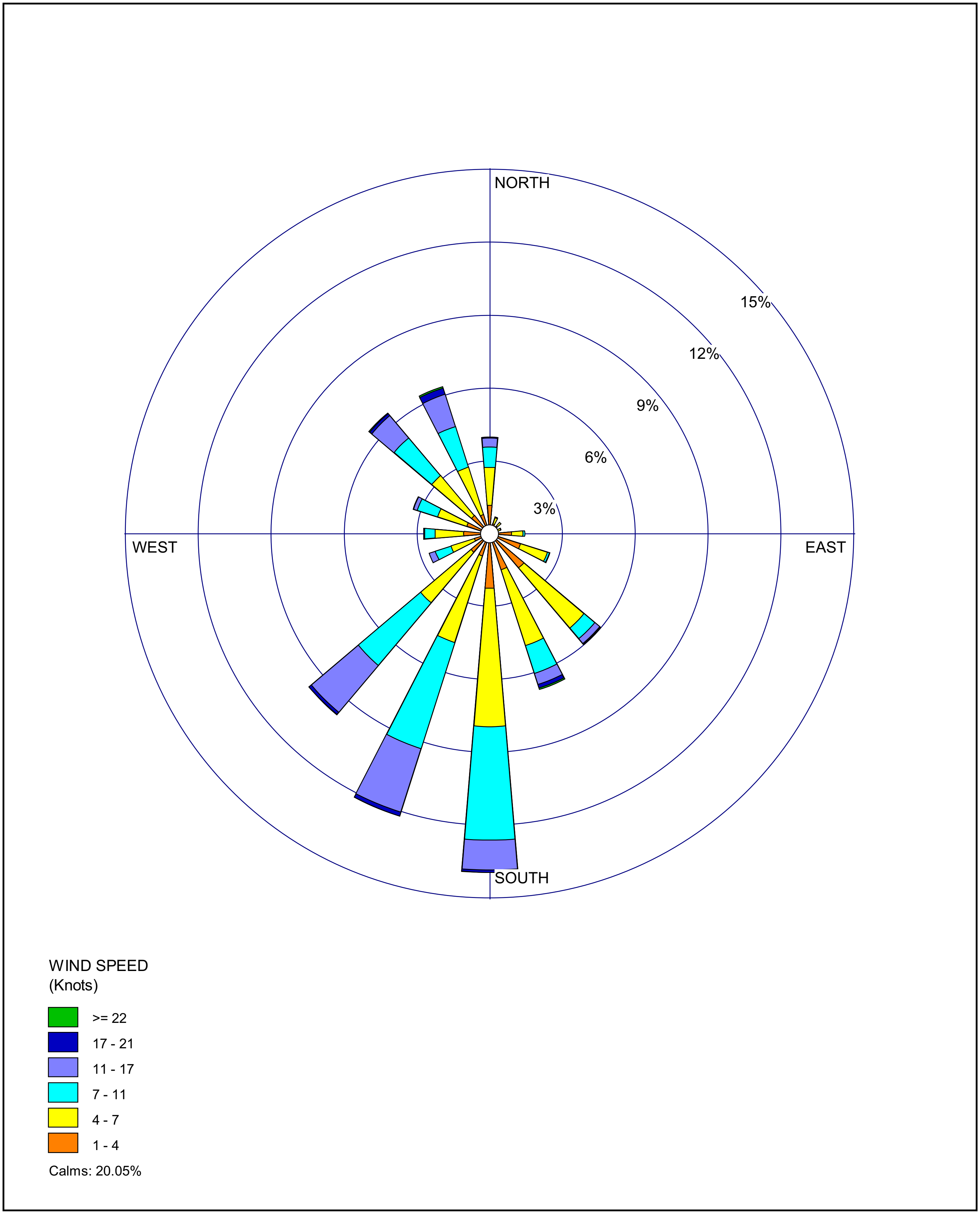
The Sacramento meteorological monitoring site is approximately 13.3 miles west of the proposed expansion site and is the closest surface meteorological monitoring station to the project area. The Oakland meteorological monitoring site is approximately 70 miles southwest of the proposed expansion site and is the closest upper air meteorological monitoring station to the project area. A wind rose illustrating prevailing wind speeds and directions during January 1, 1985, to December 31, 1985, is shown in **Figure 2, Wind Rose for the Sacramento Executive Airport Meteorological Station**.

Rural dispersion coefficients were selected because the area consists of open space and lightly developed land uses. Urban coefficients for AERMOD take into account additional surface heating from paved surfaces, which would not apply for this project.

Sources of combustion emissions, such as diesel PM_{10} and NO_X, from mobile equipment were modeled using the volume source option in AERMOD. The ARB has stated that volume sources are applicable for moving equipment.[12] The volume sources were evenly spaced throughout the central portions of the existing mine and the expansion site. The size of each volume source was determined based on ARB guidance and model considerations, such as model run time.

Sources of PM_{10} from unpaved surfaces and handling operations were modeled using the open pit source option in AERMOD. Particle size fractions for diesel vehicle exhaust and fugitive dust were obtained from the ARB's California Emission Inventory Database and Reporting System (CEIDARS). The best available particle densities for PM_{10} were obtained from the known density of quartz. This value was

[12] California Air Resources Board. *Health Risk Assessment Guidance for Rail Yard and Intermodal Facilities*. July 2006.



SOURCE: Sacramento Executive Airport Meteorological Station – January 1 - December 31, 1985

FIGURE 2

Wind Rose for the Sacramento Executive Airport Meteorological Station

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used since the primary material mined from the mine is sand composed primarily of quartz. The best available particle density for diesel engine exhaust was obtained from a recent study on the size density, and composition of diesel tailpipe particles.[13]

For the Baseline Case, the exhaust emissions and fugitive dust emissions due to travel on unpaved surfaces from off-road equipment and HHDTs and from loading operations were spread over the area roughly covering Phase X of the existing mine area.[14] Due to model limitations, open pit sources must have a rectangular shape and consist of one contiguous area; therefore, the area modeled differs in shape from the actual shape of Phase X of the existing mine area. For the Proposed Project Case, the central area of the proposed expansion area, covering approximately one-third of the total area, was used for exhaust and fugitive dust emission sources. This was done because the equipment would not operate on more than one-third of the total expansion area and the central area provides the best estimation of impacts given that sources of emissions will be present in this region throughout much of the life of the expansion site. Some individual emission sources with similar physical and operational characteristics were combined to simplify the modeling process. The source characteristics for modeling each of the sources are described in additional detail below.

Baseline Case

Off-Road Mobile Equipment	
Number of Volume Sources:	24 for PM_{10}; 24 for NO_X
Initial Lateral Dimension:	28.8 meters (94.5 feet)
Initial Vertical Dimension:	0.97 meters (3.18 feet) (based on vertical source dimension)
Release Height:	4.15 meters (13.62 feet) (nominal height of exhaust stack above ground level per ARB risk assessment scenarios)

On-Road HHDTs	
Number of Volume Sources:	16 for PM_{10}; 16 for NO_X
Initial Lateral Dimension:	28.8 meters (94.5 feet)
Initial Vertical Dimension:	0.97 meters (3.18 feet) (based on vertical source dimension)
Release Height:	4.15 meters (13.62 feet) (nominal height of exhaust stack above ground level per ARB risk assessment scenarios)

13 Zalenyuk/Imre, Alla, et al. *Real-Time Simultaneous Measurements of Size, Density, and Composition of Single Ultrafine Diesel Tailpipe Particles*. Diesel Engine Emission Reduction Conference. 2005.

14 Phase X is approximately in the center of the existing site and was assumed to represent long-term average conditions with respect to air quality impacts of the current operations.

Unpaved Surfaces	
Number of Open Pit Area Sources:	5
Pit Depth:	13.716 meters (45 feet)
Volume of each Open Pit Source:	1,832,542 cubic meters (64,700,000 cubic feet)
Release Height:	0 meters (ground-level release height)

Handling	
Number of Open Pit Sources:	2
Pit Depth:	13.716 meters (45 feet)
Volume of each Open Pit Source:	1,832,542 cubic meters (64,700,000 cubic feet)
Release Height:	0 meters (ground-level release height)

Proposed Project Case

Off-Road Mobile Equipment	
Number of Volume Sources:	18 for PM_{10}; 18 for NO_X
Initial Lateral Dimension:	31.01 meters (101.7 feet)
Initial Vertical Dimension:	0.97 meters (3.18 feet) (based on vertical source dimension)
Release Height:	4.15 meters (13.62 feet) (nominal height of exhaust stack above ground level per ARB risk assessment scenarios)

On-Road HHDTs	
Number of Volume Sources:	12 for PM_{10}; 12 for NO_X
Initial Lateral Dimension:	31.01 meters (101.7 feet)
Initial Vertical Dimension:	0.97 meters (3.18 feet) (based on vertical source dimension)
Release Height:	4.15 meters (13.62 feet) (nominal height of exhaust stack above ground level per ARB risk assessment scenarios)

Unpaved Surfaces	
Number of Open Pit Area Sources:	5
Pit Depth:	12.192 meters (40 feet)
Volume of each Open Pit Source:	1,331,889 cubic meters (47,035,000 cubic feet)
Release Height:	0 meters (ground-level release height)

Handling	
Number of Open Pit Sources:	2
Pit Depth:	12.192 meters (40 feet)
Volume of each Open Pit Source:	1,331,889 cubic meters (47,035,000 cubic feet)
Release Height:	0 meters (ground-level release height)

6.0 RECEPTORS USED FOR EVALUATING MODELED IMPACTS

The nearest residences, which are considered "sensitive receptors,"[15] are located sporadically around the project site; the closest residence to the expansion site is located on Sunrise Boulevard on the east side of the Folsom South Canal approximately 0.10 mile directly east of the project boundary. Several other residences are located along Eagles Nest Road, the closest of which is approximately 0.45 mile to the west of the project site. Other nearby residences are located on Jackson Highway, approximately 1.3 mile to the northwest, and on Grantline Road, approximately 0.33 miles to the southeast. The location of these residences is shown in **Figure 3, Location of Sensitive Receptors**.

A discrete receptor was placed at each of the residences identified above for a total of nine residential receptors. A fenceline receptor grid was placed around the boundaries of the Triangle Rock Products property extending out to 200 meters with 25-meter intervals between each receptor. A Cartesian grid was spaced at 100-meter intervals extending out 2,000 meters (2.0 kilometers) from the boundaries of the Triangle Rock Products property (as measured from the extremities of the property) to the south and west and to 3,000 meters (3.0 kilometers) to the north and east. This was done to account for the prevailing southerly and southwesterly winds. The overall receptor grid was designed to cover areas of potential public access where receptors could be exposed to pollutants associated with the project operations.

7.0 EVALUATION OF AMBIENT AIR QUALITY IMPACTS

The ambient air quality impacts were determined using a net change approach, similar to the emissions calculations above. The maximally impacted receptor and maximally impacted residential receptors were determined using emissions data from the proposed mine expansion site. The existing impacts were determined using baseline emissions data for the existing mine. The resulting net change is the difference between the impacts from the proposed expansion site and those from existing mine at the identified maximally-impacted receptors.

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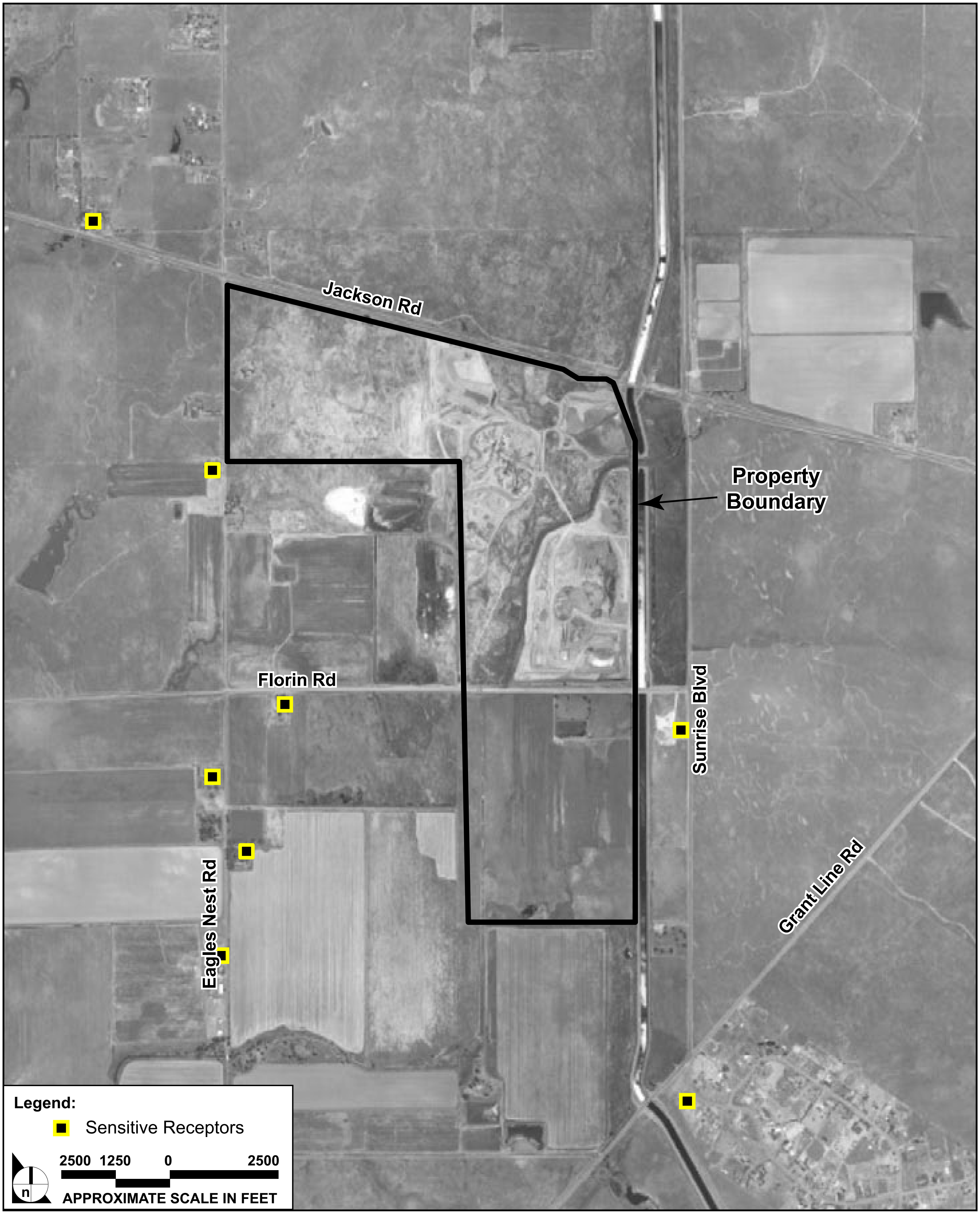
15 Sensitive receptors are facilities that house or attract children, the elderly, people with illnesses, or others who are especially sensitive to the effects of air pollutants. Hospitals, schools, convalescent facilities, and residential areas are examples of sensitive receptors (Sacramento Metropolitan Air Quality Management District, *Guide to Air Quality Assessment in Sacramento County*, July 2004, p. 2-5).



SOURCE: Google Earth – 2006, Impact Sciences, Inc. – January 2007

FIGURE 3

Location of Sensitive Receptors

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7.1 Particulate Matter

The PM_{10} impact analysis was performed using AERMOD (AERMOD input and output files are included in **Appendix B**). **Table 4, Summary of Maximum Modeled Net PM_{10} Impacts due to the Proposed Operations (24-Hour Averaging Period)** and **Table 5, Summary of Maximum Modeled Net PM_{10} Impacts due to the Proposed Operations (Annual Averaging Period)**, show the maximum impacts due to PM_{10} emissions in the receptor grid for the 24-hour and annual averaging periods, respectively. It should be noted that these impacts reflect the maximum production rates discussed in **Section 3.0, Activity Data**. The net PM_{10} impacts at the points of maximum impact indicate that the project's PM_{10} emissions could contribute to exceedances of the CAAQS (24-hour and annual) and exceed the SMAQMD significance threshold for PM_{10} ambient air quality impacts. These impacts would occur near the boundary of Triangle Rock Products' property, where there would be relatively limited exposure to the public. Modeled impacts at nearby residential receptors would be greater than the CAAQS and the SMAQMD significance thresholds for PM_{10} ambient air quality impacts.

Table 4
Summary of Maximum Modeled Net PM_{10} Impacts due to the Proposed Operations
(24-Hour Averaging Period)

Receptor	Background Concentration (μg/m³)	Modeled Net Impact (μg/m³)	Impact plus Background (μg/m³)	CAAQS (μg/m³)	Project Impact Percent of CAAQS
Maximum Impact (Cartesian Grid)	77.0	93.4	170.4	50	187%
Residential					
1st Maximum Impacted Residence	77.0	38.7	115.7	50	77%
2nd Maximum Impacted Residence	77.0	18.4	95.4	50	37%

Source: Impact Sciences, Inc.

1 *The values in the* Impact plus Background *column are compared to the values in* CAAQS *column to assess if the emissions from the proposed project would contribute to exceedances of the CAAQS.*

Table 5
Summary of Maximum Modeled Net PM_{10} Impacts due to the Proposed Operations
(Annual Averaging Period)

Receptor	Background Concentration (µg/m³)	Modeled Net Impact (µg/m³)	Impact plus Background (µg/m³)	CAAQS (µg/m³)	Project Impact Percent of CAAQS
Maximum Impact (Cartesian Grid)	28.8	6.2	35.0	20	31%
Residential					
1st Maximum Impacted Residence	28.8	0.8	29.6	20	4%
2nd Maximum Impacted Residence	28.8	0.6	29.4	20	3%

Source: Impact Sciences, Inc.
1 *The values in the* Impact plus Background *column are compared to the values in* CAAQS *column to assess if the emissions from the proposed project would contribute to exceedance of the CAAQS.*

7.2 Nitrogen Dioxide

The NO_2 impact analysis was performed using AERMOD (AERMOD input and output files are included in **Appendix B**). **Table 6 Summary of Maximum Modeled Net NO_2 Impacts due to the Proposed Operations (1-Hour Averaging Period)**, and **Table 7, Summary of Maximum Modeled Net NO_2 Impacts due to the Proposed Operations (Annual Averaging Period)**, shows the maximum impacts due to NO_2 emissions in the receptor grid for the 1-hour and annual averaging periods, respectively. It should be noted that these impacts reflect the maximum production rates discussed in **Section 3.0, Activity Data**. These impacts also assume that the NO_X emitted into the atmosphere, primarily as nitric oxide (NO) is converted to NO_2. The Ozone Limiting Method (OLM) was selected to model the atmospheric conversion of NO_X to NO_2. NO_X is converted to NO_2 in the atmosphere by chemical reactions with ozone. The OLM methodology uses the ambient ozone concentration to calculate the NO_2 concentration at each receptor point. The use of the OLM option in AERMOD requires an hourly ambient ozone data file for a full year. The file for calendar year 2005 was obtained from the SMAQMD monitoring station located at Folsom-Natoma Street in the northeast part of Sacramento County. This station was chosen because it regularly records the highest ozone values in the district and provides full year data sets. The nearest monitoring station at Sloughhouse only provides partial-year data sets. Calendar year 2005 was selected because it represents a recent and relatively high ozone year with respect to local ambient ozone concentrations. Error values, which account for less than 2-percent of data, in the file were replaced with the AERMOD default value of 40 parts per billion (ppb).

The net NO_2 impacts at the points of maximum impact indicate that the change in the project's NO_2 emissions would not lead to an exceedance of the 1-hour CAAQS or an exceedance of the annual

NAAQS. The maximum impacts would occur near the boundary of Triangle Rock Products' property, where there would be relatively limited exposure to the public. Modeled impacts at nearby residential receptors also would be less than the CAAQS and the NAAQS.

Table 6
Summary of Maximum Modeled Net NO_2 Impacts due to the Proposed Operations
(1-Hour Averaging Period)

Receptor	Background Concentration (μg/m³)	Modeled Net Impact (μg/m³)	Impact plus Background (μg/m³)	CAAQS (μg/m³)
Maximum Impact (Cartesian Grid)	160.6	131.9	292.5	470
Residential				
1st Maximum Impacted Residence	160.6	81.6	242.2	470
2nd Maximum Impacted Residence	160.6	36.1	196.7	470

Source: Impact Sciences, Inc.

1 *The values in the* Impact plus Background *column are compared to the values in* CAAQS *column to assess if the emissions from the proposed project would contribute to exceedances of the CAAQS.*

Table 7
Summary of Maximum Modeled Net NO_2 Impacts due to the Proposed Operations
(Annual Averaging Period)

Receptor	Background Concentration (μg/m³)	Modeled Net Impact (μg/m³)	Impact plus Background (μg/m³)	NAAQS (μg/m³)
Maximum Impact (Cartesian Grid)	32.5	0.6	33.1	100
Residential				
1st Maximum Impacted Residence	32.5	0.1	32.6	100
2nd Maximum Impacted Residence	32.5	0.1	32.6	100

Source: Impact Sciences, Inc.

1 *The values in the* Impact plus Background *column are compared to the values in* NAAQS *column to assess if the emissions from the proposed project would contribute to exceedances of the NAAQS.*

8.0 CONCLUSIONS

The results determined in this analysis reflect reasonable estimates of mobile source emissions (over the project life), fugitive dust emissions, and loading emissions; available meteorological data in the vicinity of the project site; available terrain data in the vicinity of the project site; and the use of currently approved air quality models. While this particular project involves a complex set of sources, meteorological conditions, and terrain, this air quality impact analysis portrays a representative picture of the ambient air quality impacts that might occur as a result of implementation of the proposed project. Given the limits of available tools for such an analysis, the actual impacts may vary from the estimates in this assessment. Furthermore, the AERMOD dispersion model may overpredict actual impacts. Accordingly, the ambient air quality impacts are not expected to be higher than those estimated in this assessment, and they may be lower than predicted herein.

Based on this analysis, the net change in daily emissions associated with the mine operations would not exceed the daily SMAQMD emission thresholds for ROG and NO_X. However, the net ambient air quality impacts resulting from this project could result in exceedances of the SMAQMD significance criteria for PM_{10} (ambient air quality impact). The project could contribute to exceedances of the California ambient air quality standards for PM_{10} (24-hour and annual averages). The exceedances of the California standards would occur near the boundary of the Triangle Rock Products property in locations that would not generally be inhabited for long periods (e.g., along nearby roads) and at nearby residential receptors. This would be a significant impact to PM_{10} ambient concentrations.

While the modeled 24-hour and annual PM_{10} impacts, when added to the background concentrations, would exceed or contribute to existing exceedances of the CAAQS, such exceedances would occur only if (1) the actual background concentrations were as high as those used in this analysis, (2) the amount of activity (e.g., number and types of equipment, hours of operation, process rates) assumed in this analysis actually occurred, and (3) the meteorological conditions in the data set used in the dispersion modeling analysis occurred in the vicinity of the project site during the peak operating periods.

APPENDIX A

Emission Calculations

Triangle Rock Products, Inc
Equipment Used for Proposed Mining Operation
Emission Factors for Offroad Equipment (Year 2013)

Equipment	Year (1)	Horsepower (1)	Load Factor (1)	Operating Hours per Day (1)	Cumulative Hours (2)	Useful Life	Zero-Hour Emission Factor (g/brake HP-hr) (3)					Deterioration Factor (% increase per % useful life consumed) (3)					Deterioration Rate (g/hp-hr^2) (3)					Emission Factor (g/brake HP-hr) (3)				
							CO	NOx	PM10	SO2	HC	CO	NOx	PM10	SO2	HC	CO	NOx	PM10	SO2	HC	CO	NOx	PM10	SO2	HC
D9R CAT DOZER	1996	450	0.575	4	21216	12625	0.92	6.25	0.15	0.005	0.32	0.25	0.21	0.67	0.00	0.44	1.82E-05	1.04E-04	7.96E-06	0.00E+00	1.12E-05	1.31	8.46	0.319	0.005	0.557
140H CAT MOTORGRADER	2000	165	0.575	2	4056	12625	2.7	6.90	0.38	0.005	0.68	0.16	0.14	0.44	0.00	0.28	3.42E-05	7.65E-05	1.32E-05	0.00E+00	1.51E-05	2.84	7.21	0.434	0.005	0.741
EX1200 HITACHI EXCAVATOR	2004	625	0.58	8	22464	12625	0.92	4.29	0.11	0.005	0.12	0.25	0.21	0.67	0.00	0.44	1.82E-05	7.14E-05	5.84E-06	0.00E+00	4.18E-06	1.33	5.89	0.241	0.005	0.214
988F CAT LOADER	1998	425	0.465	8	37440	12625	0.92	6.25	0.15	0.005	0.32	0.25	0.21	0.67	0.00	0.44	1.82E-05	1.04E-04	7.96E-06	0.00E+00	1.12E-05	1.60	10.14	0.448	0.005	0.738
988F CAT LOADER	1999	425	0.465	8	34944	12625	0.92	6.25	0.15	0.005	0.32	0.25	0.21	0.67	0.00	0.44	1.82E-05	1.04E-04	7.96E-06	0.00E+00	1.12E-05	1.56	9.88	0.428	0.005	0.710
R40-C EUCLID RIGID HAULER	2001	525	0.49	8	29952	12625	0.92	6.25	0.15	0.005	0.32	0.25	0.21	0.67	0.00	0.44	1.82E-05	1.04E-04	7.96E-06	0.00E+00	1.12E-05	1.47	9.36	0.388	0.005	0.654
R40-C EUCLID RIGID HAULER	2001	525	0.49	8	29952	12625	0.92	6.25	0.15	0.005	0.32	0.25	0.21	0.67	0.00	0.44	1.82E-05	1.04E-04	7.96E-06	0.00E+00	1.12E-05	1.47	9.36	0.388	0.005	0.654

Notes:
1. Based on data obtained from the client.
2. Based on year 2013 and an operating schedule of 6 days per week, 52 weeks a year.
3. Emission factors from ARB OFF-ROAD model.

Triangle Rock Products, Inc
Equipment Used for Existing Mining Operations
Emission Factors for Offroad Equipment (Year 2007)

Equipment	Year (1)	Horsepower (1)	Load Factor (1)	Operating Hours per Day (1)	Cumulative Hours (2)	Useful Life	Zero-Hour Emission Factor (g/brake HP-hr) (3)					Deterioration Factor (% increase per % useful life consumed) (3)					Deterioration Rate (g/hp-hr^2) (3)					Emission Factor (g/brake HP-hr) (3)				
							CO	NOx	PM10	SO2	HC	CO	NOx	PM10	SO2	HC	CO	NOx	PM10	SO2	HC	CO	NOx	PM10	SO2	HC
D9R CAT DOZER	1996	450	0.575	4	13728	12625	0.92	6.25	0.15	0.005	0.32	0.25	0.21	0.67	0.00	0.44	1.82E-05	1.04E-04	7.96E-06	0.00E+00	1.12E-05	1.17	7.68	0.259	0.005	0.473
140H CAT MOTORGRADER	2000	165	0.575	2	2184	12625	2.7	6.90	0.38	0.005	0.68	0.16	0.14	0.44	0.00	0.28	3.42E-05	7.65E-05	1.32E-05	0.00E+00	1.51E-05	2.77	7.07	0.409	0.005	0.713
EX1200 HITACHI EXCAVATOR	2004	625	0.58	8	7488	12625	0.92	4.29	0.11	0.005	0.12	0.25	0.21	0.67	0.00	0.44	1.82E-05	7.14E-05	5.84E-06	0.00E+00	4.18E-06	1.06	4.82	0.154	0.005	0.151
988F CAT LOADER	1998	425	0.465	8	22464	12625	0.92	6.25	0.15	0.005	0.32	0.25	0.21	0.67	0.00	0.44	1.82E-05	1.04E-04	7.96E-06	0.00E+00	1.12E-05	1.33	8.59	0.329	0.005	0.571
988F CAT LOADER	1999	425	0.465	8	19968	12625	0.92	6.25	0.15	0.005	0.32	0.25	0.21	0.67	0.00	0.44	1.82E-05	1.04E-04	7.96E-06	0.00E+00	1.12E-05	1.28	8.33	0.309	0.005	0.543
R40-C EUCLID RIGID HAULER	2001	525	0.49	8	14976	12625	0.92	6.25	0.15	0.005	0.32	0.25	0.21	0.67	0.00	0.44	1.82E-05	1.04E-04	7.96E-06	0.00E+00	1.12E-05	1.19	7.81	0.269	0.005	0.487
R40-C EUCLID RIGID HAULER	2001	525	0.49	8	14976	12625	0.92	6.25	0.15	0.005	0.32	0.25	0.21	0.67	0.00	0.44	1.82E-05	1.04E-04	7.96E-06	0.00E+00	1.12E-05	1.19	7.81	0.269	0.005	0.487

Notes:
1. Based on data obtained from the client.
2. Based on year 2007 and an operating schedule of 6 days per week, 52 weeks a year.
3. Emission factors from ARB OFF-ROAD model.

Triangle Rock Products, Inc.
On-road Truck Emissions at Proposed Mining Operation (Year 2013)

Service Truck (1988)
Avg Speed (mph) 15

Moving Emissions		ROG	CO	NOx	SO2	PM10	Tire	Brake
Daily Emissions - HHDTs (Sacramento Co.)	lb/day	0.07	0.41	0.65	0.00	0.03	0.00	0.00
Daily VMT - HHDTs (Sacramento Co.)	VMT/day	15	15	15	15	15	15	15
Emission Factor (1)	g/VMT	2.01	12.39	19.74	0.021	0.910	0.036	0.013

Idling Emissions		ROG	CO	NOx	SO2	PM10	Tire	Brake
Daily Emissions - HHDTs (Sacramento Co.)	lb/day	0.00	0.03	0.09	0.00	0.00	0.00	0.00
Daily Idling Hours - HHDTs (Sacramento Co.)	hr/day	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Emission Factor (2)	g/hr	4.41	26.3	80.7	0.039	3.17	0	0

Water Truck (2005)
Avg Speed (mph) 15

Moving Emissions		ROG	CO	NOx	SO2	PM10	Tire	Brake
Daily Emissions - HHDTs (Sacramento Co.)	lb/day	0.03	0.21	0.50	0.00	0.03	0.00	0.00
Daily VMT - HHDTs (Sacramento Co.)	VMT/day	30	30	30	30	30	30	30
Emission Factor (1)	g/VMT	0.524	3.17	7.62	0.021	0.397	0.036	0.013

Idling Emissions		ROG	CO	NOx	SO2	PM10	Tire	Brake
Daily Emissions - HHDTs (Sacramento Co.)	lb/day	0.00	0.03	0.09	0.00	0.00	0.00	0.00
Daily Idling Hours - HHDTs (Sacramento Co.)	hr/day	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Emission Factor (2)	g/hr	4.41	26.3	80.7	0.039	1.00	0	0

Notes:
1. Emission factors derived from EMFAC2002 for HHDTs traveling at 15 mph in Sacramento County in 2013 in Winter. This would represent a reasonable worst-case year as the service truck is likely to be replaced in the near future with a model that meets stricter emission standards.
2. Emission factors derived from EMFAC2002 for HHDTs traveling at 0 mph in Sacramento County in 2013 in Winter.

Triangle Rock Products, Inc.
On-road Truck Emissions at Existing Mining Operation (Year 2007)

Service Truck (1988)
Avg Speed (mph) 15

Moving Emissions		ROG	CO	NOx	SO2	PM10	Tire	Brake
Daily Emissions - HHDTs (Sacramento Co.)	lb/day	0.06	0.38	0.65	0.00	0.03	0.00	0.00
Daily VMT - HHDTs (Sacramento Co.)	VMT/day	15	15	15	15	15	15	15
Emission Factor (1)	g/VMT	1.86	11.50	19.58	0.021	0.910	0.036	0.013

Idling Emissions		ROG	CO	NOx	SO2	PM10	Tire	Brake
Daily Emissions - HHDTs (Sacramento Co.)	lb/day	0.00	0.03	0.09	0.00	0.00	0.00	0.00
Daily Idling Hours - HHDTs (Sacramento Co.)	hr/day	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Emission Factor (2)	g/hr	4.41	26.3	80.7	0.039	3.17	0	0

Water Truck (2005)
Avg Speed (mph) 15

Moving Emissions		ROG	CO	NOx	SO2	PM10	Tire	Brake
Daily Emissions - HHDTs (Sacramento Co.)	lb/day	0.02	0.14	0.49	0.00	0.03	0.00	0.00
Daily VMT - HHDTs (Sacramento Co.)	VMT/day	30	30	30	30	30	30	30
Emission Factor (1)	g/VMT	0.344	2.08	7.37	0.021	0.385	0.036	0.013

Idling Emissions		ROG	CO	NOx	SO2	PM10	Tire	Brake
Daily Emissions - HHDTs (Sacramento Co.)	lb/day	0.00	0.03	0.09	0.00	0.00	0.00	0.00
Daily Idling Hours - HHDTs (Sacramento Co.)	hr/day	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Emission Factor (2)	g/hr	4.41	26.3	80.7	0.039	1.00	0	0

Notes:
1. Emission factors derived from EMFAC2002 for HHDTs traveling at 15 mph in Sacramento County in 2007 in Winter. This would represent a reasonable worst-case year as the service truck is likely to be replaced in the near future with a model that meets stricter emission standards.
2. Emission factors derived from EMFAC2002 for HHDTs traveling at 0 mph in Sacramento County in 2007 in Winter.

Triangle Rock Products, Inc
Equipment Used for Proposed Mining Operation (Year 2013)
Combustion Emission Sources

Off-Road Equipment	Year (1)	Horsepower (1)	Load Factor (1)	Operating Hours per Day (1)	Emission Factor (g/brake HP-hr) (2)							Emissions (lbs/day)							Est. Weight
					CO	NOx	PM10	Tire	Brake	SO2	HC	CO	NOx	PM10	Tire	Brake	SO2	HC	
D9R CAT DOZER	1996	450	0.575	4	1.31	8.46	0.319	-	-	0.005	0.557	3.0	19.3	0.73	-	-	0.01	1.27	107,550
140H CAT MOTORGRADER	2000	165	0.575	2	2.84	7.21	0.434	-	-	0.005	0.741	1.2	3.0	0.18	-	-	0.00	0.31	32,357
EX1200 HITACHI EXCAVATOR	2004	625	0.58	8	1.33	5.89	0.241	-	-	0.005	0.214	8.5	37.7	1.54	-	-	0.03	1.37	244,500
988F CAT LOADER	1998	425	0.465	8	1.60	10.14	0.448	-	-	0.005	0.738	5.6	35.4	1.56	-	-	0.02	2.6	103,514
988F CAT LOADER	1999	425	0.465	8	1.56	9.88	0.428	-	-	0.005	0.710	5.4	34.4	1.49	-	-	0.02	2.5	103,514
R40-C EUCLID RIGID HAULER	2001	525	0.49	8	1.47	9.36	0.388	-	-	0.005	0.654	6.6	42.5	1.76	-	-	0.02	3.0	49,400
R40-C EUCLID RIGID HAULER	2001	525	0.49	8	1.47	9.36	0.388	-	-	0.005	0.654	6.6	42.5	1.76	-	-	0.02	3.0	49,400
Subtotal (lb/day)												36.98	214.75	9.03			0.14	13.93	
Subtotal (lb/yr)			Days per Year:	312	(156 days per year for Motograder)							11,351	66,531	2,789			42	4,297	

On-Road Equipment	Year (1)	Horsepower (1)	Load Factor (1)	Operating Hours per Day (1)	Emission Factor (g/VMT) (3)							Emissions (lbs/day) (4)							Est. Weight
					CO	NOx	PM10	Tire	Brake	SO2	HC	CO	NOx	PM10	Tire	Brake	SO2	HC	
357 PETERBILT WATER TRUCK	2005	385	1	2	3.17	7.62	0.40	0.04	0.01	0.02	0.52	0.24	0.59	0.03	0.00	0.00	0.001	0.04	83,040
384 PETERBILT SERVICE TRUCK	1988	190	1	1	12.39	19.74	0.91	0.04	0.01	0.02	2.0	0.44	0.74	0.03	0.00	0.00	0.001	0.07	33,000
Subtotal (lb/day)												0.68	1.33	0.06	0.00	0.00	0.00	0.11	
Subtotal (lb/yr)			Days per Year:	312								211.33	416.45	19.02	1.11	0.40	0.68	34.54	
Total (lb/day)												37.65	216.08	9.09	0.00	0.00	0.14	14.04	
Total (lb/yr)			Days per Year:	312								11,563	66,948	2,808	1	0	43	4,331	

	Gross Power (HP)	Reference
D9R CAT DOZER	474	(5)
140H CAT MOTORGRADER	182	(6)
EX1200 HITACHI EXCAVATOR	671	(7)
988F CAT LOADER	430	(8)
357 PETERBILT WATER TRUCK	385	(9)
384 PETERBILT SERVICE TRUCK	190	(9)
R40-C EUCLID RIGID HAULER	525	(10)

Notes:
1. Based on data obtained from the client.
2. Emission factors from ARB OFF-ROAD model. Includes deterioration factor, based on year 2008 as the starting project year. Refer to reference 3 below for on-road emission factors.
3. Emission factors derived from EMFAC2002 for HHDTs traveling at 15 mph in Sacramento County in 2008. This would represent a reasonable worst-case year as the service truck is likely to be replaced in the near future with a model that meets more strict emission standards.
4. Includes idling emissions for on-road trucks, assuming 30 minutes of idling per day.
5. http://en.wikipedia.org/wiki/Caterpillar_D9
6. http://www.cat.com/cda/layout?m=37840&x=7&location=drop
7. http://www.hitachiconstruction.com/en_US/cfd/mining/docs/ex1200_intro_newsroom.html
8. http://www.leggattllc.com/detail.asp?recordid=100319627&IndID=3&Cat=9
9. http://www.peterbilt.com/357Details.asp?model=model357
10. http://www.volvo.se/constructionequipment/global/en-gb/AboutUs/history/products/Rigid+haulers/Euclid/R40C.htm

Triangle Rock Products, Inc
Equipment Used for Existing Mining Operations (Year 2007)
Combustion Emission Sources

Off-Road Equipment	Year (1)	Horse Power (1)	Load Factor (1)	Operating Hours per Day (1)	Emission Factor (g/brake HP-hr) (2)							Emissions (lbs/day)							Est. Weight
					CO	NOx	PM10	Tire	Brake	SO2	HC	CO	NOx	PM10	Tire	Brake	SO2	HC	
D9R CAT DOZER	1996	450	0.575	4	1.17	7.68	0.259	-	-	0.005	0.473	2.7	17.5	0.59	-	-	0.01	1.08	107,550
140H CAT MOTORGRADER	2000	165	0.575	2	2.77	7.07	0.409	-	-	0.005	0.713	1.2	3.0	0.17	-	-	0.00	0.30	32,357
EX1200 HITACHI EXCAVATOR	2004	625	0.58	8	1.06	4.82	0.154	-	-	0.005	0.151	6.8	30.8	0.98	-	-	0.03	0.97	244,500
988F CAT LOADER	1998	425	0.465	8	1.33	8.59	0.329	-	-	0.005	0.571	4.6	29.9	1.15	-	-	0.02	2.0	103,514
988F CAT LOADER	1999	425	0.465	8	1.28	8.33	0.309	-	-	0.005	0.543	4.5	29.0	1.08	-	-	0.02	1.9	103,514
R40-C EUCLID RIGID HAULER	2001	525	0.49	8	1.19	7.81	0.269	-	-	0.005	0.487	5.4	35.4	1.22	-	-	0.02	2.2	49,400
R40-C EUCLID RIGID HAULER	2001	525	0.49	8	1.19	7.81	0.269	-	-	0.005	0.487	5.4	35.4	1.22	-	-	0.02	2.2	49,400
Subtotal (lb/day)												30.52	181.10	6.41			0.14	10.64	
Subtotal (lb/yr)			Days per Year:	312	(156 days per year for Motograder)							9,340	56,042	1,974			42	3,275	

On-Road Equipment	Year (1)	Horse Power (1)	Load Factor (1)	Operating Hours per Day (1)	Emission Factor (g/VMT) (3)							Emissions (lbs/day) (4)							Est. Weight
					CO	NOx	PM10	Tire	Brake	SO2	HC	CO	NOx	PM10	Tire	Brake	SO2	HC	
357 PETERBILT WATER TRK	2005	385	1	2	2.08	7.37	0.39	0.04	0.01	0.02	0.34	0.17	0.58	0.03	0.00	0.00	0.001	0.03	83,040
384 PETERBILT SERVICE TRK	1988	190	1	1	11.50	19.58	0.91	0.04	0.01	0.02	1.9	0.41	0.74	0.03	0.00	0.00	0.001	0.07	33,000
Subtotal (lb/day)												0.58	1.31	0.06	0.00	0.00	0.00	0.09	
Subtotal (lb/yr)			Days per Year:	312								179.76	409.58	18.77	1.11	0.40	0.68	29.34	

Total (lb/day)												31.09	182.41	6.47	0.00	0.00	0.14	10.74	
Total (lb/yr)			Days per Year:	312								9,520	56,452	1,992	1	0	43	3,304	

	Gross Power (HP)	Reference
D9R CAT DOZER	474	(5)
140H CAT MOTORGRADER	182	(6)
EX1200 HITACHI EXCAVATOR	671	(7)
988F CAT LOADER	430	(8)
357 PETERBILT WATER TRK	385	(9)
384 PETERBILT SERVICE TRK	190	(9)
R40-C EUCLID RIGID HAULER	525	(10)

Notes:
1. Based on data obtained from the client.
2. Emission factors from ARB OFF-ROAD model. Includes deterioration factor, based on year 2008 as the starting project year.
   Refer to reference 3 below for on-road emission factors.
3. Emission factors derived from EMFAC2002 for HHDTs traveling at 15 mph in Sacramento County in 2008.
   This would represent a reasonable worst-case year as the service truck is likely to be replaced in the near future
   with a model that meets more strict emission standards.
4. Includes idling emissions for on-road trucks, assuming 30 minutes of idling per day.
5. http://en.wikipedia.org/wiki/Caterpillar_D9
6. http://www.cat.com/cda/layout?m=37840&x=7&location=drop
7. http://www.hitachiconstruction.com/en_US/cfd/mining/docs/ex1200_intro_newsroom.html
8. http://www.leggattllc.com/detail.asp?recordid=100319627&IndID=3&Cat=9
9. http://www.peterbilt.com/357Details.asp?model=model357
10. http://www.volvo.se/constructionequipment/global/en-gb/AboutUs/history/products/Rigid+haulers/Euclid/R40C.htm

Triangle Rock Products, Inc.
"Unpaved Road" Emissions from Mining Operations

D9R CAT DOZER

Emission Factor (1)

$E = k * (s/12)^{0.9} * (W/3)^{0.45}$ [maximum hour]

$E = k * (s/12)^{0.9} * (W/3)^{0.45} * (365 - P)/365$ [average day]

E	emission factor	3.945	lb/VMT
k	particle size multiplier	1.5	lb/VMT
s (2)	silt content	8.3	%
W	weight (empty)	54	tons
	weight (loaded)	54	tons
	weight (mean)	54	tons

100	feet/hr
0.019	VMT/hr
0.07	lb PM10/hr
124,800	feet/yr
23.6	VMT/yr
93.2	lb PM10/yr

Controlled Emissions

68%	control efficiency for watering roads (3)
0.02	lb PM10/hr
0.10	lb PM10/day
29.8	lb PM10/yr

Triangle Rock Products, Inc.
"Unpaved Road" Emissions from Mining Operations

140H CAT MOTORGRADER

Emission Factor (1)

$E = k * (s/12)^{0.9} * (W/3)^{0.45}$ [maximum hour]

$E = k * (s/12)^{0.9} * (W/3)^{0.45} * (365 - P)/365$ [average day]

E	emission factor	2.298	lb/VMT
k	particle size multiplier	1.5	lb/VMT
s (2)	silt content	8.3	%
W	weight (empty)	16	tons
	weight (loaded)	16	tons
	weight (mean)	16	tons

15.0	VMT/hr
34.47	lb PM10/hr
4,680	VMT/yr (3 days per week)
10,754	lb PM10/yr

Controlled Emissions

68%	control efficiency for watering roads (3)
11.03	lb PM10/hr
22.06	lb PM10/day
3,441.2	lb PM10/yr

Triangle Rock Products, Inc.
"Unpaved Road" Emissions from Mining Operations

EX1200 HITACHI EXCAVATOR

Emission Factor (1)

$E = k * (s/12)^{0.9} * (W/3)^{0.45}$ [maximum hour]

$E = k * (s/12)^{0.9} * (W/3)^{0.45} * (365 - P)/365$ [average day]

E	emission factor	5.709	lb/VMT
k	particle size multiplier	1.5	lb/VMT
s (2)	silt content	8.3	%
W	weight (empty)	122	tons
	weight (loaded)	122	tons
	weight (mean)	122	tons

6.25	feet/hr
0.00	VMT/hr
0.01	lb PM10/hr

15600	feet/yr
3.0	VMT/yr
16.9	lb PM10/yr

Controlled Emissions

0%	control efficiency for watering roads (3)
0.007	lb PM10/hr
0.05	lb PM10/day
16.9	lb PM10/yr

Triangle Rock Products, Inc.
"Unpaved Road" Emissions from Mining Operations

988F CAT LOADER

Emission Factor (1)

$E = k * (s/12)^{0.9} * (W/3)^{0.45}$ [maximum hour]

$E = k * (s/12)^{0.9} * (W/3)^{0.45} * (365 - P)/365$ [average day]

E	emission factor	4.082	lb/VMT
k	particle size multiplier	1.5	lb/VMT
s (2)	silt content	8.3	%
W	weight (empty)	52	tons
	weight (loaded)	64	tons
	weight (mean)	58	tons

40	miles/day
5.0	VMT/hr
20.4	lb PM10/hr
12,480	VMT/yr
50,942	lb PM10/yr

Controlled Emissions

68%	control efficiency for watering roads (3)
6.53	lb PM10/hr
52.25	lb PM10/day
16,301	lb PM10/yr

Triangle Rock Products, Inc.
"Unpaved Road" Emissions from Mining Operations

357 PETERBILT WATER TRUCK

Emission Factor (1)

$E = k * (s/12)^{0.9} * (W/3)^{0.45}$ [maximum hour]

$E = k * (s/12)^{0.9} * (W/3)^{0.45} * (365 - P)/365$ [average day]

E	emission factor	2.988	lb/VMT
k	particle size multiplier	1.5	lb/VMT
s (2)	silt content	8.3	%
W	weight (empty)	17	tons
	weight (loaded)	42	tons
	weight (mean)	29	tons

15	VMT/hr
44.8	lb PM10/hr
9,360	VMT/yr
27,972	lb PM10/yr

Controlled Emissions

68%	control efficiency for watering roads (3)
14.34	lb PM10/hr
28.69	lb PM10/day
8,951	lb PM10/yr

Triangle Rock Products, Inc.
"Unpaved Road" Emissions from Mining Operations

384 PETERBILT SERVICE TRUCK

Emission Factor (1)

$E = k * (s/12)^{0.9} * (W/3)^{0.45}$ [maximum hour]

$E = k * (s/12)^{0.9} * (W/3)^{0.45} * (365 - P)/365$ [average day]

E	emission factor	2.350	lb/VMT
k	particle size multiplier	1.5	lb/VMT
s (2)	silt content	8.3	%
W	weight (empty)	17	tons
	weight (loaded)	17	tons
	weight (mean)	17	tons

15	VMT/hr
35.2	lb PM10/hr
4,680	VMT/yr
10,996	lb PM10/yr

Controlled Emissions

68%	control efficiency for watering roads (3)
11.28	lb PM10/hr
11.28	lb PM10/day
3,519	lb PM10/yr

Triangle Rock Products, Inc.
"Unpaved Road" Emissions from Mining Operations

R40-C EUCLID RIGID HAULER

Emission Factor (1)

$E = k * (s/12)^{0.9} * (W/3)^{0.45}$ [maximum hour]

$E = k * (s/12)^{0.9} * (W/3)^{0.45} * (365 - P)/365$ [average day]

E	emission factor	2.780	lb/VMT
k	particle size multiplier	1.5	lb/VMT
s (2)	silt content	8.3	%
W	weight (empty)	15	tons
	weight (loaded)	34	tons
	weight (mean)	25	tons

7.50	VMT/hr
20.8	lb PM10/hr
18,720	VMT/yr
52,037	lb PM10/yr

Controlled Emissions

68%	control efficiency for watering roads (3)
6.67	lb PM10/hr
53.37	lb PM10/day
16,652	lb PM10/yr

Notes:
1. Emission factors from AP-42, Section 13.2.2 (Unpaved Roads).
2. Silt content from Section 13.2.2, Table 13.2.2-1 (haul road).
3. Control efficiency is assumed to be 68% for watering disturbed areas 3-4 times per day as recommended by the South Coast AQMD for mitigation of fugitive dust at construction sites.

Triangle Rock Products, Inc.
"Unpaved Road" Emissions from Mining Operations

SUMMARY

	lb/day	lb/yr
D9R CAT DOZER	0.10	29.8
140H CAT MOTORGRADER	22.06	3,441.2
EX1200 HITACHI EXCAVATOR	0.05	16.9
988F CAT LOADER	52.25	16,301.4
988F CAT LOADER	52.25	16,301.4
357 PETERBILT WATER TRUCK	28.69	8,950.9
384 PETERBILT SERVICE TRUCK	11.28	3,518.8
R40-C EUCLID RIGID HAULER	53.37	16,651.9
R40-C EUCLID RIGID HAULER	53.37	16,651.9
TOTAL	273.41	81,864.1

Triangle Rock Products, Inc.
Aggregate Handling and Storage Pile Emissions from Mining Operations

Aggregate
Emission Factor (1)
$E = k * (0.0032) * [(U/5)^{1.3} / (M/2)^{1.4}]$ [pounds per ton]

E	emission factor (1)	0.0004	lb/ton
k	particle size multiplier (dimensionless)	0.35	
U	mean wind speed (miles per hour)	6.93	mph
M	material moisture content (%)	6	%

6,000	tons aggregate/day (2)
2.21	lb PM10/day
688	lb PM10/yr

Soil/Overburden
Emission Factor (1)
$E = k * (0.0032) * [(U/5)^{1.3} / (M/2)^{1.4}]$ [pounds per ton]

E	emission factor (1)	0.0004	lb/ton
k	particle size multiplier (dimensionless)	0.35	
U	mean wind speed (miles per hour)	6.93	mph
M	material moisture content (%)	6	%

4,364	tons overburden/day (3)
1.60	lb PM10/day
500	lb PM10/yr

Notes:
1. Emission factors from AP-42, Section 13.2.4 (Aggregate Handling and Storage Piles).
2. Control efficiency is assumed to be 68% for watering disturbed areas 3-4 times per day as recommended by the South Coast AQMD for mitigation of fugitive dust at construction sites.
2. Data provided by Triangle Rock Products.
3. Estimated by using a 20:55 ratio between soil/overburden to aggregate. Triangle Rock estimates the first 20 feet is overburden and the underlying 55 feet is aggregate yielding a final pit depth of 75 feet.

Triangle Rock Products, Inc.
Additional Air Quality Analysis

Prepared by:

Impact Sciences, Inc.
Air Quality Technical Services Group
3256 Penryn Road, Suite 220
Loomis, California 95650

At the request of Triangle Rock Products, Inc., Impact Sciences has prepared this additional air quality assessment of the proposed mine expansion in southeastern Sacramento County.

1.0 EMISSION MITIGATION

The Sacramento County Department of Environmental Review and Assessment, at the request of the Sacramento Metropolitan Air Quality Management District (AQMD), has proposed to implement the following mitigation measure for oxides of nitrogen (NO_X) and particulate matter (PM):

> *The proponent shall provide a plan, for approval of the lead agency and the Sacramento Metropolitan Air Quality Management District (SMAQMD), demonstrating that the heavy-duty (>50 horsepower) off-road vehicles to be used in the project, including owned or leased and subcontracted vehicles, will achieve a project wide fleet-average 20 percent NOx reduction and 45 percent particulate reduction (acceptable options below) compared to the most recent CARB fleet average at time of each annual report; and*
>
> *The proponent shall submit to the lead agency and SMAQMD a comprehensive inventory of all off-road equipment, equal to or greater than 50 horsepower, that will be used an aggregate of 40 or more hours per year during any portion of the project. The inventory shall include the horsepower rating, engine production year, and projected hours of use or fuel throughput for each piece of equipment. The inventory shall be updated and submitted annually throughout the duration of the project. The proponent shall provide SMAQMD with the name and phone number of the project manager and/or on-site foreman.*

The SMAQMD typically requests implementation of this measure for the construction phase of development projects. In conjunction with this measure, the SMAQMD has prepared a spreadsheet-based calculator to determine if the required reduction in NO_X and PM emissions will be achieved using a project's actual construction equipment fleet. While the proposed mine expansion project is not a construction project, the same emission reductions can be applied to the off-road mining equipment. Impact Sciences has input the relevant data into the calculator. For the mine expansion, the equipment-related parameters in **Table 1, Mine Equipment Specifications and Operating Hours,** were assumed and input into the calculator.

Table 1
Mine Equipment Specifications and Operating Hours

Equipment	Model	Model Year	Horsepower	Hours/Day	Hours/Year[1]
Dozer	Caterpillar D9R	1996	450	4	1,248
Motorgrader	Caterpillar 140H	2006	165	2	312
Excavator	Hitachi EX1200	2004	625	8	2,496
Loader	Caterpillar 988F	1998	425	8	2,496
Loader	Caterpillar 988F	1999	425	8	2,496
Haul Truck[2]	Euclid R40-C	2001	525	8	2,496
Haul Truck	Euclid R40-C	2001	525	8	2,496

Source: Triangle Rock Products, Inc.

[1] *All equipment operates 6 days per week, except the motorgrader, which operates 3 days per week. Although the mining operation will be active for up to 10 years, the annual operating hours were input into the calculator as the estimated hours that the equipment will operate during the "project."*

[2] *The haul trucks are also referred to as rigid haulers and are off-road vehicles.*

The results from the emissions mitigation calculator (see **Attachment 1**) demonstrate that the proposed off-road vehicle fleet would comply with the NO_X and PM reductions in the mitigation measure.

2.0 GREENHOUSE GAS EMISSIONS

The mine expansion project would result in emissions of greenhouse gases (GHG) from off-road mobile equipment and on-road trucks. The greenhouse gases associated with mobile equipment and trucks include carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). The contribution of CH_4 and N_2O from diesel engines to overall GHG emissions is small on a CO_2 equivalent basis[1] (less than 1 percent of total CO_2 equivalent).[2] Therefore, the emissions of these other GHGs were not included in this calculation, and only the CO_2 emissions have been calculated.

The CO_2 emissions from off-road mobile equipment were calculated using an emission factor (grams per brake-horsepower-hour) from California Air Resources Board's (CARB) OFFROAD2007 emissions

[1] The CO_2 equivalent emissions are commonly expressed as "metric tons of carbon dioxide equivalent ($MTCO_2E$)," where the emissions for individual GHGs are summed. The CO_2 equivalent for a gas is derived by multiplying the tons of the gas by the associated global warming potential (GWP), such that $MTCO_2E$ = (metric tons of a GHG) x (GWP of the GHG). For example, the GWP for methane is 21. This means that one metric ton of methane is equivalent to emissions of 21 metric tons of CO_2.

[2] California Climate Action Registry, *General Reporting Protocol, Version 3.0*, (2008) 39, 94, 96. http://www.climateregistry.org/resources/docs/protocols/grp/GRP_V3_April2008_FINAL.pdf

inventory model.[3] The emission factors in the OFFROAD2007 model include an initial emission factor based on the equipment model year and a deterioration rate that accounts for increased emissions as the equipment is used. For CO_2 emissions, however, the same CO_2 emission factor (568.3 grams per brake-horsepower-hour [g/BHP-hr]) is applied to all diesel equipment regardless of the equipment type or model year, and the deterioration rate is zero. The emissions for the off-road mobile equipment were calculated using the following equations:

Emission Factor (568.3 g/BHP-hr) × Engine Rating (BHP) × Load Factor ÷ 453.6 g/lb = Pounds/hour

Pounds/hour × Hours/year = Pounds/year

Pounds/year ÷ 2,204.6 metric tons/lb = Metric Tons/year

The CO_2 emission factor for on-road heavy-heavy-duty trucks (HHDTs) was derived from CARB's motor vehicle emission inventory program, EMFAC2007.[4] The two water trucks and service truck used at the expansion site will be diesel-fueled HHDTs. EMFAC2007 can generate emission factors for different classes of motor vehicles and model years within a county for a particular study year. For this analysis, Sacramento County and calendar year 2013 was selected in EMFAC2007. Model years for the HHDTs were provided by Triangle Rock Products. An inventory of CO_2 emissions corresponding to a vehicle speed of 15 miles per hour was used to generate emission factors for on-site travel by the trucks. This vehicle speed was assumed to be the average speed at which trucks would travel in and around the expansion site. The EMFAC2007 emission factors, expressed in grams per mile, were extracted from the program based on an ambient temperature of 60 degrees Fahrenheit and a relative humidity of 50 percent. The emission factors include exhaust emissions while trucks are starting, running, and idling.

The daily miles traveled for each on-site truck were estimated from the average vehicle speed and daily operating hours. The emission factor was then multiplied by the daily miles traveled to obtain daily emission rates and annual emission rates in units of pounds per day and pounds per year, respectively. In summary, the hourly and annual on-site truck emissions were calculated using the following equations:

Daily Distance Traveled (miles) × Emission Factor (g/mi) ÷ 453.6 g/lb = Pounds/hour

Annual Distance Traveled (miles) × Emission Factor (g/mi) ÷ 453.6 g/lb = Pounds/year

Pounds/year ÷ 2,204.6 metric tons/lb = Metric Tons/year

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3 California Air Resources Board. *User's Guide for OFFROAD2007*, (2007).

4 California Air Resources Board, *EMFAC2007 Version 2.3 – Calculating Emission Inventories for Vehicles in California, User's Guide*, undated.

As an alternative to the above calculations, the greenhouse gas emissions could have been estimated using the estimated fuel consumption of the diesel equipment and trucks. This method, however, would have required equipment-specific fuel consumption rates (e.g., gallons per BHP-hr or mile per gallon), which vary with load, idling, and other factors. This information is not known for the specific equipment and vehicles, although some assumptions could have been made. Nonetheless, this alternative approach would not have generated more accurate greenhouse gas emission rates than the methods described above. Furthermore, these methods are consistent with those used to calculate the emissions of other pollutants in the Air Quality Impact Analysis[5] and Health Risk Assessment[6] prepared for the proposed project.

The estimated GHG emissions associated with the on-site mobile equipment and vehicles for the mine expansion are shown in **Table 2, Estimated Operational Greenhouse Gas Emissions**.

Table 2
Estimated Operational Greenhouse Gas Emissions

Emissions Source	Emissions in Metric Tons CO_2E Per Year
Off-Road Equipment	2,005.0
On-Road Vehicles	36.4
Total GHG Emissions	2,041.4

Source: Impact Sciences, Inc.
Emissions calculations are provided in ***Attachment 2****.*

5 Impact Sciences, Inc., *Air Quality Impact Analysis for Triangle Rock Products, Inc. Expansion of Sacramento Aggregates Operations* (2007).

6 Impact Sciences, Inc., *Health Risk Assessment for Triangle Rock Products, Inc. Expansion of Sacramento Aggregates Operations* (2007).

ATTACHMENT 1

Emission Mitigation Calculations

SMAQMD Construction Mitigation Calculator Outputs

Version 6.0.3 updated by TIAX LLC for SMAQMD, 2007 March

[Triangle Rock Products, Robert Fine (916) 682-0850]

Comparison of your project fleet's emissions with the statewide average for construction equipment

Fleet average emissions reductions for this project relative to California state average (g/bhp-hr)**

Compare your fleet-wide g/bhp-hr average with the statewide g/bhp-hr average for construction equipment

Your fleet's emission factors based on what you have entered so far >>	Fleet NOx: 3.62	Fleet ROG: 0.22	Fleet PM10: 0.097	Fleet PM2.5 0.092
Statewide average emission factors as determined by this calculator >>	ARB Average NOx: 6.65	ARB Average ROG: 0.91	ARB Average PM10: 0.33	ARB Average PM2.5: 0.31
	NOx Reduced: 3.04	ROG Reduced: 0.69	PM10 Reduced: 0.23	PM2.5 Reduced: 0.22
	Reduction NOx: 46%	**Reduction ROG: 75%**	**Reduction PM10: 71%**	**Reduction PM2.5: 70%**
	NOx Passes, >20%	**ROG Passes, >20%**	**PM10 Passes, >45%**	**PM2.5 Passes, >45%**

Compare your fleet-wide average daily emissions with statewide average fleet of same size (lbs/day)

Fleet NOx: 176.75	Fleet ROG: 10.99	Fleet PM10: 4.76	Fleet PM2.5: 4.51
ARB Average NOx: 296.03	ARB Average ROG: 40.52	ARB Average PM10: 14.77	ARB Average PM2.5: 13.83

Your overall project emissions (lbs):

Total NOx: 55145	Total ROG: 3430	Total Lbs PM10: 1485	Total PM2.5: 1407

**Only emissions rates from construction equipment considered in statewide average. All state average calculations use emission factors provided in ARB MO99-32.5 (diesel engines >25hp) and MO98-23 (gasoline engines >25hp).

ULSD use is assumed in state average.

#N/A or #Value! indicates that you must return to the input page and correct engine data.
Be sure to press the Record Data button after each entry.

4/24/2008 16:07

ATTACHMENT 2

Greenhouse Gas Emission Calculations

16 CLIMATE CHANGE

Introduction to Climate Change and Global Warming

The average surface temperature of the Earth has risen by about 1 degree Fahrenheit in the past century, with most of that occurring during the past two decades (World Meteorological Organization, 2005). To the layperson, this apparently small amount of warming may appear insignificant. Correspondingly, the probable increases in average temperatures of between 3 to 8 degrees Fahrenheit (Cayan, et al., 2006) may appear noticeable, but still insignificant. The word *average* is of critical importance to understanding climate change and global warming. In July, the average high temperature in Sacramento is 94 degrees Fahrenheit (The Weather Channel website, 2007). This number is created by averaging temperatures over decades, not just for one particular year. Although the average is 94 degrees Fahrenheit, residents know that the individual days and weeks making up that average are as much as 20 degrees warmer or cooler in the extreme cases and up to 10 degrees warmer or cooler on a more regular basis. Therefore, applying an average increase of 8 degrees in a strictly linear way (omitting forcing effects) would mean that the *average* July temperature in Sacramento would be 102 degrees, and that temperatures could get as hot as 122 degrees in an extreme event (the current record is 114) and could regularly reach 112 degrees. This kind of temperature shift would have significant consequences to citizens and the environment alike.

There is evidence that most of the warming over the last 50 years is due to human activities. Human activities, such as energy production and internal combustion vehicles, have increased the amount of greenhouse gases in the atmosphere, which in turn is causing the Earth's average temperature to rise. Rises in average temperature are leading to changes in climate patterns, shrinking polar ice caps and a rise in sea level, with a host of corresponding impacts to humans and ecosystems.

Greenhouse gases are atmospheric gases that act as global insulators by reflecting visible light and infrared radiation back to Earth. Some greenhouse gases, such as water vapor, carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), occur naturally and are emitted to the atmosphere through natural processes. Although CO_2, CH_4, and N_2O occur naturally in the atmosphere, human activities have changed their atmospheric concentrations. From 1750 to 2004, concentrations of CO_2, CH_4, and N_2O have increased globally by 35, 143, and 18 percent, respectively. Other greenhouse gases, such as fluorinated gases, are created and emitted solely through human activities. (EPA 2006.)

The principal greenhouse gases that enter the atmosphere because of human activities are CO_2, CH_4, N_2O, and fluorinated gases. Carbon dioxide, or CO_2, is the gas that is most commonly referenced when discussing climate change because it is the most commonly emitted gas. While some of the less common gases do make up less of the total greenhouse gases emitted to the atmosphere, some have a greater climate-forcing effect per molecule and/or are more toxic than carbon dioxide.

"In order to stabilize the concentration of GHGs in the atmosphere, emissions would need to peak and decline thereafter. The lower the stabilization level, the more quickly this peak and decline would need to occur. Mitigation efforts over the next two to three decades will have a large impact on opportunities to achieve lower stabilization levels." (IPCC 2007c)

CARBON DIOXIDE

The natural production and absorption of carbon dioxide (CO_2) is achieved through the terrestrial biosphere and the ocean. However, humankind has altered the natural carbon cycle by burning coal, oil, natural gas, and wood. Since the industrial revolution began in the mid-1700s, each of these activities has increased in scale and distribution. Carbon dioxide was the first greenhouse gas demonstrated to be increasing in atmospheric concentration, with the first conclusive measurements being made in the last half of the 20th Century. Prior to the industrial revolution, concentrations were fairly stable at 280 ppm. Today, they are around 370 ppm, an increase of well over 30% (EPA 2006). Left unchecked, the concentration of carbon dioxide in the atmosphere is projected to increase to a minimum of 535 ppm by 2100 as a direct result of anthropogenic sources (IPCC 2007a). This could result in an average global temperature rise of at least two degrees Celsius (IPCC 2007a).

Carbon dioxide emissions are mainly associated with combustion of carbon-bearing fossil fuels such as gasoline, diesel, and natural gas used in mobile sources and energy-generation-related activities. The U.S. EPA estimates that CO_2 emissions accounted for 84.6% of greenhouse gas emissions in the United States in 2004. (EPA 2006.) The California Energy Commission (CEC) estimates that CO_2 emissions account for 84% of California's anthropogenic (manmade) greenhouse gas emissions, nearly all of which is associated with fossil fuel combustion. (CEC 2005.) Total CO_2 emissions in the United States increased by 20% from 1990 to 2004. (EPA 2006.)

METHANE

Methane (CH_4) is an extremely effective absorber of radiation, though its atmospheric concentration is less than carbon dioxide and its lifetime in the atmosphere is brief (10-12 years), compared to some other greenhouse gases (such as CO_2, N_2O, and CFCs). CH_4 has both natural and anthropogenic sources. Landfills, natural gas distribution systems, agricultural activities, fireplaces and wood stoves, stationary and mobile fuel combustion, and gas and oil production fields are the major sources of these emissions. (EPA 2006.)

The U.S. EPA estimates that CH_4 emissions accounted for 7.9% of total greenhouse gas emissions in the United States in 2004. (EPA 2006.) The CEC estimates that CH_4 emissions from various sources represent 6.2% of California's total greenhouse gas emissions. (CEC 2005.) Total CH_4 emissions in the United States decreased by 10% from 1990 to 2004. (EPA 2006.)

NITROUS OXIDE

Concentrations of nitrous oxide (N_2O) also began to rise at the beginning of the industrial revolution. N_2O is produced by microbial processes in soil and water, including those reactions which occur in fertilizers that contain nitrogen. Use of these fertilizers has increased over the last century. Global concentration for N_2O in 1998 was 314 ppb, and in addition to agricultural sources for the gas, some industrial processes (fossil fuel fired power plants, nylon production, nitric acid production, and vehicle emissions) also contribute to its atmospheric load. (EPA 2006.)

The U.S. EPA estimates that N_2O emissions accounted for 5.5% of total greenhouse gas emissions in the United States in 2004. (EPA 2006.) The CEC estimates that nitrous oxide emissions from various sources represent 6.6% of California's total greenhouse gas emissions. (CEC 2005.) Total N_2O emissions in the United States decreased by 2% from 1990 to 2004. (EPA 2006.)

FLUORINATED GASES (HFCS, PFCS, AND SF_6)

Fluorinated gases, such as hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfurhexafluoride (SF_6), are powerful greenhouse gases that are emitted from a variety of industrial processes. Fluorinated gases are occasionally used as substitutes for ozone-depleting substances such as chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), and halons, which have been regulated since the mid-1980s because of their ozone destroying potential. Fluorinated gases are typically emitted in smaller quantities than CO_2, CH_4, and N_2O, but each molecule can have a much greater global warming effect. Therefore, fluorinated gases are sometimes referred to as High Global Warming Potential (GWP) gases. (EPA 2006.)

The primary sources of fluorinated gas emissions in the United States include the production of HCFC-22, electrical transmission and distribution systems, semiconductor manufacturing, aluminum production, magnesium production and processing, and substitution for ozone-depleting substances. The U.S. EPA estimates that fluorinated gas (HFC, PFC, and SF_6) emissions accounted for 2.0% of total greenhouse gas emissions in the United States in 2004. (EPA 2006.) The CEC estimates that fluorinated gas emissions from various sources represent 3.4% of California's total greenhouse gas emissions. (CEC 2005.) Total fluorinated gas emissions in the United States increased by 58% from 1990 to 2004. (EPA 2006.)

WORLDWIDE, NATIONAL AND STATEWIDE EMISSIONS

Table CC-1 presents estimated GHG emissions from California, the United States, and from worldwide sources. The results are presented in units of million metric tons per year of CO_2 equivalents (MMTCO2Eq). Worldwide GHG emissions were taken from the World Resources Institute's Climate Analysis Indicators Tool (CAIT) version 4 for calendar year 2000 (the latest year for which complete data are available). The United States GHG emissions were taken from Energy Information Administration's Emissions of Greenhouse Gases in the United States 2004. While data for 2005 are available, 2004 data were used because the California data are for 2004. California GHG emissions were taken from the California *Air Resources Board* ~~Energy Commission's~~ Inventory of California Greenhouse Gas Emissions and Sinks: 1990 to 2004 (the latest year for which complete data are available).

Table CC-1
Greenhouse Gases Emissions Worldwide, United States, and California

Geographic Region	CO_2	CH_4	N_2O
	$MMTCO_2Eq$[a]	$MMTCO_2Eq$[b]	$MMTCO_2Eq$[c]
Worldwide GHG Emissions for calendar year 2000[1]	32,541.3	5,854.9	3,349.4
United States GHG Emissions for calendar year 2004[2]	5,973.0	639.5	353.7
California GHG Emissions for calendar year 2004[3]	*427.4* ~~484.4~~	*25.9* ~~27.9~~	*15.1* ~~33.3~~

Notes:

[a]$MMTCO_2Eq$ means million metric tons per year of CO_2 equivalent, using Global Warming Potential (GWP) values provided by IPCC in its Fourth Assessment Report (TAR) (IPCC 2007a). The GWP for CO_2 is 1.

[b]The GWP from IPCC's TAR for CH_4 is 21.

[c]The GWP from IPCC's TAR for N_2O is 310.

CO_2 = carbon dioxide; N_2O = Nitrous oxide; CH_4 = Methane.

[1]Worldwide GHG emissions taken from Climate Analysis Indicators Tool (CAIT) version 4.0. Washington, DC: World Resources Institute, 2007. Available at http://cait.wri.org.

[2]United States GHG emissions taken from *Emissions of Greenhouse Gases in the United States 2004*, Energy Information Administration, U.S. Department of Energy, Washington, DC, December 2005.

[3]California GHG emissions taken from *Inventory of California Greenhouse Gas Emissions and Sinks: 1990 to 2004*, California Air Resources Board, November 2007.

Emissions Thresholds

The United Nations Intergovernmental Panel on Climate Change (IPCC) constructed several emission trajectories of carbon dioxide needed to stabilize global temperatures and climate change impacts. It concluded that a stabilization of greenhouse gases at 400-450 ppm carbon dioxide-equivalent concentration is required to keep global mean warming below 2°C, which in turn is assumed to be necessary to avoid dangerous climate change (IPCC 2007a). The California Climate Change Center (CCCC) at UC Berkeley has determined that an 11 percent reduction of greenhouse gases from present levels is required by year 2010, a 25 percent reduction is required by 2020, and an 80 percent reduction by 2050 in order to stabilize greenhouse gases at 400-450 ppm carbon dioxide-equivalent concentrations and avoid potentially dangerous climate change impacts (CCCC 2006). The California Legislature required these reduction levels by enacting AB 32.

Though reduction rates were established in California law (AB 32), as of the writing of this document there are no established CEQA thresholds for greenhouse gases. AB 32 requires ARB to adopt a statewide greenhouse gas emissions limit equivalent to the statewide greenhouse gas emissions levels in 1990 to be achieved by 2020, as specified.

Executive Order S-3-05

Executive Order S-3-05 was the precursor to Assembly Bill 32 (AB 32 is described in the next section) and was signed by Governor Schwarzenegger in June 2005. This Executive Order was significant because of its clear declarative statements that climate change poses a threat to the State of California. The Executive Order states that California is "particularly vulnerable" to the impacts of climate change, and that climate change has the potential to reduce Sierra snowpack (a primary source of drinking water), exacerbate existing air quality problems, adversely impact human health, threaten coastal real estate and habitat by causing sea level rise, and impact crop production. The Executive Order also states that "mitigation efforts will be necessary to reduce greenhouse gas emissions".

To address the issues described above, the Executive Order established emission reduction targets for the state: reduce GHG emissions to 2000 levels by 2010, to 1990 levels by 2020 and to 80% below 1990 levels by 2050. The Secretary of the California Environmental Protection Agency was named as coordinator for this effort, and the Executive Order required a progress report by January 2006 and biannually thereafter. As a result, the Climate Action Team was created by the California Environmental Protection Agency. The first report from the Climate Act Team was released in March of 2006, which proposed to meet the emissions targets through voluntary compliance and state incentive and regulatory programs.

ASSEMBLY BILL 32

In September 2006, Assembly Bill (AB) 32 was signed by Governor Schwarzenegger of California. AB 32 requires that California GHG emissions be reduced to 1990 levels by the year 2020, just like Executive Order S-3-05. However, AB 32 is a comprehensive bill that requires the California Air Resources Board (ARB) to adopt regulations requiring the reporting and verification of statewide greenhouse gas emissions, and it establishes a schedule of action measures. AB 32 also requires that a list of emission reduction strategies be published to achieve emissions reduction goals.

The following is a list of critical path items incorporated into AB 32 – deadlines that cannot be extended unless the Governor agrees there are "extraordinary circumstances", and then only for one year:

January 1, 2007: AB 32 goes into effect;

June 30, 2007: CARB must publish "a list of discrete early action GHG emission reduction measures" (Cal. Health & Safety Code § 38560.5(a)); this list is not just advisory - the measures must be implemented by regulations by 2010;

January 1, 2008: ARB must establish the 1990 baseline of statewide GHG emissions that will be the cap to be implemented by 2020 (*id*. at § 38550);

January 1, 2008: ARB must also adopt regulations requiring the monitoring and annual reporting of GHG emissions from all significant sources (*id.* at § 38530);

January 1, 2009: ARB must prepare and approve a "scoping plan" for "achieving the maximum technologically feasible and cost-effective reductions in GHG emissions from sources or categories of sources of GHG gases by 2020" (*id.* at § 38561); this scoping plan will be the template for the regulations that will be adopted by 2011;

January 1, 2010: ARB must "adopt regulations to implement" the list of reduction measures that it publishes by June 30, 2007 *(id.* at § 38560.5(b));

January 1, 2011: ARB must adopt regulations establishing "GHG emission limits and emission reduction measures" (*id.* at § 38562(a)); and

January 1, 2012: the 2011 regulations must become operative. (*Id.)*

As of this writing, the first four critical path items have occurred. AB 32 is in effect and the list of early action measures was adopted by the ARB on June 21, 2007 (Resolution 07-25). Three early action measures were identified by the deadline: establishment of a low-carbon fuel standard, restriction on the use of refrigerants, and the establishment of statewide standards for the installation and performance of landfill methane capture. Subsequently, the California Air Resources Board added many additional items to the early action measures list, at a hearing on October 25, 2007.

STATE OF CALIFORNIA EMISSION REDUCTION STRATEGIES

Several strategies to reduce vehicle emissions have been identified by the California Environmental Protection Agency's Climate Action Team. These include, but are not limited to, the following:

VEHICLE CLIMATE CHANGE STANDARDS

With the passage of AB 1493, Pavley, Chapter 200, Statutes of 2002, California moved to the forefront of reducing vehicle climate change emissions. This bill required the state to develop and adopt regulations that achieve the maximum feasible and cost-effective reduction of climate change emissions emitted by passenger vehicles and light duty trucks. Regulations were adopted by the ARB in September 2004. The ARB analysis of this regulation indicates emissions savings of 1 million tons CO_2 equivalent ($MMtCO_2e$) by 2010 and 30 million tons CO_2 equivalent by 2020. *Implementation of the AB 1493 standards was subject to the granting of a waiver by the U.S. Environmental Protection Agency, which was denied in December 2007. However, in January 2008, the Attorney General filed a lawsuit to overturn the denial; additionally, the decision may be overturned by the next administration.*

DIESEL ANTI-IDLING

Reduced idling times and the electrification of truck stops can reduce diesel use in trucks by about 4 percent, with major air quality benefits. In July 2004 the ARB adopted a measure to limit diesel-fueled commercial motor vehicle idling. AB 32 analysis indicates that anti-idling measures could reduce climate change emissions by 1.2 MMtCO2e in 2020.

OTHER NEW LIGHT DUTY VEHICLE TECHNOLOGY IMPROVEMENTS

In September 2004 the California Air Resources Board approved regulations to reduce climate change emissions from new motor vehicles. The regulations apply to new passenger vehicles and light duty trucks beginning with the 2009 model year. The standards adopted by the Board phase in during the 2009 through 2016 model years. When fully phased in, the near term (2009–2012) standards will result in about a 22 percent reduction as compared to the 2002 fleet, and the mid-term (2013–2016) standards will result in about a 30 percent reduction.

New standards would be adopted to phase in beginning in the 2017 model year (following up on the existing mid-term standards that reach maximum stringency in 2016). Assuming that the new standards call for about a 50 percent reduction, phased in beginning in 2017, this measure would achieve about a 4 MMT reduction in 2020. The reduction achieved by this measure would significantly increase in subsequent years as clean new vehicles replace older vehicles in the fleet—staff estimates a 2030 reduction of about 27 MMT.

EXECUTIVE ORDER S-01-07

This Executive Order was signed by Governor Schwarzenegger on January 18, 2007 and directed the Climate Action Team to determine whether the items in the Order could be established as an early action measure pursuant to AB 32 – which the Climate Action Team has now done. The Executive Order states that the State of California relies on petroleum-based fuels for 96% of its transportation needs, there were more than 24 million motor vehicles registered in California, and statewide gasoline consumption was almost 16 billion gallons in 2005. To address the carbon emitted by this use of fuel, the Executive Order states that a statewide goal must be established to reduce the "carbon intensity of California's transportation fuels" by at least 10% by the year 2020 and that a Low Carbon Fuel Standard for transportation fuels be established. The Low Carbon Fuel Standard applies to all "refiners, blenders, producers or importers of transportation fuels in California".

SACRAMENTO COUNTY EMISSION REDUCTION EFFORTS

CHICAGO CLIMATE EXCHANGE

In February 2007, the County joined the Chicago Climate Exchange. The Chicago Climate Exchange is the world's first and North America's only voluntary, legally binding rules-based greenhouse gas (GHG) emission reduction and trading system. Chicago Climate Exchange Phase I members commit to reduce GHG emissions 1% per year over the years 2003 through 2006 relative to a 1998 through 2001 average baseline. Phase I members agree to reduce GHG emissions by a total of 4% below the baseline by 2006. Chicago Climate Exchange Phase II members commit to reduce GHG emissions from 1¼% to ½% per year through the years 2007 through 2010 for grand total of 6% below the baseline.

Those members that reduce their emissions annually beyond the committed level can sell surplus emission allowances on the Chicago Climate Exchange or bank them. A member that cannot achieve the annual reduction target within its organization can meet its commitment by purchasing emissions allowances through the Chicago Climate Exchange from other Chicago Climate Exchange members that reduce their emissions beyond the reduction target.

The goals of Chicago Climate Exchange are:

1. To facilitate the transaction of GHG emissions allowance trading with price transparency, design excellence and environmental transparency.
2. To build the skills and institutions needed to cost-effectively manage GHG emissions.
3. To facilitate capacity-building in both public and private sector to facilitate mitigation.

4. To strengthen the intellectual framework required for cost effective and valid reduction.
5. To help inform the public debate on managing the risk of global climate change.

Chicago Climate Exchange members make a commitment to:

1. Measure, report, and reduce GHG emissions.
2. Establish an emission reduction schedule.
3. Implement GHG emissions management.
4. Participate in annual emissions audits.

ENERGY CONSERVATION/ENERGY EFFICIENCY PROGRAM

For years, the County of Sacramento has taken a leadership role in implementing policies and programs to conserve energy in County facilities and reduce emissions from the County fleet of vehicles.

The Board of Supervisors approved an Energy Conservation/Energy Efficiency Program in 2001. The essence of the program is to reduce electrical energy usage during peak periods of the day. The program contains ten measures such as participating in Sacramento Municipal Utility District's Voluntary Emergency Curtailment Program, setting building temperatures to 78° F to decrease cooling demand and dual switching of lights.

The County converted 108 of 150 trucks to liquid natural gas (LNG) in the Refuse Collection Fleet. The Heavy Rental Fleet now includes 18 propane powered vehicles. The Light Fleet includes 95 hybrid vehicles and 3 Compressed Natural Gas (CNG) vehicles. Replacement vehicles to the Light Fleet will be hybrid vehicles. The Sacramento International Airport operates LNG shuttle buses.

GHG emissions from County operations are either direct emissions or indirect emissions. Direct emissions result from on-site direct combustion by the County of fossil fuels such as natural gas to heat facilities and gasoline to fuel vehicles. Therefore, increasing the number of vehicles, which use alternative fuels, reduces GHG emissions.

Indirect emissions result from the purchase of energy, such as electricity, and the corresponding emissions associated with that generation. Therefore, purchasing electricity from green energy sources, or reducing energy use reduces GHG emissions. Direct and indirect emissions are the GHG emissions, expressed in metric tons of carbon dioxide (CO_2) equivalent.

The County provided Chicago Climate Exchange current and historical energy and fuel purchase data for fiscal years 2000, 2001, 2002, 2003, 2004, and 2005. The data submitted is for County-owned facilities and vehicles. The County's commitment to join does not apply to businesses, other government agencies or residents within the

County boundary, only to emissions generated by Sacramento County as an organization. Preliminary review by the Chicago Climate Exchange indicates the County could be in a position to sell surplus emission allowances for the period of 2003 through 2010. This data will be subject to an audit before a formal Baseline is established and exact credits can be calculated.

It is expected, based on information available and preliminary review by the Chicago Climate Exchange, that the County will receive potential financial reward from participation in the Chicago Climate Exchange. The County may be eligible to sell excess allowances. The preliminary baseline for direct and indirect emissions for the County is 226,700 metric tons of CO_2.

SUSTAINABILITY CABINET

Recognizing the need to work together as a County to address climate change, the Sacramento County Sustainability Cabinet was formed in September of 2007. The cabinet will develop a County sustainability plan for County energy management, develop a County green building policy and explore legislative priorities. The intent is to gather together the various environmental initiatives that are currently underway to ensure a coordinated County effort. The Sustainability Cabinet will also facilitate the baseline reporting for the Chicago Climate Exchange, CCAR, ICLEI and conformance with AB 32.

NATIONAL ASSOCIATION OF COUNTIES

The National Association of Counties (NACo) represents county governments in the United States. NACo offers legislative, research, technical, and public affairs assistance to member counties, and facilitates conferences and meetings on issues of concern to counties throughout the country.

CALIFORNIA CLIMATE ACTION REGISTRY

The County joined the California Climate Action Registry (Registry) in December 2006. The Registry is non-profit public/private partnership that serves as a voluntary GHG registry to protect, encourage and promote early actions to reduce GHG emissions. Registry participants agree to calculate, certify and publicly report GHG emissions. The Registry provides a reporting tool, standards and protocol for reporting GHG emissions.

AB32 recognizes participation in the Registry in a number of ways. First, AB 32 requires the ARB to incorporate the standards and protocols developed by the Registry in the rulemaking process. Second, AB 32 provides that entities that join the Registry prior to December 31, 2006 and report their emissions according to the Registry protocols will not be required to significantly alter their reporting program.

CITIES FOR CLIMATE PROTECTION (ICLEI)

Sacramento County joined ICLEI in 2007. The Cities for Climate Protection is administered under the International Council for Local Environmental Initiatives (ICLEI). The following is a brief description of the program from their website (www.iclei.org):

> The Cities for Climate Protection™ (CCP) Campaign enlists cities to adopt policies and implement measures to achieve quantifiable reductions in local greenhouse gas emissions, improve air quality, and enhance urban livability and sustainability. More than 650 local governments participate in the CCP, integrating climate change mitigation into their decision-making processes.
>
> The campaign is based on an innovative performance framework structured around five milestones that local governments commit to undertake. The milestones allow local governments to understand how municipal decisions affect energy use and how these decisions can be used to mitigate global climate change while improving community quality of life. The CCP methodology provides a simple, standardized way of acting to reduce greenhouse gas emissions and of monitoring, measuring, and reporting performance.

BENEFITS OF PARTICIPATION

> Communities that participate in the CCP benefit from the actions that they take to reduce greenhouse gas emissions through:
>
> - Financial savings in reduced utility and fuel costs to the local government, households, and businesses.
> - Improved local air quality, contributing to the general health and well being of the community. Economic development and new local jobs as investments in locally produced energy products and services keep money circulating in the local economy.
> - ICLEI provides regionally specific tools and technical assistance to assist local governments in reducing their greenhouse gas emissions.

Cities for Climate Protection® (CCP) is ICLEI's flagship campaign. The program is designed to educate and empower local governments worldwide to take action on climate change. CCP is a performance-oriented campaign that offers a framework for local governments to reduce greenhouse gas emissions and improve livability within their municipalities. This campaign would give Sacramento County a framework and tools to develop a plan for greenhouse emissions. The basic framework is called the 5 Milestones and consists of the following steps:

1. Conduct a baseline emissions inventory and forecast. Based on energy and waste data, the member calculates greenhouse gas emissions for a base year (e.g., 2000) and for a forecast year (e.g., 2015). The inventory and the forecast capture emissions from all municipal operations (e.g., city owned and/or operated buildings, streetlights, transit systems, wastewater treatment facilities) and from

all community-related activities (e.g., residential and commercial buildings, motor vehicles, waste streams, industry). The inventory and forecast provide a benchmark against which the city can measure progress.

2. Adopt an emissions reduction target for the forecast year. The city passes a council resolution establishing an emission reduction target for the city. The target is essential both to foster political will and to create a framework to guide the planning and implementation of measures.
3. Develop a Local Action Plan. The local government develops a Local Action Plan that describes or lists the policies and measures that the local government will take to reduce greenhouse gas emissions and achieve its emissions reduction target. Most plans include a timeline, a description of financing mechanisms, and an assignment of responsibility to departments and staff. In addition to direct greenhouse gas reduction measures, most plans also incorporate public awareness and education efforts. The development of the Local Action Plan should include strong public input and involvement in order to build the consensus among stakeholders required to implement measures.
4. Implement policies and measures. The city implements the policies and measures contained in their Local Action Plan. Typical policies and measures implemented by CCP participants include energy efficiency improvements to municipal buildings and water treatment facilities, streetlight retrofits, public transit improvements, installation of renewable power applications, and methane recovery from waste management.
5. Monitor and verify results. Monitoring and verifying progress on the implementation of measures to reduce or avoid greenhouse gas emissions is an ongoing process. Monitoring begins once measures are implemented and continues for the life of the measures, providing important feedback that can be use to improve the measures over time. ICLEI's software provides a uniform methodology for cities to report on measures.

The County has completed the emissions inventory, which is available on the Department of Environmental Review and Assessment website at www.dera.saccounty.net (see the home page under special studies).

Green Fleets

The City and County of Sacramento have adopted a heavy-duty low-emission vehicle (LEV) acquisition policy. The policy goal is to reduce oxides of nitrogen (NOx) emissions from heavy-duty fleet vehicles to meet the year 2005 standard for ozone in the Sacramento Federal Ozone Non-attainment area.

The foundation statements for this project are:

1. We recognize that the region has an air quality problem which is related to vehicle operations, especially the operation of heavy-duty vehicles;

2. We recognize that public agencies in Sacramento County operate large vehicle fleets which have significant numbers of heavy-duty vehicles.

3. We recognize that public agencies have a significant role to play in improving air quality by reducing the emissions from their fleet operations, especially their heavy-duty vehicles.

The commitments of this program are to show how fleets can aggressively incorporate low-emission vehicles into fleet operations, and how fleets can overcome training, facility and operational issues with resolve. The efforts will focus on the conversion of the on-road, heavy-duty equipment fleets to certified low-emission vehicles as these vehicles are replaced as part of regular systematic replacement programs. As of 2004 the County has committed to replace 50% off the fleet to low-emission vehicles.

Cool Counties Initiative

On July 16, 2007 at the National Association of Counties Annual Conference in Richmond, Virginia, 12 pioneering counties representing 17 million people launched "Cool Counties." The Cool Counties initiative seeks to marshal the resources of all 3,066 counties across the nation to address the challenges climate change poses to our communities. On May 27, 2008 the Sacramento County Board of Supervisors approved a resolution to become a Cool County and participate in the initiative.

Participating counties commit to four smart actions:

1. reducing our own contributions to climate change through our internal operations;

2. demonstrating regional leadership to achieve climate stabilization and protect our communities;

3. helping our community become climate resilient;

4. urging the federal government to support our efforts.

These actions are consistent with the state requirements under Assembly Bill (AB) 32 and Executive Order S-3-05, including:

- Assessing local operations that impact greenhouse gas emissions;

- Working to reduce greenhouse gas emissions 80% below current levels by 2050;

- Identifying local vulnerabilities to climate change and creating a plan to address them;

- Working with counties nationally to urge the federal government to adopt legislation to reduce greenhouse gas emissions 80% below current levels by 2050.

IMPACTS AND MITIGATION MEASURES

The following section discloses the potential impacts of the proposed project on global climate change, and the potential impacts of global climate change on the proposed project. Mitigation measures have been identified where feasible.

SIGNIFICANCE CRITERIA

Though it is clear that emissions throughout the state must be reduced in order to meet reductions targets, none of the Air Districts in California have identified a significance threshold for GHG emissions, a methodology for making a finding, or developed a measuring tool to determine when mitigation reduces emissions “enough”. The California Office of Planning and Research (OPR), the agency responsible for development and updates to the CEQA Guidelines, is not required to have a draft set of guidelines for climate change until July 1, 2009 (pursuant to Senate Bill 97, Chapter 185, 2007). OPR has indicated publically that thresholds will not be established as part of the new guidance. One could use the emissions reduction targets established through AB 32. However, the ARB is not set to adopt quantified reduction measures until January 1, 2009. Even after this inventory is complete, it is recognized that for most projects there is no clear or established method to determine if a particular project will negatively impact the ability of the state to meet the emissions goals. At the time of this writing, a host of white papers on the subject have been published, and many conferences and workshops are being held each month. While all conclude that actions must be taken, the subject of significance criteria is a matter of great debate.

Sacramento County has prepared a GHG emissions inventory as part of preparation of the Environmental Impact Report for the General Plan Update project (Control Number 02-GPB-0105). It is the intent of this process to identify reductions targets for the County that would mirror those of AB 32, and to recommend policies that new development must follow in order to allow achievement of the reductions. Once this is in place, a significance finding can be made based on whether the project does or does not comply with the adopted policies. Even in absence of the completion of the General Plan Update EIR, the basic premise of the above strategy can be implemented.

100% OFFSET STANDARD

Sacramento County has developed both a screening criteria and a significance threshold for GHG. The screening criteria is used to determine whether a project is large enough to warrant quantitative analysis, instead of relying on qualitative analysis. If quantitative analysis is warranted, emissions are quantified using URBEMIS (or other models, as appropriate). Because traffic is a significant contributor of GHG emissions, the typical screening threshold is based on the number of trips a given project may generate. If a project generates less than 100 peak-hour trips and less than 1,000 total daily trips, quantitative modeling will not be required. Mining projects are handled differently due to the continued long-term operation of heavy equipment which usually warrants quantitative analysis, even in the absence of vehicle trips which exceed the screening threshold.

All GHG impacts to climate change are exclusively cumulative impacts, and all projects that result in an expansion of use also result in cumulative climate change impacts. The issue is determining which projects result in significant impacts, and which projects will not contribute emissions great enough to impact State goals. Sacramento County will determine that a project is less than significant if approval of the project without mitigation will not jeopardize the State's GHG emissions reductions goals, when considered as part of cumulative development in Sacramento County. For this project a 100% offset is appropriate due to the size of the project.

METHODOLOGY

This project's GHG impacts are derived mainly form the combustion of fossil fuels involved with the operation of the mining equipment and haul trucks. This project provides a unique challenge in addressing traffic and air quality impacts because it is an expansion of an already permitted aggregate mine and processing plant. The mine is currently permitted through the year 2033 as provided in the previously issued Use Permit. This expansion opens up an additional 98 acres for mining but it does not increase the production plant capacity, location of the production plant, change the sales rate or extend the planned year 2033 cessation of mining. For these reasons traffic impacts were determined to be less than significant (see the Traffic chapter) because no new trips were being generated. In other words the same haul trucks would continue using the same off-site haul routes and in the same numbers. For this reason the emissions of those trucks are not considered in this analysis.

The applicant provided an Air Quality Analysis (Appendix ~~G~~*K*) that quantified the emissions from the on-site heavy duty and off-road vehicles that would be used to mine the expansion site. The applicant asserted a net change approach, arguing that the fleet would simply move from the existing mining site and begin to mine at the expansion site. Therefore, the applicant argues, the only impact to air quality from the expansion site would be the net change in pollution caused as the fleet's engines deteriorate over time. In the Air Quality chapter, this EIR accepted the emissions numbers provided by the applicant's air quality analysis but challenged the net change assertion. According to the Air Quality chapter, because approval of the site for mining would allow those pieces of equipment to operate on the new site, their emissions were considered a new impact or at least a continuation of a previously identified significant impact. These emissions (nitrogen oxides) when considered as a new impact were determined to be a significant and unavoidable impact. The same approach will be used for this chapter in regard to the equipments' production of CO_2.

The applicant asserts that by permitting a local source of aggregate, there is actually a savings on GHG emissions because the aggregate is not hauled from farther distances to the Sacramento market. This argument may be valid from a land use point of view in deciding whether or not to permit the project but it does not address the climate change impacts of this project. Furthermore, to accept the argument would mean assigning the previously dismissed off-site haul truck trips to the expansion site and not the originally permitted mine and processing plant. The fact remains that if the expansion project was not permitted, then this site would not produce the amount of CO_2 reported below.

For determining the CO_2 produced by the heavy duty equipment operating at the expansion mining site, the applicant provided a supplemental air quality analysis (Appendix K) prepared by Impact Sciences, Inc. The analysis used emissions factors from the EMFAC2007 model for estimating the water trucks' CO_2 emissions and the OFFROAD2007 model for estimating the heavy equipment emissions. Then the emission factor was used to determine CO_2 emissions based on estimates of the daily miles traveled by the equipment.

ESTIMATED PROJECT CARBON DIOXIDE (CO_2) EMISSIONS

The analysis concluded that the project would result in emissions of 2,041.4 metric tons (MT) of CO_2 annually. Table CC-2 presents the project emissions compared to County and State levels.

Table CC-2 Relative CO_2 Emissions (in CO_2 Equivalents)

Source	CO_2	% of State - 2004	% of State - 1990	% of Unincorporated County
Project	0.0020414 MMT/yr	~~0.0000042~~ *0.00047*	~~0.0000047~~ *0.00052*	~~0.0005103~~ *0.05103*
Unincorporated County	4 MMT/yr	*0.9* ~~0.8~~	*1 0* ~~0.9~~	
State – 1990	*389*~~427~~ MMT/yr			
State – 2004	*427*~~484~~ MMT/yr			

MMT: Million Metric Tons

IMPACTS OF ESTIMATED PROJECT CO EMISSIONS

As shown by Table CC-2, on a singular basis the project makes only a ~~0.0005103~~ *0.05103*% annual contribution to the unincorporated County's GHG emissions. The contribution at the State levels is statically insignificant and two orders of magnitude smaller. As a singular impact this is less than significant. Nonetheless, it is obvious that climate change is a problem of cumulative consideration. Every addition of GHG to the earth's atmosphere, however small, adds to the problem. Consequently, as described above, the County has adopted a 100% offset standard and in order to reduce this project's cumulative impacts, mitigation will be required. This mitigation takes two forms. "Soft" mitigation based on qualitative benefits and "Hard" mitigation based on quantitative reductions.

Soft vs. Hard Mitigation

Soft mitigation can be in the form of bike trails, vegetation plantings, and other options that provide a GHG benefit but that are difficult to quantify. Hard mitigation can be the retrofit of an engine, installation of solar panels, conversion of a generator from diesel to natural gas or other similar options for which quantitative reduction calculations can be performed or for which generally accepted calculators exist.

The county has worked with the Sacramento Metropolitan Air Quality Management District SMAQMD) to establish a list of soft mitigation measures and a point system associated with various mitigation strategies. These points would be applied to a project's emissions to achieve quantitative reduction based on the qualitative measures. However, because this system was developed with commercial and residential development in mind, it does not contain items directly applicable to a mining project such as this one.

Mitigation Strategy

The mitigation strategy for this project will be to achieve a 75% reduction in GHG emissions through "soft" qualitative mitigation and then require the remaining 25% to be reduced through quantitative "hard" mitigation. The project's estimated total GHG contribution is calculated to be 2,041.4 metric tons of CO_2 annually, 25% of that or 510.4 metric tons of quantifiable "hard" mitigation will be required annually *for the expected 12-year life of the project. This results in a one-time hard mitigation requirement of 6,124.8 metric tons of CO_2 equivalents.*

Qualitative Mitigation

As mentioned above, the point system developed by SMAQMD is not particularly applicable to this mining project. However, the project contains several design components and other required mitigation that, when taken in the aggregate are considered by this EIR to achieve a quantitative 75% reduction in GHG emissions. These elements are described below and have been incorporated into mitigation measures at the end of this chapter.

- The project will utilize an electric conveyor instead of haul trucks to transfer raw materials from the expansion site to the processing plant. This will prevent increased emissions from hauling by truck.

- The project will be required to provide a plan, for approval by the Environmental Coordinator and the Sacramento Metropolitan Air Quality Management District (SMAQMD), demonstrating that the heavy-duty (>50 horsepower) off-road vehicles to be used in the project, including owned or leased and subcontracted vehicles, will achieve a project wide fleet-average 20 percent NO_X reduction and 45 percent particulate reduction compared to the most recent ARB fleet average at time of each annual report. Note that this requirement applies to the entire fleet at time of operation not just to replacement vehicles for the fleet. This will increase the fleet efficiency and also help reduce GHG emissions.

- The project will concurrently reclaim mined phases with vegetation as mining progresses. The vegetation will accumulate biomass and increase carbon sequestration.

- The project will provide an enhanced Laguna Creek Corridor, consisting of dedications for a multi-use pedestrian and bicycle trail and an enhanced riparian corridor. The portion of Laguna Creek through the project site will be enhanced from a straight and channelized creek with limited riparian vegetation to a terraced meandering stream course. The corridor will average 600 feet in width and encompass 42.8 acres. Consisting of 17.14 aces of grasslands, 0.96 acres of vernal pools, 18.50 acres of emergent wetlands and 6.20 acres of riparian terrace wetlands. This enhancement of the corridor will increase the carbon sequestration on the site over the existing condition.

QUANTITATIVE MITIGATION

The project will be required to provide documented and calculated emissions reductions or offsets to account for 510.4 metric tons of CO_2 annually *for the expected life of the project. The project's CO_2 estimates are based on a maximum production scenario which would exhaust the expansion site's reserves in approximately 12 years. Therefore, the project should be responsible for 6,124.8 metric tons of CO_2 equivalent mitigation.* . This can be in the form of engine retrofits, solar panels *or other green energy solutions*, natural gas powered buses for local schools, energy efficient upgrades to existing buildings, *white roofs, methane recovery, and market based offsets or credits*, etc. Since global climate change is a cumulative, worldwide problem, these measures need not be confined to just the project site. However, because of the need for local control over mitigation measures, they shall be restricted to unincorporated Sacramento County *unless the mitigation takes the form of the purchase of market based offsets or credits; in which case the market system must be generally recognized as appropriate for use in California but need not necessarily be located in California.*

Because this project is finite in duration as opposed to a new housing development which would be expected to exist indefinitely, it is appropriate to allow credit for mitigation that exceeds the expected life of the expansion project. For example, solar panels have a 20 to 35 year life expectancy depending on manufacturer's specifications. If a solar panel system was expected to last 25 years and it was expected to offset 200 metric tons of CO2 per year, then the mitigation credit would be 200 times 25 or 5,000 metric tons of CO2.

SUMMARY OF PROJECT RELATED CLIMATE CHANGE IMPACTS

The project is expected to annually contribute 2041.4 metric tons of CO_2 to the atmosphere during its expected 12 year lifetime. Annually, this impact is only ~~0.0005103~~ *0.05103*% of unincorporated Sacramento County's GHG contribution. While not significant singularly, this impact, if not completely mitigated, would be cumulatively significant and unavoidable. Mitigation proposed consisting of 75% “soft” and 25% “hard” mitigation will result in both qualitative and quantitative reductions and offsets. At this time no generally accepted calculators exist for some of the mitigation measures comprising the “soft” mitigation and therefore, the corresponding 75% reduction credit for “soft” mitigation is only an estimate which could be considered by some as arbitrary and possibly not resulting in “enough” mitigation. Consequently, even with the described mitigation, this project’s cumulative climate change impacts are considered significant and unavoidable. While recognizing this impact as significant and unavoidable, this EIR also acknowledges that some of the design elements the project contains in regard to site restoration and enhancement, open space corridors and multi-use trails, while not completely quantifiable at this time represent the type of visionary thinking that will be required to solve the global climate change crisis.

Potential Mitigation Costs

The following sections contain information on a potential mitigation program through the Sacramento Metropolitan Air Quality Management District as well as information related to the potential costs of mitigating the project’s CO_2 emissions.

Sacramento Metropolitan Air Quality Management District

On August 28, 2008, shortly after the close of the public review period for this project’s DEIR, the Sacramento Metropolitan Air Quality Management District (SMAQMD) went to their Board with a proposal to enhance their Climate Change Protection Program. The Board Letter introducing the District’s proposal is included as Appendix L of this FEIR and includes a request to develop the following:

1. *Mechanisms wherein entities (industry, developers, businesses, agencies) that emit greenhouse gas (GHG) emissions can “bank” or sell emissions which have been voluntarily reduced.*

2. *Mechanisms wherein project proponents seeking CEQA mitigation of projected GHG emissions can buy into District-sponsored GHG mitigation projects.*

3. *Assistance for Sacramento area sources in complying with the reporting mandates of AB 32 (Global Warming Solutions Act of 2006.)*

4. *Mechanisms to assure that climate protection measures do not cause increases in toxic or criteria air pollutants that adversely impact public health or environmental justice communities or attainment of federal national Ambient Air Quality Standards (NAAQS).*

The SMAQMD Board approved the request to initiate the enhancements and consistent with item #2 above, the District has worked with the preparers of this EIR to develop additional mitigation strategies for this project that would allow the applicant to participate in a pilot program to satisfy their mitigation requirement for 6,124.8 metric tons of CO_2 equivalents by paying a fee to the Air District. On October 23, 2008, SMAQMD staff approached their Board to request permission to initiate a pilot CO_2 CEQA mitigation program for this project. The SMAQMD Board approved the request. Because this program is under development, no fees have yet been set. Initial research indicates that mitigation may cost as low as $2.00 per metric ton to over $300.000 per metric ton of CO_2 equivalents. As of this writing, research into a fee is ongoing and the District is working with the Sacramento Municipal Utility District and the Pacific Gas and Electric Company to explore potential programs and partnerships.

CHICAGO CLIMATE EXCHANGE

The Chicago Climate Exchange is currently accepting membership for their Phase II program in which members commit to reducing their baseline by 6% by 2010. Credits can be purchased or sold depending on whether or not 6% is achieved. Additional credits can be purchased for additional offsets. The Chicago Climate Exchange charges a membership fee and yearly fee based on the member's existing baseline. Assuming the membership fee was $5,000 and the annual fee was $10,000, there would be about $35,000 in fees through 2010. If all 6,124.8 metric tons of offsets required under mitigation measure CC-5 were purchased through the Chicago Climate Exchange at a price of $2.50 per metric ton, there would be approximately $15,312 dollars of additional fees for a total rounded to $50,000. Any quantifiable reductions through the exchange would reduce the amount of credits needed for purchase.

The applicant estimates that there are 10.7 million tons ("short tons" or 2,000 pounds) of aggregate to be extracted from the expansion site. A $50,000 cost for mitigation in this case would come out to about ½ of a cent per ton of aggregate. For comparison and according to the applicant's comment letter, the cost of aggregate in Sacramento County is approximately $10 to $11 per ton and transportation costs about 15 cents per mile.

MITIGATION COST COMPARISON

Table CC-3 provides calculations indicating the total cost to the applicant, cost increase per ton of aggregate produced and percent increase in the price of a ton of aggregate for a range of mitigation fees from five to 300 dollars per metric ton of CO_2 mitigated. The table assumes 10.7 million tons of aggregate reserves at the expansion site with a sales price of $10.50 per ton. The table shows that cost increases per ton of aggregate range from one third of a cent to 17 cents per ton. This corresponds to only a 0.03% to 1.64% increase to the price of a ton of aggregate if the cost is added to a $10.50 per base price. Even when taken at the highest value of 17 cents per ton, the cost of mitigating the project's GHG contributions are roughly equivalent to one mile of extra transportation using the applicant's 15 cents a mile transportation cost estimate. This mitigation cost would be substantially lower than any costs incurred by transporting aggregate from greater distances.

It is the opinion of the preparers of this FEIR that the range of potential costs is certainly not infeasible or excessively burdensome to the applicant but instead represents a fair share contribution towards solving California's climate change problem.

Table CC-3 Mitigation Cost Comparison

Cost of mitigating one metric to CO2 equivalents (in dollars)[1]	Total cost to applicant (in dollars)	Cost increase per ton of aggregate produced (in dollars)	Percent increase in a $10.50 ton of aggregate
300.00	1,837,400.00	0.1717	1.64
250.00	1,531,200.00	0.1431	1.36
200.00	1,224,960.00	0.1145	1.09
150.00	918,720.00	0.0859	0.82
100.00	612,480.00	0.0572	.55
50.00	306,240.00	0.0286	0.27
25.00	153,120.00	0.0143	0.14
10.00	61,248.00	0.0057	0.05
5.00	30,624.00	0.0029	0.03

[1] *These ranges were selected based on the mitigation costs reported in the following sources:*

The Chicago Climate Exchange 2006 vintage Carbon Financial Instrument has ranged from $1.70 to $7.50 per metric ton CO2 during 2008 (as of 9/26/08) (http://www.chicagoclimatex.com/market/data/summary.jsf).
The Tuffts Climate Initiative reports that in 2006 the price of a metric ton of carbon offsets ranged from $5.50 to $27.40 among 16 different companies (http://www.tufts.edu/tie/tci/carbonoffsets/price.htm)
The Measure Documentation Supplement of the Climate Change Draft Scoping Plan prepared Pursuant to AB 32 indicates that for energy efficient upgrades, mitigation costs range from $269.67 to $301.79 per metric ton CO2 (http://www.arb.ca.gov/cc/scopingplan/document/draftscopingplan.htm)
Mr. Keith Roberts, with the City of Sacramento estimates the cost of CO2 sequestration by planting urban forests at $100.00 a metric ton with about 2/3 of the cost going to long term maintenance (personal communication 9/29/08).

MITIGATION MEASURES

CC-1: The project shall utilize an electric conveyor instead of haul trucks to transfer raw materials from the expansion site to the processing plant.

CC-2: The project will be required to provide a plan, for approval by the Environmental Coordinator and the Sacramento Metropolitan Air Quality Management District (SMAQMD), demonstrating that the heavy-duty (>50 horsepower) off-road vehicles to be used in the project, including owned or leased and subcontracted vehicles, will achieve a project wide fleet-average 20 percent NO_X reduction and 45 percent particulate reduction compared to the most recent ARB fleet average at time of each annual report. Note that this requirement applies to the entire fleet at time of operation not just to replacement vehicles for the fleet.

Due to the long term nature of this project, the requirement for the emission reduction plan referenced herein will sunset on July 30, 2013 due to existing SMAQMD and CARB rules that will affect CARB fleet averages at that time.

CC-3: The project shall concurrently reclaim mined phases with vegetation as mining progresses.

CC-4: The project shall provide an enhanced Laguna Creek Corridor, consisting of dedications for a multi-use pedestrian and bicycle trail and an enhanced riparian corridor. The portion of Laguna Creek through the project site shall be enhanced from a straight and channelized creek with limited riparian vegetation to a terraced meandering stream course. The corridor shall average 600 feet in width and encompass at least 42.8 acres. Consisting of approximately 17.14 aces of grasslands, 0.96 acres of vernal pools, 18.50 acres of emergent wetlands and 6.20 acres of riparian terrace wetlands.

CC-5: *Either*

Prior to any mining on the expansion site, ~~T~~the applicant shall prepare and implement a plan subject to the approval of the Department of Environmental Review and Assessment *and the Sacramento Metropolitan Air Quality Management District* that achieves an emissions reduction or offset equal to *6,124.8* ~~510.4~~ metric tons CO_2 ~~annually for the duration of mining~~. Examples of quantifiable measures include natural gas vehicles, white roofs, energy efficient upgrades, ~~and~~ solar panels *and other green energy solutions, land dedications, woodland preservation, or methane recovery, and market based offsets or credits*,. These measures need not be applied on-site but ~~may be utilized~~ *shall occur* ~~anywhere~~ within unincorporated Sacramento County. *Cooperation and* ~~P~~*p*artnership~~s~~ with *other quarries in securing land dedications for carbon sequestration while enhancing open space connectivity in the east county is highly encouraged as are partnerships with* schools, non-profits, and *other* public agencies ~~are encouraged~~.

Or

Prior to any mining on the expansion site, the applicant shall participate in a GHG mitigation pilot program pursuant to the Sacramento Metropolitan Air

Quality Management District's, August 28, 2008 Board of Director's approval to enhance its Climate Protection Program with the following components:

1. *Creation of a voluntary GHG reduction credit program*

2. *Creation of a voluntary GHG mitigation program*

3. *Creation of an integrated emissions reporting system to satisfy state reporting requirements*

4. *Assuring that public health is the top priority in designing and implementing GHG emissions reduction measures.*

Participation shall consist of paying a mitigation fee to fund off-site GHG reduction programs established by the District, likely in cooperation with local utilities. This pilot program would operate similar to the District's existing off-site mitigation fee program for criteria pollutants. The amount of fee payment will be determined by the District and shall correspond to expected offsets of 6,124.8 pounds of CO2 equivalents.

Or

Prior to any mining on the expansion site, the applicant shall secure market-based offsets or credits for 6,124.8 metric tons CO2 to the satisfaction of the Department of Environmental Review and Assessment and the Sacramento Metropolitan Air Quality Management District. This mitigation is not restricted to unincorporated Sacramento County; however, any system used shall be quantifiable, verifiable and generally recognized as appropriate for use in California.

APPENDIX D

WHAT CONSTITUTES AN ADVERSE HELATH EFFECT OF AIR POLLUTION?

(American Thoracic Society, July 1999)

American Thoracic Society

What Constitutes an Adverse Health Effect of Air Pollution?

This Official Statement of the American Thoracic Society Was Adopted by the ATS Board of Directors, July 1999

PURPOSE OF THE STATEMENT

As the twentieth century ends, the health effects of outdoor air pollution remain a public health concern in developing and developed countries alike. In the United States, the principal pollutants monitored for regulatory purposes (carbon monoxide, nitrogen dioxide, sulfur dioxide, particles, ozone, and lead; see Table 1) show general trends of declining concentrations, although ozone pollution now affects many regions of the country besides southern California (1). Yet, even at levels of air pollution now measured in many cities of the United States, associations between air pollution levels and health indicators are being demonstrated at concentrations around those set by standards of the U.S. Environmental Protection Agency (2, 3). In many countries of the developing world, concentrations of air pollutants are rising with industrialization and the increasing numbers of motor vehicles (4, 5). Extremely large and densely populated urban areas, often referred to as "megacities," have the potential to generate unprecedented air quality problems.

There are common principles to air quality management throughout the world. Public health protection unifies all approaches, whether based on voluntary guidelines, mandated standards for concentrations, or source control. The intent is to limit or to avoid any impact of air pollution on the public's health. Air quality management is thus based on a scientific foundation built from the epidemiologic, toxicologic, and clinical evidence on health effects of air pollution. In interpreting this evidence for public health protection, there is a need to identify those effects that are considered "adverse" and to separate them from those effects not considered adverse.

The American Thoracic Society has previously provided guidance on the distinction between adverse and nonadverse health effects of air pollution in its 1985 statement, "Guidelines as to What Constitutes an Adverse Respiratory Health Effect" (6). Definitions of adverse effects have also been offered by the World Health Organization (7–10), but the guidance of the American Thoracic Society has received particular emphasis in the United States. Preparation of the original statement was intended to coincide with consideration of the passage of an amended Clean Air Act and to provide a framework for interpreting scientific evidence relevant to the mandate of the act. In particular, the Clean Air Act requires that the Administrator of the Environmental Protection Agency promulgate, for certain pollutants, standards that will be sufficient to protect against adverse effects of the air pollutants on health. The act is silent on the definition of "adverse effect" and, at the time of the 1985 statement, there was considerable controversy around the interpretation of this language as revision of the act was being considered. Recognizing the need of policy makers for expert guidance, the American Thoracic Society released the 1985 statement, which to date constitutes the sole set of recommendations on this issue from an expert panel convened by a health organization.

The American Thoracic Society has revised the 1985 statement because new scientific findings, published since the original statement, have again raised questions as to the boundary between adverse and nonadverse in considering health effects of air pollution. These new findings reflect improved sensitivity of research approaches and the application of biomarkers that can detect even subtle perturbations of biologic systems by air pollutants. Epidemiologic research designs have been refined and large sample sizes and increasingly accurate methods for exposure assessment have increased the sensitivity of epidemiologic data for detecting evidence of effects. New statistical approaches and advances in software and hardware have facilitated analyses of large databases of mortality and morbidity information. The design of clinical studies-including controlled exposures of volunteers-has also advanced and biologic specimens may be obtained after exposure, for example, by fiberoptic bronchoscopy, to identify changes in levels of markers of injury. Toxicologic studies have also gained in sophistication through incorporation of more sensitive indicators of effect and the careful tracing of the relationship between exposure and biologically relevant doses to target sites, which may now be considered at a molecular level.

New dimensions have been added to the array of outcome measures. Medical outcomes research now recognizes that patient well-being should be broadly conceptualized and measured rigorously, in addition to considering the biological process of the disease itself. As a result, health-related quality of life, the perception of well-being, is now considered a necessary component of outcomes research. Validated instruments have been developed to assess the impact of health-related symptoms and impairment on functional status and quality of life (11-14). The formalization of the concept of environmental justice acknowledges that the effects of specific pollutants cannot be evaluated in isolation without giving consideration to the overlapping exposures of populations, often minority group members of low socioeconomic status, who live in neighborhoods that are heavily exposed to multiple environmental contaminants (15).

This new statement, like the 1985 statement, is intended to provide guidance to policy makers and others who interpret the scientific evidence on the health effects of air pollution for the purpose of risk management. The statement does not offer strict rules or numerical criteria, but rather proposes principles to be used in weighing the evidence and setting boundaries between adverse and nonadverse health effects. Even if the technical tools were available for scaling the consequences of air pollution on the multiple relevant axes, the placement of dividing lines should be a societal judgment and consequently

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TABLE 1

U.S. NATIONAL AMBIENT AIR QUALITY STANDARDS*

Pollutant	NAAQS Concentration (ppm)	($\mu g/m^3$)	Standard Type
Particulate matter ≥ 10 Pm (PM,,)			
24-h average		150	Primary and secondary
Annual arithmetic mean		50	Primary and secondary
Particulate matter ≥ 2.5 μm ($PM_{2.5}$)			
24-h average		65	Primary and secondary
Annual arithmetic mean		15	Primary and secondary
Ozone (0,)			
24-h average	0.12	235	Primary and secondary
Annual arithmetic mean	0.08	157	Primary and secondary
Sulfur dioxide (SO,)			
24-h average	0.14	365	Primary
Annual arithmetic mean	0.03	80	Primary
3-h average	0.50	1,300	Secondary
Nitrogen dioxide (NO,)			
Annual arithmetic mean	0.053	100	Primary and secondary
Carbon monoxide (CO)			
1-h average	35	40	Primary
8-h average	9	10	Primary
Lead (Pb)			
Quarterly average		1.5	Primary and secondary

* For detailed information on scientific bases and policy considerations underlying decisions establishing the NAAQS listed here, see the AQCDs, staff papers, and NAAQS Promulgation notices cited in text. Such information can also be obtained from several internet websites (e.g., http://www.epa.giv/airs/criteria.html; http://www.epa.gov/oar/oaqps/publicat.html; and http://www.epa.gov/ncea/biblio.htm).

this committee does not propose specific boundaries for separating adverse from nonadverse effects.

OVERVIEW OF THE 1985 STATEMENT

The 1985 statement of the American Thoracic Society was directed at respiratory health effects of air pollution and emphasized the interpretation of the epidemiologic evidence. The statement recognized the spectrum of responses to air pollution, which begins with exposure and evidence of exposure and ends at death. This spectrum has been characterized as a pyramid, based in the most common consequence-exposure-and having mortality, the least common and most severe consequence, at its tip. The statement included a table that lists adverse respiratory health effects, seemingly in order of declining severity (Table 2). The 1985 statement hinged the distinction between adverse and nonadverse effects on medical considerations. The committee recognized that the boundary is further influenced by societal considerations: "Where one draws the line to categorize it as an adverse health effect or an action level between pathophysiologic or physiologic change is probably best left to the individual or the community."

The committee's definition of adverse respiratory health effects was ". medically significant physiologic or pathologic changes generally evidenced by one or more of the following: (*1*) interference with the normal activity of the affected person or persons, (2) episodic respiratory illness, (3) incapacitating illness, (4) permanent respiratory injury, and/or (5) progressive respiratory dysfunction." The committee noted that all changes are not adverse, citing the example of carboxyhemoglobin. The level of carboxyhemoglobin, beyond that from endogenous production, is indicative of exposure but it is not predictive of adverse effects until reaching threshold levels, depending on the effect and the susceptibility of the exposed person. The statement recognized that a distinction should be

TABLE 2

ADVERSE RESPIRATORY HEALTH EFFECTS

A. Increased mortality (*Increased* as used here and subsequently means significantly [$p < 0.05$] increased above that recorded in some standard, comparable population. In selected situation, $p < 0.1$ may be appropriate)
B. Increased incidence of cancer
C. Increased frequency of symptomatic asthmatic attacks
D. Increased incidence of lower respiratory tract infections
E. Increased exacerbations of disease in persons with chronic cardiopulmonary or other disease that could be reflected in a variety of ways
  1. Less able to cope with daily activities (i.e., shortness of breath or increased anginal episodes)
  2. Increased hospitalization, both frequency and duration
  3. Increased emergency ward or physician visits
  4. Increased pulmonary medication
  5. Decreased pulmonary function
F. Reduction in FEV_1 or FVC associated with clinical symptoms
  1. Chronic reduction in FEV, or FVC associated with clinical symptoms
  2. A significant increase in number of persons with FEV_1 below normal limits: chronically reduced FEV, is a 'predictor of increased risk of mortality. Transient or reversible reductions that are not associated with an asthmatic attack appear to be less important. It should be emphasized that a small but significant reduction in a population mean FEV, or $FEV_{.75}$ is probably medically significant, as such a difference may indicate an increase in the number of persons witn respiratory impairment in the population. In other words, a small part of the population may manifest a marked change that is medically significant to them, but when diluted with the rest of the population the change appears to be small
  3 An increased rate of decline in pulmonary function (FEV,) relative to the predicted value in adults with increasing age or failure of children to maintain their predicted FEV, growth curve. Such data must be standardized for sex, race, height, and other demographic and anthropometric factors
G. Increased prevalence of wheezing in the chest apart from colds, or of wheezing most days or nights. (The significance of wheezing with colds needs more study and evaluation.)
H. Increased prevalence or incidence of chest tightness
I. Increased prevalence or incidence of cough/phlegm production requiring medical attention
I. Increased incidence of acute upper respiratory infections that interfere with normal activity
K. Acute upper respiratory tract infections that do not interfere with normal activity
L. Eye, nose, and throat irritation that may interfere with normal activity (i.e., driving a car) if severe
M. Odors

drawn between effects to individuals and effects to populations and that populations are heterogeneous in their susceptibility. The comment was offered that a change in a population could be "medically significant" for that group. The statement also provides guidance on interpretation of'reversible effects and on interpreting irreversible effects. In acknowledging that research would continue to address uncertainties, the committee recommended that the guidelines should be periodically reviewed and updated.

METHODOLOGY FOR DEVELOPING THIS STATEMENT

Following the recommendation of the committee that authored the 1985 statement, the Environmental and Occupational Health Assembly of the American Thoracic Society recognized a need to reconvene a group to review and revise the prior statement. The statement had been used for more than a decade and new investigative approaches were being used to identify effects of air pollution that were not considered by the first committee. In addition, societal perspectives had shifted since the early 1980s and a forma1 concern for the impact of air pollution on specific groups had been expressed through the environmental justice movement.

To revise the statement, a multidisciplinary committee was convened in 1997 that included expertise in pulmonary medicine, public health, epidemiology, both clinical and animal toxicology, biochemistry, and cellular and molecular biology. This committee conducted several planning meetings and consulted experts in environmental economics and in ethics. In addition, a multidisciplinary workshop was convened to gain input from the range of groups potentially interested in the statement and its application. The committee's approach was discussed at a symposium held at the 1999 Annual Meeting of the American Thoracic Society. After further revisions, the statement was reviewed and submitted to the Board of the American Thoracic Society.

BACKGROUND ON THE CLEAN AIR ACT

The preparation of the original statement was largely motivated by potential ambiguity in interpreting the language of the Clean Air Act, which addresses adverse effects of air pollution without providing clear guidance as to the distinction between adverse and nonadverse effects. In addition, questions regarding this distinction arise repeatedly in interpreting the findings of research studies, whether observational or experimental. Consequently, the 1985 statement has had broader application than just the interpretation of evidence on air pollution and health for the purpose of promulgating air quality regulations. Nonetheless, the committee found the legislative history of the Clean Air Act to be relevant to its charge.

The first national legislation on air pollution, the Air Pollution Control Act, was passed in the mid-1950s; the original Clean Air Act was passed in 1963 and last revised in 1990. The act is lengthy and complex in its provisions; most relevant to considerations in defining an adverse health effect are Sections 108 (Air Quality Criteria and Control Techniques), 109 (National Ambient Air Quality Standards), and 112 (Hazardous Air Pollutants). National Ambient Air Quality Standards (NAAQS) are set individually for six prevalent pollutants (Table 1), often referred to as "criteria pollutants." They are so designated because of the requirement for comprehensively reviewing relevant information in a criteria document. The primary NAAQS are to be set at a level that protects the public health with an adequate margin of safety, regardless of economic or technical feasibility of attainment. The secondary standards are concerned with welfare and environmental consequences.

The hazardous air pollutants, as defined in Section 112, are not covered under Sections 108 and 109 as criteria pollutants. In 1990, the Congress offered a list of 189 such pollutants and a process for listing and delisting substances. The 1990 Clean Air Act states: "The Administrator shall periodically review [and revise] the list [of 189 hazardous air pollutants] by. adding pollutants which present, or may present, through inhalation or other routes of exposure, a threat of adverse human health effects (including, but not limited to substances which are known to be, or may reasonably be anticipated to be, carcinogenic, mutagenic, teratogenic, neurotoxic, which cause reproductive dysfunction, or which are acutely or chronically toxic). ." Section 112(f)(2) further directs the Environmental Protection Agency to assess whether the emissions standards for the listed hazardous air pollutants required under other subsections "provide an ample margin of safety to protect public health" and if not, then the agency is to develop standards that will address the "remaining risk."

The historical record provides an indication of the intent of the Congress in framing the language of the Clean Air Act with regard to protection of the public's health. Research now shows that the most highly susceptible individuals may respond to common exposures that are often at or close to natural background pollutant levels.

With regard to sensitivity, the 1970 Clean Air Act recognized that some persons were so ill as to need controlled environments, e.g., persons in intensive care units or newborn infants in nurseries; the act stated that the standards might not necessarily protect such individuals. It further stated, however, that the standards should protect "particularly sensitive citizens such as bronchial asthmatics and emphysematics who in the normal course of daily activity are exposed to the ambient environment." The act further suggested that the adequacy of any standard could be tested in a statistically representative sample of sensitive individuals. The hearing record on the 1970 act is informative. Dr. Hon T. Middleton (Commissioner, National Air Pollution Control Administration, Department of Health, Education, and Welfare) addressed the Senate Subcommittee on Air and Water Pollution of the Committee on Public Works on May 27, 1970. He testified that the intent of any national air quality standard is to be "protective of health in all places" and set at a level below which effects have not been observed. Dr. Middleton recognized the difficulty of finding a demarcation point of exposure below which there is no effect and he noted that there may be subtle effects and evolving scientific understanding.

Further difficulties in the language of the Clean Air Act were later noted in ***A Legislative History of the Clean Air Act Amendments of 1977: A Continuation of the Clean Air Act Amendments of 1970.*** This document noted the difficulty of applying the margin of safety and the erosion of margins of safety by advancing scientific knowledge. The document also commented on the implicit assumption of a safe threshold in the language of the act and the implausibility of this assumption. The report questioned whether the NAAQS (I) protect against genetic mutations, birth defects, and cancer, (2) take sufficient account of the consequences of long-term low-level exposures or short-term peaks, and (3) sufficiently consider synergism among pollutants and the formation of secondary pollutants, e.g., sulfates, with their own toxicity. These considerations remain relevant more than 20 years later.

This selective review of the historical record indicates that Congress intended that the NAAQS would afford health protection not only to the general population but to subgroups with enhanced susceptibility to air pollution, including people with asthma and people with chronic obstructive lung disease. Nevertheless, it is also clear that some exquisitely susceptible individuals might remain outside the ambit of protection of the NAAQS. A margin of safety was to be provided but quantitative specification was not offered. The evolutionary nature of the supporting scientific evidence was repetitively acknowledged and the need to distinguish adverse from nonadverse effects was at least implicitly recognized. The current language of Section 112 explicitly acknowledges the possibility of shifting understanding of risks of specific hazardous air pollutants.

GENERAL CONSIDERATIONS

In preparing the statement, the committee identified several general considerations that are relevant to interpreting evidence on the health effects of air pollution. Each of these considerations and the committee's judgment as to their proper weighting are detailed below.

Population Health versus Individual Risk

The effects of air pollution can be viewed in the complementary contexts of the increment of an individual's risk for disease—the clinician's measure of impact-and of the additional risk incurred by a population, which is the public health perspective (16). Both perspectives are relevant to interpreting research findings on air pollution and to regulations that are protective of the public's health. Any risk incurred by an exposed individual beyond some boundary, determined by the individual or on a societal basis, could be deemed unacceptable. For example. prolonged exposure to a respiratory carcinogen could result in an individual-level incremental risk of exposure of 10^{-4}, more than two orders of magnitude lower than the baseline lifetime individual risk in the United States. Nevertheless, among an exposed population of IO', the estimated number of cancer cases that might result from such an exposure would number 10^3, illustrating that minute individual risks may be significant from the standpoint of population exposures.

Exposure could also enhance risk for a population to an unacceptable degree, perhaps without shifting the risks of any particular individuals to an unacceptable level. Figure 1 illustrates the distinction. In Figure 1 A, the population's distribution of exposure shifts toward a higher level and some members of the population cross the boundary to an unacceptable risk. In Figure 1B, the shift affects the position of the population distribution, but no individuals move to an unacceptable level of risk. Effects on persons with asthma are illustrative. A population of children with asthma could have a distribution of lung function such that no individual child has a level associated with significant impairment. Exposure to air pollution could shift the distribution toward lower levels without bringing any individual child to a level that is associated with clinically relevant consequences. Individuals within the population would, however, have diminished reserve function and are at potentially increased risk if affected by another agent, e.g., a viral infection. Assuming that the relationship between the risk factor and the disease is causal, the committee considered that such a shift in the risk factor distribution, and hence the risk profile of the exposed population. should be considered adverse, even in the absence of the immediate occurrence of frank illness.

Ethics and Equity

The past decade has brought increasing concern over the ethics of heterogeneous, inequitable distributions of environmental and occupational exposures (IS). Within the United States, some groups receive disproportionate exposures to environmental agents that are injurious to health; the environmental justice movement seeks to redress these inequities. The exposures of concern originate in breathing polluted outdoor air, living in substandard housing with indoor air pollution problems, including exposures to certain bioacrosols and combustion products, and working in jobs with occupational respiratory risks. Groups encompassed by this movement in the United States include various racial and ethnic minority populations. particularly those living within urban areas, and the socioeconomically disadvantaged. In the developing world, such exposures can occur at substantially higher levels and may, in some instances, extend to a majority of a given nation's population. Limited access to care and medications may enhance susceptibility to pollution.

The concept of environmental equity had not been formally voiced when the 1985 statement was written. The present committee viewed inequities of exposure as potentially representing a form of susceptibility to air pollution. In other words, individuals within the target groups may be at increased risk of experiencing adverse effects from a given level of ambient air pollution because their baseline risk level may have been raised by other exposures. Moreover, in some instances there may be genetic and nutritional factors enhancing susceptibility as well. It should be noted, however, that there are other exposure scenarios and other subpopulations with increased baseline risks that are not formally included within the environmental justice movement. The heterogeneity of populations needs full acknowledgment, whether it reflects disproportionate noxious exposures or other factors. Observing that there have been few investigations of the effects of other exposures, genetics, or nutrition on susceptibility to air pollution-related effects, either in the United States or internationally, the committee issued a call for additional research in these areas.

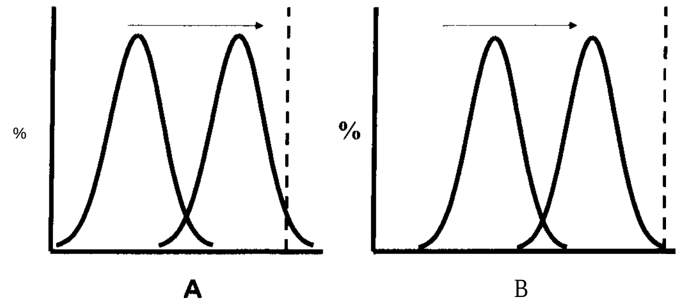

Figure 7. Hypothetical distributions **of exposure for two populations, *A* and *B*. (See text for explanation.)**

Economic Costs

Adverse health effects of air pollution incur costs, including direct costs of providing treatment for illness and indirect costs of lost work time and productivity. Cost-benefit analysis provides an estimate of the balancing of the costs of controls against the benefits; cost effectiveness analysis provides an indication of the level of control accomplished in relation to costs. Cost-benefit and cost-effectiveness analysis are assumption-laden tools now being used for policy-making purposes. Cost estimates depend on the valuation given to illness, lost work time and productivity, and even to lost life. It has been proposed that cost-benefit analysis may facilitate the process of deciding whether a given air pollution-related health impact should be considered adverse. The legislative history of the Clean Air Act explicitly excludes consideration of economic factors in setting ambient air quality standards or in developing emissions standards for hazardous air pollutants. In the context of air quality regulation, cost-benefit analysis is a multistep process involving the articulation of value judgments regarding potential costs (expenditures of public and private resources to reduce pollutant emissions and exposures) versus benefits (avoidance of specified adverse health impacts in a designated population). Benefits, in theory, should be quantified as the willingness of beneficiaries to pay to avoid the adverse impact. In practice, quantification of such health impacts from exposure to air pollution is often based on direct costs related to medical treatment and indirect costs such as school absenteeism, lost work time, decreased productivity, and, at the extreme, person-years of life lost. Valuations of a given effect may vary internationally, as differences in population age distributions, comorbidity, nutritional status, and other circumstances can affect this process. Ideally, cost–benefit analysis should make explicit the value judgments underlying these assessments, highlighting distinctions among alternative pollution control strategies to achieve specific air quality standards. Willingness of individuals to pay to avoid adverse health effects is also estimated from responses to contingent valuation surveys and from market data concerning choices about employment that carries health risks.

Nevertheless, the committee concurred that the specification of which health effects should be considered adverse must precede the application of cost-benefit analysis for evaluation of air pollution control strategies. That is, once a given outcome is designated as adverse, this information can be used as input to cost-benefit analysis. Estimates of costs associated with a given health outcome. while useful from a public policy perspective, cannot be translated into any clinical or biological framework to distinguish adverse from nonadverse effects. Therefore, the committee concluded that however valuable this economists' tool may be for regulatory decision-making, cost-benefit analysis lay outside the scope of this position paper and, indeed, the expertise of the American Thoracic Society.

Susceptibility

The issue of susceptibility has been recognized throughout the history of our initiatives to regulate outdoor air pollution. Susceptibility, broadly defined, may include extrinsic factors, including the profile of exposures to other pollutants, for example, in the workplace or at home, and intrinsic factors, for example, genotype. The size of the population of individuals susceptible to indoor air pollution is large, potentially including infants and the elderly, persons with chronic heart and lung diseases, and the immunocompromised. Persons with multiple deleterious exposures may also be considered as having heightened susceptibility, particularly if the combined effects of the agents are synergistic. Even with the populations considered as susceptible there is a distribution of the degree of susceptibility. For example, levels of nonspecific airway responsiveness in persons with asthma span several orders of magnitude.

The current explosive growth in knowledge of the genetic basis of lung disease, including responses to environmental agents, will provide increasing insights into the mechanistic basis of susceptibility and provide markers of risk status. We already have evidence of between-person variation in the pulmonary function response to ozone and interstrain variation in the pulmonary effects of environmental exposures, including criteria pollutants, in rodent species. As we develop the capacity to more precisely identify those at risk, we may find it increasingly challenging to assure protection for all individuals against adverse health effects.

The present committee agreed with the principle espoused in the Clean Air Act: that regulations should extend protection to include those with enhanced susceptibility to air pollution, recognizing that some highly susceptible individuals may still respond to low-level exposures. Research now shows that some highly susceptible individuals may respond to common exposures that are often unavoidable. Furthermore, by definition, susceptible individuals cannot have the same margin of safety as the nonsusceptible groups within the population.

Heterogeneity of Perspectives

In society there is an extraordinary range of views on environmental issues and tolerance of risk. Looking more globally to other developed countries and to the developing countries, the range of perspectives is even broader. The committee acknowledges that any defined boundaries for distinguishing adverse health effects may not be embraced by all groups. This heterogeneity and the possibility that some may reject the committee's proposal challenged the committee to recommend in principle that control measures should maximize public health benefits while assuring equity.

DIMENSIONS OF ADVERSE EFFECTS

Biomarkers

Biomarkers are indicators of exposure, effect, or susceptibility that are measured in biologic materials, such as blood or bronchoalveolar lavage fluid. The concept of biomarkers has been formalized since the 1985 statement (17) and since then. a continuously increasing number of candidate indicators of exposure, effect, and susceptibility have been developed and applied in laboratory studies of humans and animals and in both occupational and environmental population studies. The progressive refinement of techniques in the field of cellular and molecular biology, and the burgeoning understanding of the complex chemical intracellular and cell-to-cell signaling pathways collectively termed "cytokines" (18), have rapidly expanded the spectrum of candidate markers of effects. It is now possible to detect very early, or initiating phases of responses at the molecular level, such as the production of mRNA for cytokines. Similarly, the progressive development of genetic assays and understanding of the human genome have provided numerous candidate markers of both effects and susceptibility (19).

Biomarkers relevant to air pollution have been measured in blood, exhaled air, urine, sputum, and in bronchoalveolar lavage fluids and tissue specimens collected by bronchoscopy. Bronchoalveolar lavage fluids, for example, are now frequently analyzed for cell numbers and types, cytokines (e.g., several interleukins and tumor necrosis factor α), enzymes (e.g., lactate dehydrogenasc and β-glucoronidase), fibronectin, protein, arachidonic acid metabolites, and reactive oxygen species. Because many of the epithelial cell types of the nasopharyngeal region are similar to epithelia and responses in the trachea, bronchi, and bronchioles, responses of nasal cells have been examined as potential biomarkers for their ability to predict parallel responses in lung airways, which are more difficult to sample.

Biomarkers have been extensively applied in toxicologic studies of air pollution, both in animals and in clinical studies involving exposures of human volunteers. The biomarkcrs are examined for their ability to provide evidence of "biologically effective" doses, including the earliest phases of homeostatic responses, the occurrence of injury, outcomes that are intermediate between injury and disease, and the presence of established disease processes. Genetic markers of susceptibility have begun to be applied to the respiratory system, and this application will undoubtedly expand rapidly. A frequent goal of biomarker development is the ability to readily measure changes that precede and predict continued or progressive events leading to clinical effects and disease (Figure 2).

To date, although biomarkers have proved informative about homeostatic adjustments to exposure and the mechanisms of injury and disease, lack of validation against previously established measures of effect. such as clinical status or even physiologic impairment, remains an important weakness. We do not know if elevations of biomarkers during short-term experimental exposures signal risk for ongoing injury and clinical effects or simply indicate transient responses that can provide insights into mechanisms of injury. The utility of some older biomarkers is well established, such as the relationships among carboxyhemoglobin. exposure to carbon monoxide,

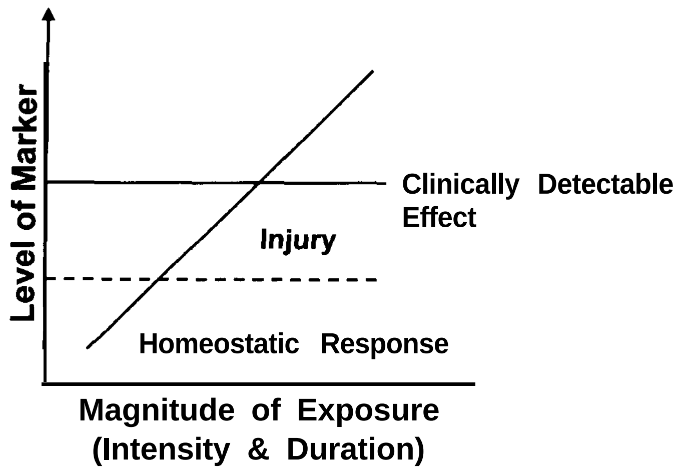

figure 2. Schema for considering biomarkers of response.

impairment of oxygen-carrying capacity, and the risk for angina in the presence of ischemic heart disease. However, the interpretative value for the majority of the many promising new cytokine and genetic biomarkers remains to be established. Not only is it difficult to assess the value of many biomarkers for distinguishing between physiological, homeostatic responses and injury, but it is also difficult to judge the value of changes during short-term exposures for predicting ongoing injury or risk for longer-term clinical effects.

The committee concluded that the continued development of biomarkers is an important need because of their considerable potential not only for detecting the adverse effects of air pollution exposure, but also for aiding the determination of the types and levels of response that should be considered adverse. We often do not know in a parallel, iterative manner, whether the exploration and validation of biomarkers will unquestionably advance our understanding of the mechanisms of homeostatic and injury responses. At this time, however, few of the rapidly growing list of candidate biomarkers have been validated to such an extent that their responses can be used with confidence to define the point at which a response should be equated to an adverse effect warranting preventive measures. Thus, we presently have only a very modest ability to translate evidence from biomarkers directly into a taxonomy of adverse health effects. Consequently, the committee cautions that not all changes in biomarkers related to air pollution should be considered as indicative of injury that represents an adverse effect.

Quality of Life

Health, in its broadest definition, includes not only the absence of disease but the attainment of well-being. Since the preparation of the 198.5 statement, the National Institutes of Health, the Centers of Disease Control, the Food and Drug Administration, and the World Health Organization have broadened their perspective of health to incorporate the concept of health-related quality of life as a valid and important health outcome. Health-related quality of life (HRQL) refers to the individual's perception of well-being, and includes such factors as self-care functioning, mental health, pain, and sense of overall well-being. Decreased health-related quality of life is widely accepted to be an adverse health effect. For this reason, measurable negative effects of air pollution on quality of life, whether for persons with chronic respiratory conditions or the population in general, were consequently considered by this committee to be adverse health effects. Air pollution exposure can adversely affect several domains of quality of life including physical functioning (particularly for persons with respiratory or cardiovascular conditions) and general well-being. Stinging, watery eyes resulting from air pollution not only reflect a chronic physical symptom but may decrease overall quality of life. Outdoor air pollution and odors have been associated with psychiatric symptoms, including anxiety and depression. Increased levels of some air pollutants have been reported to be associated with an increase in psychiatric admissions. The potential effects of air pollution and respiratory symptoms on different domains of quality of life are illustrated in Figure 3.

Measurement of the impact of air pollution on health-related quality of life can be accomplished either by measuring specific domains that may be influenced by air quality (e.g., anxiety, functional status), or by using specific quality of life instruments designed to measure multiple health-related domains (e.g., MOS-SF-36, St. George's Respiratory Questionnaire). The cost-benefits of improved air quality on health-related quality of life could also be measured by the use of quality of life measures that employ utility rating scales. The effects of air pollution of a magnitude considered to be clinically significant with these instruments should be regarded as adverse in interpreting evidence on the health effects of air pollution, regardless of the affected dimension. Additional research is needed to develop an information base for interpreting data from new and more sensitive instruments directed specifically at air pollution.

Physiological impact

The 198.5 statement acknowledged a distinction between reversible and irreversible effects. Healthy persons may sustain transient reductions in pulmonary function associated with air pollution exposure, e.g., reduction of the forced vital capacity (FVC) with exercise at times of higher levels of ozone pollution. However, the committee recommends that a small, transient loss of lung function, by itself, should not automatically be designated as adverse. In drawing the distinction between adverse and nonadverse reversible effects, this committee recommended that reversible loss of lung function in combination with the presence of symptoms should be considered as adverse. This recommendation is consistent with the 1985 statement. The Environmental Protection Agency has also needed to address the interpretation of such data. The Envi-

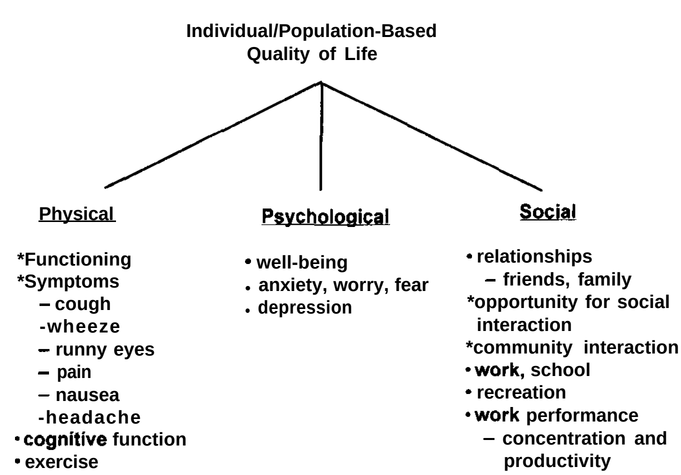

Figure 3. Quality of life domains vulnerable to the adverse health/respiratory effects of air pollution.

ronmental Protection Agency, in its 1989 review of ozone (20), offered a graded classification of lung function changes in persons with asthma. Reduction of the forced expiratory volume in 1 s (FEV_1) was graded as mild, moderate, or severe for reductions of less than 10%, 10–20%, and more than 20%, respectively. This classification has not been validated for acceptability or against other measures.

There is also epidemiologic evidence that air pollution may adversely affect lung growth or accelerate the age-related decline of lung function. Epidemiologic studies are limited in their power to detect such permanent effects and any evidence of association between air pollution exposure and permanent loss of function is indicative of an adverse effect at the population level. Some individuals may sustain clinically relevant, permanent losses of lung function. This committee considered that any detectable level of permanent lung function loss attributable to air pollution exposure should be considered as adverse.

Symptoms

Air pollution exposure can evoke symptoms in persons without underlying chronic heart or lung conditions and also provoke or increase symptom rates in persons with asthma and chronic obstructive lung disease. The Environmental Protection Agency also offered a scale for cough and pain on taking a deep breath in its 1989 ozone review (20). "Infrequent cough" was classified as "None/Normal."

Do all levels of increased symptom occurrence constitute an adverse health effect? The committee judged that air pollution-related symptoms associated with diminished quality of life or with a change in clinical status should be considered as adverse at the individual level. Characterizing the degree of symptomatology associated with diminished quality of life is an appropriate focus for research and a topic that could be investigated using new approaches for assessing quality of life. A change in clinical status can be appropriately set in a medical framework as one requiring medical care or a change in medication. At the population level, any detectable increment in symptom frequency should be considered as constituting an adverse health effect.

Clinical Outcomes

A wide range of clinical outcome measures has been considered in relation to air pollution, including population-level effects, such as increases in numbers of emergency room visits for asthma or hospitalizations for pneumonia, and individual-level effects, such as increased need for bronchodilator therapy. The present committee shared the view of the previous group: detectable effects of air pollution on clinical measures should be considered adverse.

At the population level, the magnitude of the detectable air pollution effect will depend on the extent of the data available for evaluation and methodological aspects of the data, including the degree of error affecting exposure and outcome variables. With large databases, seemingly modest effects may be detectable. However, the committee recommends that no level of effect of air pollution on population-level clinical indicators can be considered acceptable.

Mortality

Following the development of new approaches for the analysis of time-series data, extensive analyses have now been reported on the relationship between daily mortality counts and levels of air pollution on the same or prior days. Several prospective cohort studies have also addressed the effect of longer-term indicators of air pollution exposure on mortality, controlling for relevant individual factors, including age, sex, cigarette smoking, and occupational exposures, among others. Cross-sectional studies-comparing mortality across locations having different levels of air pollution while controlling for a variety of potential confounding factors-have also been conducted. The air pollution-associated mortality findings figured prominently in the recent revision of the U.S. NAAQS for particulate matter.

Associations between air pollution levels and daily mortality counts have been interpreted by some as reflecting the impact of air pollution on a pool of frail individuals with severe underlying heart or lung disease. One explanation for the day-to-day associations attributes them to a brief advancement of the time of death for extremely frail individuals who would have been expected to die soon even in the absence of an air pollution-related insult (21). Work has shown, however, that while this phenomenon of advancement, referred to as mortality displacement, may occur, it cannot provide a full explanation of the associations repeatedly found between daily fluctuations of air pollution and mortality (22, J. Schwartz, "Harvesting and long term exposure effects in the relationship between air pollution and mortality" [1999, unpublished manuscript]). In addition, some mortality time-series studies have found effects across all age strata, not just among the elderly or the very young, suggesting potentially substantial effects on person-years of life lost. Finally, studies of long-term exposures have shown a gradient of mortality risk from cardiopulmonary disease as well as differences in life expectancy across cities with different long-term pollution levels. Thus, although we still have little insight into the extent to which mortality displacement occurs, the evidentiary ensemble from several types of study designs consistently shows that air pollution can shorten the life span to an unacceptable degree.

Risk Assessment

Since the publication of the 1985 statement, quantitative risk assessment has emerged as a key tool for summarizing information on risks to health from environmental agents. Quantitative risk assessment offers a framework for organizing information on risks within its four elements: hazard identification, exposure assessment, dose-response assessment, and risk characterization. The findings of a risk assessment, encompassed in the risk characterization component, may include an overall assessment of impact, a description of the distribution of risk in the population, and an evaluation of risk for susceptible persons within the population. Quantitative risk assessment has been a cornerstone in evaluating risks of environmental carcinogens and we anticipate increasing application to noncarcinogenic health effects of environmental agents, including air pollution.

In interpreting the findings of risk assessments, guidance can be found in precedents offered by key interpretations of regulatory requirements, including the Supreme Court's decision on the benzene standard proposed by the Occupational Safety and Health Administration, and in pollutant-specific regulatory actions. Risks may be couched as the numbers of attributable events in the population and also as the level of risk incurred by individual members of the population.

The committee recognized the rising use and potential utility of quantitative risk assessment in characterizing the health effects of air pollution. However, the committee noted that the results of quantitative risk assessment can often be sensitive to assumptions regarding the distribution and magnitude of exposure, the choice of an appropriate dose-response relationship, and other input decisions. Judgments on acceptability of risk are societal and made through complex regulatory processes involving extensive public input. The committee did not consider that its mandate extended to offering specific guidance on acceptable risk levels for populations or individuals, nor is risk assessment an appropriate basis for determining what constitutes an adverse effect.

CONCLUSIONS

Since the preparation of the 1985 statement of the American Thoracic Society, there have been tremendous advances in the scientific methods used to investigate the health effects of air pollution. These advances range from the molecular to the behavioral levels of inquiry. As a result, this statement covers topics that are new since the 1985 statement. Yet, this committee, like the 1985 group, was confronted by a lack of formal research or investigation on the very topic of this statement: the boundary between adverse and nonadverse effects. Consequently, the committee needed to exercise its collective judgment on matters that should be based in some broader, societal decision-making process. Its recommendations are summarized below.

- ***Biomarkers.*** Few of the rapidly growing list of candidate biomarkers have been validated sufficiently that their responses can be used with confidence to define the point at which a response should be equated to an adverse effect warranting preventive measures. The committee cautions that not all changes in biomarkers related to air pollution should be considered as indicative of injury that represents an adverse effect.
- ***Quality of life.*** Decreased health-related quality of life is widely accepted as an adverse health effect. For this reason, measurable negative effects of air pollution on quality of life, whether for persons with chronic respiratory conditions or for the population in general, were consequently considered to be adverse by this committee.
- ***Physiological impact.*** The committee recommends that a small, transient loss of lung function, by itself. should not automatically be designated as adverse. In drawing the distinction between adverse and nonadverse reversible effects, this committee recommended that reversible loss of lung function in combination with the presence of symptoms should be considered adverse. This committee considered that any detectable level of permanent lung function loss attributable to air pollution exposure should be considered adverse.
- ***Symptoms.*** The committee judged that air pollution-related symptoms associated with diminished quality of life or with a change in clinical status should be considered adverse at the individual level.
- ***Clinical outcomes.*** The present committee shared the view of the previous group: detectable effects of air pollution on clinical measures should be considered as adverse.
- ***Mortality.*** This committee agreed with the conclusion articulated by the 1985 group that any effect on mortality should be judged as adverse. In addition, we are now faced with the challenge of interpreting the findings of time-series studies of effects on short time frames. In interpreting this type of evidence, consideration needs to be given to the extent of life-shortening underlying the association.
- ***Population health versus individual risk.*** Assuming that the relationship between the risk factor and the disease is causal, the committee considered that such a shift in the risk factor distribution, and hence the risk profile of the exposed population, should be considered adverse, even in the absence of the immediate occurrence of frank illness.

This statement was prepared by an ad-hoc committee of the Assembly on Environmental and Occupational Health. Members of the committee are:

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APPENDIX E

LIST OF RULES TENTATIVELY PROPOSED TO BE ADOPTED OR AMENDED BY SMAQMD IN 2017

2018 RULES LIST

The following rules are tentatively proposed to be adopted or amended in 2018:

Rule #	Rule Name (note: rule name may be modified as part of the rule development process)
261	Emission Reduction Credits for Replacement of Wood Burning Appliances
412	Stationary Internal Combustion Engines Located at Major Stationary Sources of NOx (proposed name change to Stationary Internal Combustion Engines)
414	Water Heaters, Boilers and Process Heaters Rated Less Than 1,000,000 Btu per Hour
419	NOx from Miscellaneous Combustion Sources
460	Adhesives and Sealants
461	Natural Gas Production and Processing
468	Surface Coating of Miscellaneous Plastic Parts and Products
485	Municipal Landfill Gas
490	Liquefied Petroleum Gas Transfer and Dispensing
801	New Source Performance Standards
902	Asbestos
904	Air Toxics Control Measures

The following rules are included in case adoption or amendment is needed during 2018:

Rule #	Rule Name
101	General Provisions and Definitions
102	Circumvention
103	Exceptions
104	General Conformity
105	Emission Statement
107	Alternative Compliance
108	Minor Violation
201	General Permit Requirements
202	New Source Review
203	Prevention of Significant Deterioration
204	Emission Reduction Credits
205	Community Bank and Priority Reserve Bank
206	Mobile and Transportation Source Emission Reduction Credits
207	Title V – Federal Operating Permit Program
208	Acid Rain
209	Limiting Potential to Emit
210	Synthetic Minor Source Status
211	Maximum Achievable Control Technology Requirements for Major Sources of Hazardous Air Pollutants
212	Toxic Air Contaminant Review
213	Federal Major Modifications
214	Federal New Source Review
215	Agricultural Permit Requirements and New Agricultural Permit Review
216	Registration of Agricultural Compression Ignition Engines
217	Public Notice Requirements for Permits
218	Permit Streamlining
220	Registration of Unpermitted Equipment
221	Registration of Unpermitted Equipment Used in Oil and Natural Gas Production and Processing
250	Sacramento Carbon Exchange Program
251	Greenhouse Gas Investment Program
252	Greenhouse Gas Permit Requirements
262	Rice Straw Emission Reduction Credits

Rule #	Rule Name
301	Permit Fees – Stationary Source
302	Hearing Board Fees
303	Agricultural Burning Permit Fees
304	Plan Fees
305	Environmental Document Preparation and Processing Fees
306	Air Toxics Fees
307	Clean Air Act Fees
309	Mitigation Fees
310	Permit Fees - Agricultural Source
311	Registration Fees for Agricultural Compression Ignition Engines
320	Fees for Coatings
321	Fees for Unpermitted Sources
322	Registration Fees for Unpermitted Equipment Used in Oil and Natural Gas Production and Processing
350	Greenhouse Gas Program Fees
401	Ringelmann Chart
402	Nuisance
403	Fugitive Dust
404	Particulate Matter
405	Dust and Condensed Fumes
406	Specific Contaminants
407	Open Burning
408	Incinerator Burning
409	Orchard Heaters
410	Reduction of Animal Matter
411	NOx from Boilers, Process Heaters, and Steam Generators
413	Stationary Gas Turbines
415	Flares
416	Residential Furnaces
417	Wood Burning Appliances
418	Commercial Cooking and Frying Operations
420	Sulfur Content of Fuels
421	Mandatory Episodic Curtailment of Wood and Other Solid Fuel Burning
425	PM10-Efficient Street Sweepers
426	Fugitive Dust from Construction, Demolition, Excavation and Earthmoving Activities
427	Fugitive Dust from Unpaved Roads
440	General Surface Coatings
441	Organic Solvents
442	Architectural Coatings
443	Leaks from Synthetic Organic Chemical and Polymer Manufacturing
444	Petroleum Solvent Dry Cleaning
446	Storage of Petroleum Products
447	Organic Liquid Loading
448	Gasoline Transfer into Stationary Storage Containers
449	Transfer of Gasoline into Vehicle Fuel Tanks
450	Graphic Arts Operations
451	Surface Coating of Miscellaneous Metal Parts and Products
452	Can Coating
453	Cutback and Emulsified Asphalt Paving Materials
454	Degreasing Operations
456	Aerospace Assembly and Component Coating Operations
457	Methanol Compatible Tanks
458	Large Commercial Bread Bakeries

Rule #	Rule Name
459	Automotive, Mobile Equipment, and Associated Parts and Components Coating Operations
463	Wood Products Coatings
464	Organic Chemical Manufacturing Operations
465	Polyester Resin Operations
466	Solvent Cleaning
467	Metalworking Fluids and Direct-Contact Lubricants
470	Asphalt Paving/Roofing Materials
471	Asphaltic Concrete Production
489	Composting Operations
491	Wineries/Breweries
492	Transfer of Fuel into Aircraft
493	Natural Gas Transmission
494	Wastewater Treatment
495	Sewage Treatment
496	Large Confined Animal Facilities
497	Conservation Management Practices
501	Agricultural Burning
601	Procedure before the Hearing Board
602	Breakdown Conditions: Emergency Variance
701	Emergency Episode Plan
810	Greenhouse Gas New Source Performance Standards
901	General Requirements
903	Mercury
1002	Fleet Inventory
1003	Reduced-Emission Fleet Vehicles/Alternative Fuels
1005	Mobile Source Emission Reduction Credits/Banking
1006	Transportation Conformity
1010	State Implementation Plan Credit for Emission Reductions Generated Through Incentive Programs
1025	Construction Equipment Fleet
1051	Indirect Source Rule for New Land Use Projects
1052	Construction Mitigation
1053	On-Road Motor Vehicle Mitigation

APPENDIX F

CRITERIA POLLUTANT EMISSIONS

HOURLY PROJECT EMISSIONS

Source	ROG (lb/hr)	NOx (lb/hr)	CO (lb/hr)	SOx (lb/hr)	PM10 (lb/hr)	PM2.5 (lb/hr)
Mining						
Engines	1.15	13.20	6.65	0.02	0.53	0.48
Travel on Unpaved Surfaces	-	-	-	-	15.11	1.51
Material Handling/Stockpiles	-	-	-	-	0.48	0.07
A&C Processing						
Engines	0.99	9.87	7.17	0.01	0.33	0.30
Travel on Unpaved Surfaces	-	-	-	-	3.23	0.40
Material Handling/Stockpiles	-	-	-	-	0.04	0.01
Plant Equipment	-	-	-	-	0.79	0.23
RMC Plant					2.38	0.70
Total	2.14	23.08	13.81	0.03	22.88	3.71

DAILY PROJECT EMISSIONS

Source	ROG (lb/day)	NOx (lb/day)	CO (lb/day)	SOx (lb/day)	PM_{10} (lb/day)	$PM_{2.5}$ (lb/day)
Mining						
Engines	6.80	78.23	39.90	0.10	3.0	2.8
Travel on Unpaved Surfaces	-	-	-	-	177.4	17.7
Material Handling/Stockpiles	-	-	-	-	5.7	0.9
A&C Processing						
Engines	11.87	118.48	86.02	0.18	3.91	3.60
Travel on Unpaved Surfaces	-	-	-	-	48.1	4.8
Material Handling/Stockpiles	-	-	-	-	0.5	0.1
Plant Equipment	-	-	-	-	9.5	2.8
RMC Plant					57.2	16.7
Total	18.67	196.71	125.91	0.27	305.38	49.41
Baseline	14.00	216.10			286.3	46.3
Project	4.674	-19.395			19.1	3.1

ANNUAL PROJECT EMISSIONS

Source	ROG (ton/yr)	NO_X (ton/yr)	CO (ton/yr)	SO_2 (ton/yr)	PM_{10} (ton/yr)	$PM_{2.5}$ (ton/yr)
Mining						
Engines	0.72	8.58	4.23	0.01	0.32	0.30
Travel on Unpaved Surfaces	-	-	-	-	15.24	1.52
Loading/Handling	-	-	-	-	0.59	0.09
A&C Processing						
Engines	0.72	8.58	4.23	0.01	0.32	0.30
Travel on Unpaved Surfaces	-	-	-	-	0.82	0.08
Material Handling/Stockpiles	-	-	-	-	0.01	0.002
Plant Equipment	-	-	-	-	0.12	0.03
RMC Plant					1.79	0.52
Total	1.45	17.16	8.45	0.02	19.21	2.85
Baseline	2.2	33.5			42.9	6.4
Project	-0.7	-16.3			-23.7	-3.5

Project Fugitive Dust PM10 Emissions

Source	Years 2017 & 2018 (Age Bin: 3rd Trimester Through 2 years) PM10 (lb/hr)	PM10 (lb/yr)	Years 2019 - 2027 (Age Bin: Years 3 through 10) PM10 (lb/hr)	PM10 (lb/yr)	Maximum Day Activity (hr/day)	PM10 (lb/day)
Road Dust - Dozer	0.011	25	0.011	25	4	0.04
Road Dust - Grader	2.319	2,894	2.319	2,894	2	5
Road Dust - Excavator	0.005	14	0.005	14	8	0.04
Road Dust - Loader [d]	0.000	0	0.000	0	8	44
Road Dust - Loader [d]	0.000	0	0.000	0	8	44
Road Dust - Water Truck	1.508	3,764	1.508	3,764	2	3
Road Dust - Service Truck	1.186	2,960	1.186	2,960	1	1
Road Dust - Haul Trucks	5.038	5,206	10.076	10,412	8	40
Road Dust - Haul Trucks	5.038	5,206	10.076	10,412	8	40
Aggregate Handling/Storage	0.276	688	0.276	688	12	3.32
Overburden Handling/Storage	0.200	500	0.200	500	12	2.40
Total	16	21,257	26	31,669		#
Control Efficiency with Mitigation [b]	80%					
Mitigated Emissions	12.173	13,286	16.036	19,793		#

Fugitive Dust PM2.5 Emissions

Source	Years 2017 & 2018 (Age Bin: 3rd Trimester Through PM2.5 (lb/hr)	PM2.5 (lb/yr)	Years 2019 - 2027 (Age Bin: Years 3 through 10) PM2.5 (lb/hr)	PM2.5 (lb/yr)	Maximum Day Operation (hr/day)	PM2.5 (lb/day)
Road Dust - Dozer	0.001	2.51	0.001	2.51	4	0.004
Road Dust - Grader	0.232	289	0.232	289	2	0.464
Road Dust - Excavator	0.001	1.42	0.001	1.42	8	0.004
Road Dust - Loader [d]	0.000	0	0.000	0	8	4.395
Road Dust - Loader [d]	0.000	0	0.000	0	8	4.395
Road Dust - Water Truck	0.151	376	0.151	376	2	0.302
Road Dust - Service Truck	0.119	296	0.119	296	1	0.119
Road Dust - Haul Trucks	0.504	521	1.008	1,041	8	4.030
Road Dust - Haul Trucks	0.504	521	1.008	1,041	8	4.030
Aggregate Handling/Storage	0.042	104	0.042	104	12	0.502
Overburden Handling/Storage	0.030	76	0.030	76	12	0.363
Total	1.583	2,187	2.590	3,228		18.61
Control Efficiency with Mitigation [b]	80%					
Mitigated Emissions	0.989	1,367	1.619	2,017		11.6

Notes:

[a] Haul truck road dust emissions are updated from those presented in the 2008 FEIR for the previous expansion project to incorporate geometry of the Project site and dust control resulting from rain days. Other sources were calculated by applying rain day control factor to the calculations in the 2008 EIR

[b] Sources in above table already controlled at 68%

[c] PM2.5 emissions are based on the particle size multipliers in AP-42 Sections 13.2.2, and 13.2.4 which result in PM2.5 being 10% of unpaved road PM10 and 15.1% of handling PM10.

[d] Loader emissions are accounted for in drops rather than as fugitive emissions from vehicle traffic. Baseline emissions have been adjusted to match this industry standard calculation method.

Project Haul Truck Emissions Rates

Parameter	Years 2017 & 2018 (Age Bin: 3rd Trimester Through 2 years)	Years 2019 - 2027 (Age Bin: Years 3 through 10)	Units
Longest Possible Haul Route[a]	0.32	0.64	miles
Annual Excavation Rate[b]	1,965,600	1,965,600	tons/year
Average Trip Length[a]	0.10	0.20	miles
Number of Trips per Load	2	2	trips/load
Haul Truck Capacity[b]	40	40	tons/load
Annual Trips	98,280	98,280	trips/year
Annual Miles Traveled	9,828	19,656	VMT/year
Road Dust Control Efficiency for Watering[b]	68	68	%
Individual Haul Truck Emissions Rate[c]	5.04	10.08	lb PM10/hr
Total Emissions Rate[c]	10,412	20,823	lb PM10/year
Average Vehicle Speed[b]	7.5	7.5	VMT/op-hr
Estimated Hourly Trips [d]	40.0	40.0	trips/hr
Total Hours of Operation	1,310	2,621	op-hr/year
Number of Haul Trucks	2	2	
Individual Vehicle Activity	655	1,310	op-hr/year
Hour[c]	5.04	10.08	lbPM10/hr
Year[c]	5,206	10,412	lbPM10/yr

Notes: [a] Google Earth (measured).
[b] FEIR, Appendix A (SCH#2007072116)
[c] Emissions calculated using emissions factors determined in table below. Annual emissions account for rain
[d]Based on loader cycle time of 30 seconds, loaded travel time of 30 seconds, dump time of 10 seconds, unloaded travel time of 20 seconds. Based on Caterpillar Performance Handbook edition 38, pg 10-22 and 12 - 79. Assumptions: 740 articulated truck with 10% resistance due to pit grade. Average loader cycle time.

Unpaved Road Emission Factor

	Parameter		Reference[a]
k (particle size multiplier)	1.5	lb PM10/VMT	FEIR, SCH#2007072116
s (silt content)	8.3	%	Table 13.2.2-1, Stone Quarry[a]
W (mean weight)	53.5	tons	Volvo Website[b]
P (days in a year with 0.01 inches precipitation)	58	days	CalEEMod Appendix D
Fraction of Days without Rain	84.11%		Calculated (365-58/365)
E_{annual} (emission factor, lb/VMT)	3.3105	lb PM10/VMT	Equations 1[a] and 2[a]
E_{hourly} (emission factor, lb/VMT)	3.9360	lb PM10/VMT	Equation 1a[a]

Notes:
[a] AP-42, Section 13.2.2 Predictive Equation: PM10 (lb/VMT) = k * (s/12)^0.9 * (W/3)^0.45
[b] https://www.volvoce.com/global/en/product-archive/rigid-haulers/euclid/r40c/

Baseline Fugitive Dust Emissions from Road Dust (2008 FEIR, SCH#2007072116)

Source	PM10 (lb/hr)	PM2.5 (lb/hr)	PM10 (lb/day)	PM2.5 (lb/day)	PM10 (lb/yr)	PM2.5 (lb/yr)
DR9 Cat Dozer	0.0125	0.001	0.1	0.01	25	2.5
140H Cat Motograder	2.7575	0.276	22.1	2.21	2,894	289
EX1200 Hitatchi Excavator	0.0063	0.001	0.1	0.01	14	1.4
988F Cat Loader	0.0000	0.000	0.0	0.00	0	0
988F Cat Loader	0.0000	0.000	0.0	0.00	0	0
357 Peterbilt Water Truck	1.7931	0.179	5.6	0.56	3,764	376
384 Peterbilt Service Truck	1.4100	0.141	28.7	2.87	2,960	296
R40-C Euclid Rigid Hauler	6.6713	0.667	53.4	5.34	14,006	#
R40-C Euclid Rigid Hauler	6.6713	0.667	53.4	5.34	14,006	#
Aggregate Handling/Storage	0.2763	0.028	2.2	0.22	579	57.9
Soil Handling/Storage	0.2000	0.020	1.6	0.16	421	42.1
Total	**19.8**	**2.0**	**167**	**17**	**38,669**	**#**

Notes: Annual emissions adjusted for 58 day/yr rain for Sacramento County (CalEEMod default for Sacramento).
Ratio of PM2.5 to PM10 based on ratio of constant "k" used in the predictive emissions factor equations provided by AP-42 Section 13.2.2. Specifically PM2.5 is 10% of the PM10.
Water truck emissions have been reduced by 50% from FEIR to provide a more representative emission rate.

PM2.5 Fractions Based on AP-42 Sections 13.2.2 and 13.2.4

	Handling/Storage Equation	Unpaved Roads
PM10 Particle Size Multipliers (k)	0.35	1.5
PM2.5 Particle Size Multipliers (k)	0.053	0.15
Fractions of PM2.5 in PM10	15.1%	10.0%

Dust Emissions From Activities Related to Asphalt and Concrete Processing

	Project Emissions		Mitigated Emissions	
	PM10	**PM2.5**	**PM10**	**PM2.5**
Hourly (lb/hr)	4.85	0.64	3.97	0.56
Daily (lb/day)	58.15	15.05	47.62	6.68
Annual (lb/yr)	1,880.95	235.15	1,523.11	199.37

Activity Levels

Throughput (tons/hr)	500
Operation (hr/day)	12
Production (tons/year)	150000

Recycle Plant Fugitive Dust Emissions Calculations

Equipment [a]	Percent of Plant Feed Rate	Rate (ton/hr)	PM10 (lb/ton)	PM2.5 (lb/ton)	PM10 (lb/hr)	PM2.5 (lb/hr)	PM10 (lb/day)	PM2.5 (lb/day)	PM10 (lb/yr)	PM2.5 (lb/yr)
Crusher (500 tph) with feeder	100%	500	0.00054	0.000158	0.270	0.079	3.2	0.95	81.0	23.7
Side discharge conveyor with magnet	100%	500	0.000046	0.000013	0.023	0.007	0.3	0.08	6.9	2.0
Screen (3-deck, 6' x 24')	120%	600	0.00074	0.000216	0.444	0.130	5.3	1.56	111.0	32.4
Oversize return conveyor	50%	250	0.000046	0.000013	0.012	0.003	0.1	0.04	6.9	2.0
Transfer conveyor	50%	250	0.000046	0.000013	0.012	0.003	0.1	0.04	6.9	2.0
Radial stacker conveyor	50%	250	0.000046	0.000013	0.012	0.003	0.1	0.04	6.9	2.0
Transfer conveyor	50%	250	0.000046	0.000013	0.012	0.003	0.1	0.04	6.9	2.0
Radial stacker conveyor	50%	250	0.000046	0.000013	0.012	0.003	0.1	0.04	6.9	2.0
A&C Rubble Handling/Storage (in Pile)	100%	500	0.000016	0.000005	0.008	0.002	0.1	0.03	2.4	0.7
A&C Rubble Handling/Storage (in Plant)	100%	500	0.000016	0.000005	0.008	0.002	0.1	0.03	2.4	0.7
A&C Rubble Handling/Storage (out Truck)	100%	500	0.00005	0.000013	0.023	0.007	0.3	0.08	6.9	2.0
Total					**0.83**	**0.243**	**10.0**	**2.92**	**245.1**	**71.6**

Note: Handling and storage emissions based on mining handling and storage as presented in the 2008 FEIR.

Truck Road Dust	General Assumptions		Reference
Activity	12	hr/day	Project feature.
Annual Throughput Rate	150,000	tons/year	Project feature.
Average Trip Length	0.32	miles/trip	Round Trip Loop as measured in Google Earth
Number of Trips per Load	1	trips/load	N/A
Haul Truck Capacity	25	tons/load	https://www.volvoce.com/global/en/product-archive/rigid-haulers/euclid/r40c/
Annual Trips	6,000	trips/year	Calculated.
Annual Miles Traveled	1,920	VMT/year	Calculated.

Truck Road Dust (uncontrolled)	Uncontrolled PM10		Uncontrolled PM2.5		Reference
k (particle size multiplier)	1.5	lb PM10/VMT	0.15	lb PM2.5/VMT	AP-42, Section 13.2.2.
s (silt content)	8.3	%	8.3	%	AP-42 Table 13.2.2-1
W (mean weight)	27.5	tons	27.5	tons	Average 40 ton full, 15 ton empty.
P (days with 0.01" precipitation)	58	days	58	days	CalEEMod Appendix D
Fraction of Days without Rain	84.1%		84.1%		Calculated (365-58/365)
EFannual (lb/VMT)	2.45	lb PM10/VMT	0.245	lb PM2.5/VMT	Eqns 1 & 2 (AP-42 Section 13.2.2).
EFhourly (lb/VMT)	2.92	lb PM10/VMT	0.292	lb PM2.5/VMT	Eqn 1 (AP-42 Section 13.2.2).
Loaders avaliable	1	Loader	1	Loader	One loads truck, other loads plant.
Loads per Hour	12	Truck Loads	12	Truck Loads	Takes 5 min to load truck
Hourly Emissions	11.2	lb PM10/hr	1.12	lb PM2.5/hr	
Daily Emissions	134	lb PM10/day	13	lb PM2.5/day	
Annual Emissions	4,711	lb PM10/year	471	lb PM2.5/year	

Project Truck Road Dust	Project PM10		Project PM2.5	
Project Control Factor	68%		68%	
Hourly Emissions	3.58	lb PM10/hr	0.36	lb PM2.5/hr
Daily Emissions	43.0	lb PM10/day	4.3	lb PM2.5/day
Annual Emissions	1,508	lb PM10/year	151	lb PM2.5/year

Truck Road Dust	Mitigated PM10		Mitigated PM2.5	
Mitigation Control Factor	75%		75%	
Hourly Emissions	2.80	lb PM10/hr	0.28	lb PM2.5/hr
Daily Emissions	33.6	lb PM10/day	3.4	lb PM2.5/day
Annual Emissions	1,178	lb PM10/year	118	lb PM2.5/year

Loader Road Dust	**Parameter**	**Units**	**Reference**
Loaders avaliable	1	Loader	One loads truck, other loads plant.
Hourly Loads	12	Truck Loads	assumption that it takes 5 min to load truck
Loader Capacity	10	cubic yards/bucket	Caterpillar Handbook, Edition 45, Model 998K
Loader Capacity	17	Tons/bucket	
Buckets Per loaded Truck	2	trips/truck	
Cycles per Load	3	cycles/trip (load bucket from pile, backup, forward, dump to truck or plant, backup, forward)	
Length of Loader	24	ft/cycle	Caterpillar Handbook, Edition 45, Model 998K
Distance traveled	144	ft/truck	Each cycle involves driving the length of the loader 3 times
Distance traveled	0.027	VMT/trip	
Distance traveled	0.327	VMT/hr	
Distance traveled	3.927	VMT/day	
Distance traveled	98.2	VMT/yr	
Annual Operation	300	hours/year	150,000 ton/yr / 500 tons/hr

Loader Road Dust	**PM10 Emissions**		**PM2.5 Emissions**		**Reference**
k (particle size multiplier)	1.5	lb PM10/VMT	0.15	lb PM2.5/VMT	AP-42, Section 13.2.2.
s (silt content)	8.3	%	8.3	%	AP-42 Table 13.2.2-1
W (mean weight)	58	tons	58	tons	
P (days in a year with 0.01 inches precipitatic	58	days	58	days	CalEEMod Appendix D
Fraction of Days without Rain	84.1%		84.1%		Calculated (365-58/365)
EFannual (emission factor, lb/VMT)	3.43	lb PM10/VMT	0.34	lb PM2.5/VMT	Eqns 1 & 2 (AP-42 Section 13.2.2).
EFhourly (emission factor, lb/VMT)	4.08	lb PM10/VMT	0.41	lb PM2.5/VMT	Eqn 1 (AP-42 Section 13.2.2).
Hourly Emissions	1.3	lb PM10/hr	0.1	lb PM2.5/hr	
Daily Emissions	16.0	lb PM10/day	1.6	lb PM2.5/day	
Annual Emissions	400.7	lb PM10/year	40.1	lb PM2.5/year	

Project Control Factor	68%		68%	
Loader Road Dust	**Project PM10 Emissions**		**Project PM2.5 Emissions**	
Hourly Emissions	0.43	lb PM10/hr	0.04	lb PM2.5/hr
Daily Emissions	5.13	lb PM10/day	0.51	lb PM2.5/day
Annual Emissions	128.24	lb PM10/year	12.82	lb PM2.5/year

Mitigated Control Factor	75%		75%	
Loader Road Dust	**Mitigated PM10 Emissions**		**Mitigated PM2.5 Emissions**	
Hourly Emissions	0.33	lb PM10/hr	0.03	lb PM2.5/hr
Daily Emissions	4.01	lb PM10/day	0.40	lb PM2.5/day
Annual Emissions	100.19	lb PM10/year	10.02	lb PM2.5/year

[a] AP-42, Section 13.2.2 Predictive Emissions Factor Equation: PM10 (lb/VMT) = k * (s/12)^0.9 * (W/3)^0.45

[b] https://www.volvoce.com/global/en/product-archive/rigid-haulers/euclid/r40c/

[1] Emission factors for controlled emissions as defined in AP-42 Section 11.19.2 dated 8/04 and Section 13.2 for loader drop of aggregate with 3% moisture.

[2] $PM_{2.5}$ emissions based on SCAQMD's "Final-Methodology to Calculate Particulate Matter (PM) 2.5 and PM 2.5 Significance Thresholds" from October, 2006, Mineral Process Loss: Loading and Unloading Bulk Materials and Mineral Products: Crushing, Screening, Blasting, Loading, Unloading.

Carli Expansion Mining Engine Emissions by Calendar Year

Equipment Type & Horsepower	Number of Units	Sum of ROG (lb/hr)	Sum of NOX (lb/hr)	Sum of CO (lb/hr)	Sum of SO2 (lb/hr)	Sum of PM10 (lb/hr)	Sum of PM2.5 (lb/hr)
2017	**9**	**1.154**	**13.204**	**6.646**	**0.016**	**0.526**	**0.484**
2018	**9**	**1.023**	**11.343**	**6.133**	**0.016**	**0.446**	**0.411**
2019	**9**	**0.947**	**10.090**	**5.776**	**0.016**	**0.397**	**0.365**
2020	**9**	**0.895**	**9.192**	**5.591**	**0.016**	**0.363**	**0.333**
2021	**9**	**0.830**	**8.041**	**5.376**	**0.016**	**0.320**	**0.295**
2022	**9**	**0.741**	**6.660**	**5.051**	**0.016**	**0.266**	**0.245**
2023	**9**	**0.707**	**6.029**	**4.940**	**0.016**	**0.240**	**0.222**
2024	**9**	**0.686**	**5.609**	**4.818**	**0.016**	**0.222**	**0.204**
2025	**9**	**0.634**	**4.799**	**4.660**	**0.016**	**0.190**	**0.174**
2026	**9**	**0.634**	**4.799**	**4.660**	**0.016**	**0.190**	**0.174**
2030	**9**	**0.686**	**1.833**	**3.822**	**0.016**	**0.068**	**0.068**
2035	**9**	**0.642**	**1.288**	**3.794**	**0.016**	**0.049**	**0.049**
2040	**9**	**0.621**	**1.057**	**3.781**	**0.016**	**0.041**	**0.041**

Scenario	ROG (lb/hr)	NOx (lb/hr)	CO (lb/hr)	SOx (lb/hr)	PM10 (lb/hr)	PM2.5 (lb/hr)
Project (CY2017 Emissions from Above)	1.154	13.204	6.646	0.016	0.526	0.484
Baseline (2008 FEIR Emissions, CY2013)	ND	ND	ND	ND	ND	ND
Change in Emissions	ND	ND	ND	ND	ND	ND

Notes: PM2.5 assumed to be 92% of PM10 in diesel engine exhaust. PM10 (lb/yr) used in HRA modeling and presented for disclosure purposes.

Carli Expansion Mining Engine Emissions by Calendar Year

Equipment Type & Horsepower	Number of Units	Sum of ROG (lb/day)	Sum of NOX (lb/day)	Sum of CO (lb/day)	Sum of SO2 (lb/day)	Sum of PM10 (lb/day)	Sum of PM2.5 (lb/day)	Sum of ROG (ton/yr)	Sum of NOX (ton/yr)	Sum of CO (ton/yr)	Sum of SO2 (ton/yr)	Sum of PM10 (ton/yr)	Sum of PM2.5 (ton/yr)
2017	9	6.80	78.23	39.90	0.0972	3.02	2.78	0.725	8.58	4.23	0.0110	0.323	0.297
2018	9	6.07	67.55	36.94	0.0972	2.57	2.37	0.649	7.40	3.92	0.0110	0.277	0.255
2019	9	5.63	60.13	34.65	0.0972	2.30	2.11	0.694	7.51	4.26	0.0124	0.283	0.260
2020	9	5.35	55.07	33.64	0.0972	2.11	1.94	0.659	6.87	4.11	0.0124	0.259	0.238
2021	9	5.00	48.27	32.28	0.0972	1.86	1.72	0.615	6.03	3.94	0.0124	0.229	0.212
2022	9	4.48	40.22	30.17	0.0972	1.56	1.43	0.552	5.00	3.72	0.0124	0.192	0.176
2023	9	4.31	36.65	29.49	0.0972	1.42	1.31	0.526	4.50	3.62	0.0124	0.173	0.160
2024	9	4.19	34.28	28.70	0.0972	1.32	1.21	0.511	4.19	3.54	0.0124	0.160	0.147
2025	9	3.87	29.32	27.65	0.0972	1.12	1.03	0.474	3.60	3.41	0.0124	0.137	0.126
2026	9	3.87	29.32	27.65	0.0972	1.12	1.03	0.474	3.60	3.41	0.0124	0.137	0.126
2030	9	4.18	10.78	22.12	0.0976	0.39	0.39	0.533	1.42	2.80	0.0125	0.051	0.051
2035	9	3.93	7.66	21.99	0.0976	0.29	0.29	0.499	1.00	2.78	0.0125	0.037	0.037
2040	9	3.82	6.39	21.93	0.0976	0.25	0.25	0.485	0.83	2.77	0.0125	0.032	0.032

Scenario	ROG (lb/day)	NOx (lb/day)	CO (lb/day)	SOx (lb/day)	PM10 (lb/day)	PM2.5 (lb/day)	ROG (ton/yr)	NOx (ton/yr)	CO (ton/yr)	SOx (ton/yr)	PM10 (ton/yr)	PM2.5 (ton/yr)
Project (CY2017 Emissions from Above)	6.80	78.23	39.90	0.10	3.02	2.78	0.72	8.58	4.23	0.01	0.32	0.30
Baseline (2008 FEIR Emissions, CY2013)	14.04	216.08	37.65	0.14	9.09	8.36	2.17	33.47	5.78	0.022	1.40	1.29
Change in Emissions	-7.237	-137.85	2.25	-0.04	-6.07	-5.59	-1.44	-24.89	-1.55	-0.011	-1.08	-0.99

Notes: PM2.5 assumed to be 92% of PM10 in diesel engine exhaust. PM10 (lb/yr) used in HRA modeling and presented for disclosure purposes.

# Units	Equiptment	Year	HP	Hours / Day	Hours / Year	Load Factor	Hourly Activity/Unit (HP-hr)	Total Hourly (hp-hr)	Total Daily (hp-hr)	Total Annual (hp-hr)
1	Graders	2017	165	2	312	0.41	68	68	135	21,107
1	Graders	2018	165	2	312	0.41	68	68	135	21,107
1	Graders	2019	165	2	312	0.41	68	68	135	21,107
1	Graders	2020	165	2	312	0.41	68	68	135	21,107
1	Graders	2021	165	2	312	0.41	68	68	135	21,107
1	Graders	2022	165	2	312	0.41	68	68	135	21,107
1	Graders	2023	165	2	312	0.41	68	68	135	21,107
1	Graders	2024	165	2	312	0.41	68	68	135	21,107
1	Graders	2025	165	2	312	0.41	68	68	135	21,107
1	Graders	2030	165	2	312	0.41	68	68	135	21,107
1	Graders	2035	165	2	312	0.41	68	68	135	21,107
1	Graders	2040	165	2	312	0.41	68	68	135	21,107
1	Off-Highway Trucks	2017	190	1	312	0.38	72	72	72	22,526
1	Off-Highway Trucks	2018	190	1	312	0.38	72	72	72	22,526
1	Off-Highway Trucks	2019	190	1	312	0.38	72	72	72	22,526
1	Off-Highway Trucks	2020	190	1	312	0.38	72	72	72	22,526
1	Off-Highway Trucks	2021	190	1	312	0.38	72	72	72	22,526
1	Off-Highway Trucks	2022	190	1	312	0.38	72	72	72	22,526
1	Off-Highway Trucks	2023	190	1	312	0.38	72	72	72	22,526
1	Off-Highway Trucks	2024	190	1	312	0.38	72	72	72	22,526
1	Off-Highway Trucks	2025	190	1	312	0.38	72	72	72	22,526
1	Off-Highway Trucks	2030	190	1	312	0.38	72	72	72	22,526
1	Off-Highway Trucks	2035	190	1	312	0.38	72	72	72	22,526
1	Off-Highway Trucks	2040	190	1	312	0.38	72	72	72	22,526
1	Off-Highway Trucks	2017	385	2	624	0.38	146	146	293	91,291
1	Off-Highway Trucks	2018	385	2	624	0.38	146	146	293	91,291
1	Off-Highway Trucks	2019	385	2	624	0.38	146	146	293	91,291
1	Off-Highway Trucks	2020	385	2	624	0.38	146	146	293	91,291
1	Off-Highway Trucks	2021	385	2	624	0.38	146	146	293	91,291
1	Off-Highway Trucks	2022	385	2	624	0.38	146	146	293	91,291
1	Off-Highway Trucks	2023	385	2	624	0.38	146	146	293	91,291
1	Off-Highway Trucks	2024	385	2	624	0.38	146	146	293	91,291
1	Off-Highway Trucks	2025	385	2	624	0.38	146	146	293	91,291
1	Off-Highway Trucks	2030	385	2	624	0.38	146	146	293	91,291
1	Off-Highway Trucks	2035	385	2	624	0.38	146	146	293	91,291
1	Off-Highway Trucks	2040	385	2	624	0.38	146	146	293	91,291
2	Rubber Tired Loaders	2017	425	8	2,496	0.36	153	306	2,448	763,776
2	Rubber Tired Loaders	2018	425	8	2,496	0.36	153	306	2,448	763,776
2	Rubber Tired Loaders	2019	425	8	2,496	0.36	153	306	2,448	763,776
2	Rubber Tired Loaders	2020	425	8	2,496	0.36	153	306	2,448	763,776
2	Rubber Tired Loaders	2021	425	8	2,496	0.36	153	306	2,448	763,776
2	Rubber Tired Loaders	2022	425	8	2,496	0.36	153	306	2,448	763,776
2	Rubber Tired Loaders	2023	425	8	2,496	0.36	153	306	2,448	763,776
2	Rubber Tired Loaders	2024	425	8	2,496	0.36	153	306	2,448	763,776
2	Rubber Tired Loaders	2025	425	8	2,496	0.36	153	306	2,448	763,776
2	Rubber Tired Loaders	2030	425	8	2,496	0.36	153	306	2,448	763,776
2	Rubber Tired Loaders	2035	425	8	2,496	0.36	153	306	2,448	763,776
2	Rubber Tired Loaders	2040	425	8	2,496	0.36	153	306	2,448	763,776

# Units	Equiptment	Year	HP	Hours / Day	Hours / Year	Load Factor	Hourly Activity/Unit (HP-hr)	Total Hourly (hp-hr)	Total Daily (hp-hr)	Total Annual (hp-hr)
1	Crawler Tractors	2017	450	4	1,248	0.43	194	194	774	241,488
1	Crawler Tractors	2018	450	4	1,248	0.43	194	194	774	241,488
1	Crawler Tractors	2019	450	4	1,248	0.43	194	194	774	241,488
1	Crawler Tractors	2020	450	4	1,248	0.43	194	194	774	241,488
1	Crawler Tractors	2021	450	4	1,248	0.43	194	194	774	241,488
1	Crawler Tractors	2022	450	4	1,248	0.43	194	194	774	241,488
1	Crawler Tractors	2023	450	4	1,248	0.43	194	194	774	241,488
1	Crawler Tractors	2024	450	4	1,248	0.43	194	194	774	241,488
1	Crawler Tractors	2025	450	4	1,248	0.43	194	194	774	241,488
1	Crawler Tractors	2030	450	4	1,248	0.43	194	194	774	241,488
1	Crawler Tractors	2035	450	4	1,248	0.43	194	194	774	241,488
1	Crawler Tractors	2040	450	4	1,248	0.43	194	194	774	241,488
2	Off-Highway Trucks	2017	525	8	655	0.38	200	399	3,192	261,425
2	Off-Highway Trucks	2018	525	8	655	0.38	200	399	3,192	261,425
2	Off-Highway Trucks	2019	525	8	1,310	0.38	200	399	3,192	522,850
2	Off-Highway Trucks	2020	525	8	1,310	0.38	200	399	3,192	522,850
2	Off-Highway Trucks	2021	525	8	1,310	0.38	200	399	3,192	522,850
2	Off-Highway Trucks	2022	525	8	1,310	0.38	200	399	3,192	522,850
2	Off-Highway Trucks	2023	525	8	1,310	0.38	200	399	3,192	522,850
2	Off-Highway Trucks	2024	525	8	1,310	0.38	200	399	3,192	522,850
2	Off-Highway Trucks	2025	525	8	1,310	0.38	200	399	3,192	522,850
2	Off-Highway Trucks	2030	525	8	1,310	0.38	200	399	3,192	522,850
2	Off-Highway Trucks	2035	525	8	1,310	0.38	200	399	3,192	522,850
2	Off-Highway Trucks	2040	525	8	1,310	0.38	200	399	3,192	522,850
1	Excavators	2017	625	8	2,496	0.38	238	238	1,900	592,800
1	Excavators	2018	625	8	2,496	0.38	238	238	1,900	592,800
1	Excavators	2019	625	8	2,496	0.38	238	238	1,900	592,800
1	Excavators	2020	625	8	2,496	0.38	238	238	1,900	592,800
1	Excavators	2021	625	8	2,496	0.38	238	238	1,900	592,800
1	Excavators	2022	625	8	2,496	0.38	238	238	1,900	592,800
1	Excavators	2023	625	8	2,496	0.38	238	238	1,900	592,800
1	Excavators	2024	625	8	2,496	0.38	238	238	1,900	592,800
1	Excavators	2025	625	8	2,496	0.38	238	238	1,900	592,800
1	Excavators	2030	625	8	2,496	0.38	238	238	1,900	592,800
1	Excavators	2035	625	8	2,496	0.38	238	238	1,900	592,800
1	Excavators	2040	625	8	2,496	0.38	238	238	1,900	592,800

Equiptment	ROG (g/hp-hr)	CO (g/hp-hr)	NOX (g/hp-hr)	SO2 (g/hp-hr)	PM10 (g/hp-hr)	PM2.5 (g/hp-hr)	Mitigated PM10 (g/hp-hr)	Mitigated PM2.5 (g/hp-hr)
Graders	0.757	3.85	7.66	0.005	0.43	0.396	0.43	0.3956
Graders	0.661	3.71	6.60	0.005	0.371	0.342	0.371	0.34132
Graders	0.609	3.66	6.01	0.005	0.337	0.31	0.337	0.31004
Graders	0.567	3.62	5.53	0.005	0.309	0.284	0.309	0.28428
Graders	0.505	3.56	4.84	0.005	0.27	0.248	0.27	0.2484
Graders	0.440	3.49	4.12	0.005	0.229	0.211	0.229	0.21068
Graders	0.390	3.45	3.55	0.005	0.195	0.18	0.195	0.1794
Graders	0.364	3.43	3.20	0.005	0.177	0.163	0.177	0.16284
Graders	0.329	3.42	2.77	0.005	0.152	0.14	0.152	0.13984
Graders	0.237	3.33	0.82	0.006	0.038	0.038	0.038	0.03496
Graders	0.206	3.33	0.51	0.006	0.022	0.022	0.022	0.02024
Graders	0.193	3.33	0.38	0.006	0.017	0.017	0.017	0.01564
Off-Highway Trucks	0.417	1.75	4.37	0.005	0.189	0.174	0.189	0.17388
Off-Highway Trucks	0.341	1.54	3.45	0.005	0.141	0.13	0.141	0.12972
Off-Highway Trucks	0.307	1.46	2.98	0.005	0.119	0.109	0.119	0.10948
Off-Highway Trucks	0.275	1.39	2.51	0.005	0.098	0.09	0.098	0.09016
Off-Highway Trucks	0.249	1.35	2.11	0.005	0.082	0.076	0.082	0.07544
Off-Highway Trucks	0.215	1.28	1.62	0.005	0.064	0.059	0.064	0.05888
Off-Highway Trucks	0.207	1.27	1.46	0.005	0.059	0.054	0.059	0.05428
Off-Highway Trucks	0.202	1.26	1.36	0.005	0.054	0.05	0.054	0.04968
Off-Highway Trucks	0.185	1.21	1.13	0.005	0.043	0.04	0.043	0.03956
Off-Highway Trucks	0.217	1.17	0.48	0.006	0.017	0.017	0.017	0.01564
Off-Highway Trucks	0.208	1.17	0.35	0.006	0.013	0.013	0.013	0.01196
Off-Highway Trucks	0.204	1.17	0.31	0.006	0.012	0.012	0.012	0.01104
Off-Highway Trucks	0.325	1.75	3.67	0.005	0.136	0.125	0.136	0.12512
Off-Highway Trucks	0.287	1.56	3.09	0.005	0.113	0.104	0.113	0.10396
Off-Highway Trucks	0.263	1.48	2.67	0.005	0.097	0.089	0.097	0.08924
Off-Highway Trucks	0.246	1.41	2.35	0.005	0.086	0.079	0.086	0.07912
Off-Highway Trucks	0.225	1.34	1.95	0.005	0.072	0.066	0.072	0.06624
Off-Highway Trucks	0.196	1.25	1.49	0.005	0.054	0.05	0.054	0.04968
Off-Highway Trucks	0.187	1.22	1.32	0.005	0.048	0.044	0.048	0.04416
Off-Highway Trucks	0.184	1.21	1.24	0.005	0.044	0.041	0.044	0.04048
Off-Highway Trucks	0.177	1.18	1.06	0.005	0.038	0.035	0.038	0.03496
Off-Highway Trucks	0.216	1.10	0.46	0.005	0.017	0.017	0.017	0.01564
Off-Highway Trucks	0.208	1.11	0.35	0.005	0.013	0.013	0.013	0.01196
Off-Highway Trucks	0.204	1.11	0.31	0.005	0.012	0.012	0.012	0.01104
Rubber Tired Loaders	0.369	2.06	4.25	0.005	0.16	0.147	0.16	0.1472
Rubber Tired Loaders	0.334	1.87	3.73	0.005	0.14	0.128	0.14	0.1288
Rubber Tired Loaders	0.306	1.72	3.29	0.005	0.123	0.113	0.123	0.11316
Rubber Tired Loaders	0.289	1.63	3.02	0.005	0.112	0.103	0.112	0.10304
Rubber Tired Loaders	0.264	1.53	2.61	0.005	0.097	0.09	0.097	0.08924
Rubber Tired Loaders	0.237	1.44	2.18	0.005	0.081	0.075	0.081	0.07452
Rubber Tired Loaders	0.217	1.38	1.87	0.005	0.069	0.064	0.069	0.06348
Rubber Tired Loaders	0.209	1.35	1.70	0.005	0.063	0.058	0.063	0.05796
Rubber Tired Loaders	0.193	1.28	1.43	0.005	0.053	0.048	0.053	0.04876
Rubber Tired Loaders	0.208	1.09	0.62	0.005	0.021	0.021	0.021	0.01932
Rubber Tired Loaders	0.191	1.08	0.42	0.005	0.015	0.015	0.015	0.0138
Rubber Tired Loaders	0.185	1.08	0.34	0.005	0.013	0.013	0.013	0.01196

Equiptment	ROG (g/hp-hr)	CO (g/hp-hr)	NOX (g/hp-hr)	SO2 (g/hp-hr)	PM10 (g/hp-hr)	PM2.5 (g/hp-hr)	Mitigated PM10 (g/hp-hr)	Mitigated PM2.5 (g/hp-hr)
Crawler Tractors	0.385	2.63	5.03	0.005	0.195	0.179	0.195	0.1794
Crawler Tractors	0.344	2.38	4.37	0.005	0.169	0.156	0.169	0.15548
Crawler Tractors	0.319	2.22	3.93	0.005	0.153	0.141	0.153	0.14076
Crawler Tractors	0.301	2.09	3.62	0.005	0.141	0.13	0.141	0.12972
Crawler Tractors	0.283	2.02	3.28	0.005	0.129	0.119	0.129	0.11868
Crawler Tractors	0.254	1.92	2.74	0.005	0.111	0.102	0.111	0.10212
Crawler Tractors	0.241	1.85	2.48	0.005	0.102	0.094	0.102	0.09384
Crawler Tractors	0.228	1.78	2.24	0.005	0.093	0.085	0.093	0.08556
Crawler Tractors	0.208	1.72	1.92	0.005	0.081	0.074	0.081	0.07452
Crawler Tractors	0.257	1.20	1.02	0.005	0.038	0.038	0.038	0.03496
Crawler Tractors	0.227	1.15	0.66	0.005	0.025	0.025	0.025	0.023
Crawler Tractors	0.210	1.11	0.47	0.005	0.018	0.018	0.018	0.01656
Off-Highway Trucks	0.394	2.36	4.26	0.005	0.17	0.157	0.17	0.1564
Off-Highway Trucks	0.348	2.18	3.69	0.005	0.143	0.132	0.143	0.13156
Off-Highway Trucks	0.327	2.04	3.32	0.005	0.129	0.118	0.129	0.11868
Off-Highway Trucks	0.312	2.03	3.06	0.005	0.12	0.11	0.12	0.1104
Off-Highway Trucks	0.293	1.94	2.67	0.005	0.106	0.098	0.106	0.09752
Off-Highway Trucks	0.263	1.75	2.27	0.005	0.088	0.081	0.088	0.08096
Off-Highway Trucks	0.263	1.72	2.18	0.005	0.084	0.078	0.084	0.07728
Off-Highway Trucks	0.259	1.65	2.08	0.005	0.079	0.073	0.079	0.07268
Off-Highway Trucks	0.235	1.58	1.75	0.005	0.066	0.061	0.066	0.06072
Off-Highway Trucks	0.217	1.10	0.46	0.005	0.017	0.017	0.017	0.01564
Off-Highway Trucks	0.208	1.11	0.35	0.005	0.013	0.013	0.013	0.01196
Off-Highway Trucks	0.204	1.11	0.31	0.005	0.012	0.012	0.012	0.01104
Excavators	0.210	1.23	2.72	0.005	0.09	0.083	0.09	0.0828
Excavators	0.189	1.22	2.27	0.005	0.076	0.07	0.076	0.06992
Excavators	0.176	1.17	1.99	0.005	0.067	0.062	0.067	0.06164
Excavators	0.170	1.15	1.80	0.005	0.061	0.056	0.061	0.05612
Excavators	0.165	1.15	1.62	0.005	0.056	0.052	0.056	0.05152
Excavators	0.150	1.14	1.29	0.005	0.047	0.043	0.047	0.04324
Excavators	0.144	1.13	1.16	0.005	0.043	0.04	0.043	0.03956
Excavators	0.142	1.13	1.10	0.005	0.041	0.037	0.041	0.03772
Excavators	0.139	1.13	1.03	0.005	0.038	0.035	0.038	0.03496
Excavators	0.202	1.09	0.44	0.005	0.016	0.016	0.016	0.01472
Excavators	0.195	1.09	0.34	0.005	0.013	0.013	0.013	0.01196
Excavators	0.192	1.09	0.30	0.005	0.011	0.011	0.011	0.01012

Carli Expansion Mitigated Mining Engine Emissions by Calendar Year

Equipment Type & Horsepower	Number of Units	Sum of ROG (lb/hr)	Sum of NOX (lb/hr)	Sum of CO (lb/hr)	Sum of SO2 (lb/hr)	Sum of PM10 (lb/hr)	Sum of PM2.5 (lb/hr)
2017	9	1.154	13.204	6.646	0.016	0.047	0.047
2018	9	1.023	11.343	6.133	0.016	0.047	0.047
2019	9	0.947	10.090	5.776	0.016	0.047	0.047
2020	9	0.895	9.192	5.591	0.016	0.047	0.047
2021	9	0.830	8.041	5.376	0.016	0.047	0.047
2022	9	0.741	6.660	5.051	0.016	0.047	0.047
2023	9	0.707	6.029	4.940	0.016	0.047	0.047
2024	9	0.686	5.609	4.818	0.016	0.047	0.047
2025	9	0.634	4.799	4.660	0.016	0.047	0.047
2026	9	0.634	4.799	4.660	0.016	0.170	0.156
2030	9	0.686	1.833	3.822	0.016	0.050	0.047
2035	9	0.642	1.288	3.794	0.016	0.047	0.047
2040	9	0.621	1.057	3.781	0.016	0.047	0.047

Note: Teir 4I mitigation only applied to PM10 Emissions for conservative analysis

Scenario	ROG (lb/hr)	NOx (lb/hr)	CO (lb/hr)	SOx (lb/hr)	PM10 (lb/hr)	PM2.5 (lb/hr)
Project (CY2017 Emissions from Above)	1.154	13.204	6.646	0.016	0.047	0.047
Baseline (2008 FEIR Emissions, CY2013)	ND	ND	ND	ND	ND	ND
Change in Emissions	ND	ND	ND	ND	ND	ND

Notes: PM2.5 assumed to be 92% of PM10 in diesel engine exhaust. PM10 (lb/yr) used in HRA modeling and presented for disclosure purposes.

Carli Expansion Mitigated Mining Engine Emissions by Calendar Year

Equipment Type & Horsepower	Number of Units	Sum of ROG (lb/day)	Sum of NOX (lb/day)	Sum of CO (lb/day)	Sum of SO2 (lb/day)	Sum of PM10 (lb/day)	Sum of PM2.5 (lb/day)	Sum of ROG (ton/yr)	Sum of NOX (ton/yr)	Sum of CO (ton/yr)	Sum of SO2 (ton/yr)	Sum of PM10 (ton/yr)	Sum of PM2.5 (ton/yr)
2017	9	6.80	78.23	39.90	0.0972	0.29	0.29	0.725	8.58	4.23	0.0110	0.033	0.033
2018	9	6.07	67.55	36.94	0.0972	0.29	0.29	0.649	7.40	3.92	0.0110	0.033	0.033
2019	9	5.63	60.13	34.65	0.0972	0.29	0.29	0.694	7.51	4.26	0.0124	0.037	0.037
2020	9	5.35	55.07	33.64	0.0972	0.29	0.29	0.659	6.87	4.11	0.0124	0.037	0.037
2021	9	5.00	48.27	32.28	0.0972	0.29	0.29	0.615	6.03	3.94	0.0124	0.037	0.037
2022	9	4.48	40.22	30.17	0.0972	0.29	0.29	0.552	5.00	3.72	0.0124	0.037	0.037
2023	9	4.31	36.65	29.49	0.0972	0.29	0.29	0.526	4.50	3.62	0.0124	0.037	0.037
2024	9	4.19	34.28	28.70	0.0972	0.29	0.29	0.511	4.19	3.54	0.0124	0.037	0.037
2025	9	3.87	29.32	27.65	0.0972	0.29	0.29	0.474	3.60	3.41	0.0124	0.037	0.037
2026	9	3.87	29.32	27.65	0.0972	1.08	0.99	0.474	3.60	3.41	0.0124	0.134	0.123
2030	9	4.18	10.78	22.12	0.0976	0.30	0.29	0.533	1.42	2.80	0.0125	0.038	0.037
2035	9	3.93	7.66	21.99	0.0976	0.29	0.29	0.499	1.00	2.78	0.0125	0.037	0.037
2040	9	3.82	6.39	21.93	0.0976	0.29	0.29	0.485	0.83	2.77	0.0125	0.037	0.037

Note: Teir 4I mitigation only applied to PM10 Emissions for conservative analysis

Scenario	ROG (lb/day)	NOx (lb/day)	CO (lb/day)	SOx (lb/day)	PM10 (lb/day)	PM2.5 (lb/day)	ROG (ton/yr)	NOx (ton/yr)	CO (ton/yr)	SOx (ton/yr)	PM10 (ton/yr)	PM2.5 (ton/yr)
Project (CY2017 Emissions from Above)	6.80	78.23	39.90	0.10	0.29	0.29	0.72	8.58	4.23	0.01	0.03	0.03
Baseline (2008 FEIR Emissions, CY2013)	14.04	216.08	37.65	0.14	9.09	8.36	2.17	33.47	5.78	0.022	1.40	1.29
Change in Emissions	-7.237	-137.85	2.25	-0.04	-8.80	-8.07	-1.44	-24.89	-1.55	-0.011	-1.37	-1.26

Notes: PM2.5 assumed to be 92% of PM10 in diesel engine exhaust. PM10 (lb/yr) used in HRA modeling and presented for disclosure purposes.

# Units	Equiptment	Year	HP	Hours / Day	Hours / Year	Load Factor	Hourly Activity/Unit (HP-hr)	Total Hourly (hp-hr)	Total Daily (hp-hr)	Total Annual (hp-hr)
1	Graders	2017	165	2	312	0.41	68	68	135	21,107
1	Graders	2018	165	2	312	0.41	68	68	135	21,107
1	Graders	2019	165	2	312	0.41	68	68	135	21,107
1	Graders	2020	165	2	312	0.41	68	68	135	21,107
1	Graders	2021	165	2	312	0.41	68	68	135	21,107
1	Graders	2022	165	2	312	0.41	68	68	135	21,107
1	Graders	2023	165	2	312	0.41	68	68	135	21,107
1	Graders	2024	165	2	312	0.41	68	68	135	21,107
1	Graders	2025	165	2	312	0.41	68	68	135	21,107
1	Graders	2030	165	2	312	0.41	68	68	135	21,107
1	Graders	2035	165	2	312	0.41	68	68	135	21,107
1	Graders	2040	165	2	312	0.41	68	68	135	21,107
1	Off-Highway Trucks	2017	190	1	312	0.38	72	72	72	22,526
1	Off-Highway Trucks	2018	190	1	312	0.38	72	72	72	22,526
1	Off-Highway Trucks	2019	190	1	312	0.38	72	72	72	22,526
1	Off-Highway Trucks	2020	190	1	312	0.38	72	72	72	22,526
1	Off-Highway Trucks	2021	190	1	312	0.38	72	72	72	22,526
1	Off-Highway Trucks	2022	190	1	312	0.38	72	72	72	22,526
1	Off-Highway Trucks	2023	190	1	312	0.38	72	72	72	22,526
1	Off-Highway Trucks	2024	190	1	312	0.38	72	72	72	22,526
1	Off-Highway Trucks	2025	190	1	312	0.38	72	72	72	22,526
1	Off-Highway Trucks	2030	190	1	312	0.38	72	72	72	22,526
1	Off-Highway Trucks	2035	190	1	312	0.38	72	72	72	22,526
1	Off-Highway Trucks	2040	190	1	312	0.38	72	72	72	22,526
1	Off-Highway Trucks	2017	385	2	624	0.38	146	146	293	91,291
1	Off-Highway Trucks	2018	385	2	624	0.38	146	146	293	91,291
1	Off-Highway Trucks	2019	385	2	624	0.38	146	146	293	91,291
1	Off-Highway Trucks	2020	385	2	624	0.38	146	146	293	91,291
1	Off-Highway Trucks	2021	385	2	624	0.38	146	146	293	91,291
1	Off-Highway Trucks	2022	385	2	624	0.38	146	146	293	91,291
1	Off-Highway Trucks	2023	385	2	624	0.38	146	146	293	91,291
1	Off-Highway Trucks	2024	385	2	624	0.38	146	146	293	91,291
1	Off-Highway Trucks	2025	385	2	624	0.38	146	146	293	91,291
1	Off-Highway Trucks	2030	385	2	624	0.38	146	146	293	91,291
1	Off-Highway Trucks	2035	385	2	624	0.38	146	146	293	91,291
1	Off-Highway Trucks	2040	385	2	624	0.38	146	146	293	91,291
2	Rubber Tired Loaders	2017	425	8	2,496	0.36	153	306	2,448	763,776
2	Rubber Tired Loaders	2018	425	8	2,496	0.36	153	306	2,448	763,776
2	Rubber Tired Loaders	2019	425	8	2,496	0.36	153	306	2,448	763,776
2	Rubber Tired Loaders	2020	425	8	2,496	0.36	153	306	2,448	763,776
2	Rubber Tired Loaders	2021	425	8	2,496	0.36	153	306	2,448	763,776
2	Rubber Tired Loaders	2022	425	8	2,496	0.36	153	306	2,448	763,776
2	Rubber Tired Loaders	2023	425	8	2,496	0.36	153	306	2,448	763,776
2	Rubber Tired Loaders	2024	425	8	2,496	0.36	153	306	2,448	763,776
2	Rubber Tired Loaders	2025	425	8	2,496	0.36	153	306	2,448	763,776
2	Rubber Tired Loaders	2030	425	8	2,496	0.36	153	306	2,448	763,776
2	Rubber Tired Loaders	2035	425	8	2,496	0.36	153	306	2,448	763,776
2	Rubber Tired Loaders	2040	425	8	2,496	0.36	153	306	2,448	763,776

# Units	Equiptment	Year	HP	Hours / Day	Hours / Year	Load Factor	Hourly Activity/Unit (HP-hr)	Total Hourly (hp-hr)	Total Daily (hp-hr)	Total Annual (hp-hr)
1	Crawler Tractors	2017	450	4	1,248	0.43	194	194	774	241,488
1	Crawler Tractors	2018	450	4	1,248	0.43	194	194	774	241,488
1	Crawler Tractors	2019	450	4	1,248	0.43	194	194	774	241,488
1	Crawler Tractors	2020	450	4	1,248	0.43	194	194	774	241,488
1	Crawler Tractors	2021	450	4	1,248	0.43	194	194	774	241,488
1	Crawler Tractors	2022	450	4	1,248	0.43	194	194	774	241,488
1	Crawler Tractors	2023	450	4	1,248	0.43	194	194	774	241,488
1	Crawler Tractors	2024	450	4	1,248	0.43	194	194	774	241,488
1	Crawler Tractors	2025	450	4	1,248	0.43	194	194	774	241,488
1	Crawler Tractors	2030	450	4	1,248	0.43	194	194	774	241,488
1	Crawler Tractors	2035	450	4	1,248	0.43	194	194	774	241,488
1	Crawler Tractors	2040	450	4	1,248	0.43	194	194	774	241,488
2	Off-Highway Trucks	2017	525	8	655	0.38	200	399	3,192	261,425
2	Off-Highway Trucks	2018	525	8	655	0.38	200	399	3,192	261,425
2	Off-Highway Trucks	2019	525	8	1,310	0.38	200	399	3,192	522,850
2	Off-Highway Trucks	2020	525	8	1,310	0.38	200	399	3,192	522,850
2	Off-Highway Trucks	2021	525	8	1,310	0.38	200	399	3,192	522,850
2	Off-Highway Trucks	2022	525	8	1,310	0.38	200	399	3,192	522,850
2	Off-Highway Trucks	2023	525	8	1,310	0.38	200	399	3,192	522,850
2	Off-Highway Trucks	2024	525	8	1,310	0.38	200	399	3,192	522,850
2	Off-Highway Trucks	2025	525	8	1,310	0.38	200	399	3,192	522,850
2	Off-Highway Trucks	2030	525	8	1,310	0.38	200	399	3,192	522,850
2	Off-Highway Trucks	2035	525	8	1,310	0.38	200	399	3,192	522,850
2	Off-Highway Trucks	2040	525	8	1,310	0.38	200	399	3,192	522,850
1	Excavators	2017	625	8	2,496	0.38	238	238	1,900	592,800
1	Excavators	2018	625	8	2,496	0.38	238	238	1,900	592,800
1	Excavators	2019	625	8	2,496	0.38	238	238	1,900	592,800
1	Excavators	2020	625	8	2,496	0.38	238	238	1,900	592,800
1	Excavators	2021	625	8	2,496	0.38	238	238	1,900	592,800
1	Excavators	2022	625	8	2,496	0.38	238	238	1,900	592,800
1	Excavators	2023	625	8	2,496	0.38	238	238	1,900	592,800
1	Excavators	2024	625	8	2,496	0.38	238	238	1,900	592,800
1	Excavators	2025	625	8	2,496	0.38	238	238	1,900	592,800
1	Excavators	2030	625	8	2,496	0.38	238	238	1,900	592,800
1	Excavators	2035	625	8	2,496	0.38	238	238	1,900	592,800
1	Excavators	2040	625	8	2,496	0.38	238	238	1,900	592,800

Equiptment	ROG (g/hp-hr)	CO (g/hp-hr)	NOX (g/hp-hr)	SO2 (g/hp-hr)	PM10 (g/hp-hr)	PM2.5 (g/hp-hr)	Mitigated PM10 (g/hp-hr)	Mitigated PM2.5 (g/hp-hr)
Graders	0.757	3.85	7.66	0.005	0.015	0.015	0.015	0.0138
Graders	0.661	3.71	6.60	0.005	0.015	0.015	0.015	0.0138
Graders	0.609	3.66	6.01	0.005	0.015	0.015	0.015	0.0138
Graders	0.567	3.62	5.53	0.005	0.015	0.015	0.015	0.0138
Graders	0.505	3.56	4.84	0.005	0.015	0.015	0.015	0.0138
Graders	0.440	3.49	4.12	0.005	0.015	0.015	0.015	0.0138
Graders	0.390	3.45	3.55	0.005	0.015	0.015	0.015	0.0138
Graders	0.364	3.43	3.20	0.005	0.015	0.015	0.015	0.0138
Graders	0.329	3.42	2.77	0.005	0.015	0.015	0.015	0.0138
Graders	0.237	3.33	0.82	0.006	0.038	0.015	0.038	0.03496
Graders	0.206	3.33	0.51	0.006	0.015	0.015	0.015	0.0138
Graders	0.193	3.33	0.38	0.006	0.015	0.015	0.015	0.0138
Off-Highway Trucks	0.417	1.75	4.37	0.005	0.015	0.015	0.015	0.0138
Off-Highway Trucks	0.341	1.54	3.45	0.005	0.015	0.015	0.015	0.0138
Off-Highway Trucks	0.307	1.46	2.98	0.005	0.015	0.015	0.015	0.0138
Off-Highway Trucks	0.275	1.39	2.51	0.005	0.015	0.015	0.015	0.0138
Off-Highway Trucks	0.249	1.35	2.11	0.005	0.015	0.015	0.015	0.0138
Off-Highway Trucks	0.215	1.28	1.62	0.005	0.015	0.015	0.015	0.0138
Off-Highway Trucks	0.207	1.27	1.46	0.005	0.015	0.015	0.015	0.0138
Off-Highway Trucks	0.202	1.26	1.36	0.005	0.015	0.015	0.015	0.0138
Off-Highway Trucks	0.185	1.21	1.13	0.005	0.015	0.015	0.015	0.0138
Off-Highway Trucks	0.217	1.17	0.48	0.006	0.015	0.015	0.015	0.0138
Off-Highway Trucks	0.208	1.17	0.35	0.006	0.015	0.015	0.015	0.0138
Off-Highway Trucks	0.204	1.17	0.31	0.006	0.015	0.015	0.015	0.0138
Off-Highway Trucks	0.325	1.75	3.67	0.005	0.015	0.015	0.015	0.0138
Off-Highway Trucks	0.287	1.56	3.09	0.005	0.015	0.015	0.015	0.0138
Off-Highway Trucks	0.263	1.48	2.67	0.005	0.015	0.015	0.015	0.0138
Off-Highway Trucks	0.246	1.41	2.35	0.005	0.015	0.015	0.015	0.0138
Off-Highway Trucks	0.225	1.34	1.95	0.005	0.015	0.015	0.015	0.0138
Off-Highway Trucks	0.196	1.25	1.49	0.005	0.015	0.015	0.015	0.0138
Off-Highway Trucks	0.187	1.22	1.32	0.005	0.015	0.015	0.015	0.0138
Off-Highway Trucks	0.184	1.21	1.24	0.005	0.015	0.015	0.015	0.0138
Off-Highway Trucks	0.177	1.18	1.06	0.005	0.015	0.015	0.015	0.0138
Off-Highway Trucks	0.216	1.10	0.46	0.005	0.015	0.015	0.015	0.0138
Off-Highway Trucks	0.208	1.11	0.35	0.005	0.015	0.015	0.015	0.0138
Off-Highway Trucks	0.204	1.11	0.31	0.005	0.015	0.015	0.015	0.0138
Rubber Tired Loaders	0.369	2.06	4.25	0.005	0.015	0.015	0.015	0.0138
Rubber Tired Loaders	0.334	1.87	3.73	0.005	0.015	0.015	0.015	0.0138
Rubber Tired Loaders	0.306	1.72	3.29	0.005	0.015	0.015	0.015	0.0138
Rubber Tired Loaders	0.289	1.63	3.02	0.005	0.015	0.015	0.015	0.0138
Rubber Tired Loaders	0.264	1.53	2.61	0.005	0.015	0.015	0.015	0.0138
Rubber Tired Loaders	0.237	1.44	2.18	0.005	0.015	0.015	0.015	0.0138
Rubber Tired Loaders	0.217	1.38	1.87	0.005	0.015	0.015	0.015	0.0138
Rubber Tired Loaders	0.209	1.35	1.70	0.005	0.015	0.015	0.015	0.0138
Rubber Tired Loaders	0.193	1.28	1.43	0.005	0.015	0.015	0.015	0.0138
Rubber Tired Loaders	0.208	1.09	0.62	0.005	0.015	0.015	0.015	0.0138
Rubber Tired Loaders	0.191	1.08	0.42	0.005	0.015	0.015	0.015	0.0138
Rubber Tired Loaders	0.185	1.08	0.34	0.005	0.015	0.015	0.015	0.0138

Equiptment	ROG (g/hp-hr)	CO (g/hp-hr)	NOX (g/hp-hr)	SO2 (g/hp-hr)	PM10 (g/hp-hr)	PM2.5 (g/hp-hr)	Mitigated PM10 (g/hp-hr)	Mitigated PM2.5 (g/hp-hr)
Crawler Tractors	0.385	2.63	5.03	0.005	0.015	0.015	0.015	0.0138
Crawler Tractors	0.344	2.38	4.37	0.005	0.015	0.015	0.015	0.0138
Crawler Tractors	0.319	2.22	3.93	0.005	0.015	0.015	0.015	0.0138
Crawler Tractors	0.301	2.09	3.62	0.005	0.015	0.015	0.015	0.0138
Crawler Tractors	0.283	2.02	3.28	0.005	0.015	0.015	0.015	0.0138
Crawler Tractors	0.254	1.92	2.74	0.005	0.015	0.015	0.015	0.0138
Crawler Tractors	0.241	1.85	2.48	0.005	0.015	0.015	0.015	0.0138
Crawler Tractors	0.228	1.78	2.24	0.005	0.015	0.015	0.015	0.0138
Crawler Tractors	0.208	1.72	1.92	0.005	0.015	0.015	0.015	0.0138
Crawler Tractors	0.257	1.20	1.02	0.005	0.015	0.015	0.015	0.0138
Crawler Tractors	0.227	1.15	0.66	0.005	0.015	0.015	0.015	0.0138
Crawler Tractors	0.210	1.11	0.47	0.005	0.015	0.015	0.015	0.0138
Off-Highway Trucks	0.394	2.36	4.26	0.005	0.015	0.015	0.015	0.0138
Off-Highway Trucks	0.348	2.18	3.69	0.005	0.015	0.015	0.015	0.0138
Off-Highway Trucks	0.327	2.04	3.32	0.005	0.015	0.015	0.015	0.0138
Off-Highway Trucks	0.312	2.03	3.06	0.005	0.015	0.015	0.015	0.0138
Off-Highway Trucks	0.293	1.94	2.67	0.005	0.015	0.015	0.015	0.0138
Off-Highway Trucks	0.263	1.75	2.27	0.005	0.015	0.015	0.015	0.0138
Off-Highway Trucks	0.263	1.72	2.18	0.005	0.015	0.015	0.015	0.0138
Off-Highway Trucks	0.259	1.65	2.08	0.005	0.015	0.015	0.015	0.0138
Off-Highway Trucks	0.235	1.58	1.75	0.005	0.015	0.015	0.015	0.0138
Off-Highway Trucks	0.217	1.10	0.46	0.005	0.015	0.015	0.015	0.0138
Off-Highway Trucks	0.208	1.11	0.35	0.005	0.015	0.015	0.015	0.0138
Off-Highway Trucks	0.204	1.11	0.31	0.005	0.015	0.015	0.015	0.0138
Excavators	0.210	1.23	2.72	0.005	0.015	0.015	0.015	0.0138
Excavators	0.189	1.22	2.27	0.005	0.015	0.015	0.015	0.0138
Excavators	0.176	1.17	1.99	0.005	0.015	0.015	0.015	0.0138
Excavators	0.170	1.15	1.80	0.005	0.015	0.015	0.015	0.0138
Excavators	0.165	1.15	1.62	0.005	0.015	0.015	0.015	0.0138
Excavators	0.150	1.14	1.29	0.005	0.015	0.015	0.015	0.0138
Excavators	0.144	1.13	1.16	0.005	0.015	0.015	0.015	0.0138
Excavators	0.142	1.13	1.10	0.005	0.015	0.015	0.015	0.0138
Excavators	0.139	1.13	1.03	0.005	0.015	0.015	0.015	0.0138
Excavators	0.202	1.09	0.44	0.005	0.015	0.015	0.015	0.0138
Excavators	0.195	1.09	0.34	0.005	0.015	0.015	0.015	0.0138
Excavators	0.192	1.09	0.30	0.005	0.015	0.015	0.015	0.0138

Equipment Type & Horsepower	Sum of # Units	Sum of ROG (lb/hr)	Sum of NOX (lb/hr)	Sum of CO (lb/hr)	Sum of SO2 (lb/hr)	Sum of PM10 (lb/hr)	Sum of PM2.5 (lb/hr)
2017	5	0.989	9.873	7.168	0.0148	0.326	0.300
2018	5	0.936	9.152	6.922	0.0148	0.298	0.274
2019	5	0.904	8.618	6.738	0.0148	0.276	0.254
2020	5	0.882	8.266	6.665	0.0148	0.262	0.241
2021	5	0.853	7.740	6.538	0.0148	0.242	0.223
2022	5	0.816	7.189	6.356	0.0148	0.220	0.203
2023	5	0.802	6.924	6.301	0.0148	0.208	0.192
2024	5	0.794	6.751	6.234	0.0148	0.201	0.186
2025	5	0.768	6.354	6.137	0.0148	0.191	0.175
2026	5	0.768	6.354	6.137	0.0148	0.191	0.175
2030	5	0.766	4.974	5.702	0.0148	0.156	0.145
2035	5	0.749	4.763	5.697	0.0148	0.149	0.139
2040	5	0.743	4.683	5.697	0.0148	0.147	0.137

Equipment Type & Horsepower	Sum of # Units	Sum of ROG (lb/day)	Sum of NOX (lb/day)	Sum of CO (lb/day)	Sum of SO2 (lb/day)	Sum of PM10 (lb/day)	Sum of PM2.5 (lb/day)
2017	**5**	**11.871**	**118.477**	**86.018**	**0.177**	**3.914**	**3.599**
2018	**5**	**11.232**	**109.829**	**83.065**	**0.177**	**3.574**	**3.282**
2019	**5**	**10.842**	**103.414**	**80.861**	**0.177**	**3.313**	**3.045**
2020	**5**	**10.589**	**99.190**	**79.985**	**0.177**	**3.139**	**2.886**
2021	**5**	**10.239**	**92.881**	**78.456**	**0.177**	**2.909**	**2.680**
2022	**5**	**9.788**	**86.262**	**76.275**	**0.177**	**2.640**	**2.435**
2023	**5**	**9.627**	**83.092**	**75.609**	**0.177**	**2.496**	**2.300**
2024	**5**	**9.531**	**81.011**	**74.811**	**0.177**	**2.417**	**2.228**
2025	**5**	**9.216**	**76.245**	**73.644**	**0.177**	**2.289**	**2.100**
2026	**5**	**9.216**	**76.245**	**73.644**	**0.177**	**2.289**	**2.100**
2030	**5**	**9.198**	**59.691**	**68.426**	**0.177**	**1.868**	**1.742**
2035	**5**	**8.990**	**57.158**	**68.361**	**0.177**	**1.788**	**1.663**
2040	**5**	**8.911**	**56.194**	**68.361**	**0.177**	**1.764**	**1.639**

Equipment Type & Horsepower	Sum of # Units	Sum of PM10 (lb/yr)	Sum of ROG (ton/yr)	Sum of NOX (ton/yr)	Sum of CO (ton/yr)	Sum of SO2 (ton/yr)	Sum of PM10 (ton/yr)
2017	**5**	**97.855**	**0.148**	**1.481**	**1.075**	**0.002**	**0.049**
2018	**5**	**89.356**	**0.140**	**1.373**	**1.038**	**0.002**	**0.045**
2019	**5**	**82.819**	**0.136**	**1.293**	**1.011**	**0.002**	**0.041**
2020	**5**	**78.464**	**0.132**	**1.240**	**1.000**	**0.002**	**0.039**
2021	**5**	**72.719**	**0.128**	**1.161**	**0.981**	**0.002**	**0.036**
2022	**5**	**65.998**	**0.122**	**1.078**	**0.953**	**0.002**	**0.033**
2023	**5**	**62.408**	**0.120**	**1.039**	**0.945**	**0.002**	**0.031**
2024	**5**	**60.420**	**0.119**	**1.013**	**0.935**	**0.002**	**0.030**
2025	**5**	**57.235**	**0.115**	**0.953**	**0.921**	**0.002**	**0.029**
2026	**5**	**57.235**	**0.115**	**0.953**	**0.921**	**0.002**	**0.029**
2030	**5**	**46.694**	**0.115**	**0.746**	**0.855**	**0.002**	**0.023**
2035	**5**	**44.706**	**0.112**	**0.714**	**0.855**	**0.002**	**0.022**
2040	**5**	**44.108**	**0.111**	**0.702**	**0.855**	**0.002**	**0.022**

# Units	Mobility	Equiptment	Year	HP	Hours per Day	Hours per Year	Load Factor	Total Hourly (hp-hr)	Total Daily (hp-hr)
2	Mobile	On-Road Trucks	2017	385	12	300	0.38	293	3,511
2	Mobile	On-Road Trucks	2018	385	12	300	0.38	293	3,511
2	Mobile	On-Road Trucks	2019	385	12	300	0.38	293	3,511
2	Mobile	On-Road Trucks	2020	385	12	300	0.38	293	3,511
2	Mobile	On-Road Trucks	2021	385	12	300	0.38	293	3,511
2	Mobile	On-Road Trucks	2022	385	12	300	0.38	293	3,511
2	Mobile	On-Road Trucks	2023	385	12	300	0.38	293	3,511
2	Mobile	On-Road Trucks	2024	385	12	300	0.38	293	3,511
2	Mobile	On-Road Trucks	2025	385	12	300	0.38	293	3,511
2	Mobile	On-Road Trucks	2030	385	12	300	0.38	293	3,511
2	Mobile	On-Road Trucks	2035	385	12	300	0.38	293	3,511
2	Mobile	On-Road Trucks	2040	385	12	300	0.38	293	3,511
1	Portable	Portable Generator	2017	1,000	12	300	0.74	740	8,880
1	Portable	Portable Generator	2018	1,000	12	300	0.74	740	8,880
1	Portable	Portable Generator	2019	1,000	12	300	0.74	740	8,880
1	Portable	Portable Generator	2020	1,000	12	300	0.74	740	8,880
1	Portable	Portable Generator	2021	1,000	12	300	0.74	740	8,880
1	Portable	Portable Generator	2022	1,000	12	300	0.74	740	8,880
1	Portable	Portable Generator	2023	1,000	12	300	0.74	740	8,880
1	Portable	Portable Generator	2024	1,000	12	300	0.74	740	8,880
1	Portable	Portable Generator	2025	1,000	12	300	0.74	740	8,880
1	Portable	Portable Generator	2030	1,000	12	300	0.74	740	8,880
1	Portable	Portable Generator	2035	1,000	12	300	0.74	740	8,880
1	Portable	Portable Generator	2040	1,000	12	300	0.74	740	8,880
2	Mobile	Rubber Tired Loaders	2017	425	12	300	0.36	306	3,672
2	Mobile	Rubber Tired Loaders	2018	425	12	300	0.36	306	3,672
2	Mobile	Rubber Tired Loaders	2019	425	12	300	0.36	306	3,672
2	Mobile	Rubber Tired Loaders	2020	425	12	300	0.36	306	3,672
2	Mobile	Rubber Tired Loaders	2021	425	12	300	0.36	306	3,672
2	Mobile	Rubber Tired Loaders	2022	425	12	300	0.36	306	3,672
2	Mobile	Rubber Tired Loaders	2023	425	12	300	0.36	306	3,672
2	Mobile	Rubber Tired Loaders	2024	425	12	300	0.36	306	3,672
2	Mobile	Rubber Tired Loaders	2025	425	12	300	0.36	306	3,672
2	Mobile	Rubber Tired Loaders	2030	425	12	300	0.36	306	3,672
2	Mobile	Rubber Tired Loaders	2035	425	12	300	0.36	306	3,672
2	Mobile	Rubber Tired Loaders	2040	425	12	300	0.36	306	3,672

Equiptment	Year	Daily Activity/Unit (HP-hr)	Total Annual (hp-hr)
On-Road Trucks	2017	1,756	87,780
On-Road Trucks	2018	1,756	87,780
On-Road Trucks	2019	1,756	87,780
On-Road Trucks	2020	1,756	87,780
On-Road Trucks	2021	1,756	87,780
On-Road Trucks	2022	1,756	87,780
On-Road Trucks	2023	1,756	87,780
On-Road Trucks	2024	1,756	87,780
On-Road Trucks	2025	1,756	87,780
On-Road Trucks	2030	1,756	87,780
On-Road Trucks	2035	1,756	87,780
On-Road Trucks	2040	1,756	87,780
Portable Generator	2017	8,880	222,000
Portable Generator	2018	8,880	222,000
Portable Generator	2019	8,880	222,000
Portable Generator	2020	8,880	222,000
Portable Generator	2021	8,880	222,000
Portable Generator	2022	8,880	222,000
Portable Generator	2023	8,880	222,000
Portable Generator	2024	8,880	222,000
Portable Generator	2025	8,880	222,000
Portable Generator	2030	8,880	222,000
Portable Generator	2035	8,880	222,000
Portable Generator	2040	8,880	222,000
Rubber Tired Loaders	2017	1,836	91,800
Rubber Tired Loaders	2018	1,836	91,800
Rubber Tired Loaders	2019	1,836	91,800
Rubber Tired Loaders	2020	1,836	91,800
Rubber Tired Loaders	2021	1,836	91,800
Rubber Tired Loaders	2022	1,836	91,800
Rubber Tired Loaders	2023	1,836	91,800
Rubber Tired Loaders	2024	1,836	91,800
Rubber Tired Loaders	2025	1,836	91,800
Rubber Tired Loaders	2030	1,836	91,800
Rubber Tired Loaders	2035	1,836	91,800
Rubber Tired Loaders	2040	1,836	91,800

Equiptment	Year	ROG (g/hp-hr)	CO (g/hp-hr)	NOX (g/hp-hr)	SO2 (g/hp-hr)	PM10 (g/hp-hr)	PM2.5 (g/hp-hr)	Mitigated PM10 (g/hp-hr)	Mitigated PM2.5 (g/hp-hr)
On-Road Trucks	2017	0.394	2.356	4.257	0.005	0.136	0.125	0.136	0.12512
On-Road Trucks	2018	0.348	2.176	3.691	0.005	0.113	0.104	0.113	0.10396
On-Road Trucks	2019	0.327	2.041	3.320	0.005	0.097	0.089	0.097	0.08924
On-Road Trucks	2020	0.312	2.027	3.058	0.005	0.086	0.079	0.086	0.07912
On-Road Trucks	2021	0.293	1.935	2.668	0.005	0.072	0.066	0.072	0.06624
On-Road Trucks	2022	0.263	1.746	2.268	0.005	0.054	0.05	0.054	0.04968
On-Road Trucks	2023	0.263	1.719	2.182	0.005	0.048	0.044	0.048	0.04416
On-Road Trucks	2024	0.259	1.650	2.085	0.005	0.044	0.041	0.044	0.04048
On-Road Trucks	2025	0.235	1.578	1.751	0.005	0.038	0.035	0.038	0.03496
On-Road Trucks	2030	0.217	1.104	0.463	0.005	0.017	0.017	0.017	0.01564
On-Road Trucks	2035	0.208	1.105	0.348	0.005	0.013	0.013	0.013	0.01196
On-Road Trucks	2040	0.204	1.105	0.305	0.005	0.012	0.012	0.012	0.01104
Portable Generator	2017	0.298	2.610	2.610	0.005	0.08	0.0736	0.08	0.0736
Portable Generator	2018	0.298	2.610	2.610	0.005	0.08	0.0736	0.08	0.0736
Portable Generator	2019	0.298	2.610	2.610	0.005	0.08	0.0736	0.08	0.0736
Portable Generator	2020	0.298	2.610	2.610	0.005	0.08	0.0736	0.08	0.0736
Portable Generator	2021	0.298	2.610	2.610	0.005	0.08	0.0736	0.08	0.0736
Portable Generator	2022	0.298	2.610	2.610	0.005	0.08	0.0736	0.08	0.0736
Portable Generator	2023	0.298	2.610	2.610	0.005	0.08	0.0736	0.08	0.0736
Portable Generator	2024	0.298	2.610	2.610	0.005	0.08	0.0736	0.08	0.0736
Portable Generator	2025	0.298	2.610	2.610	0.005	0.08	0.0736	0.08	0.0736
Portable Generator	2030	0.298	2.610	2.610	0.005	0.08	0.0736	0.08	0.0736
Portable Generator	2035	0.298	2.610	2.610	0.005	0.08	0.0736	0.08	0.0736
Portable Generator	2040	0.298	2.610	2.610	0.005	0.08	0.0736	0.08	0.0736
Rubber Tired Loaders	2017	0.369	2.060	4.253	0.005	0.16	0.147	0.16	0.1472
Rubber Tired Loaders	2018	0.334	1.868	3.726	0.005	0.14	0.128	0.14	0.1288
Rubber Tired Loaders	2019	0.306	1.725	3.288	0.005	0.123	0.113	0.123	0.11316
Rubber Tired Loaders	2020	0.289	1.630	3.017	0.005	0.112	0.103	0.112	0.10304
Rubber Tired Loaders	2021	0.264	1.529	2.610	0.005	0.097	0.09	0.097	0.08924
Rubber Tired Loaders	2022	0.237	1.441	2.175	0.005	0.081	0.075	0.081	0.07452
Rubber Tired Loaders	2023	0.217	1.384	1.866	0.005	0.069	0.064	0.069	0.06348
Rubber Tired Loaders	2024	0.209	1.352	1.702	0.005	0.063	0.058	0.063	0.05796
Rubber Tired Loaders	2025	0.193	1.276	1.433	0.005	0.053	0.048	0.053	0.04876
Rubber Tired Loaders	2030	0.208	1.085	0.619	0.005	0.021	0.021	0.021	0.01932
Rubber Tired Loaders	2035	0.191	1.076	0.416	0.005	0.015	0.015	0.015	0.0138
Rubber Tired Loaders	2040	0.185	1.076	0.338	0.005	0.013	0.013	0.013	0.01196

Ready Mix Concrete Plant Emission Calculations

	Tons	Cubic Yards	PM10 (lb)	PM2.5 (lb)
Peak Hour	149.1053678	300	2.38	0.70
Peak Day	3578.528827	7,200	57.2	16.7
Peak Year	223658.0517	450,000	3,573	1,043

				Fugitive Dust Emissions								
Equipment / Emission Unit Description	Throughput (tph)	Throughput (tpd)	Throughput (tpy)	Emission Factor	EF Unit	PM10 Emissions lb/hr	PM2.5 Emissions lb/hr[1]	PM10 Emissions lb/day	PM2.5 Emissions lb/hr[1]	PM_{10} Emissions lb/yr	$PM_{2.5}$ Emissions lb/yr[1]	Emission Source Comments
Haul Truck to Plant Feed/Pile	492.9	11829.6	739,350	0.000016	lb PM10 / ton aggregate	0.007886	0.002303	0.189274	0.055268	11.830	3.454243	AP42, table 11.19.2-2, 8/04, Truck Unloading... AP42 emission factor of 0.000016 lb/ton. Aggregate kept moist.
Loader to Plant	492.9	11829.6	739,350	0.000016	lb PM10 / ton aggregate	0.007886	0.002303	0.189274	0.055268	11.830	3.454243	
Conveyor transfer to aggregate storage bin	492.9	11829.6	739,350	0.000046	lb PM10 / ton aggregate	0.022673	0.006621	0.544162	0.158895	34.010	9.930949	AP42, table 11.19.2-2, 8/04, conveyor transfer point. AP42 emission factor of 0.000046 lb/ton. Aggregate kept moist.
Discharge from aggregate storage bin to belt conveyor	492.9	11829.6	739,350	0.000046	lb PM10 / ton aggregate	0.022673	0.006621	0.544162	0.158895	34.010	9.930949	
Pneumatic transfer of cement to controlled silo	73.65	1767.6	110,475	0.000340	lb PM10 / ton cement	0.025041	0.007312	0.600984	0.175487	37.562	10.967958	AP42 Table 11.12-2 (June 2006). Cement unloading to elevated storage silo controlled by fabric filter.
Pneumatic transfer of cement supplements to controlled silo	10.95	262.8	16,425	0.004900	lb PM10 / ton cement supplement	0.053655	0.015667	1.287720	0.376014	80.483	23.500890	AP42 Table 11.12-2 (June 2006). Cement supplement unloading to elevated storage silo controlled by fabric filter.
Cement / flyash conveyed with cement batcher screw	73.65	1767.6	110,475	0.000000	NA	0.000000	0.000000	0.000000	0.000000	0.000	0.000000	Closed system
Weigh hopper loading (aggregate and cement / flyash)	603.6	14486.4	905,400	0.000028	lb PM10 / ton aggregate	0.016901	0.004935	0.405619	0.118441	25.351	7.402550	AP42 Table 11.12-2 (June 2006). Weigh hopper loading, with 99% control from fabric filter.
Truck Loading	84.6	2030.4	126,900	0.0263	lb PM10 / ton cement and cement supplement	2.224980	0.649694	53.399520	15.592660	3337.470	974.541240	AP42 Table 11.12-2 (June 2006). Truck loading.
					Total	2.381696	0.695455	57.160714	16.690928	3572.544600	1043.183023	

Metals - lbs per Hour

Equipment / Emission Unit Description	Throughput (tph)	Arsenic lb/hr	Beryllium lb/hr	Cadmium lb/hr	Chromium lb/hr	Lead lb/hr	Manganese lb/hr	Nickel lb/hr	Phosphorus lb/hr	Selenium lb/hr
Pneumatic transfer of cement to controlled silo	73.65	3.12276E-07	3.57939E-08	1.72341E-05	2.13585E-06	8.02785E-07	8.61705E-06	3.07857E-06	0.00086907	0.00007365
Pneumatic transfer of cement supplements to controlled silo	10.95	0.00001095	9.8988E-07	2.1681E-09	0.000013359	0.000005694	2.8032E-06	0.000024966	0.000038763	7.9278E-07
Truck Loading	84.6	5.09292E-05	8.7984E-06	7.66476E-07	0.00034686	0.000129438	0.00175968	0.000404388	0.00104058	9.5598E-06
	Total:	6.21915E-05	9.82407E-06	1.80027E-05	0.000362355	0.000135935	0.0017711	0.000432433	0.001948413	8.40026E-05

Metals - lbs per year

Equipment / Emission Unit Description	Throughput (tpy)	Arsenic lb/yr	Beryllium lb/yr	Cadmium lb/yr	Chromium lb/yr	Lead lb/yr	Manganese lb/yr	Nickel lb/yr	Phosphorus lb/yr	Selenium lb/yr
Pneumatic transfer of cement to controlled silo	110,475	0.000468414	5.36909E-05	0.02585115	0.003203775	0.001204178	0.012925575	0.004617855	1.303605	0.110475
Pneumatic transfer of cement supplements to controlled silo	16,425	0.016425	0.00148482	3.25215E-06	0.0200385	0.008541	0.0042048	0.037449	0.0581445	0.00118917
Truck Loading	126,900	0.0763938	0.0131976	0.001149714	0.52029	0.194157	2.63952	0.606582	1.56087	0.0143397
	Total:	**0.093287214**	**0.014736111**	**0.027004116**	**0.543532275**	**0.203902178**	**2.656650375**	**0.648648855**	**2.9226195**	**0.12600387**

Throughput Information

Annual Production =	450,000	yd^3
Density of Concrete =	2.01	$tons/yd^3$
Annual Concrete Production =	905,400	tons
Amount of Sand and Gravel =	739,350	tons
Amount of Cement =	110,475	tons
Amount of Cement Supplements =	16,425	tons

AP-42 Table 11.12-2, Footnote a.

1865	lb gravel	46%
1421	lb sand	35%
491	lb cement	12%
73	lb supplement	2%
174	lb water	4%
4024	lb concrete	100%

[1]PM2.5 emission factor assumed to be 29.2% of PM10 for material drops based on SCAQMD's Updated CEIDARS

Carli Mine Expansion

Sacramento County, Annual

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
General Heavy Industry	10.00	1000sqft	0.23	10,000.00	5

1.2 Other Project Characteristics

Urbanization	Rural	**Wind Speed (m/s)**	3.5	**Precipitation Freq (Days)**	58
Climate Zone	6			**Operational Year**	2019
Utility Company	Sacramento Municipal Utility District				
CO2 Intensity (lb/MWhr)	590.31	**CH4 Intensity (lb/MWhr)**	0.029	**N2O Intensity (lb/MWhr)**	0.006

1.3 User Entered Comments & Non-Default Data

Project Characteristics -

Land Use - number of employees involved in erecting ready-mix plant

Construction Phase - two weeks to erect ready mix plant that is prefabricated and delivered to project site.

Trips and VMT - each of five workers, vendors, and trucks transporting parts of the ready-mix plant make 2 trips each

On-road Fugitive Dust - assume on-site distance traveled is unpaved and 5% of total travel distance

Construction Off-road Equipment Mitigation -

Vehicle Trips - This CalEEMod model run includes only construction phase emissions. Operation phase emissions are calculated in spreadsheets. No additional trips during operation phase occur.

Table Name	Column Name	Default Value	New Value
tblConstructionPhase	NumDays	100.00	10.00
tblConstructionPhase	PhaseEndDate	12/31/2010	7/13/2018
tblConstructionPhase	PhaseStartDate	1/1/2011	7/1/2018
tblLandUse	Population	0.00	5.00
tblOnRoadDust	HaulingPercentPave	100.00	95.00
tblOnRoadDust	VendorPercentPave	100.00	95.00
tblOnRoadDust	WorkerPercentPave	100.00	95.00
tblProjectCharacteristics	UrbanizationLevel	Urban	Rural
tblTripsAndVMT	HaulingTripNumber	0.00	10.00
tblTripsAndVMT	VendorTripNumber	2.00	10.00
tblTripsAndVMT	WorkerTripNumber	4.00	10.00

2.0 Emissions Summary

2.1 Overall Construction

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2018	6.0900e-003	0.0645	0.0440	8.0000e-005	0.0799	3.6200e-003	0.0835	8.1400e-003	3.3300e-003	0.0115	0.0000	7.6029	7.6029	1.7500e-003	0.0000	7.6466
Maximum	**6.0900e-003**	**0.0645**	**0.0440**	**8.0000e-005**	**0.0799**	**3.6200e-003**	**0.0835**	**8.1400e-003**	**3.3300e-003**	**0.0115**	**0.0000**	**7.6029**	**7.6029**	**1.7500e-003**	**0.0000**	**7.6466**

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2018	6.0900e-003	0.0645	0.0440	8.0000e-005	0.0799	3.6200e-003	0.0835	8.1400e-003	3.3300e-003	0.0115	0.0000	7.6029	7.6029	1.7500e-003	0.0000	7.6466
Maximum	**6.0900e-003**	**0.0645**	**0.0440**	**8.0000e-005**	**0.0799**	**3.6200e-003**	**0.0835**	**8.1400e-003**	**3.3300e-003**	**0.0115**	**0.0000**	**7.6029**	**7.6029**	**1.7500e-003**	**0.0000**	**7.6466**

	ROG	**NOx**	**CO**	**SO2**	**Fugitive PM10**	**Exhaust PM10**	**PM10 Total**	**Fugitive PM2.5**	**Exhaust PM2.5**	**PM2.5 Total**	**Bio- CO2**	**NBio-CO2**	**Total CO2**	**CH4**	**N20**	**CO2e**
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Quarter	Start Date	End Date	Maximum Unmitigated ROG + NOX (tons/quarter)	Maximum Mitigated ROG + NOX (tons/quarter)
1	**6-15-2018**	**9-14-2018**	0.0653	0.0653
		Highest	0.0653	0.0653

2.2 Overall Operational

Unmitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	0.0437	0.0000	1.3000e-004	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.5000e-004	2.5000e-004	0.0000	0.0000	2.6000e-004
Energy	1.9300e-003	0.0176	0.0148	1.1000e-004		1.3300e-003	1.3300e-003		1.3300e-003	1.3300e-003	0.0000	59.7556	59.7556	2.3600e-003	7.6000e-004	60.0422
Mobile	6.9100e-003	0.0333	0.0978	2.8000e-004	0.0229	3.5000e-004	0.0233	6.1500e-003	3.3000e-004	6.4700e-003	0.0000	25.7920	25.7920	1.3300e-003	0.0000	25.8252
Waste						0.0000	0.0000		0.0000	0.0000	2.5171	0.0000	2.5171	0.1488	0.0000	6.2360
Water						0.0000	0.0000		0.0000	0.0000	0.8182	3.0852	3.9034	2.9700e-003	1.8100e-003	4.5171
Total	**0.0525**	**0.0509**	**0.1127**	**3.9000e-004**	**0.0229**	**1.6800e-003**	**0.0246**	**6.1500e-003**	**1.6600e-003**	**7.8000e-003**	**3.3353**	**88.6330**	**91.9683**	**0.1554**	**2.5700e-003**	**96.6207**

2.2 Overall Operational

Mitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	0.0437	0.0000	1.3000e-004	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.5000e-004	2.5000e-004	0.0000	0.0000	2.6000e-004
Energy	1.9300e-003	0.0176	0.0148	1.1000e-004		1.3300e-003	1.3300e-003		1.3300e-003	1.3300e-003	0.0000	59.7556	59.7556	2.3600e-003	7.6000e-004	60.0422
Mobile	6.9100e-003	0.0333	0.0978	2.8000e-004	0.0229	3.5000e-004	0.0233	6.1500e-003	3.3000e-004	6.4700e-003	0.0000	25.7920	25.7920	1.3300e-003	0.0000	25.8252
Waste						0.0000	0.0000		0.0000	0.0000	2.5171	0.0000	2.5171	0.1488	0.0000	6.2360
Water						0.0000	0.0000		0.0000	0.0000	0.8182	3.0852	3.9034	2.9700e-003	1.8100e-003	4.5171
Total	**0.0525**	**0.0509**	**0.1127**	**3.9000e-004**	**0.0229**	**1.6800e-003**	**0.0246**	**6.1500e-003**	**1.6600e-003**	**7.8000e-003**	**3.3353**	**88.6330**	**91.9683**	**0.1554**	**2.5700e-003**	**96.6207**

	ROG	**NOx**	**CO**	**SO2**	**Fugitive PM10**	**Exhaust PM10**	**PM10 Total**	**Fugitive PM2.5**	**Exhaust PM2.5**	**PM2.5 Total**	**Bio- CO2**	**NBio-CO2**	**Total CO2**	**CH4**	**N20**	**CO2e**
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

3.0 Construction Detail

Construction Phase

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Building Construction	Building Construction	7/1/2018	7/13/2018	5	10	erect ready-mix plant

Acres of Grading (Site Preparation Phase): 0

Acres of Grading (Grading Phase): 0

Acres of Paving: 0

Residential Indoor: 0; Residential Outdoor: 0; Non-Residential Indoor: 0; Non-Residential Outdoor: 0; Striped Parking Area: 0 (Architectural Coating – sqft)

OffRoad Equipment

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
Building Construction	Cranes	1	4.00	231	0.29
Building Construction	Forklifts	2	6.00	89	0.20
Building Construction	Tractors/Loaders/Backhoes	2	8.00	97	0.37

Trips and VMT

Phase Name	Offroad Equipment Count	Worker Trip Number	Vendor Trip Number	Hauling Trip Number	Worker Trip Length	Vendor Trip Length	Hauling Trip Length	Worker Vehicle Class	Vendor Vehicle Class	Hauling Vehicle Class
Building Construction	5	10.00	10.00	10.00	15.00	8.50	20.00	LD_Mix	HDT_Mix	HHDT

3.1 Mitigation Measures Construction

3.2 Building Construction - 2018

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	5.4200e-003	0.0552	0.0388	6.0000e-005		3.5400e-003	3.5400e-003		3.2600e-003	3.2600e-003	0.0000	5.2006	5.2006	1.6200e-003	0.0000	5.2411
Total	**5.4200e-003**	**0.0552**	**0.0388**	**6.0000e-005**		**3.5400e-003**	**3.5400e-003**		**3.2600e-003**	**3.2600e-003**	**0.0000**	**5.2006**	**5.2006**	**1.6200e-003**	**0.0000**	**5.2411**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	5.0000e-005	1.6500e-003	4.2000e-004	0.0000	6.2700e-003	1.0000e-005	6.2800e-003	6.4000e-004	1.0000e-005	6.5000e-004	0.0000	0.3909	0.3909	2.0000e-005	0.0000	0.3915
Vendor	3.2000e-004	7.4800e-003	2.4400e-003	2.0000e-005	0.0267	7.0000e-005	0.0267	2.7300e-003	6.0000e-005	2.7900e-003	0.0000	1.4956	1.4956	9.0000e-005	0.0000	1.4978
Worker	3.0000e-004	2.3000e-004	2.4000e-003	1.0000e-005	0.0470	0.0000	0.0470	4.7700e-003	0.0000	4.7800e-003	0.0000	0.5158	0.5158	2.0000e-005	0.0000	0.5162
Total	**6.7000e-004**	**9.3600e-003**	**5.2600e-003**	**3.0000e-005**	**0.0799**	**8.0000e-005**	**0.0800**	**8.1400e-003**	**7.0000e-005**	**8.2200e-003**	**0.0000**	**2.4023**	**2.4023**	**1.3000e-004**	**0.0000**	**2.4055**

3.2 Building Construction - 2018

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	5.4200e-003	0.0552	0.0388	6.0000e-005		3.5400e-003	3.5400e-003		3.2600e-003	3.2600e-003	0.0000	5.2006	5.2006	1.6200e-003	0.0000	5.2411
Total	**5.4200e-003**	**0.0552**	**0.0388**	**6.0000e-005**		**3.5400e-003**	**3.5400e-003**		**3.2600e-003**	**3.2600e-003**	**0.0000**	**5.2006**	**5.2006**	**1.6200e-003**	**0.0000**	**5.2411**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	5.0000e-005	1.6500e-003	4.2000e-004	0.0000	6.2700e-003	1.0000e-005	6.2800e-003	6.4000e-004	1.0000e-005	6.5000e-004	0.0000	0.3909	0.3909	2.0000e-005	0.0000	0.3915
Vendor	3.2000e-004	7.4800e-003	2.4400e-003	2.0000e-005	0.0267	7.0000e-005	0.0267	2.7300e-003	6.0000e-005	2.7900e-003	0.0000	1.4956	1.4956	9.0000e-005	0.0000	1.4978
Worker	3.0000e-004	2.3000e-004	2.4000e-003	1.0000e-005	0.0470	0.0000	0.0470	4.7700e-003	0.0000	4.7800e-003	0.0000	0.5158	0.5158	2.0000e-005	0.0000	0.5162
Total	**6.7000e-004**	**9.3600e-003**	**5.2600e-003**	**3.0000e-005**	**0.0799**	**8.0000e-005**	**0.0800**	**8.1400e-003**	**7.0000e-005**	**8.2200e-003**	**0.0000**	**2.4023**	**2.4023**	**1.3000e-004**	**0.0000**	**2.4055**

4.0 Operational Detail - Mobile

4.1 Mitigation Measures Mobile

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Mitigated	6.9100e-003	0.0333	0.0978	2.8000e-004	0.0229	3.5000e-004	0.0233	6.1500e-003	3.3000e-004	6.4700e-003	0.0000	25.7920	25.7920	1.3300e-003	0.0000	25.8252
Unmitigated	6.9100e-003	0.0333	0.0978	2.8000e-004	0.0229	3.5000e-004	0.0233	6.1500e-003	3.3000e-004	6.4700e-003	0.0000	25.7920	25.7920	1.3300e-003	0.0000	25.8252

4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
General Heavy Industry	15.00	15.00	15.00	61,394	61,394
Total	15.00	15.00	15.00	61,394	61,394

4.3 Trip Type Information

	Miles			Trip %			Trip Purpose %		
Land Use	H-W or C-W	H-S or C-C	H-O or C-NW	H-W or C-W	H-S or C-C	H-O or C-NW	Primary	Diverted	Pass-by
General Heavy Industry	15.00	7.50	8.50	59.00	28.00	13.00	92	5	3

4.4 Fleet Mix

Land Use	LDA	LDT1	LDT2	MDV	LHD1	LHD2	MHD	HHD	OBUS	UBUS	MCY	SBUS	MH
General Heavy Industry	0.547085	0.042365	0.202414	0.127049	0.023381	0.005779	0.018348	0.021363	0.002103	0.002394	0.006067	0.000620	0.001032

5.0 Energy Detail

Historical Energy Use: N

5.1 Mitigation Measures Energy

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Electricity Mitigated						0.0000	0.0000		0.0000	0.0000	0.0000	40.6460	40.6460	2.0000e-003	4.1000e-004	40.8190
Electricity Unmitigated						0.0000	0.0000		0.0000	0.0000	0.0000	40.6460	40.6460	2.0000e-003	4.1000e-004	40.8190
NaturalGas Mitigated	1.9300e-003	0.0176	0.0148	1.1000e-004		1.3300e-003	1.3300e-003		1.3300e-003	1.3300e-003	0.0000	19.1096	19.1096	3.7000e-004	3.5000e-004	19.2231
NaturalGas Unmitigated	1.9300e-003	0.0176	0.0148	1.1000e-004		1.3300e-003	1.3300e-003		1.3300e-003	1.3300e-003	0.0000	19.1096	19.1096	3.7000e-004	3.5000e-004	19.2231

5.2 Energy by Land Use - NaturalGas

Unmitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					
General Heavy Industry	358100	1.9300e-003	0.0176	0.0148	1.1000e-004		1.3300e-003	1.3300e-003		1.3300e-003	1.3300e-003	0.0000	19.1096	19.1096	3.7000e-004	3.5000e-004	19.2231
Total		**1.9300e-003**	**0.0176**	**0.0148**	**1.1000e-004**		**1.3300e-003**	**1.3300e-003**		**1.3300e-003**	**1.3300e-003**	**0.0000**	**19.1096**	**19.1096**	**3.7000e-004**	**3.5000e-004**	**19.2231**

Mitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					
General Heavy Industry	358100	1.9300e-003	0.0176	0.0148	1.1000e-004		1.3300e-003	1.3300e-003		1.3300e-003	1.3300e-003	0.0000	19.1096	19.1096	3.7000e-004	3.5000e-004	19.2231
Total		**1.9300e-003**	**0.0176**	**0.0148**	**1.1000e-004**		**1.3300e-003**	**1.3300e-003**		**1.3300e-003**	**1.3300e-003**	**0.0000**	**19.1096**	**19.1096**	**3.7000e-004**	**3.5000e-004**	**19.2231**

5.3 Energy by Land Use - Electricity

Unmitigated

	Electricity Use	Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	MT/yr			
General Heavy Industry	151800	40.6460	2.0000e-003	4.1000e-004	40.8190
Total		**40.6460**	**2.0000e-003**	**4.1000e-004**	**40.8190**

Mitigated

	Electricity Use	Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	MT/yr			
General Heavy Industry	151800	40.6460	2.0000e-003	4.1000e-004	40.8190
Total		**40.6460**	**2.0000e-003**	**4.1000e-004**	**40.8190**

6.0 Area Detail

6.1 Mitigation Measures Area

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Mitigated	0.0437	0.0000	1.3000e-004	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.5000e-004	2.5000e-004	0.0000	0.0000	2.6000e-004
Unmitigated	0.0437	0.0000	1.3000e-004	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.5000e-004	2.5000e-004	0.0000	0.0000	2.6000e-004

6.2 Area by SubCategory

Unmitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Architectural Coating	4.6400e-003					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Consumer Products	0.0391					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	1.0000e-005	0.0000	1.3000e-004	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.5000e-004	2.5000e-004	0.0000	0.0000	2.6000e-004
Total	**0.0437**	**0.0000**	**1.3000e-004**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**2.5000e-004**	**2.5000e-004**	**0.0000**	**0.0000**	**2.6000e-004**

6.2 Area by SubCategory

Mitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Architectural Coating	4.6400e-003					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Consumer Products	0.0391					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	1.0000e-005	0.0000	1.3000e-004	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.5000e-004	2.5000e-004	0.0000	0.0000	2.6000e-004
Total	**0.0437**	**0.0000**	**1.3000e-004**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**2.5000e-004**	**2.5000e-004**	**0.0000**	**0.0000**	**2.6000e-004**

7.0 Water Detail

7.1 Mitigation Measures Water

	Total CO2	CH4	N2O	CO2e
Category	MT/yr			
Mitigated	3.9034	2.9700e-003	1.8100e-003	4.5171
Unmitigated	3.9034	2.9700e-003	1.8100e-003	4.5171

7.2 Water by Land Use

Unmitigated

	Indoor/Outdoor Use	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
General Heavy Industry	2.3125 / 0	3.9034	2.9700e-003	1.8100e-003	4.5171
Total		**3.9034**	**2.9700e-003**	**1.8100e-003**	**4.5171**

7.2 Water by Land Use

Mitigated

	Indoor/Outdoor Use	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
General Heavy Industry	2.3125 / 0	3.9034	2.9700e-003	1.8100e-003	4.5171
Total		**3.9034**	**2.9700e-003**	**1.8100e-003**	**4.5171**

8.0 Waste Detail

8.1 Mitigation Measures Waste

Category/Year

	Total CO2	CH4	N2O	CO2e
	MT/yr			
Mitigated	2.5171	0.1488	0.0000	6.2360
Unmitigated	2.5171	0.1488	0.0000	6.2360

8.2 Waste by Land Use

Unmitigated

	Waste Disposed	Total CO2	CH4	N2O	CO2e
Land Use	tons	MT/yr			
General Heavy Industry	12.4	2.5171	0.1488	0.0000	6.2360
Total		**2.5171**	**0.1488**	**0.0000**	**6.2360**

Mitigated

	Waste Disposed	Total CO2	CH4	N2O	CO2e
Land Use	tons	MT/yr			
General Heavy Industry	12.4	2.5171	0.1488	0.0000	6.2360
Total		**2.5171**	**0.1488**	**0.0000**	**6.2360**

9.0 Operational Offroad

Equipment Type	Number	Hours/Day	Days/Year	Horse Power	Load Factor	Fuel Type

10.0 Stationary Equipment

Fire Pumps and Emergency Generators

Equipment Type	Number	Hours/Day	Hours/Year	Horse Power	Load Factor	Fuel Type

Boilers

Equipment Type	Number	Heat Input/Day	Heat Input/Year	Boiler Rating	Fuel Type

User Defined Equipment

Equipment Type	Number

11.0 Vegetation

Carli Mine Expansion

Sacramento County, Summer

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
General Heavy Industry	10.00	1000sqft	0.23	10,000.00	5

1.2 Other Project Characteristics

Urbanization	Rural	**Wind Speed (m/s)**	3.5	**Precipitation Freq (Days)**	58
Climate Zone	6			**Operational Year**	2019
Utility Company	Sacramento Municipal Utility District				
CO2 Intensity (lb/MWhr)	590.31	**CH4 Intensity (lb/MWhr)**	0.029	**N2O Intensity (lb/MWhr)**	0.006

1.3 User Entered Comments & Non-Default Data

Project Characteristics -

Land Use - number of employees involved in erecting ready-mix plant

Construction Phase - two weeks to erect ready mix plant that is prefabricated and delivered to project site.

Trips and VMT - each of five workers, vendors, and trucks transporting parts of the ready-mix plant make 2 trips each

On-road Fugitive Dust - assume on-site distance traveled is unpaved and 5% of total travel distance

Construction Off-road Equipment Mitigation -

Vehicle Trips - This CalEEMod model run includes only construction phase emissions. Operation phase emissions are calculated in spreadsheets. No additional trips during operation phase occur.

Table Name	Column Name	Default Value	New Value
tblConstructionPhase	NumDays	100.00	10.00
tblConstructionPhase	PhaseEndDate	12/31/2010	7/13/2018
tblConstructionPhase	PhaseStartDate	1/1/2011	7/1/2018
tblLandUse	Population	0.00	5.00
tblOnRoadDust	HaulingPercentPave	100.00	95.00
tblOnRoadDust	VendorPercentPave	100.00	95.00
tblOnRoadDust	WorkerPercentPave	100.00	95.00
tblProjectCharacteristics	UrbanizationLevel	Urban	Rural
tblTripsAndVMT	HaulingTripNumber	0.00	10.00
tblTripsAndVMT	VendorTripNumber	2.00	10.00
tblTripsAndVMT	WorkerTripNumber	4.00	10.00

2.0 Emissions Summary

2.1 Overall Construction (Maximum Daily Emission)

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	lb/day										lb/day					
2018	1.2253	12.8426	8.8802	0.0166	18.9656	0.7239	19.6895	1.9280	0.6665	2.5945	0.0000	1,691.6224	1,691.6224	0.3850	0.0000	1,701.2464
Maximum	**1.2253**	**12.8426**	**8.8802**	**0.0166**	**18.9656**	**0.7239**	**19.6895**	**1.9280**	**0.6665**	**2.5945**	**0.0000**	**1,691.6224**	**1,691.6224**	**0.3850**	**0.0000**	**1,701.2464**

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	lb/day										lb/day					
2018	1.2253	12.8426	8.8802	0.0166	18.9656	0.7239	19.6895	1.9280	0.6665	2.5945	0.0000	1,691.6224	1,691.6224	0.3850	0.0000	1,701.2464
Maximum	**1.2253**	**12.8426**	**8.8802**	**0.0166**	**18.9656**	**0.7239**	**19.6895**	**1.9280**	**0.6665**	**2.5945**	**0.0000**	**1,691.6224**	**1,691.6224**	**0.3850**	**0.0000**	**1,701.2464**

	ROG	**NOx**	**CO**	**SO2**	**Fugitive PM10**	**Exhaust PM10**	**PM10 Total**	**Fugitive PM2.5**	**Exhaust PM2.5**	**PM2.5 Total**	**Bio- CO2**	**NBio-CO2**	**Total CO2**	**CH4**	**N20**	**CO2e**
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

2.2 Overall Operational

Unmitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Area	0.2395	1.0000e-005	1.0300e-003	0.0000		0.0000	0.0000		0.0000	0.0000		2.1900e-003	2.1900e-003	1.0000e-005		2.3400e-003
Energy	0.0106	0.0962	0.0808	5.8000e-004		7.3100e-003	7.3100e-003		7.3100e-003	7.3100e-003		115.4231	115.4231	2.2100e-003	2.1200e-003	116.1090
Mobile	0.0461	0.1731	0.6179	1.6800e-003	0.1303	1.9000e-003	0.1322	0.0349	1.7900e-003	0.0367		169.3304	169.3304	8.3900e-003		169.5401
Total	**0.2962**	**0.2693**	**0.6997**	**2.2600e-003**	**0.1303**	**9.2100e-003**	**0.1396**	**0.0349**	**9.1000e-003**	**0.0440**		**284.7556**	**284.7556**	**0.0106**	**2.1200e-003**	**285.6514**

Mitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Area	0.2395	1.0000e-005	1.0300e-003	0.0000		0.0000	0.0000		0.0000	0.0000		2.1900e-003	2.1900e-003	1.0000e-005		2.3400e-003
Energy	0.0106	0.0962	0.0808	5.8000e-004		7.3100e-003	7.3100e-003		7.3100e-003	7.3100e-003		115.4231	115.4231	2.2100e-003	2.1200e-003	116.1090
Mobile	0.0461	0.1731	0.6179	1.6800e-003	0.1303	1.9000e-003	0.1322	0.0349	1.7900e-003	0.0367		169.3304	169.3304	8.3900e-003		169.5401
Total	**0.2962**	**0.2693**	**0.6997**	**2.2600e-003**	**0.1303**	**9.2100e-003**	**0.1396**	**0.0349**	**9.1000e-003**	**0.0440**		**284.7556**	**284.7556**	**0.0106**	**2.1200e-003**	**285.6514**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

3.0 Construction Detail

Construction Phase

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Building Construction	Building Construction	7/1/2018	7/13/2018	5	10	erect ready-mix plant

Acres of Grading (Site Preparation Phase): 0

Acres of Grading (Grading Phase): 0

Acres of Paving: 0

Residential Indoor: 0; Residential Outdoor: 0; Non-Residential Indoor: 0; Non-Residential Outdoor: 0; Striped Parking Area: 0 (Architectural Coating – sqft)

OffRoad Equipment

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
Building Construction	Cranes	1	4.00	231	0.29
Building Construction	Forklifts	2	6.00	89	0.20
Building Construction	Tractors/Loaders/Backhoes	2	8.00	97	0.37

Trips and VMT

Phase Name	Offroad Equipment Count	Worker Trip Number	Vendor Trip Number	Hauling Trip Number	Worker Trip Length	Vendor Trip Length	Hauling Trip Length	Worker Vehicle Class	Vendor Vehicle Class	Hauling Vehicle Class
Building Construction	5	10.00	10.00	10.00	15.00	8.50	20.00	LD_Mix	HDT_Mix	HHDT

3.1 Mitigation Measures Construction

3.2 Building Construction - 2018

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	1.0848	11.0316	7.7512	0.0114		0.7087	0.7087		0.6520	0.6520		1,146.5323	1,146.5323	0.3569		1,155.4555
Total	**1.0848**	**11.0316**	**7.7512**	**0.0114**		**0.7087**	**0.7087**		**0.6520**	**0.6520**		**1,146.5323**	**1,146.5323**	**0.3569**		**1,155.4555**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	9.4900e-003	0.3189	0.0825	8.1000e-004	1.4884	1.4300e-003	1.4899	0.1515	1.3700e-003	0.1528		86.7110	86.7110	5.0800e-003		86.8379
Vendor	0.0638	1.4505	0.4719	3.1500e-003	6.3305	0.0130	6.3435	0.6461	0.0124	0.6585		332.5125	332.5125	0.0187		332.9809
Worker	0.0672	0.0416	0.5746	1.2700e-003	11.1467	8.0000e-004	11.1475	1.1304	7.4000e-004	1.1312		125.8666	125.8666	4.2200e-003		125.9721
Total	**0.1405**	**1.8110**	**1.1290**	**5.2300e-003**	**18.9656**	**0.0152**	**18.9808**	**1.9280**	**0.0145**	**1.9425**		**545.0901**	**545.0901**	**0.0280**		**545.7908**

3.2 Building Construction - 2018

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	1.0848	11.0316	7.7512	0.0114		0.7087	0.7087		0.6520	0.6520	0.0000	1,146.532 3	1,146.532 3	0.3569		1,155.455 5
Total	**1.0848**	**11.0316**	**7.7512**	**0.0114**		**0.7087**	**0.7087**		**0.6520**	**0.6520**	**0.0000**	**1,146.532 3**	**1,146.532 3**	**0.3569**		**1,155.455 5**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	9.4900e-003	0.3189	0.0825	8.1000e-004	1.4884	1.4300e-003	1.4899	0.1515	1.3700e-003	0.1528		86.7110	86.7110	5.0800e-003		86.8379
Vendor	0.0638	1.4505	0.4719	3.1500e-003	6.3305	0.0130	6.3435	0.6461	0.0124	0.6585		332.5125	332.5125	0.0187		332.9809
Worker	0.0672	0.0416	0.5746	1.2700e-003	11.1467	8.0000e-004	11.1475	1.1304	7.4000e-004	1.1312		125.8666	125.8666	4.2200e-003		125.9721
Total	**0.1405**	**1.8110**	**1.1290**	**5.2300e-003**	**18.9656**	**0.0152**	**18.9808**	**1.9280**	**0.0145**	**1.9425**		**545.0901**	**545.0901**	**0.0280**		**545.7908**

4.0 Operational Detail - Mobile

4.1 Mitigation Measures Mobile

Category	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
	lb/day										lb/day					
Mitigated	0.0461	0.1731	0.6179	1.6800e-003	0.1303	1.9000e-003	0.1322	0.0349	1.7900e-003	0.0367		169.3304	169.3304	8.3900e-003		169.5401
Unmitigated	0.0461	0.1731	0.6179	1.6800e-003	0.1303	1.9000e-003	0.1322	0.0349	1.7900e-003	0.0367		169.3304	169.3304	8.3900e-003		169.5401

4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
General Heavy Industry	15.00	15.00	15.00	61,394	61,394
Total	15.00	15.00	15.00	61,394	61,394

4.3 Trip Type Information

	Miles			Trip %			Trip Purpose %		
Land Use	H-W or C-W	H-S or C-C	H-O or C-NW	H-W or C-W	H-S or C-C	H-O or C-NW	Primary	Diverted	Pass-by
General Heavy Industry	15.00	7.50	8.50	59.00	28.00	13.00	92	5	3

4.4 Fleet Mix

Land Use	LDA	LDT1	LDT2	MDV	LHD1	LHD2	MHD	HHD	OBUS	UBUS	MCY	SBUS	MH
General Heavy Industry	0.547085	0.042365	0.202414	0.127049	0.023381	0.005779	0.018348	0.021363	0.002103	0.002394	0.006067	0.000620	0.001032

5.0 Energy Detail

Historical Energy Use: N

5.1 Mitigation Measures Energy

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
NaturalGas Mitigated	0.0106	0.0962	0.0808	5.8000e-004		7.3100e-003	7.3100e-003		7.3100e-003	7.3100e-003		115.4231	115.4231	2.2100e-003	2.1200e-003	116.1090
NaturalGas Unmitigated	0.0106	0.0962	0.0808	5.8000e-004		7.3100e-003	7.3100e-003		7.3100e-003	7.3100e-003		115.4231	115.4231	2.2100e-003	2.1200e-003	116.1090

5.2 Energy by Land Use - NaturalGas

Unmitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	lb/day										lb/day					
General Heavy Industry	981.096	0.0106	0.0962	0.0808	5.8000e-004		7.3100e-003	7.3100e-003		7.3100e-003	7.3100e-003		115.4231	115.4231	2.2100e-003	2.1200e-003	116.1090
Total		**0.0106**	**0.0962**	**0.0808**	**5.8000e-004**		**7.3100e-003**	**7.3100e-003**		**7.3100e-003**	**7.3100e-003**		**115.4231**	**115.4231**	**2.2100e-003**	**2.1200e-003**	**116.1090**

Mitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	lb/day										lb/day					
General Heavy Industry	0.981096	0.0106	0.0962	0.0808	5.8000e-004		7.3100e-003	7.3100e-003		7.3100e-003	7.3100e-003		115.4231	115.4231	2.2100e-003	2.1200e-003	116.1090
Total		**0.0106**	**0.0962**	**0.0808**	**5.8000e-004**		**7.3100e-003**	**7.3100e-003**		**7.3100e-003**	**7.3100e-003**		**115.4231**	**115.4231**	**2.2100e-003**	**2.1200e-003**	**116.1090**

6.0 Area Detail

6.1 Mitigation Measures Area

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Mitigated	0.2395	1.0000e-005	1.0300e-003	0.0000		0.0000	0.0000		0.0000	0.0000		2.1900e-003	2.1900e-003	1.0000e-005		2.3400e-003
Unmitigated	0.2395	1.0000e-005	1.0300e-003	0.0000		0.0000	0.0000		0.0000	0.0000		2.1900e-003	2.1900e-003	1.0000e-005		2.3400e-003

6.2 Area by SubCategory

Unmitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	lb/day										lb/day					
Architectural Coating	0.0254					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Consumer Products	0.2140					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Landscaping	1.0000e-004	1.0000e-005	1.0300e-003	0.0000		0.0000	0.0000		0.0000	0.0000		2.1900e-003	2.1900e-003	1.0000e-005		2.3400e-003
Total	**0.2395**	**1.0000e-005**	**1.0300e-003**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**		**2.1900e-003**	**2.1900e-003**	**1.0000e-005**		**2.3400e-003**

6.2 Area by SubCategory

Mitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	lb/day										lb/day					
Architectural Coating	0.0254					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Consumer Products	0.2140					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Landscaping	1.0000e-004	1.0000e-005	1.0300e-003	0.0000		0.0000	0.0000		0.0000	0.0000		2.1900e-003	2.1900e-003	1.0000e-005		2.3400e-003
Total	**0.2395**	**1.0000e-005**	**1.0300e-003**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**		**2.1900e-003**	**2.1900e-003**	**1.0000e-005**		**2.3400e-003**

7.0 Water Detail

7.1 Mitigation Measures Water

8.0 Waste Detail

8.1 Mitigation Measures Waste

9.0 Operational Offroad

Equipment Type	Number	Hours/Day	Days/Year	Horse Power	Load Factor	Fuel Type

10.0 Stationary Equipment

Fire Pumps and Emergency Generators

Equipment Type	Number	Hours/Day	Hours/Year	Horse Power	Load Factor	Fuel Type

Boilers

Equipment Type	Number	Heat Input/Day	Heat Input/Year	Boiler Rating	Fuel Type

User Defined Equipment

Equipment Type	Number

11.0 Vegetation

Carli Mine Expansion
Sacramento County, Winter

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
General Heavy Industry	10.00	1000sqft	0.23	10,000.00	5

1.2 Other Project Characteristics

Urbanization	Rural	**Wind Speed (m/s)**	3.5	**Precipitation Freq (Days)**	58
Climate Zone	6			**Operational Year**	2019
Utility Company	Sacramento Municipal Utility District				
CO2 Intensity (lb/MWhr)	590.31	**CH4 Intensity (lb/MWhr)**	0.029	**N2O Intensity (lb/MWhr)**	0.006

1.3 User Entered Comments & Non-Default Data

Project Characteristics -

Land Use - number of employees involved in erecting ready-mix plant

Construction Phase - two weeks to erect ready mix plant that is prefabricated and delivered to project site.

Trips and VMT - each of five workers, vendors, and trucks transporting parts of the ready-mix plant make 2 trips each

On-road Fugitive Dust - assume on-site distance traveled is unpaved and 5% of total travel distance

Construction Off-road Equipment Mitigation -

Vehicle Trips - This CalEEMod model run includes only construction phase emissions. Operation phase emissions are calculated in spreadsheets. No additional trips during operation phase occur.

Table Name	Column Name	Default Value	New Value
tblConstructionPhase	NumDays	100.00	10.00
tblConstructionPhase	PhaseEndDate	12/31/2010	7/13/2018
tblConstructionPhase	PhaseStartDate	1/1/2011	7/1/2018
tblLandUse	Population	0.00	5.00
tblOnRoadDust	HaulingPercentPave	100.00	95.00
tblOnRoadDust	VendorPercentPave	100.00	95.00
tblOnRoadDust	WorkerPercentPave	100.00	95.00
tblProjectCharacteristics	UrbanizationLevel	Urban	Rural
tblTripsAndVMT	HaulingTripNumber	0.00	10.00
tblTripsAndVMT	VendorTripNumber	2.00	10.00
tblTripsAndVMT	WorkerTripNumber	4.00	10.00

2.0 Emissions Summary

2.1 Overall Construction (Maximum Daily Emission)

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	lb/day										lb/day					
2018	1.2267	12.9172	8.8444	0.0164	18.9656	0.7242	19.6898	1.9280	0.6668	2.5948	0.0000	1,668.3151	1,668.3151	0.3860	0.0000	1,677.9659
Maximum	**1.2267**	**12.9172**	**8.8444**	**0.0164**	**18.9656**	**0.7242**	**19.6898**	**1.9280**	**0.6668**	**2.5948**	**0.0000**	**1,668.3151**	**1,668.3151**	**0.3860**	**0.0000**	**1,677.9659**

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	lb/day										lb/day					
2018	1.2267	12.9172	8.8444	0.0164	18.9656	0.7242	19.6898	1.9280	0.6668	2.5948	0.0000	1,668.3151	1,668.3151	0.3860	0.0000	1,677.9659
Maximum	**1.2267**	**12.9172**	**8.8444**	**0.0164**	**18.9656**	**0.7242**	**19.6898**	**1.9280**	**0.6668**	**2.5948**	**0.0000**	**1,668.3151**	**1,668.3151**	**0.3860**	**0.0000**	**1,677.9659**

	ROG	**NOx**	**CO**	**SO2**	**Fugitive PM10**	**Exhaust PM10**	**PM10 Total**	**Fugitive PM2.5**	**Exhaust PM2.5**	**PM2.5 Total**	**Bio- CO2**	**NBio-CO2**	**Total CO2**	**CH4**	**N20**	**CO2e**
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

2.2 Overall Operational

Unmitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Area	0.2395	1.0000e-005	1.0300e-003	0.0000		0.0000	0.0000		0.0000	0.0000		2.1900e-003	2.1900e-003	1.0000e-005		2.3400e-003
Energy	0.0106	0.0962	0.0808	5.8000e-004		7.3100e-003	7.3100e-003		7.3100e-003	7.3100e-003		115.4231	115.4231	2.2100e-003	2.1200e-003	116.1090
Mobile	0.0367	0.1900	0.5488	1.5100e-003	0.1303	1.9100e-003	0.1323	0.0349	1.8100e-003	0.0367		152.7327	152.7327	8.1000e-003		152.9354
Total	**0.2868**	**0.2862**	**0.6306**	**2.0900e-003**	**0.1303**	**9.2200e-003**	**0.1396**	**0.0349**	**9.1200e-003**	**0.0440**		**268.1580**	**268.1580**	**0.0103**	**2.1200e-003**	**269.0467**

Mitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Area	0.2395	1.0000e-005	1.0300e-003	0.0000		0.0000	0.0000		0.0000	0.0000		2.1900e-003	2.1900e-003	1.0000e-005		2.3400e-003
Energy	0.0106	0.0962	0.0808	5.8000e-004		7.3100e-003	7.3100e-003		7.3100e-003	7.3100e-003		115.4231	115.4231	2.2100e-003	2.1200e-003	116.1090
Mobile	0.0367	0.1900	0.5488	1.5100e-003	0.1303	1.9100e-003	0.1323	0.0349	1.8100e-003	0.0367		152.7327	152.7327	8.1000e-003		152.9354
Total	**0.2868**	**0.2862**	**0.6306**	**2.0900e-003**	**0.1303**	**9.2200e-003**	**0.1396**	**0.0349**	**9.1200e-003**	**0.0440**		**268.1580**	**268.1580**	**0.0103**	**2.1200e-003**	**269.0467**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

3.0 Construction Detail

Construction Phase

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Building Construction	Building Construction	7/1/2018	7/13/2018	5	10	erect ready-mix plant

Acres of Grading (Site Preparation Phase): 0

Acres of Grading (Grading Phase): 0

Acres of Paving: 0

Residential Indoor: 0; Residential Outdoor: 0; Non-Residential Indoor: 0; Non-Residential Outdoor: 0; Striped Parking Area: 0 (Architectural Coating – sqft)

OffRoad Equipment

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
Building Construction	Cranes	1	4.00	231	0.29
Building Construction	Forklifts	2	6.00	89	0.20
Building Construction	Tractors/Loaders/Backhoes	2	8.00	97	0.37

Trips and VMT

Phase Name	Offroad Equipment Count	Worker Trip Number	Vendor Trip Number	Hauling Trip Number	Worker Trip Length	Vendor Trip Length	Hauling Trip Length	Worker Vehicle Class	Vendor Vehicle Class	Hauling Vehicle Class
Building Construction	5	10.00	10.00	10.00	15.00	8.50	20.00	LD_Mix	HDT_Mix	HHDT

3.1 Mitigation Measures Construction

3.2 Building Construction - 2018

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	1.0848	11.0316	7.7512	0.0114		0.7087	0.7087		0.6520	0.6520		1,146.5323	1,146.5323	0.3569		1,155.4555
Total	**1.0848**	**11.0316**	**7.7512**	**0.0114**		**0.7087**	**0.7087**		**0.6520**	**0.6520**		**1,146.5323**	**1,146.5323**	**0.3569**		**1,155.4555**

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	9.8600e-003	0.3330	0.0886	8.0000e-004	1.4884	1.4700e-003	1.4899	0.1515	1.4100e-003	0.1529		85.4305	85.4305	5.3300e-003		85.5637
Vendor	0.0666	1.5010	0.5245	3.0800e-003	6.3305	0.0132	6.3437	0.6461	0.0127	0.6587		325.8943	325.8943	0.0201		326.3968
Worker	0.0654	0.0516	0.4800	1.1100e-003	11.1467	8.0000e-004	11.1475	1.1304	7.4000e-004	1.1312		110.4581	110.4581	3.6700e-003		110.5499
Total	**0.1419**	**1.8856**	**1.0932**	**4.9900e-003**	**18.9656**	**0.0155**	**18.9811**	**1.9280**	**0.0148**	**1.9428**		**521.7828**	**521.7828**	**0.0291**		**522.5104**

3.2 Building Construction - 2018

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	1.0848	11.0316	7.7512	0.0114		0.7087	0.7087		0.6520	0.6520	0.0000	1,146.532 3	1,146.532 3	0.3569		1,155.455 5
Total	**1.0848**	**11.0316**	**7.7512**	**0.0114**		**0.7087**	**0.7087**		**0.6520**	**0.6520**	**0.0000**	**1,146.532 3**	**1,146.532 3**	**0.3569**		**1,155.455 5**

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	9.8600e-003	0.3330	0.0886	8.0000e-004	1.4884	1.4700e-003	1.4899	0.1515	1.4100e-003	0.1529		85.4305	85.4305	5.3300e-003		85.5637
Vendor	0.0666	1.5010	0.5245	3.0800e-003	6.3305	0.0132	6.3437	0.6461	0.0127	0.6587		325.8943	325.8943	0.0201		326.3968
Worker	0.0654	0.0516	0.4800	1.1100e-003	11.1467	8.0000e-004	11.1475	1.1304	7.4000e-004	1.1312		110.4581	110.4581	3.6700e-003		110.5499
Total	**0.1419**	**1.8856**	**1.0932**	**4.9900e-003**	**18.9656**	**0.0155**	**18.9811**	**1.9280**	**0.0148**	**1.9428**		**521.7828**	**521.7828**	**0.0291**		**522.5104**

4.0 Operational Detail - Mobile

4.1 Mitigation Measures Mobile

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Mitigated	0.0367	0.1900	0.5488	1.5100e-003	0.1303	1.9100e-003	0.1323	0.0349	1.8100e-003	0.0367		152.7327	152.7327	8.1000e-003		152.9354
Unmitigated	0.0367	0.1900	0.5488	1.5100e-003	0.1303	1.9100e-003	0.1323	0.0349	1.8100e-003	0.0367		152.7327	152.7327	8.1000e-003		152.9354

4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
General Heavy Industry	15.00	15.00	15.00	61,394	61,394
Total	15.00	15.00	15.00	61,394	61,394

4.3 Trip Type Information

	Miles			Trip %			Trip Purpose %		
Land Use	H-W or C-W	H-S or C-C	H-O or C-NW	H-W or C-W	H-S or C-C	H-O or C-NW	Primary	Diverted	Pass-by
General Heavy Industry	15.00	7.50	8.50	59.00	28.00	13.00	92	5	3

4.4 Fleet Mix

Land Use	LDA	LDT1	LDT2	MDV	LHD1	LHD2	MHD	HHD	OBUS	UBUS	MCY	SBUS	MH
General Heavy Industry	0.547085	0.042365	0.202414	0.127049	0.023381	0.005779	0.018348	0.021363	0.002103	0.002394	0.006067	0.000620	0.001032

5.0 Energy Detail

Historical Energy Use: N

5.1 Mitigation Measures Energy

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
NaturalGas Mitigated	0.0106	0.0962	0.0808	5.8000e-004		7.3100e-003	7.3100e-003		7.3100e-003	7.3100e-003		115.4231	115.4231	2.2100e-003	2.1200e-003	116.1090
NaturalGas Unmitigated	0.0106	0.0962	0.0808	5.8000e-004		7.3100e-003	7.3100e-003		7.3100e-003	7.3100e-003		115.4231	115.4231	2.2100e-003	2.1200e-003	116.1090

5.2 Energy by Land Use - NaturalGas

Unmitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	lb/day										lb/day					
General Heavy Industry	981.096	0.0106	0.0962	0.0808	5.8000e-004		7.3100e-003	7.3100e-003		7.3100e-003	7.3100e-003		115.4231	115.4231	2.2100e-003	2.1200e-003	116.1090
Total		**0.0106**	**0.0962**	**0.0808**	**5.8000e-004**		**7.3100e-003**	**7.3100e-003**		**7.3100e-003**	**7.3100e-003**		**115.4231**	**115.4231**	**2.2100e-003**	**2.1200e-003**	**116.1090**

Mitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	lb/day										lb/day					
General Heavy Industry	0.981096	0.0106	0.0962	0.0808	5.8000e-004		7.3100e-003	7.3100e-003		7.3100e-003	7.3100e-003		115.4231	115.4231	2.2100e-003	2.1200e-003	116.1090
Total		**0.0106**	**0.0962**	**0.0808**	**5.8000e-004**		**7.3100e-003**	**7.3100e-003**		**7.3100e-003**	**7.3100e-003**		**115.4231**	**115.4231**	**2.2100e-003**	**2.1200e-003**	**116.1090**

6.0 Area Detail

6.1 Mitigation Measures Area

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Mitigated	0.2395	1.0000e-005	1.0300e-003	0.0000		0.0000	0.0000		0.0000	0.0000		2.1900e-003	2.1900e-003	1.0000e-005		2.3400e-003
Unmitigated	0.2395	1.0000e-005	1.0300e-003	0.0000		0.0000	0.0000		0.0000	0.0000		2.1900e-003	2.1900e-003	1.0000e-005		2.3400e-003

6.2 Area by SubCategory

Unmitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	lb/day										lb/day					
Architectural Coating	0.0254					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Consumer Products	0.2140					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Landscaping	1.0000e-004	1.0000e-005	1.0300e-003	0.0000		0.0000	0.0000		0.0000	0.0000		2.1900e-003	2.1900e-003	1.0000e-005		2.3400e-003
Total	**0.2395**	**1.0000e-005**	**1.0300e-003**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**		**2.1900e-003**	**2.1900e-003**	**1.0000e-005**		**2.3400e-003**

6.2 Area by SubCategory

Mitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	lb/day										lb/day					
Architectural Coating	0.0254					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Consumer Products	0.2140					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Landscaping	1.0000e-004	1.0000e-005	1.0300e-003	0.0000		0.0000	0.0000		0.0000	0.0000		2.1900e-003	2.1900e-003	1.0000e-005		2.3400e-003
Total	**0.2395**	**1.0000e-005**	**1.0300e-003**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**		**2.1900e-003**	**2.1900e-003**	**1.0000e-005**		**2.3400e-003**

7.0 Water Detail

7.1 Mitigation Measures Water

8.0 Waste Detail

8.1 Mitigation Measures Waste

9.0 Operational Offroad

Equipment Type	Number	Hours/Day	Days/Year	Horse Power	Load Factor	Fuel Type

10.0 Stationary Equipment

Fire Pumps and Emergency Generators

Equipment Type	Number	Hours/Day	Hours/Year	Horse Power	Load Factor	Fuel Type

Boilers

Equipment Type	Number	Heat Input/Day	Heat Input/Year	Boiler Rating	Fuel Type

User Defined Equipment

Equipment Type	Number

11.0 Vegetation

(Adopted January 7, 2005)(Amended September 8, 2006)

RULE 1157. PM10 EMISSION REDUCTIONS FROM AGGREGATE AND RELATED OPERATIONS

(a) Purpose

The purpose of this rule is to reduce PM10 emissions from aggregate and related operations.

(b) Applicability

This rule applies to all permanent and temporary aggregate and related operations, unless otherwise exempt under subdivision (h).

(c) Definitions

(1) AGGREGATE OPERATIONS are defined as operations that produce sand, gravel, crushed stone, and/or quarried rocks.

(2) AGGREGATE OR RELATED MATERIAL means material that is produced and/or used by the aggregate and related operations.

(3) AGGREGATE TRUCKS mean trucks with open tops, used to transport the products of the aggregate and related operations to other processors, retailers, or end users.

(4) BLASTING OPERATIONS are defined as operations that break or displace rock by means of explosives.

(5) BUNKER is defined as a three-sided enclosure of which one side may be a windscreen with a maximum porosity of 20%.

(6) CARRY-BACK is defined as materials that fall off the underside of the conveyor belt and accumulate on the ground.

(7) CHEMICAL STABILIZERS are any non-toxic chemical dust suppressant. The chemical stabilizers shall meet any specifications, criteria, or tests required by any federal, state, or local water agency.

(8) CONVEYOR means an above-ground, outdoor conveyor system to move materials from any location, process, or equipment to another in a continuous fashion.

(9) DISTURBED SURFACE AREA means a portion of a surface which has been physically moved, uncovered, destabilized, or otherwise modified from its undisturbed natural soil condition, thereby increasing the potential

for emission of fugitive dust. This definition excludes those areas which have:

(A) been restored to a natural state, such that the vegetative ground cover and soil characteristics are similar to adjacent or nearby natural conditions;

(B) been paved or otherwise completely covered by a permanent structure; or

(C) sustained a vegetative ground cover of at least 70 percent of the native cover for a particular area for at least 30 days.

(10) DUST SUPPRESSANTS are water, hygroscopic materials, or chemical stabilizers used as a treatment material to reduce fugitive dust emissions.

(11) ENCLOSED SCREENING EQUIPMENT means screening equipment where the top portion of the equipment is enclosed, except for the area where materials enter the screening equipment.

(12) END OF WORK DAY means the end of a working period that may include one or more work shifts, but no later than 8 p.m.

(13) EQUIPMENT BREAKDOWN means an unforeseeable impairment of an air pollution control equipment or related operating equipment which causes a violation of any emission limitation or restriction prescribed by this rule or by State law and which: is not the result of neglect or disregard of any air pollution control law, rule, or regulation; is not a recurrent breakdown of the same equipment; and, does not constitute a nuisance as defined in the State of California Health and Safety Code, Section 41700, with the burden of proving the criteria of this section placed upon the person seeking to come under the provisions of this rule.

(14) EXISTING FACILITY/OPERATION means a facility or an operation that has begun to operate, or has an application for Permit to Construct that has been deemed complete by the Executive Officer on or before December 3, 2004.

(15) FRONT-END LOADER means a wheeled or tractor loader, with a bucket or fork hinged to lifting arms that loads or digs entirely at the front end.

(16) FUGITIVE DUST means any solid particulate matter that becomes airborne, other than that emitted from an exhaust stack, directly or indirectly as a result of the activities of any person.

(17) GEOTEXTILE means permeable textile, including but not limited to, mesh, net, or even grid that is used in contact with soil or rocks with the purpose of adding stability to the gravel pad.

(18) HAUL ROAD means an unpaved road that is used by haul trucks to carry materials from the quarry to different locations within the facility.

(19) HAUL TRUCK means a diesel heavy-duty truck having a minimum capacity of 50 tons and is used to transport aggregates within the facility.

(20) HIGH WINDS means instantaneous wind speeds exceed 25 miles per hour.

(21) INFREQUENT MINING OPERATIONS mean operations that have state mine IDs, approved reclamation plans and bonding as required by State Mining and Reclamation Act of 1975, and only operate on an average of 52 days per year over the past three years from December 3, 2004.

(22) INTERNAL ROADS mean private paved and unpaved roads within the facility's property boundary.

(23) LOADING means an activity to move materials from any location to a truck.

(24) MATERIAL SPILLAGE means material inadvertently lost or scattered by spilling.

(25) MIXER TRUCK means truck that mixes cement and other ingredients in a drum to produce concrete.

(26) NEW FACILITY/OPERATION means a facility or an operation that has not begun to operate, or does not have an application for Permit to Construct that has been deemed complete by the Executive Officer as of December 3, 2004.

(27) NON-POROUS WALLS are walls that have zero percent porosity. Non-porous walls include but are not limited to concrete and steel walls.

(28) OPEN STORAGE PILE is any accumulation of aggregate or related material which is not fully enclosed, covered or chemically stabilized, and which attains a height of three feet or more and a total surface area of 150 or more square feet.

(29) OTHER DUST CONTROL METHODS including but not limited to baghouses, filter bags, enclosures, and partial enclosures.

(30) PAVED ROAD means a public or private improved street, highway, alley, public way, or easement that is covered by typical roadway materials, but excluding access roadways that connect a facility with a public paved

roadway and are not open to through traffic. Public paved roads are those open to public access and that are owned by any federal, state, county, municipal or any other governmental or quasi-governmental agencies. Private paved roads are any paved roads not defined as public.

(31) PERMANENT FACILITY/OPERATION means a facility or an operation that is performed at one physical location for more than two years.

(32) PM10 means particulate matter with an aerodynamic diameter smaller than or equal to 10 microns as measured by the applicable State and Federal reference test methods.

(33) PRODUCTION WORK SHIFT is an eight hour operating period based on the 24 hour operating schedule.

(34) RELATED OPERATIONS are defined as operations that use sand, gravel, cement, crushed stone, and/or quarried rocks in their products, or crush miscellaneous base, and inert landfills that handle construction/demolition debris.

(35) RETURNED PRODUCTS mean left over concrete or asphalt products that were not used at the job sites and were brought back to the facility.

(36) RUMBLE GRATE is a system where the vehicle is vibrated while traveling over grates with the purpose of removing dust and other debris.

(37) SCALPING SCREEN means a screen where debris and oversized materials are rejected.

(38) SENSITIVE RECEPTOR is a school (kindergarten through grade 12), licensed daycare center, hospital, or convalescent home.

(39) SILO means an elevated storage container, with or without a top, that releases material through the bottom.

(40) STABILIZED SURFACE means any previously disturbed surface area or open storage pile which, through the application of dust suppressants, shows visual or other evidence of surface crusting and is resistant to wind-driven fugitive dust and is demonstrated to be stabilized. Stabilization can be demonstrated by one or more of the applicable test methods contained in the Rule 403 Implementation Handbook.

(41) STAGING AREA is a place where aggregate and mixer trucks temporarily queue for their loading or unloading turn.

(42) TEMPORARY FACILITY/OPERATION means a facility that operates or an operation that is performed at one physical location for two years or less. Temporary facility/operation includes portable facility/operation.

(43) TRACK-OUT means any material that adheres to and agglomerates on the exterior surface of motor vehicles, haul trucks, and equipment (including tires) that has been released onto a paved road and can be removed by a vacuum sweeper or a broom sweeper under normal operating conditions.

(44) TRANSFER means an activity to move materials from any location to any location within a facility.

(45) TRANSFER POINT is a point in a conveying system where the materials are dropped onto a stockpile, equipment, or another conveyor, or where a conveyor belt enters or exits the processing equipment.

(46) TRUCK TRIMMING AREA means an area where trucks that are exiting a facility/operation are inspected to determine whether the amount and type of loaded material is correct. Any excess material is removed in this area of the facility/operation.

(47) TRUCK WASHER means a system that is used to wash the entire surface and the tires of a truck.

(48) TUNNEL FEED is underground belt conveyor system to move the materials from any location to any location within a facility in a continuous fashion.

(49) TYPICAL ROADWAY MATERIALS means concrete, asphaltic concrete, recycled asphalt, asphalt, or any other material of equivalent performance as determined by the Executive Officer and the U.S. EPA.

(50) UNLOADING means an activity to release the materials from a truck or a front-end loader to any location located inside the facility.

(51) UNPAVED ROADS mean any roads, equipment paths, or travel ways that are not covered by typical roadway materials. Public unpaved roads are any unpaved roadway owned by Federal, State, county, municipal or other governmental or quasi-governmental agencies. Private unpaved roads are all other unpaved roadways not defined as public. Internal unpaved roads are private unpaved roads within the facility's property boundary.

(52) WATER IRRIGATION SYSTEM means devices that are mounted above an open storage pile to deliver water to a pile.

(53) WHEEL WASHER means a system that is capable of washing the entire circumference of each wheel of the vehicle.

(54) VALIDATED NOTICE OF VIOLATION means a notice of violation issued by a District enforcement officer that has been finally resolved by means of either a settlement with the alleged violator resulting in the

payment of a civil penalty in any amount or a court judgment imposing civil or criminal liability on the alleged violator based on the conduct alleged in the notice of violation.

(d) Requirements

Unless otherwise stated, effective July 1, 2005, aggregate and related operations shall comply with the following requirements:

(1) General Performance Standards

(A) The operator of a facility/operation shall not cause or allow:

(i) a discharge into the atmosphere of, fugitive dust emissions exceeding 20 percent opacity from any activity, equipment, storage pile, or disturbed surface area, based on an average of 12 consecutive readings, using the SCAQMD Opacity Test Method No. 9B; or

(ii) discharges into the atmosphere of, fugitive dust emissions exceeding 50 percent opacity from any activity, equipment, storage pile, or disturbed surface area, based on five individual, consecutive readings, using the SCAQMD Opacity Test Method No. 9B, effective December 3, 2005; or

(iii) any visible fugitive dust plume from exceeding 100 feet in any direction from any activity, equipment, storage pile, or disturbed surface area.

(B) The operator of a facility/operation shall promptly remove any pile of material spillage on any internal paved roads. Alternatively, the operator shall maintain in a stabilized condition the pile of material spillage with dust suppressants and remove it by the end of each day.

(C) The operator of a facility/operation shall maintain in a stabilized condition all other piles of material spillage and carry-back with dust suppressants until removal.

(D) The operator of a facility/operation shall use sufficient dust suppressants or other dust control methods as necessary to meet the performance standards in subparagraph (d)(1)(A).

(E) Where applicable, the operator shall install a gravel pad that:

(i) Contains one-inch or larger washed gravel maintained to a depth of six inches;

(ii) Has a geotextile lining underneath the washed gravel; and

(iii) Is flushed with water or is completely replaced, as necessary to comply with the track out threshold set forth in Rule 403.

(2) Loading, Unloading, and Transferring

The operator of an existing permanent or temporary facility/operation shall use dust suppressants or other dust control methods at each emission source during loading, unloading, or transferring activities of materials as necessary to meet the performance standards in subparagraph (d)(1)(A).

(3) Conveyor

The operator of a facility/operation using a conveyor shall apply dust suppressants or other dust control methods at the conveyor including all transfer points where materials are released as necessary to meet the performance standards in subparagraph (d)(1)(A).

(4) Crushing Equipment

The operator of a facility/operation conducting crushing activities of materials shall use baghouses to control PM10 emissions. Alternatively, the operator may apply dust suppressants or other dust control methods at the crusher including all discharge points as necessary to meet the performance standards in subparagraph (d)(1)(A).

(5) Screening Equipment

The operator of a facility/operation conducting outdoor screening activities of materials shall use enclosed screening equipment that is equipped with a baghouse. Alternatively, the operator may apply dust suppressants or other dust control methods at the screening equipment including all discharge points during such activities as necessary to meet the performance standards in subparagraph (d)(1)(A).

(6) Storage Piles

(A) The operator of a facility/operation shall maintain in a stabilized condition the entire surface area of the open storage piles of materials, except for areas of the piles that are actively disturbed during the loading and/or unloading activities. Alternatively, the operator may:

(i) store materials in a silo or a bunker;

(ii) maintain at least two feet of freeboard from the highest portion of the piles; and

(iii) for the bunker, stabilize the sides of the pile that are not shielded by non-porous walls.

(B) At the end of each work day in which loading or unloading activities of materials were performed, the operator of a facility/operation shall re-apply dust suppressants to re-stabilize disturbed areas of the piles.

(C) The operator of a facility/operation shall not allow any open storage piles of materials to be greater than eight feet height if such piles are located within 300 feet of off-site occupied buildings or houses. Alternatively, the operator of a facility/operation shall operate a water irrigation system to maintain in a stabilized condition the entire surface of the piles.

(7) Internal Roads

(A) Unpaved Haul Roads

(i) The operator of a facility/operation shall apply chemical stabilizers on the internal unpaved haul roads so that the surface is maintained in a stabilized condition.

(ii) The operator of a facility/operation shall post signs at the two ends of the internal unpaved haul roads, stating that haul trucks shall use these roads unless traveling to the maintenance areas.

(B) Unpaved Non-Haul Roads and Parking and Staging Areas

The operator of a facility/operation shall apply chemical stabilizers on such unpaved roads and parking and staging areas so that the surface is maintained in a stabilized condition, or apply a gravel pad that meets the criteria set forth in subparagraph (d)(1)(E) on the entire unpaved non-haul road and/or the parking and staging areas.

(C) Paved Roads

(i) The operator of a facility/operation with a minimum of 60 aggregate and/or mixer trucks exiting the facility on any day shall sweep the internal paved roads with a street sweeper by the end of each production work shift.

(ii) The operator of a facility/operation with less than 60 aggregate and/or mixer trucks exiting the facility on any day shall sweep the internal paved roads with a street sweeper by the end of every other work day. On the days that the roads are not swept, the operator shall apply water as necessary to comply with subparagraph (d)(1)(A) on at least 100 feet of paved roads, or the entire length of paved roads leading to an exit to public paved roads, if such roads are less than 100 feet long.

(iii) Sweepers that are purchased after December 3, 2004 shall meet the criteria of PM10-efficient Rule 1186-certified sweepers.

(iv) The operator of a new facility/operation shall use Rule 1186-certified-sweepers to sweep the internal paved roads.

(8) Track-Out

(A) The operator of a facility/operation and the drivers must take all reasonable steps to ensure that all loads on aggregate trucks are leveled and maintained with at least 6 inches of freeboard, and that the load is stabilized by applying dust suppressants in sufficient quantities so that the performance standards in subparagraph (d)(1)(A) are met, unless the driver tarps or suitably covers the load prior to entering paved public roads or prior to the use of a rumble grate and/or wheel washer.

(B) The operator of a facility/operation must post signs at the exits of the facility to require all loads to comply with the requirements in subparagraph (d)(8)(A).

(C) Effective December 3, 2005, the operator of a facility/operation not covered under subparagraph (d)(8)(D) shall install and utilize a rumble grate, a wheel washer, or a truck washer in accordance with the following:

(i) The rumble grate, the wheel washer, or the truck washer shall be located no less than 30 feet prior to each exit that is used by aggregate and/or mixer trucks and leading to a paved public road;

(ii) The operator must ensure that all aggregate and mixer trucks leaving the facility go through the rumble grate, the wheel washer, or the truck washer;

(iii) The operator shall post a sign by the rumble grate, the wheel washer, or the truck washer to designate the speed limit to 5 miles per hour for using such control equipment; and

(iv) If the internal road from the rumble grate, the wheel washer, or the truck washer to any paved public road is not paved, the operator shall apply a gravel pad that meets the criteria set forth in subparagraph (d)(1)(E) to such roads.

(v) An operator is not subject to clause (d)(8)(C)(i) if he can demonstrate to the Executive Officer, by July 1, 2005, that there is not adequate space for 30 feet of roadway and that a rumble grate, a wheel washer, or a truck washer at a shorter distance will be adequate to prevent track out of dust to the public road. The operator of a new, temporary facility/operation shall provide such demonstration to the Executive Officer prior to the beginning of its operation.

(D) Effective December 3, 2005, the operator of a new permanent facility/operation with land size in excess of 25 acres or with a designed daily throughput of 750 tons, and the operator of an existing permanent facility/operation with a minimum of 60 aggregate and/or mixer trucks exiting the facility on any day shall install and utilize a rumble grate and a wheel washer in accordance to the following:

(i) The rumble grate and the wheel washer shall be located no less than 30 feet prior to each exit that is used by aggregate and/or mixer trucks and leading to a paved public road. The rumble grate shall be located within 10 feet from the wheel washer.

(ii) The operator must ensure that all aggregate and mixer trucks leaving the facility go through the rumble grate first and then, the wheel washer.

(iii) The operator shall post a sign by the rumble grate to designate the speed limit to 5 miles per hour for traveling over the rumble grate and wheel washer.

(iv) The operator shall pave the internal roads from the rumble grate and the wheel washer to the facility exits leading to paved public roads.

(v) The operator must ensure that all aggregate and mixer trucks stay on the internal paved roads between the wheel washer and the facility exits leading to paved public roads.

(vi) An operator is not subject to clause (d)(8)(D)(i) if he can demonstrate to the Executive Officer, by July 1, 2005, that there is not adequate space for 30 feet of roadway and that a rumble grate and a wheel washer at a shorter distance will be adequate to prevent track out of dust to the public road. The operator of a new, permanent facility/operation shall provide such demonstration to the Executive Officer prior to the beginning of its operation.

(E) The operator of a facility/operation shall provide the "Fugitive Dust Advisory" information prepared by the District to the aggregate and/or mixer truck company and/or broker at least once each calendar year.

(9) The operator of a new permanent facility/operation shall comply with all requirements set forth in this rule and apply Best Available Control Technology required by the Executive Officer.

(10) New and/or modified equipment shall comply with 40 CFR Part 60, Subpart I and/or 40 CFR Part 60, Subpart OOO as appropriate.

(e) Recordkeeping:

The operator of a facility/operation shall keep the following records on-site for 3 years, or 5 years for Title V facility, and make such records available to the Executive Officer upon request:

(1) Records of watering and sweeping schedule for internal paved roads;

(2) Records of aggregate and/or mixer trucks exiting the facility;

(3) Records of "Fugitive Dust Advisory" information distribution;

(4) Records of new equipment initial start-up and/or existing equipment start-up after a repair to fix an equipment breakdown if seeking exemption pursuant to subparagraphs (h)(1)(B) and/or (h)(1)(C);

(5) Records of scheduled maintenance activities if seeking exemption pursuant to subparagraph (h)(1)(A);

(6) Records of aggregate materials that meet the descriptions in subparagraphs (h)(2)(A) and (h)(2)(B); and

(7) Records of operating days if seeking exemption pursuant to subparagraph (h)(10)(D).

(f) Test Methods

The following test methods shall be used to determine compliance with this rule:

(1) SCAQMD Opacity Test Method No. 9B

(2) The Stabilized Surface Test Method included in the SCAQMD Rule 403 Implementation Handbook.

(g) Additional Requirements Triggered by Recurrent Violation:

(1) The operator of an existing facility located within 500 meters of off-site occupied buildings or houses or a sensitive receptor, who accrues three or more validated notices of violation for causing or allowing fugitive dust emissions exceeding the opacity limits in clauses (d)(1)(A)(i) as measured by the test methods in (f), or a visible fugitive dust plume exceeding 100 feet in any direction, issued on separate days for violations from the same emission source at the facility in any continuous twelve month period ("recurrent violations") starting from December 3, 2005 shall, within 30 days of the third notice of violation being validated, submit an emission reduction plan to the Executive Officer that meets the following requirements:

(A) The plan must propose additional emission control measures sufficient to remedy the causes of the recurrent violations and prevent future violations; and

(B) It must provide for implementation of the specified additional control measures at the earliest practicable date.

(2) The Executive Officer shall approve the emission reduction plan within 30 days of receipt of a complete plan if it is determined that implementation will likely remedy the causes of the recurrent violations. The Executive

Officer may impose additional conditions in the plan if it is determined necessary to remedy the causes of the recurrent violations, however, the Executive Officer may not require, as a condition to approving an emission reduction plan under this paragraph, an operator to implement control measures that are economically or technologically infeasible, that do not directly address the cause of the recurrent violations, or that require the operator to take responsibility for the conduct of a third party over whom the operator has no legal control. A disapproval or conditional approval of a plan by the Executive Officer may be appealed to the Hearing Board.

(3) The Executive Officer shall disapprove any plan that does not demonstrate a substantial likelihood of preventing violations in the future. If a plan is disapproved, the responsible party shall submit a revised plan which cures the defects within 30 days of receipt of notice of disapproval.

(h) Exemptions

(1) The following activities will be exempt from requirements set forth in subparagraph (d)(1)(A):

(A) The first 8 hours of the new equipment initial start-up and the first 2 hours of the equipment start-up after a repair to fix an equipment breakdown or after a maintenance activity scheduled at least 48 hours in advance by the operator of a facility.

(B) Blasting operations.

(2) During high winds, the operator of a facility/operation will be exempt from the requirements in subparagraph (d)(1)(A) if:

(A) All activities, including aggregate excavation, production, loading and unloading activities, and material transport, are ceased, except for dust controls as required by District rules; or

(B) All excavation and earthmoving operations, except for underwater dredging and the transporting of dredged materials to the surge pile, and aggregate production (but not loading or transport) are ceased, provided:

(i) dust controls as required by District rules are applied; and

(ii) unpaved roads have had chemical stabilizers applied prior to the wind event, or where unpaved roads have not had chemical stabilizers applied, water is applied twice per hour during active operations; and

(iii) within fifteen (15) minutes of each loading activity, water is applied to un-stabilized areas of open storage piles that will be actively disturbed during loading; or

(C) The only activities being conducted at ready-mixed concrete or hot mix asphalt facilities are those activities that produce materials for use in construction projects which are being paved or poured during high winds, provided that dust controls as required by District rules are applied.

(3) Scalping screens will be exempt from the enclosure required in paragraph (d)(5).

(4) The operator of a facility/operation is exempt from the use of chemical stabilizers for internal unpaved roads if the use of applicable chemical dust suppressants on those specific unpaved roads violates the rules and/or regulations of the local Water Quality Control Board or other government agency. Alternatively, the operator of a facility/operation may use water, proving that:

(A) Water is used in sufficient quantity and frequency on those specific internal unpaved roads so that the surface is maintained in a stabilized condition; and

(B) The operator notifies the Executive Officer in writing 30 days prior to the use of water and demonstrates that the use of chemical was not allowed on those specific unpaved roads.

(5) Empty haul trucks traveling to and from maintenance areas are exempt from the requirement to use internal unpaved haul roads if they travel on internal unpaved non-haul roads that comply with the requirement in subparagraph (d)(7)(B).

(6) The unpaved non-haul roads will be exempt from the requirement in subparagraph (d)(7)(B) if such roads are used less than twice a day, and signs are posted on such roads to restrict speed limit to 15 miles per hour and to restrict traffic to such vehicles only.

(7) Carry-back that is generated by the tunnel feed will be exempt from the requirement set forth in subparagraph (d)(1)(C).

(8) Truck trimming areas are exempt from the requirement in subparagraph (d)(1)(C).

(9) Facilities where aggregate trucks are not used to carry aggregate or related materials to and off the facility property are exempt from the requirements in paragraph (d)(8).

(10) The following are not required to install and operate a wheel washer:

(A) Facilities that have their internal roads all paved and with the exception of returned products, their aggregate or related materials metered directly to a ready-mix or hot mix asphalt truck. The facilities may accept returned products and are still qualified for the exemption from a wheel washer. The facilities are instead required to have a rumble grate or a truck washer and comply with subparagraph (d)(8)(C).

(B) Facilities with less than 5 acres in land size and handle recycled asphalt and recycled concrete exclusively, provided the facility installs a rumble grate, comply with clauses (d)(8)(C)(i) through (d)(8)(C)(iii), and applies a gravel pad that meets the criteria set forth in subparagraph (d)(1)(E) on the entire unpaved non-haul roads leading to a paved public road.

(C) Facilities that pave a minimum of ¼ mile from the rumble grate to the facility exit leading to a paved public road.

(D) Facilities that are infrequent mining operations, provided they install a rumble grate and apply a gravel pad that meets the criteria set forth in subparagraph (d)(1)(E) for a distance of no less than 100 feet from the rumble grate to the facility exit leading to a paved public road, and keep records in accordance with paragraph (e)(6). The facility shall inform the District in the case that they operate more than 52 days per year based on the average of a rolling 3 year period after December 3, 2004. In this case, the facility shall comply with the requirements set forth in paragraph (d)(8).

(11) The operator of a facility/operation is exempt from using the test methods set forth in paragraph (f)(2) for the demonstration of the surface stabilization of open storage piles where 90% of their volume contain materials that are larger than ½ inch product, providing such piles meet the performance standards in subparagraph (d)(1)(A).

(i) Alternative Control Options

In lieu of using dust suppressants, the operator of a facility/operation may submit for approval by the Executive Officer and the U.S. Environmental Protection Agency a plan for achieving equivalent emission reductions through alternative control measures.

APPENDIX G

HRA EMISSIONS AND MODEL INPUT

Modeling Files are available at

https://bit.ly/2l5lzQM

Or can be obtained on CDROM by contacting

schoen@sespe.com

Timeframe	Years 2017 - 2018						Years 2019 - 2026			
Representing	Project Mining (Carli, Phase E)				Baseline (Phase T)		Project Mining (Carli, Phase E)		Baseline (Phase T)	
diesel PM10	600 lb/yr		0.38 lb/hr		2,808 lb/yr	0.81 lb/hr	393 lb/yr	0.29 lb/hr	2,808 lb/yr	0.81 lb/hr
dust PM10	21,257 lb/yr		15.58 lb/hr		38,669 lb/yr	34.65 lb/hr	31,669 lb/yr	25.66 lb/hr	38,669 lb/yr	34.65 lb/hr
Location within site	Sloped perimeter of initial excavation		Flat bottom of initial excavation		Former excavation (operations cease)		Remainder of excavation (see figure)		Former excavation (operations cease)	
diesel PM10	44 lb/yr	0.02 lb/hr	556 lb/yr	0.35 lb/hr	2,808 lb/yr	0.81 lb/hr	393 lb/yr	0.29 lb/hr	2,808 lb/yr	0.81 lb/hr
dust PM10	726 lb/yr	0.38 lb/hr	20,531 lb/yr	15.20 lb/hr	38,669 lb/yr	34.65 lb/hr	31,669 lb/yr	25.66 lb/hr	38,669 lb/yr	34.65 lb/hr
Size of Model Objects	10.67 m x 10.67 m		25 m x 25 m		386.12 m x 386.12 m		28.45 m x 28.45 m		371.21 m x 371.21 m	
Model Object Names	VOL001-VOL053		VOL054-VOL153		VOL154 & VOL155		VOL001-VOL440		VOL441 & VOL442	
Annual or Hourly	(lb/yr)	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)	(lb/hr)
diesel PM10	0.83	0.00047	5.6	0.0035	1,404	0.40	0.9	0.00065	1,404	0.40
dust PM10	13.7	0.007	205	0.152	19,334	17.3	72	0.058	19,334	17.3
arsenic	5.25E-07	2.73E-10	7.87E-06	5.83E-09	7.41E-04	3.79E-07	2.76E-06	2.50E-11	7.41E-04	6.64E-07
bromine	2.47E-04	1.28E-07	3.70E-03	2.74E-06	3.48E-01	1.78E-04	1.30E-03	1.17E-08	3.48E-01	3.12E-04
cadmium	1.78E-04	9.27E-08	2.67E-03	1.98E-06	2.51E-01	1.29E-04	9.36E-04	8.48E-09	2.51E-01	2.25E-04
chlorine	1.16E-02	6.02E-06	1.73E-01	1.28E-04	1.63E+01	8.35E-03	6.07E-02	5.50E-07	1.63E+01	1.46E-02
copper	2.16E-03	1.13E-06	3.24E-02	2.40E-05	3.05E+00	1.56E-03	1.14E-02	1.03E-07	3.05E+00	2.74E-03
lead	1.78E-03	9.27E-07	2.67E-02	1.98E-05	2.51E+00	1.29E-03	9.36E-03	8.48E-08	2.51E+00	2.25E-03
manganese	1.25E-02	6.53E-06	1.88E-01	1.39E-04	1.77E+01	9.06E-03	6.59E-02	5.97E-07	1.77E+01	1.59E-02
mercury	1.92E-04	9.99E-08	2.87E-03	2.13E-06	2.71E-01	1.39E-04	1.01E-03	9.13E-09	2.71E-01	2.43E-04
nickel	9.98E-06	5.20E-09	1.50E-04	1.11E-07	1.41E-02	7.21E-06	5.25E-05	4.75E-10	1.41E-02	1.26E-05
selenium	4.11E-05	2.14E-08	6.16E-04	4.56E-07	5.80E-02	2.97E-05	2.16E-04	1.96E-09	5.80E-02	5.20E-05
vanadium (fume or dust)	1.05E-03	5.49E-07	1.58E-02	1.17E-05	1.49E+00	7.62E-04	5.54E-03	5.02E-08	1.49E+00	1.33E-03
Silica, Crystln	7.67E-01	3.99E-04	1.15E+01	8.51E-03	1.08E+03	5.54E-01	4.03E+00	3.65E-05	1.08E+03	9.70E-01

Note: Diesel exhaust particulate has no acute REL. Therefore, hourly emissions are provided for disclosure purposes only and were not used in the HRA. CARB PM Speciation Profile 470 applied to dust sources because road dust dominates emissions inventory.

	RMC and Recycle		Sink From Aggregates Plant		RMC and Recycle		Sink From Aggregates Plant	
Representing	VOL156-159		VOL160		VOL443 - VOL446		VOL447	
Model Object Multiplier	0.25		-1		0.25		-1	
Annual or Hourly	(lb/yr)	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)	(lb/hr)
diesel PM10	2.45E+01	8.15E-02	-9.79E+01	-3.26E-01	2.45E+01	8.15E-02	-9.79E+01	-3.26E-01
dust PM10	1.36E+03	1.81E+00	-1.88E+03	-4.85E+00	1.36E+03	1.81E+00	-1.88E+03	-4.85E+00
arsenic	5.33E-02	5.53E-05	-4.14E-02	-1.07E-04	5.33E-02	5.53E-05	-4.14E-02	-1.07E-04
beryllium	3.68E-03	2.46E-06	0.00E+00	0.00E+00	3.68E-03	2.46E-06	0.00E+00	0.00E+00
cadmium	5.99E-02	7.50E-05	-7.34E-02	-1.89E-04	5.99E-02	7.50E-05	-7.34E-02	-1.89E-04
chromium	4.92E-01	5.62E-04	-4.91E-01	-1.26E-03	4.92E-01	5.62E-04	-4.91E-01	-1.26E-03
copper	1.38E-01	1.82E-04	-1.90E-01	-4.89E-04	1.38E-01	1.82E-04	-1.90E-01	-4.89E-04
chlorine	1.98E+00	2.62E-03	-2.73E+00	-7.04E-03	1.98E+00	2.62E-03	-2.73E+00	-7.04E-03
lead	1.34E+00	1.74E-03	-1.77E+00	-4.56E-03	1.34E+00	1.74E-03	-1.77E+00	-4.56E-03
manganese	2.10E+00	2.34E-03	-1.98E+00	-5.09E-03	2.10E+00	2.34E-03	-1.98E+00	-5.09E-03
nickel	2.64E-01	2.44E-04	-1.41E-01	-3.63E-04	2.64E-01	2.44E-04	-1.41E-01	-3.63E-04
phosphorous	7.31E-01	4.87E-04	0.00E+00	0.00E+00	7.31E-01	4.87E-04	0.00E+00	0.00E+00
mercury	2.59E-02	3.43E-05	-3.57E-02	-9.21E-05	2.59E-02	3.43E-05	-3.57E-02	-9.21E-05
selenium	3.29E-02	3.15E-02	-1.88E-03	-4.85E-06	3.29E-02	3.15E-02	-1.88E-03	-4.85E-06
vanadium (fume or dust)	4.61E-01	6.11E-04	-6.36E-01	-1.64E-03	4.61E-01	6.11E-04	-6.36E-01	-1.64E-03
Silica, Crystln	5.45E+01	7.23E-02	-7.52E+01	-1.94E-01	5.45E+01	7.23E-02	-7.52E+01	-1.94E-01

Timeframe	Years 2017 - 2018						Years 2019 - 2026			
Representing	Mitigated Project Mining (Carli, Phase E)				Baseline (Phase T)		Mitigated Project Mining (Carli, Phase E)		Baseline (Phase T)	
diesel PM10	66 lb/yr		0.04 lb/hr		2,808 lb/yr	0.81 lb/hr	99 lb/yr	0.14 lb/hr	2,808 lb/yr	0.81 lb/hr
dust PM10	13,286 lb/yr		12.17 lb/hr		38,669 lb/yr	19.80 lb/hr	19,793 lb/yr	16.04 lb/hr	38,669 lb/yr	19.80 lb/hr
Location within site	Sloped perimeter of initial excavation		Flat bottom of initial excavation		Former excavation (operations cease)		Remainder of excavation (see figure)		Former excavation (operations cease)	
diesel PM10	5 lb/yr	0.00 lb/hr	61 lb/yr	0.03 lb/hr	2,808 lb/yr	0.81 lb/hr	99 lb/yr	0.14 lb/hr	2,808 lb/yr	0.81 lb/hr
dust PM10	454 lb/yr	0.30 lb/hr	12,832 lb/yr	11.88 lb/hr	38,669 lb/yr	19.80 lb/hr	19,793 lb/yr	16.04 lb/hr	38,669 lb/yr	19.80 lb/hr
Size of Model Objects	10.67 m x 10.67 m		25 m x 25 m		386.12 m x 386.12 m		28.45 m x 28.45 m		371.21 m x 371.21 m	
Model Object Names	VOL001-VOL053		VOL054-VOL153		VOL154 & VOL155		VOL001-VOL440		VOL441 & VOL442	
Annual or Hourly	(lb/yr)	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)	(lb/hr)	(lb/yr)	(lb/hr)
diesel PM10	0.09	0.00005	0.6	0.0003	1,404	0.40	0.2	0.00031	1,404	0.40
dust PM10	8.6	0.006	128	0.119	19,334	9.9	45	0.036	19,334	9.9
arsenic	3.28E-07	2.14E-10	4.92E-06	4.55E-09	7.41E-04	3.79E-07	1.72E-06	1.18E-11	7.41E-04	3.79E-07
bromine	1.54E-04	1.00E-07	2.31E-03	2.14E-06	3.48E-01	1.78E-04	8.10E-04	5.54E-09	3.48E-01	1.78E-04
cadmium	1.11E-04	7.24E-08	1.67E-03	1.54E-06	2.51E-01	1.29E-04	5.85E-04	4.00E-09	2.51E-01	1.29E-04
chlorine	7.23E-03	4.70E-06	1.08E-01	1.00E-04	1.63E+01	8.35E-03	3.80E-02	2.60E-07	1.63E+01	8.35E-03
copper	1.35E-03	8.81E-07	2.03E-02	1.88E-05	3.05E+00	1.56E-03	7.11E-03	4.86E-08	3.05E+00	1.56E-03
lead	1.11E-03	7.24E-07	1.67E-02	1.54E-05	2.51E+00	1.29E-03	5.85E-03	4.00E-08	2.51E+00	1.29E-03
manganese	7.83E-03	5.10E-06	1.17E-01	1.09E-04	1.77E+01	9.06E-03	4.12E-02	2.82E-07	1.77E+01	9.06E-03
mercury	1.20E-04	7.80E-08	1.80E-03	1.66E-06	2.71E-01	1.39E-04	6.30E-04	4.31E-09	2.71E-01	1.39E-04
nickel	6.24E-06	4.06E-09	9.35E-05	8.66E-08	1.41E-02	7.21E-06	3.28E-05	2.24E-10	1.41E-02	7.21E-06
selenium	2.57E-05	1.67E-08	3.85E-04	3.56E-07	5.80E-02	2.97E-05	1.35E-04	9.24E-10	5.80E-02	2.97E-05
vanadium (fume or dust)	6.59E-04	4.29E-07	9.88E-03	9.15E-06	1.49E+00	7.62E-04	3.46E-03	2.37E-08	1.49E+00	7.62E-04
Silica, Crystln	4.79E-01	3.12E-04	7.19E+00	6.65E-03	1.08E+03	5.54E-01	2.52E+00	1.72E-05	1.08E+03	5.54E-01

Note: Diesel exhaust particulate has no acute REL. Therefore, hourly emissions are provided for disclosure purposes only and were not used in the HRA. CARB PM Speciation Profile 470 applied to dust sources because road dust dominates emissions inventory.

	RMC and Recycle			Sink From Aggregates Plant		RMC and Recycle		Sink From Aggregates Plant	
Representing	VOL156 - VOL 159			VOL160		VOL443 - VOL446		VOL447	
Model Object Multiplier	0.25			-1		0.25		-1	
Annual or Hourly	(lb/yr)	(lb/hr)		lb/yr	lb/hr	(lb/yr)	(lb/hr)	lb/yr	lb/hr
diesel PM10	2.45E+01	8.15E-02		-9.79E+01	-3.26E-01	2.45E+01	8.15E-02	-9.79E+01	-3.26E-01
dust PM10	1.36E+03	1.81E+00		-1.88E+03	-4.85E+00	1.36E+03	1.81E+00	-1.88E+03	-4.85E+00
arsenic	5.33E-02	5.53E-05		-4.14E-02	-1.07E-04	5.33E-02	5.53E-05	-4.14E-02	-1.07E-04
beryllium	3.68E-03	2.46E-06		0.00E+00	0.00E+00	3.68E-03	2.46E-06	0.00E+00	0.00E+00
cadmium	5.99E-02	7.50E-05		-7.34E-02	-1.89E-04	5.99E-02	7.50E-05	-7.34E-02	-1.89E-04
chromium	4.92E-01	5.62E-04		-4.91E-01	-1.26E-03	4.92E-01	5.62E-04	-4.91E-01	-1.26E-03
copper	1.38E-01	1.82E-04		-1.90E-01	-4.89E-04	1.38E-01	1.82E-04	-1.90E-01	-4.89E-04
chlorine	1.98E+00	2.62E-03		-2.73E+00	-7.04E-03	1.98E+00	2.62E-03	-2.73E+00	-7.04E-03
lead	1.34E+00	1.74E-03		-1.77E+00	-4.56E-03	1.34E+00	1.74E-03	-1.77E+00	-4.56E-03
manganese	2.10E+00	2.34E-03		-1.98E+00	-5.09E-03	2.10E+00	2.34E-03	-1.98E+00	-5.09E-03
nickel	2.64E-01	2.44E-04		-1.41E-01	-3.63E-04	2.64E-01	2.44E-04	-1.41E-01	-3.63E-04
phosphorous	7.31E-01	4.87E-04		0.00E+00	0.00E+00	7.31E-01	4.87E-04	0.00E+00	0.00E+00
mercury	2.59E-02	3.43E-05		-3.57E-02	-9.21E-05	2.59E-02	3.43E-05	-3.57E-02	-9.21E-05
selenium	3.29E-02	3.15E-02		-1.88E-03	-4.85E-06	3.29E-02	3.15E-02	-1.88E-03	-4.85E-06
vanadium (fume or dust)	4.61E-01	6.11E-04		-6.36E-01	-1.64E-03	4.61E-01	6.11E-04	-6.36E-01	-1.64E-03
Silica, Crystln	5.45E+01	7.23E-02		-7.52E+01	-1.94E-01	5.45E+01	7.23E-02	-7.52E+01	-1.94E-01

Toxic Air Contaminant Speications

For Ready Mix Concrete

	Metals Emissions Factors lb/ton material processed									
	Arsenic	**Beryllium**	**Cadmium**	**Chromium**	**Lead**	**Manganese**	**Nickel**	**Phosphorus**	**Selenium**	**Factor Source**
Pneumatic transfer of cement to controlled silo	4.24E-09	4.86E-10	2.34E-07	2.90E-08	1.09E-08	1.17E-07	4.18E-08	1.18E-05	1.00E-06	(AP-42 Table 11.12-8)
Pneumatic transfer of cement supplements to controlled silo	1.00E-06	9.04E-08	1.98E-10	1.22E-06	5.20E-07	2.56E-07	2.28E-06	3.54E-06	7.24E-08	(AP-42 Table 11.12-8)
Truck Loading	6.02E-07	1.04E-07	9.06E-09	4.10E-06	1.53E-06	2.08E-05	4.78E-06	1.23E-05	1.13E-07	(AP-42 Table 11.12-8)

For Recycle Processes

CAS Identification Number	Chemcial Name	Fraction of PM10 Composition
7440382	arsenic	2.20E-05
7440439	cadmium	3.90E-05
7440473	chromium	2.61E-04
7440508	copper	1.01E-04
7782505	chlorine	1.45E-03
7439921	lead	9.42E-04
7439965	manganese	1.05E-03
7440020	nickel	7.50E-05
7439976	mercury	1.90E-05
7782492	selenium	1.00E-06
7440622	vanadium (fume or dust)	3.38E-04
1175	Silica, Crystln	4.00E-02

CARB Speciation Profiles (http://www.arb.ca.gov/ei/speciate/interoptvv10001.php)

For Aggregate Mining and Processing

CAS Identification Number	Chemcial Name	Fraction of PM10 Composition
7440382	arsenic	3.83E-08
7440439	cadmium	3.90E-05
7440473	chromium	2.61E-04
7440508	copper	1.01E-04
7782505	chlorine	1.45E-03
7439921	lead	9.42E-04
7439965	manganese	1.05E-03
7440020	nickel	7.29E-07
7439976	mercury	1.90E-05
7782492	selenium	1.00E-06
7440622	vanadium (fume or dust)	3.38E-04
1175	Silica, Crystln	4.00E-02

Based on Sampling Data (see appendix G, or sampling data Table below)

Results of Onsite Sampling using EPA 6010B Analysis Method

	Carli Expansion Overburden Samples						Existing Pit Samples					
Sample Label	T1	T2	T3	T4	T5	T6	E1	E2	E3	E4	E5	E6
Arsenic ppm	4.00E-03	1.00E-03	2.20E-02	4.00E-03	1.00E-03	8.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03
Nickel ppm	7.51E-02	4.16E-02	6.53E-02	6.68E-02	5.21E-02	5.60E-02	9.71E-02	7.30E-02	1.09E-01	1.02E-01	8.73E-02	4.91E-02

Average Arsenic Fraction of PM10 Composition Assumed: 3.83E-08
Average Nickel Fraction of PM10 Composition Assumed: 7.29E-07

Shaded cells represent a "Not Detected" result. In these cases, the element in question was assumed to be present at half the detection threshold level.
Sampling results represent ppm in 1 liter of solution leachate from 100 grams of soil.

tapraid4/z5p-jawma/z5p-jawma/z5p01109/z5p3420d09a | sangreyj | S=11 | 10/12/09 | 12:06 | Art: 08-00194 | Input-sw

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PM_4 Crystalline Silica Emission Factors and Ambient Concentrations at Aggregate Producing Sources in California

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ABSTRACT

Fu The California Construction and Industrial Minerals Association and the National Stone, Sand, & Gravel Association have sponsored tests at three sand and gravel plants in California to compile crystalline silica emission factors for particulate matter (PM) of aerodynamic diameter of 4 μm or less (PM_4) and ambient concentration data. This information is needed by industrial facilities to evaluate compliance with the Chronic Reference Exposure Level (REL) for ambient crystalline silica adopted in 2005 by the California Office of Environmental Health Hazard Assessment. The REL applies to PM_4 respirable PM. Air Control Techniques, P.C. sampled for PM_4 crystalline silica using a conventional sampler for PM of aerodynamic diameter of 2.5 μm or less ($PM_{2.5}$), which met the requirements of 40 *Code of Federal Regulations* Part 50, Appendix L. The sample flow rate was adjusted to modify the 50% cut size to 4 μm instead of 2.5 μm. The filter was also changed to allow for crystalline silica analyses using National Institute for Occupational Safety and Health (NIOSH) Method 7500. The particle size-capture efficiency curve for the modified Appendix L instrument closely matched the performance curve of NIOSH Method 0600 for PM_4 crystalline silica and provided a minimum detection limit well below the levels attainable with NIOSH Method 0600. The results of the tests indicate that PM_4 crystalline silica emissions range from 0.000006 to 0.000110 lb/t for screening operations, tertiary crushers, and conveyor transfer points. The PM_4 crystalline silica emission factors were proportional to the crystalline silica content of the material handled in the process equipment. Measured ambient concentrations ranged from 0 (below detectable limit) to 2.8 μg/m³. All values measured above 2 μg/m³ were at locations upwind of the facilities being tested. The ambient PM_4 crystalline silica concentrations measured during this study were below the California REL of 3 μg/m³. The measured ambient concentrations in the PM_4 size range are consistent with previously published ambient crystalline silica data applicable to the $PM_{2.5}$ and PM of aerodynamic diameter of 10 μm or less (PM_{10}) size ranges.

IMPLICATIONS

Mineral processing facilities need PM_4 crystalline silica emission factor data to evaluate compliance with the 3 μg/m³ Chronic REL for PM_4 ambient crystalline silica adopted in 2005 by the California Office of Environmental Health Hazard Assessment. Emission tests at three sand and gravel plants have provided PM_4 crystalline silica data for screens, crushers, and conveyors. Mineral processing facilities can use the emission factor data to evaluate compliance with the stringent ambient PM_4 crystalline silica limit.

INTRODUCTION

Crystalline Silica Emission Factors of Particulate Matter of Aerodynamic Diameter of 4 μm or Less

There are no previously published data concerning particulate matter (PM) of aerodynamic diameter of 4 μm or less (PM_4) crystalline silica emissions from aggregate producing plants or other mineral industry sources. The PM_4 crystalline silica emission factors can be estimated based on published data concerning emission factors for PM of aerodynamic diameter of 10 μm (PM_{10}) or 2.5 μm ($PM_{2.5}$) or less for aggregate producing plants.[1–9] The U.S. Environmental Protection Agency (EPA) AP42 Section 11.19-2 emission factors for tertiary crushers, screens, and conveyor transfer points indicate that the $PM_{2.5}$ emissions range from 0.000013 to 0.000100 lb/t of stone. The AP42 Section 11.19-2 PM_{10} emission factors for these three types of processing equipment range from 0.000046 to 0.00074 lb/t.

These emission factors provide a starting point for evaluating possible PM_4 crystalline silica emission factors. It is reasonable to expect the PM_4 total emission factors to be between the $PM_{2.5}$ and PM_{10} emission factors. The PM_4

Crystalline Silica;Emission Factors;Aggregate Producing Facilities;PM₄;Testing

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crystalline silica emission factors will depend on the crystalline silica content of the PM_4 total PM.

Ambient Crystalline Silica Concentrations

No PM_4 ambient concentration or emission factor data have been published. All previous crystalline silica ambient concentration data applied to the $PM_{2.5}$, PM_{10}, and/or PM of 15-μm or less (PM_{15}) size ranges.

One of the first studies of ambient crystalline silica concentrations was conducted by Davis et al.[10] This study focused on urban areas. Ambient crystalline silica concentrations were measured in 22 urban areas using dichotomous samplers that separate ambient PM into the 0- to 2.5-μm range ("fine PM") and the 2.5- to 15-μm range (termed here as "coarse/supercoarse PM"). Davis et al. measured mean 24-hr average ambient crystalline silica concentrations ranging from 0.9 to 8 $\mu g/M^3$ in the coarse/supercoarse size range. Crystalline silica was 1–9% of the coarse/supercoarse PM and 0–2.6% of the fine (<2.5 μm) PM.

EPA[11] used the data of Davis et al. to derive estimates of the annual average crystalline silica levels in urban areas. The city-specific crystalline silica content values were multiplied by annual average PM_{10} concentrations in these areas to estimate the annual average PM_{10} crystalline silica levels. EPA also calculated an annual average of 1.9 $\mu g/m^3$ with a range of 0.8–5 $\mu g/m^3$ in the PM_{10} size range. The crystalline silica content in the $PM_{2.5}$ size range was consistently less than 1 $\mu g/m^3$ because of the low crystalline silica content of the $PM_{2.5}$ PM and the low total concentration of $PM_{2.5}$ PM.

In 2000, the National Stone, Sand, & Gravel Association (NSSGA) sponsored upwind-downwind studies of ambient crystalline silica concentrations at four stone crushing plants processing high-quartz-content rock.[12] Air Control Techniques, P.C. used Rupprecht & Patashnick Co, Inc. Federal Reference Method (FRM)-2000 samplers that fully met the stringent design and operating specifications of 40 *Code of Federal Regulations* (CFR) Part 50, Appendix L.[13] The measured 8-hr working-shift PM_{10} crystalline silica concentrations at the collocated downwind PM_{10} samplers ranged from 1 to 10.9 $\mu g/m^3$. These values are similar to the range of mean 24-hr concentration values of 0.9–8 $\mu g/m^3$ for 24-hr concentrations measured by Davis et al. in the coarse/supercoarse size range. The measured upwind and downwind concentrations were similar. The crystalline silica levels of 5.07–6.24% by weight of the PM_{10} were similar to the 4.9 ± 2.3% levels in coarse/supercoarse PM reported by Davis et al.

Various other studies have provided limited data for urban, rural, and industrial areas. Puledda[14] measured PM_{10} crystalline silica levels in Rome, Italy of 0.11–2.27 $\mu g/m^3$. These levels were 1.7–3.4% of the measured PM_{10}. Norton and Gunter[15] measured PM_{10} crystalline silica levels averaging 10% in Moscow, ID. They also extracted PM from PM_{10} samples from numerous areas throughout Idaho and estimated crystalline silica levels to be between 7 and 16% of PM_{10} in various urban and rural areas in Idaho. Various other studies described by EPA[11] at urban, rural, and industrial areas indicated 24-hr average crystalline silica levels and crystalline silica contents in PM_{10} that were similar to those in Davis et al.,[10] Air Control Techniques, P.C.,[12] Puledda,[14] and Norton and Gunter.[15] These other studies include Schipper,[16] Goldsmith,[17] Chow et al.,[18] Chow,[19] and Chow.[20] Only the study of Shakari and Holmen[21] reported crystalline silica levels and PM_{10} crystalline silica contents outside of the range of the various papers summarized above. There are insufficient data in Shakari and Holmen to identify the possible reasons for the differences between their data and other studies.

On the basis of the available ambient crystalline silica data, the study participants concluded that there was a need for a monitoring technique having a minimum detectable limit of 0.3 $\mu g/m^3$. This is at or below the concentrations anticipated in this project. This minimum detectable concentration is also 10% of the California Relative Exposure Limit. An evaluation of National Institute for Occupational Safety and Health (NIOSH) Method 0600 used for in-plant industrial hygiene tests indicated that this method was not sufficiently precise at the necessary detection limit. Accordingly, the California Construction and Industrial Minerals Association (CalCIMA) and NSSGA sponsored the development of a more accurate and precise PM_4 crystalline silica monitoring method for this project. Information concerning the development of the PM_4 crystalline silica monitoring method on the basis of the validated $PM_{2.5}$ test method is described in the project report.[22]

TEST LOCATIONS AND PROCEDURES

PM_4 Crystalline Silica Measurement Test Locations

Study participants selected facilities for testing on the basis of (1) the representativeness of a vibrating screen, tertiary crusher, and conveyor transfer point of other California plants; (2) the representativeness of the crystalline silica content of the minerals processed; (3) the accessibility of the equipment for testing; (4) the capability to isolate the process unit tested from adjacent process units; and (5) the geographical location. The plants included the Service Rock Products, Inc. plant in Barstow; the Vulcan Materials, Inc. Carroll Canyon plant near San Diego; and the Teichert Aggregates, Inc. Vernalis plant near Tracy. These plants had crystalline silica levels ranging from 16.5 to 35.3% by weight in the minerals being processed.

PM_{10} data were compiled to provide a comparison of measured PM_4 crystalline silica emissions with measured PM_{10} emissions. The scope of the programs at each of these three facilities included PM_{10} emission factor tests on the crushers, vibrating screens, and conveyor transfer points.

The specific sources tested at Barstow included (1) a 16- by 5-ft flat vibrating screening operation, (2) a short-head crusher, and (3) a conveyor transfer point. The equipment tested at Carroll Canyon included (1) a 16- by 8-ft flat vibrating screen, (2) a set of two cone crushers, and (3) a conveyor transfer point. The sources tested at Vernalis included (1) a 20- by 8-ft triple deck sloped vibrating screen, (2) a set of two cone crushers, and (3) a conveyor transfer point. Water sprays controlled all of the units with the exception of the Carroll Canyon cone

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crushers. A fabric filter supplemented wet suppression control at the Carroll Canyon cone crushers.

PM_4 Crystalline Silica Measurement Procedures

The PM_4 crystalline silica emission concentrations were measured using TECO Model 2000 FRMs modified to have a 50% cut point of 4 μm rather than 2.5 μm. This monitoring method was developed for CalCIMA and NSSGA by Air Control Techniques, P.C. in accordance with a protocol submitted to the California Air Resources Board in July 2005. The authors consider this method to be an extension of the $PM_{2.5}$ ambient monitoring procedures specified by EPA in 40 CFR Part 50, Appendix L because of the use of identical sampling equipment, sampling procedures, and quality assurance procedures.

The main adjustment necessary to an Appendix L qualifying instrument is a change in the 50% cut size of this instrument from $PM_{2.5}$ to PM_4. The 50% cut size was adjusted by reducing the sample airflow rate into the TECO sharp cut cyclone to 11.1 L/min from the 16.67 L/min used for $PM_{2.5}$ monitoring. The adequacy of the cut size was confirmed using National Institute for Standards and Technology (NIST) traceable microspheres.

A calculated sampling time of 1–3 hr was required to meet the minimum detection limits of NIOSH 7500 for crystalline silica during tests on the process equipment. These sampling time estimates were based on (1) the NIOSH Method 7500 detection limit of 5 μg, (2) the TECO FRM 2000 sample gas flow rate of 11.1 L/min that was used to collect PM_4, and (3) the estimated crystalline silica content of the stone material being processed. Crystalline silica was detected in all but one filter sample, which confirmed the adequacy of the 1- to 3-hr sampling periods used in the study. The filter samples were weighted at R.J. Lee Group, Inc. using a microbalance and analyzed for crystalline silica using NIOSH Method 7500.

The fugitive PM_{10} PM emissions from the process equipment sources tested in Barstow were measured using a TECO tapered element oscillating microbalance (TEOM) in accordance with EPA Reference Method IO-3. For the tests at Carroll Canyon and Vernalis, the fugitive PM_{10} PM emissions were measured using TECO Model 2000 FRMs modified for PM_{10}.

Sampling arrays designed based on EPA Method 5D (40 CFR Part 60, Appendix A) captured process equipment PM_4 crystalline silica emissions. The mass fluxes

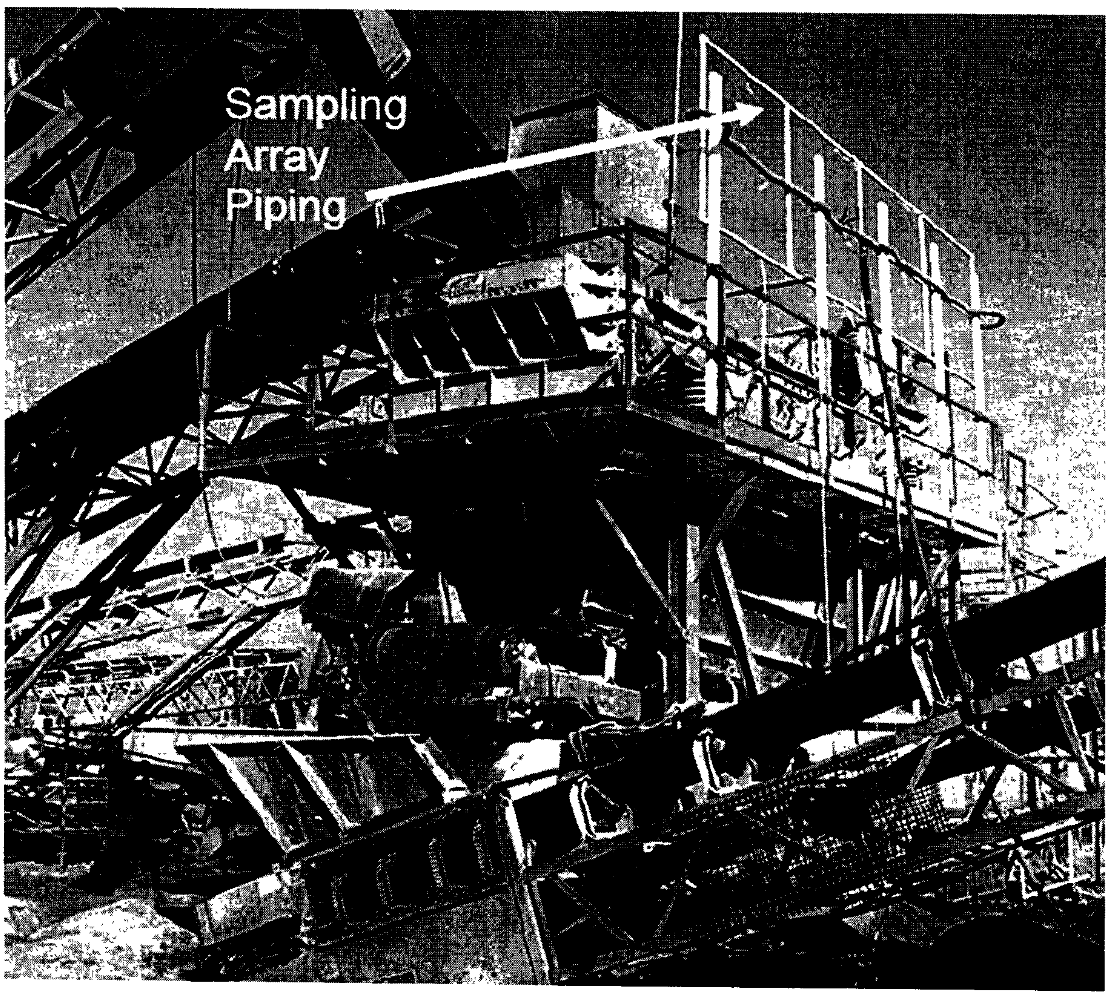

Figure 1. Side view of the sampling array on the downwind side of the vibrating sizing screen at the Barstow plant.

Figure 2. South-side view of sampling array on downwind side of the conveyor transfer point at the Barstow plant.

of PM_4 and PM_{10} fugitive PM through the arrays were calculated by multiplying the total area of the array by the ambient wind speed and the measured PM_4 and PM_{10} concentrations.

The arrays for the vibrating screens, tertiary crushers, and conveyor transfer points were mounted within 5 ft of the locations of PM entrainment by ambient air. Because of this close spacing of the arrays to the source, the "plume" did not have time to substantially disperse in the horizontal or vertical direction. Accordingly, the dispersing PM was captured from the sources even as the ambient winds shifted direction within an angle of approximately 90°.

Each sampling array had more than 100 sampling points. This substantially exceeds the 30 sampling points specified in EPA Method 5D for testing open-top sources. The area monitored by the sampling array exceeded the area subject to dispersion of the PM on the downwind side of the process unit being tested. Each array consisted of manifolds having equally spaced nozzles for air sampling. The gas transport velocities through all sampling tubes and ductwork were above a minimum of 3200 ft/min to prevent any gravitational settling of dust. The sampling manifolds and ductwork were visually inspected after each test run. Following each set of emission tests, the sampling array piping and flex ducts were disassembled and checked for solids deposits. No deposits were present in any sections of the sampling system. Wind speed data and wind direction data demonstrated that each test run was consistent with study requirements.

Each of the array sampling manifolds was ducted together to yield a single sample gas stream. This gas stream flowed through a round duct 12 in. in diameter with sampling ports for a TECO FRM 2000 (modified for PM_4) sampling head and a PM_{10} sampling head. This duct size was the minimum necessary to accommodate the relatively large inlet heads for the TECO FRM 2000 and the TEOM. The gas velocity through the portion of the duct with the sampling ports for the monitoring instruments was less than 10 mph to be consistent with typical ambient wind velocities.

The actual sample gas flow rates through the sampling arrays provided near-isokinetic sampling velocities in the nozzles of the sampling arrays. The nozzles provided isokinetic sampling velocities equal to or lower than 110% at an average ambient wind speed of 5 mph. At isokinetic sampling rates below 100%, there is a slight bias to higher-than-true PM_4 concentrations because of the inertia of the PM_4 particles; however, this isokinetic effect is small for PM_4 particles because of their extremely low mass. Figures 1–3 show the sampling array arrangements. F1-3

The ambient airflow rate through each array was calculated based on the area of the array and the measured ambient wind speed. The tests were conducted only when the ambient winds were moving across the process being tested and through the downwind array. The adequacy of fugitive dust capture by the array was documented on a continuous basis using visible wind direction indicators and on an intermittent basis using a nephelometer continuous PM concentration analyzer inside and outside of the array.

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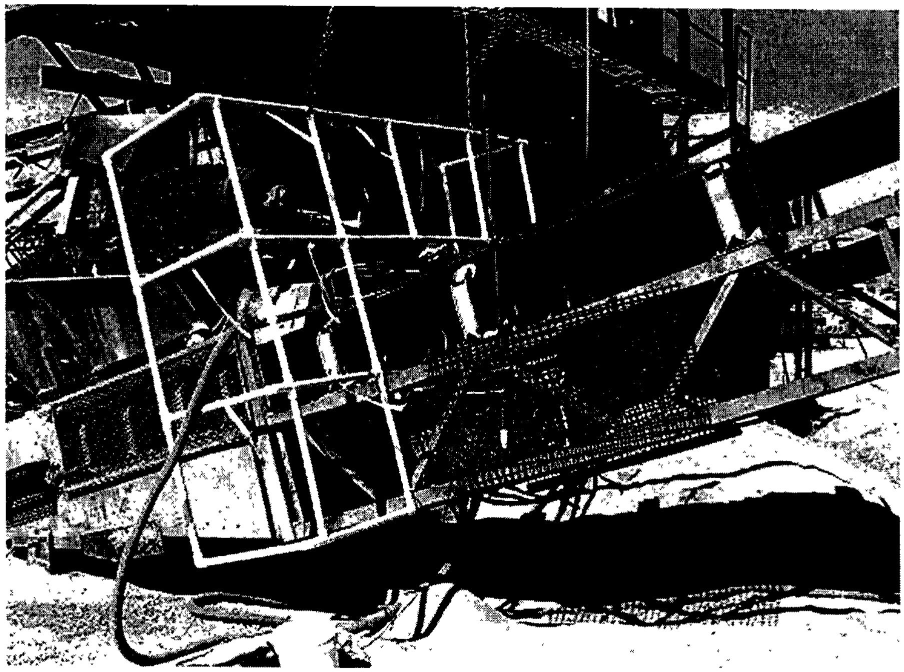

Figure 3. Close-up view of the sampling orifices in the conveyor transfer point array at the Carroll Canyon plant.

As part of this testing program, meteorological monitoring stations were installed to measure the following parameters during the process equipment test programs.

- Average and peak wind speeds
- Wind direction
- Ambient temperature

The sample gas velocities and volumetric flow rates through the main sampling duct during the PM_4 and PM_{10} tests were determined according to the procedures outlined in EPA Reference Method 2.

The authors believe that this fugitive dust capture technique provides the most accurate means possible to quantify fugitive dust emissions without affecting the rate of fugitive dust emissions and without interfering with safe plant operations.

PM_4 Emission Factor Test Program Process Data

During each of the test runs, study participants compiled data concerning the process operating conditions and the characteristics of the materials being handled.

- Crystalline silica content of aggregate being processed through the tested units
- Material moisture content (% wt)
- Material particle size distribution (sieve analyses)
- Material throughput (t/hr)

Ambient PM_4 Crystalline Silica Measurements

The PM_4 crystalline silica ambient concentrations were measured using TECO Model 2000 FRMs adjusted for PM_4 monitoring. Two Model 2000 FRMs were located

Table 1. PM_{10}, PM_4, and PM_4 crystalline silica emission factors at Barstow.

		Emission Factor Values (lb/t) of Stone Throughput		
Equipment Tested	Emission Factor	Measured Value	Ambient Upwind Equivalent[b]	Emission Factor
Vibrating screen	PM_{10}	0.000167[a,c]	NA[c]	0.000167[a,c]
	PM_4	0.000079[c]	NA[c]	0.000079[c]
	PM_4 crystalline silica	0.000006[c]	NA[c]	0.000006[c]
Crusher	PM_{10}	0 002753	0.000172	0.002581
	PM_4	0.001442	0.000172	0.001270
	PM_4 crystalline silica	0.000111	0.000028	0.000083
Conveyor transfer point	PM_{10}	0.000625	0.000050	0.000575
	PM_4	0.000402	0.000050	0.000352
	PM_4 crystalline silica	0.000035	0.000006	0.000029

Notes: [a]PM_{10} emission factors were calculated based on TEOM data. [b]Ambient levels of PM_4 PM and PM_4 crystalline silica upwind of the units tested were subtracted from the emission factors to account for material not emitted by the source. [c]Ambient levels of PM and crystalline silica upwind of the vibrating screens were not subtracted because the upwind samplers were below the elevation of the screens; therefore, the air quality at this elevation was not necessarily representative of air quality on the inlet side of the screen.

Table 2. PM_{10}, PM_4, and PM_4 crystalline silica emission factors at Carroll Canyon.

Equipment Tested	Emission Factor	Emission Factor Values (lb/t) of Stone Throughput: Measured Value	Ambient Upwind Equivalent	Emission Factor
Vibrating screen	PM_{10}	0.000930	0.000100	0.000831
	PM_4	0.000386	0.000029	0.000356
	PM_4 crystalline silica	0.000048	0.000001	0.000046
Crusher	PM_{10}	0.001271	0.000039	0.001232
	PM_4	0.000611	0.000017	0.000593
	PM_4 crystalline silica	0.000099	0.000002	0.000098
Conveyor transfer point	PM_{10}	0.000552	0.000026	0.000525
	PM_4	0.000245	0.000009	0.000236
	PM_4 crystalline silica	0.000031	0.00000	0.000031

Table 3. PM_{10}, PM_4, and PM_4 crystalline silica emission factors at Vernalis.

Equipment Tested	Emission Factor	Emission Factor Values (lb/t) of Stone Throughput: Measured Value	Ambient Upwind Equivalent	Emission Factor
Vibrating screen	PM_{10}	0.001754	0.000061	0.001693
	PM_4	0.000888	0.000006	0.000882
	PM_4 crystalline silica	0.000083	0.000002	0.000081
Crusher	PM_{10}	0.001767	0.000089	0.001677
	PM_4	0.000788	0.000021	0.000767
	PM_4 crystalline silica	0.000110	0.000001	0.000110
Conveyor transfer point	PM_{10}	0.001193	0.000103	0.001090
	PM_4	0.000476	0.000019	0.000457
	PM_4 crystalline silica	0.000088	0.000003	0.000085

Table 4. Comparison of measured PM_{10} PM emission factors and PM_4 crystalline silica emission factors.

Source	Plant	PM_{10} Emission Factors (lb/t)	Crystalline Silica PM_4 Factors (lb/t)	Ratio, Percent PM_4 Crystalline Silica to PM_{10}
Screen	Barstow	0.000167	0.000006	3.59
	Carroll Canyon	0.000831	0.000046	5.54
	Vernalis	0.001693	0.000081	4.78
Crusher	Barstow	0.002581	0.000083	3 21
	Carroll Canyon	0.001232	0.000098	7.95
	Vernalis	0.001677	0.00011	6.56
Conveyor transfer point	Barstow	0.000575	0.000029	5.04
	Carroll Canyon	0.000525	0.000031	5.90
	Vernalis	0.00109	0.000085	7.80

on the downwind side of the facility at a location immediately adjacent to the plant fence line. A single upwind Model 2000 FRM was located on the upwind side of the facility.

These instruments were operated for 24 hr and obtained sample volumes of 16 m^3. R.J. Lee Group, Inc. (RJL) weighed the filter samples using a microbalance and analyzed for crystalline silica using NIOSH Method 7500.

RESULTS

Emission Factor Test Results

The PM_{10}, PM_4, and PM_4 crystalline silica emission factors for the equipment sources measured at the three facilities are presented in Tables 1–3. The emission factors presented in the column on the right were calculated by subtracting the measured downwind concentrations from the measured upwind (ambient) concentrations. T1-3

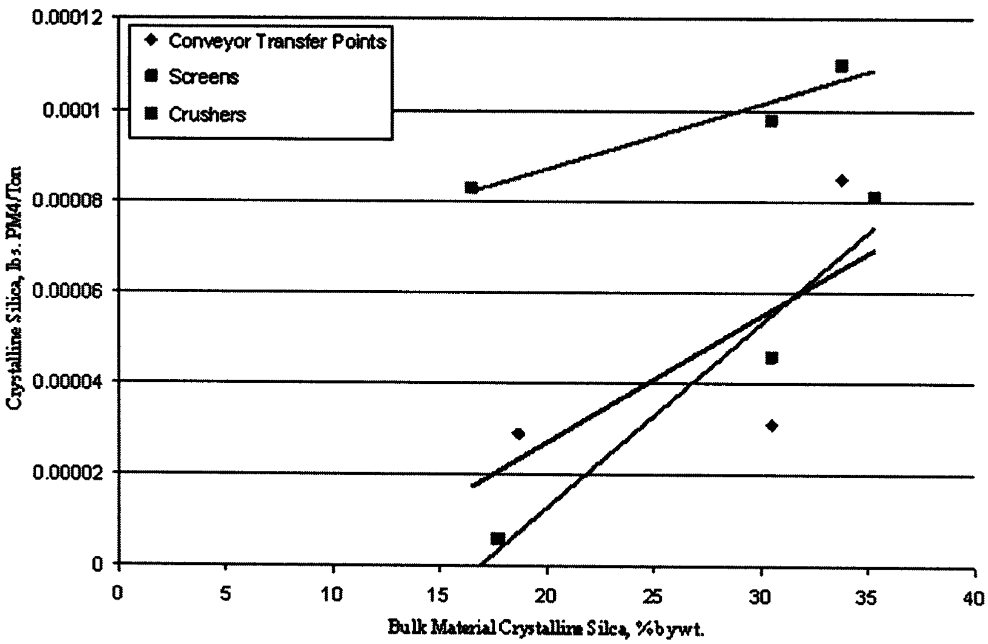

Figure 4. Relationship between bulk material crystalline silica content and the PM_4 crystalline silica emission factor.

T4 As indicated in Table 4, the crystalline silica PM_4 emission factors range from 3.21 to 7.95% of the PM_{10} emission factors. This is a useful ratio because it compares the PM_4 crystalline silica emissions with PM_{10} emissions for which data are often available.

The plant-to-plant differences in PM_4 crystalline silica emission factors are primarily due to the crystalline silica content of the material being handled. As indicated F4 in Figure 4, the bulk material crystalline silica content is responsible for most of the variance in the data. However, it is important to note that because of the small number of test values (three), it is not possible to demonstrate that the relationship between PM_4 crystalline silica emission factors and bulk crystalline silica content is significant at the 90% confidence level.

A less consistent relationship was observed for the conveyor transfer point tests. The reduced emission factor value for the Carroll Canyon plant (30.5% crystalline silica point) is probably due to the high aggregate throughput of this unit. It is theorized that at very high throughputs, some of the stone in the flowing material stream is shielded from attrition and, therefore, does not contribute to emissions. Despite this one test value, there appears to be a relationship between PM_4 crystalline silica emission factors and the crystalline silica content of the bulk material.

An alternative approach for summarizing the PM_4 crystalline silica concentrations is to compile average values for the datasets for the crushers, screens, and con- T5 veyor transfer points tested. Table 5 includes average values based on the data from the three plants provided in Tables 1–3.

T6 Table 6 summarizes the crystalline silica fraction of the total PM_4. These data demonstrate that the crystalline silica content of the PM_4 material is considerably lower than the crystalline silica content measured in the bulk samples recovered from each unit tested. On the basis of an average of the tests at the three plants, the PM_4 crystalline silica content is 44% of the bulk material crystalline silica content. It is apparent that the crystalline silica content of the rock is not as prone to attrition size reduction as other constituents in the aggregate.

The process equipment PM_4 crystalline silica emission factors summarized in Tables 1–6 are consistent with previously published emission factors for $PM_{2.5}$ and PM_{10} from similar process units. The PM_4 crystalline silica emission factors are intended for use as input data to dispersion models to evaluate annual average PM_4 concentrations at plant fence lines.

Ambient PM_4 Crystalline Silica Concentrations

Ambient concentrations of PM_4 crystalline silica were measured during 3 consecutive 24-hr periods at the

Table 5. Average emission factors from Barstow, Carroll Canyon, and Vernalis: combined dataset.

Source	Analyte	Emissions (lb/t)
Vibrating screen	PM_{10}	0.00090
	PM_4	0.00044
	PM_4 crystalline silica	0.000044
Crusher	PM_{10}	0.00183
	PM_4	0.00088
	PM_4 crystalline silica	0.000097
Conveyor transfer point	PM_{10}	0 00073
	PM_4	0.00035
	PM_4 crystalline silica	0.000048

Table 6. Crystalline silica fraction of PM_4 PM.

Plant	Source	Crystalline Silica Content (percent weight of total PM_4)	Crystalline Silica Content (percent weight of material samples)
Barstow	Screen	7.5	17.7
	Crusher	6.5	16.5
	Conveyor transfer point	8.3	18.7
	Average	6.9	17.3
Carroll Canyon	Screen	12.5	30.5
	Crusher	15.4	30.4
	Conveyor transfer point	12.8	30.6
	Average	13.6	30.5
Vernalis	Screen	9.6	35.3
	Crusher	21.9	33.9
	Conveyor transfer point	18.4	33.8
	Average	16.6	34.3

Carroll Canyon and Vernalis plants. Two collocated TECO FRM samplers modified for PM_4 crystalline silica measurement operated at a location downwind of the quarry and processing equipment. A single TECO FRM instrument for PM_4 crystalline silica monitoring operated at a location upwind of the entire facility being tested. Meteorological monitoring stations were placed at the upwind and downwind locations. The results of the ambient monitoring tests demonstrated that the plants operated at levels well below
T7-8 the 3-μg/m^3 REL value. Tables 7 and 8 summarize the results for the Carroll Canyon and Vernalis plants, respectively.

The differences between the upwind and downwind ambient PM_4 crystalline silica concentrations are small. The slightly higher upwind values observed during several of the test days are due to emissions from unpaved roads near the upwind monitoring sites.

Quality Assurance/Quality Control Procedures for PM_4 and PM_{10} Sampling

All of the PM_4 crystalline silica concentration tests conducted with modified Appendix L samplers included quality assurance (QA)/quality control (QC) procedures established by EPA for IO-1.3 (TEOMs) and 40 CFR Part 50, Appendix L (TECO FRM 2000s). The QA/QC data indicated that the TECO PM_4 samplers, the TECO PM_{10} samplers, and the TECO TEOM monitor used for PM_4 and PM_{10} monitoring performed extremely well throughout the three test programs.

All of the PM_4 concentration samplers used for emission factor testing and ambient air monitoring met all of the pre- and post-test requirements concerning filter temperature, ambient temperature, barometric pressure, sample flow, and sample gas stream leak rates.

A TEOM monitor was used during the tests at Barstow for the emission factor tests of the tertiary crusher, the vibrating screen, and the conveyor transfer point. The TEOM monitor satisfied the pre- and post-test QA requirements concerning ambient temperature, barometric pressure, sample flow, and sample gas stream leak rates.

SUMMARY

PM_4 crystalline silica emission factors measured using an Appendix L-based filter sampler ranged from 0.000006 to 0.000110 lb/t of stone processed in vibrating screens, tertiary crushers, and conveyor transfer points. The measured PM_4 crystalline silica emissions ranged from 3.21 to 7.95% of the simultaneously measured PM_{10} emission factors. The PM_4 crystalline silica emissions measured in this study appeared to be related to the crystalline silica content of the mineral being handled. The concentration of crystalline silica in PM_4 PM averaged 44% of the crystalline silica content of the bulk mineral.

Ambient concentrations of PM_4 crystalline silica were measured upwind and downwind of the facilities during the emission factor test programs. The measured ambient concentrations of PM_4 crystalline silica ranged from below the detectable limit of 0.3 μg/m^3 to 2.8 μg/m^3. These concentrations are well below the California REL of 3 μg/m^3.

Table 7. Plant upwind-downwind ambient monitoring at Carroll Canyon.

Date	PM_4 Crystalline Silica (μg/m^3) Upwind	Downwind (primary)	Downwind (collocated)
September 17	1.3	1.1	1.0
September 18	1.4	0.7	0.8
September 19	0.6	0.5	0.4

Table 8. Plant upwind-downwind ambient monitoring at Vernalis.

Date	PM_4 Crystalline Silica (μg/m^3) Upwind	Downwind (primary)	Downwind (collocated)
September 24	0.8	0.6	0.9
September 25	2.8	0.9	0.8
September 26	2.5	0.0	1.2

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About the Authors

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Analytical Chemical Labs, Inc.

EPA Reg. # CA01419 ELAP Cert. # 2505

Client: Sespe Consulting
1565 Hotel Circle South, Suite 370
San Diego, CA 92108
Attn.: Scott Cohen
Project Name: Vulcan - Carli
Purchase Order #: Prepaid

Report Date: October 26, 2017
Received Date: October 25, 2017 13:00

Phone: 530-574-0231 **Fax:**
Project #
Regular TAT

Certificate of Analysis

Lab No: 180209-1 **Sample ID:** # E1 **Matrix:** Solid - Soil
Sampled By: Andre Almeida **Date:** 05/15/2018 **Time:** 11:25 **Source:** Soil
Test according to EPA 1312 SPLP

Parameter	Results	Units	DLR	Method	Analyzed
Arsenic	**ND**	mg/L	0.002	EPA 6010B	2017/05/31
Nickel	**0.0971**	mg/L	0.0065	EPA 6010B	2017/05/31

Lab No: 180209-2 **Sample ID:** # E2 **Matrix:** Solid - Soil
Sampled By: Andre Almeida **Date:** 05/15/2018 **Time:** 11:37 **Source:** Soil
Test according to EPA 1312 SPLP

Parameter	Results	Units	DLR	Method	Analyzed
Arsenic	**ND**	mg/L	0.002	EPA 6010B	2017/05/31
Nickel	**0.0730**	mg/L	0.0065	EPA 6010B	2017/05/31

Lab No: 180209-3 **Sample ID:** # E3 **Matrix:** Solid - Soil
Sampled By: Andre Almeida **Date:** 05/15/2018 **Time:** 11:56 **Source:** Soil
Test according to EPA 1312 SPLP

Parameter	Results	Units	DLR	Method	Analyzed
Arsenic	**ND**	mg/L	0.002	EPA 6010B	2017/05/31
Nickel	**0.1087**	mg/L	0.0065	EPA 6010B	2017/05/31

Lab No: 180209-4 **Sample ID:** # E4 **Matrix:** Solid - Soil
Sampled By: Andre Almeida **Date:** 05/15/2018 **Time:** 11:54 **Source:** Soil
Test according to EPA 1312 SPLP

Parameter	Results	Units	DLR	Method	Analyzed
Arsenic	**ND**	mg/L	0.002	EPA 6010B	2017/05/31
Nickel	**0.1024**	mg/L	0.0065	EPA 6010B	2017/05/31

Lab No: 180209-5 **Sample ID:** # E5 **Matrix:** Solid - Soil
Sampled By: Andre Almeida **Date:** 05/15/2018 **Time:** 11:59 **Source:** Soil
Test according to EPA 1312 SPLP

Parameter	Results	Units	DLR	Method	Analyzed
Arsenic	**ND**	mg/L	0.002	EPA 6010B	2017/05/31
Nickel	**0.0873**	mg/L	0.0065	EPA 6010B	2017/05/31

Analytical Chemical Labs, Inc.

EPA Reg. # CA01419   ELAP Cert. # 2505

Certificate of Analysis (continue)

Lab No: 180209-6   **Sample ID:** # E6   **Matrix:** Solid - Soil
Sampled By: Andre Almeida   **Date:** 05/15/2018   **Time:** 12:14   **Source:** Soil
Test according to EPA 1312 SPLP

Parameter	Results	Units	DLR	Method	Analyzed
Arsenic	**ND**	mg/L	0.002	EPA 6010B	2017/05/31
Nickel	**0.0491**	mg/L	0.0065	EPA 6010B	2017/05/31

Approved: Andrew Moroz, MSChE
Laboratory Director

ND = Not Detected
MDL = Method Detection Limit
DLR = Detection Limit for Reporting
Any remanding sample(s) for testing will be disposed of two weeks from the final report date unless other arrangements are made in advance.

Analytical Chemical Labs Inc.
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San Diego, CA 92111-2118
Phone:(619) 276-1558
FAX: (619) 276-1581
e-mail: acl@chemist.com

CHAIN OF CUSTODY RECORD

ACL Work Order 180209

Page 1 Of 2

CLIENT NAME: Sespe Consulting
ADDRESS: 1565 Hotel Circle South San Diego CA, 92108

PROJECT: Vulcan - Carli
PHONE #: 530 5740231
FAX #:
e-mail: aalmeida@sespe.com

PROJECT MANAGER: Scott Cohen
SAMPLER: Andre Almeida
P.O.#

ANALYSIS REQUESTED: 6010B As; 6010B Ni; EPA 1312; EXTRATION

SPECIAL HANDLING
- o 1-2 Hours Rush TAT (plus 250%)
- o 3-4 Hours Rush TAT (plus200%)
- o Same Day Rush TAT (plus 150%)
- o 24 to 36 Hours TAT (plus 100%)
- o 48 - 72 Hours TAT (plus 50%)
- ● Regular TAT (5 business Days)

LAB I.D. #	DATE SAMPLED	TIME SAMPLED	SAMPLE TYPE ☆	SAMPLE DESCRIPTION	# OF CONT.	6010B As	6010B Ni	EPA 1312	EXTRATION				REMARKS
[illegible]													
E1	5/15/18	11:25	soil	Soil	1								
E2	" "	11:37	"	"	1								
E3	" "	11:56	"	"	1								
E4	" "	11:54	"	"	1								
E5	" "	11:59	"	"	1								
E6	" "	12:04	"	"	1								

RELINQUISHED BY:	DATE/TIME	RECEIVED BY:
Andre Almeida	5/15/18 9:30pm	UPS
RELINQUISHED BY:	DATE/TIME MAY 17 2018	RECEIVED BY: [signature]
RELINQUISHED BY:	DATE/TIME	RECEIVED BY: 15:00

O = AQ - Aqueous; NA - Nonaqueous; SL - Sludge; DW - Drinking Water; WW - Wastewater; GW - Groundwater; SO - Soil; SW - Solid Waste; AF - Air Filters; WP - Wipes; PT - Paint Chips; OF - Oil or Fuel; OT - Other

SAMPLE CONDITION:

Precooled	Y/N
Preserved	Y/N
Evidence seals intact	Y/N
Preserved at Lab	Y/N

DISPOSITION OF SAMPLES:

Pick Up by client	Y/N
Return	Y/N
Dispose by Lab **	Y/N

** Extra charge added

SPECIAL REQUIREMENTS OR INSTRUCTIONS:

Analytical Chemical Labs, Inc.
EPA Reg. # CA01419 ELAP Cert. # 2505

Client: Sespe Consulting
1565 Hotel Circle South, Suite 370
San Diego, CA 92108
Attn.: Scott Cohen
Project Name: Vulcan - Carli
Purchase Order #: Prepaid

Report Date: October 26, 2017
Received Date: October 25, 2017 13:00
Phone: 530-574-0231 **Fax:**
Project #
Regular TAT

Certificate of Analysis

Lab No: 180209A-1 **Sample ID:** # T1 **Matrix:** Solid - Soil
Sampled By: Andre Almeida **Date:** 05/15/2018 **Time:** 12:40 **Source:** Soil
Test according to EPA 1312 SPLP

Parameter	Results	Units	DLR	Method	Analyzed
Arsenic	**0.004**	mg/L	0.002	EPA 6010B	2017/05/31
Nickel	**0.0751**	mg/L	0.0065	EPA 6010B	2017/05/31

Lab No: 180209A-2 **Sample ID:** # T2 **Matrix:** Solid - Soil
Sampled By: Andre Almeida **Date:** 05/15/2018 **Time:** 12:50 **Source:** Soil
Test according to EPA 1312 SPLP

Parameter	Results	Units	DLR	Method	Analyzed
Arsenic	**ND**	mg/L	0.002	EPA 6010B	2017/05/31
Nickel	**0.0416**	mg/L	0.0065	EPA 6010B	2017/05/31

Lab No: 180209A-3 **Sample ID:** # T3 **Matrix:** Solid - Soil
Sampled By: Andre Almeida **Date:** 05/15/2018 **Time:** 13:30 **Source:** Soil
Test according to EPA 1312 SPLP

Parameter	Results	Units	DLR	Method	Analyzed
Arsenic	**0.022**	mg/L	0.002	EPA 6010B	2017/05/31
Nickel	**0.0653**	mg/L	0.0065	EPA 6010B	2017/05/31

Lab No: 180209A-4 **Sample ID:** # T4 **Matrix:** Solid - Soil
Sampled By: Andre Almeida **Date:** 05/15/2018 **Time:** 13:57 **Source:** Soil
Test according to EPA 1312 SPLP

Parameter	Results	Units	DLR	Method	Analyzed
Arsenic	**0.004**	mg/L	0.002	EPA 6010B	2017/05/31
Nickel	**0.0668**	mg/L	0.0065	EPA 6010B	2017/05/31

Lab No: 180209A-5 **Sample ID:** # T5 **Matrix:** Solid - Soil
Sampled By: Andre Almeida **Date:** 05/15/2018 **Time:** 14:19 **Source:** Soil
Test according to EPA 1312 SPLP

Parameter	Results	Units	DLR	Method	Analyzed
Arsenic	**ND**	mg/L	0.002	EPA 6010B	2017/05/31
Nickel	**0.0521**	mg/L	0.0065	EPA 6010B	2017/05/31

Analytical Chemical Labs, Inc.
EPA Reg. # CA01419 ELAP Cert. # 2505

Certificate of Analysis (continue)

Lab No: 180209A-6 **Sample ID:** # T6 **Matrix:** Solid - Soil
Sampled By: Andre Almeida **Date:** 05/15/2018 **Time:** 14:28 **Source:** Soil
Test according to EPA 1312 SPLP

Parameter	Results	Units	DLR	Method	Analyzed
Arsenic	**0.008**	mg/L	0.002	EPA 6010B	2017/05/31
Nickel	**0.0560**	mg/L	0.0065	EPA 6010B	2017/05/31

Approved: Andrew Moroz, MSChE
Laboratory Director

ND = Not Detected
MDL = Method Detection Limit
DLR = Detection Limit for Reporting
Any remanding sample(s) for testing will be disposed of two weeks from the final report date unless other arrangements are made in advance.

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CHAIN OF CUSTODY RECORD

ACL Work Order 180209A

CLIENT NAME: Sespe Consulting

PROJECT: Vulcan - Carli

ADDRESS: 1565 Hotel Circle South
San Diego, CA 92108

PHONE #: 530 574 0231

FAX #:

e-mail: aalmeida@sespe.com

PROJECT MANAGER: Scott Cohen

SAMPLER: Andre Almeida

P.O. #

ANALYSIS REQUESTED: 6010B As; 6010B Ni; EPA 1312 EXTRACTION

LAB I.D. #	DATE SAMPLED	TIME SAMPLED	SAMPLE TYPE ☆	SAMPLE DESCRIPTION	# OF CONT.	6010B As	6010B Ni	EPA 1312 EXTRACTION					REMARKS
T1	5/15/18	12:40	soil	soil	1	↓	↓	↓					
T2	" "	12:50	"	" "	1								
T3	" "	1:30	"	" "	1								
T4	" "	1:57	"	" "	1								
T5	" "	2:19	"	" "	1								
T6	" "	2:28	"	" "	1	↓	↓	↓					

SPECIAL HANDLING

- o 1- 2 Hours Rush TAT (plus 250%)
- o 3 - 4 Hours Rush TAT (plus 200%)
- o Same Day Rush TAT (plus 150%)
- o 24 to 36 Hours TAT (plus 100%)
- o 48 - 72 Hours TAT (plus 50%)
- o Regular TAT (5 business Days)

RELINQUISHED BY:	DATE/TIME	RECEIVED BY:
Andre Almeida	5/15/18 4:30 pm	UPS
RELINQUISHED BY:	DATE/TIME MAY 17 2018	RECEIVED BY: Bern Mm
RELINQUISHED BY:	DATE/TIME	RECEIVED BY: 15:00

☆ = AQ - Aqueous; NA - Nonaqueous; SL - Sludge; DW - Drinking Water; WW - Wastewater; GW - Groundwater; SO - Soil; SW - Solid Waste; AF - Air Filters; WP - Wipes; PT - Paint Chips; OF - Oil or Fuel; OT - Other

SAMPLE CONDITION:

- Precooled Y/N
- Preserved Y/N
- Evidence seals intact Y/N
- Preserved at Lab Y/N

DISPOSITION OF SAMPLES:

- Pick Up by client Y/N
- Return Y/N
- Dispose by Lab ** Y/N

** Extra charge added

SPECIAL REQUIREMENTS OR INSTRUCTIONS:

Analytical Chemical Labs, Inc.

8222 Vickers St.
Suite 110
San Diego, CA 92111

Invoice

Date	Invoice #
5/18/2018	2018/223

Bill To
Sespe Consulting **1565 Hotel Circle South** **Suite 370** **San Diego, CA 92108**

P.O. No.	Terms	Due Date	Account #	Project
prepaid	Due on receipt	5/18/2018	712	Vulcan - Carli

Description	Qty	Rate	Amount
SPLP test for 2 metals in soil (As, Ni) including extraction, Report # 180209	12	95.00	1,140.00

Thank you for your business.

Total	***$1,140.00***
Payments/Credits	-$1,140.00
Balance Due	**$0.00**

Payment must be recieved by the due date.
Past due account may be subject to finance charge at the periodic rate of 2.5% per month but no less then $35.
We will charge $35 for each returned check.

Phone #	Fax #	E-mail	Web Site
619-276-1558	619-276-1581	aclchem@sandiego.twcbc.com	www.aclchem.com

APPENDIX H

GREEN HOUSE GAS EMISSIONS

Equipment Name	Equiptment	HP	Load Factor	Operating (hr/day)	Operation (hr/yr)	Work (hp-hr/yr)	Diesel Use (gal/yr)	CO2 (kg/yr)	N2O (kg/yr)	CH4 (kg/yr)	CO2e (kg/yr)	CO2e (MT/yr)
DR9 CAT DOZER	Crawler Tractors	450	0.43	4	1,248	241,488	12,571	128,306	1	5	128,747	129
140H CAT MOTORGRADER	Graders	165	0.41	2	624	42,214	2,198	22,429	0	1	22,506	23
EX1200 HITACHI EXCAVATOR	Excavators	625	0.38	8	2,496	592,800	30,859	314,964	3	13	316,045	316
988F CAT LOADER	Rubber Tired Loaders	425	0.36	8	2,496	381,888	19,880	202,903	2	8	203,600	204
988F CAT LOADER	Rubber Tired Loaders	425	0.36	8	2,496	381,888	19,880	202,903	2	8	203,600	204
R40-C EUCLID RIGID HAULER	Off-Highway Trucks	525	0.38	8	2,097	418,352	21,778	222,277	2	9	223,040	223
R40-C EUCLID RIGID HAULER	Off-Highway Trucks	525	0.38	8	2,097	418,352	21,778	222,277	2	9	223,040	223
357 Peterbilt Water Truck	On-Highway Trucks	385	0.38	2	624	91,291	4,752	48,504	0	2	48,671	49
384 Peterbilt Service Truck	On-Highway Trucks	190	0.38	1	312	22,526	1,173	11,969	0	0	12,010	12
Total						**2,590,798**	**134,869**	**1,376,533**	**11**	**56**	**1,381,256**	**1,381**

*Recycle Plant Equiptment Substitutes for mining equiptment (total product output remains constant) and has lower emissions (see Appendix F) and was therefore not included

Triangle Rock	2041.4
Difference	-660.144
Percent reduced:	32%

0.367	lb diesel/hp-hr (brake specific fuel consumption (BSFC) from OFFROAD2011)	
7.05	lb/gal (density of diesel fuel)	
0.138	MMBtu/gal	
73.96	kg CO2/MMBtu	
10.20648	kg CO2/gal	
		GWP
0.414	g CH4/gal	25
0.0828	g N2O/gal	298

https://www.arb.ca.gov/cc/inventory/doc/docs1/1a2m_manufacturing_fuelcombustion_distillate_co2_2014.htm
https://www.arb.ca.gov/cc/inventory/doc/docs1/1a2m_manufacturing_fuelcombustion_distillate_n2o_2014.htm
https://www.arb.ca.gov/cc/inventory/doc/docs1/1a2m_manufacturing_fuelcombustion_distillate_ch4_2014.htm

APPENDIX I

MITIGATION MEASURE SUPPORTING DOCUMENTS

United States Environmental Protection Agency

Office of Transportation and Air Quality
EPA-420-B-16-022
March 2016

Nonroad Compression-Ignition Engines: Exhaust Emission Standards

	Rated Power (kW)	Tier	Model Year	NMHC (g/kW-hr)	NMHC + NOx (g/kW-hr)	NOx (g/kW-hr)	PM (g/kW-hr)	CO (g/kW-hr)	Smoke [a] (Percentage)	Useful Life (hours /years) [b]	Warranty Period (hours /years) [b]
Federal	kW < 8	1	2000-2004	-	10.5	-	1.0	8.0	20/15/50	3,000/5	1,500/2
		2	2005-2007	-	7.5	-	0.80	8.0			
		4	2008+	-	7.5	-	0.40 [c]	8.0			
	8 ≤ kW < 19	1	2000-2004	-	9.5	-	0.80	6.6		3,000/5	1,500/2
		2	2005-2007	-	7.5	-	0.80	6.6			
		4	2008+	-	7.5	-	0.40	6.6			
	19 ≤ kW < 37	1	1999-2003	-	9.5	-	0.80	5.5		5,000/7 [d]	3,000/5 [e]
		2	2004-2007	-	7.5	-	0.60	5.5			
		4	2008-2012	-	7.5	-	0.30	5.5			
			2013+	-	4.7	-	0.03	5.5			
	37 ≤ kW < 56	1	1998-2003	-	-	9.2	-	-		8,000/10	3,000/5
		2	2004-2007	-	7.5	-	0.40	5.0			
		3 [f]	2008-2011	-	4.7	-	0.40	5.0			
		4 (Option 1) [g]	2008-2012	-	4.7	-	0.30	5.0			
		4 (Option 2) [g]	2012	-	4.7	-	0.03	5.0			
		4	2013+	-	4.7	-	0.03	5.0			
	56 ≤ kW < 75	1	1998-2003	-	-	9.2	-	-			
		2	2004-2007	-	7.5	-	0.40	5.0			
		3	2008-2011	-	4.7	-	0.40	5.0			
		4	2012-2013 [h]	-	4.7	-	0.02	5.0			
			2014+ [i]	0.19	-	0.40	0.02	5.0			
	75 ≤ kW < 130	1	1997-2002	-	-	9.2	-	-			
		2	2003-2006	-	6.6	-	0.30	5.0			
		3	2007-2011	-	4.0	-	0.30	5.0			
		4	2012-2013 [h]	-	4.0	-	0.02	5.0			
			2014+	0.19	-	0.40	0.02	5.0			

Continued

	Rated Power (kW)	Tier	Model Year	NMHC (g/kW-hr)	NMHC + NOx (g/kW-hr	NOx (g/kW-hr	PM (g/kW-hr	CO (g/kW-hr)	Smoke [a] (Percentage)	Useful Life (hours /years) [b]	Warranty Period (hours /years) [b]
Federal	130 ≤ kW < 225	1	1996-2002	1.3 [j]	-	9.2	0.54	11.4	20/15/50	8,000/10	3,000/5
		2	2003-2005	-	6.6	-	0.20	3.5			
		3	2006-2010	-	4.0	-	0.20	3.5			
		4	2011-2013 [h]	-	4.0	-	0.02	3.5			
			2014+ [i]	0.19	-	0.40	0.02	3.5			
	225 ≤ kW < 450	1	1996-2000	1.3 [j]	-	9.2	0.54	11.4			
		2	2001-2005	-	6.4	-	0.20	3.5			
		3	2006-2010	-	4.0	-	0.20	3.5			
		4	2011-2013 [h]	-	4.0	-	0.02	3.5			
			2014+ [i]	0.19	-	0.40	0.02	3.5			
	450 ≤ kW < 560	1	1996-2001	1.3 [j]	-	9.2	0.54	11.4			
		2	2002-2005	-	6.4	-	0.20	3.5			
		3	2006-2010	-	4.0	-	0.20	3.5			
		4	2011-2013 [h]	-	4.0	-	0.02	3.5			
			2014+ [i]	0.19	-	0.40	0.02	3.5			
	560 ≤ kW < 900	1	2000-2005	1.3 [j]	-	9.2	0.54	11.4			
		2	2006-2010	-	6.4	-	0.20	3.5			
		4	2011-2014	0.40	-	3.5	0.10	3.5			
			2015+ [i]	0.19	-	3.5 [k]	0.04 [l]	3.5			
	kW > 900	1	2000-2005	1.3 [j]	-	9.2	0.54	11.4			
		2	2006-2010	-	6.4	-	0.20	3.5			
		4	2011-2014	0.40	-	3.5 [k]	0.10	3.5			
			2015+ [i]	0.19	-	3.5 [k]	0.04 [l]	3.5			

Notes on following page.

Notes:

- For Tier 1, 2, and 3 standards, exhaust emissions of nitrogen oxides (NOx), carbon monoxide (CO), hydrocarbons (HC), and non-methane hydrocarbons (NMHC) are measured using the procedures in 40 Code of Federal Regulations (CFR) Part 89 Subpart E. For Tier 1, 2, and 3 standards, particulate matter (PM) exhaust emissions are measured using the California Regulations for New 1996 and Later Heavy-Duty Off-Road Diesel Cycle Engines.
- For Tier 4 standards, engines are tested for transient and steady-state exhaust emissions using the procedures in 40 CFR Part 1039 Subpart F. Transient standards do not apply to engines below 37 kilowatts (kW) before the 2013 model year, constant-speed engines, engines certified to Option 1, and engines above 560 kW.
- Tier 2 and later model naturally aspirated nonroad engines shall not discharge crankcase emissions into the atmosphere unless these emissions are permanently routed into the exhaust. This prohibition does not apply to engines using turbochargers, pumps, blowers, or superchargers.
- In lieu of the Tier 1, 2, and 3 standards for NOX, NMHC + NOX, and PM, manufacturers may elect to participate in the averaging, banking, and trading (ABT) program described in 40 CFR Part 89 Subpart C.

a Smoke emissions may not exceed 20 percent during the acceleration mode, 15 percent during the lugging mode, and 50 percent during the peaks in either mode. Smoke emission standards do not apply to single-cylinder engines, constant-speed engines, or engines certified to a PM emission standard of 0.07 grams per kilowatt-hour (g/kW-hr) or lower. Smoke emissions are measured using procedures in 40 CFR Part 86 Subpart I.

b Useful life and warranty period are expressed hours and years, whichever comes first.

c Hand-startable air-cooled direct injection engines may optionally meet a PM standard of 0.60 g/kW-hr. These engines may optionally meet Tier 2 standards through the 2009 model years. In 2010 these engines are required to meet a PM standard of 0.60 g/kW-hr.

d Useful life for constant speed engines with rated speed 3,000 revolutions per minute (rpm) or higher is 5 years or 3,000 hours, whichever comes first.

e Warranty period for constant speed engines with rated speed 3,000 rpm or higher is 2 years or 1,500 hours, whichever comes first.

f These Tier 3 standards apply only to manufacturers selecting Tier 4 Option 2. Manufacturers selecting Tier 4 Option 1 will be meeting those standards in lieu of Tier 3 standards.

g A manufacturer may certify all their engines to either Option 1 or Option 2 sets of standards starting in the indicated model year. Manufacturers selecting Option 2 must meet Tier 3 standards in the 2008-2011 model years.

h These standards are phase-out standards. Not more than 50 percent of a manufacturer's engine production is allowed to meet these standards in each model year of the phase out period. Engines not meeting these standards must meet the final Tier 4 standards.

i These standards are phased in during the indicated years. At least 50 percent of a manufacturer's engine production must meet these standards during each year of the phase in. Engines not meeting these standards must meet the applicable phase-out standards.

j For Tier 1 engines the standard is for total hydrocarbons.

k The NOx standard for generator sets is 0.67 g/kW-hr.

l The PM standard for generator sets is 0.03 g/kW-hr.

Citations: Code of Federal Regulations (CFR) citations:

- 40 CFR 89.112 = Exhaust emission standards
- 40 CFR 1039.101 = Exhaust emission standards for after 2014 model year
- 40 CFR 1039.102 = Exhaust emission standards for model year 2014 and earlier
- 40 CFR 1039 Subpart F = Exhaust emissions transient and steady state test procedures
- 40 CFR 86 Subpart I = Smoke emission test procedures
- 40 CFR 1065 = Test equipment and emissions measurement procedures

Particulate Matter (PM) Emission Factors For Processes/Equipment at Asphalt, Cement, Concrete, and Aggregate Product Plants

December 2014

This document provides emission factors for estimating **total suspended particulate matter (PM) emissions (not PM_{10})** for **individual** emission source at aggregate (sand and gravel), brick and tile, hot mix asphalt, cement, concrete batch plants. These factors are also applicable to emission sources other than processes identified in recently adopted Rules 1156 and 1157.

The factors and equations are extracted from the US EPA AP-42 document. Some of the complex equations are simplified with either default settings or assumptions that are applicable to the conditions and operations existing in the South Coast Air Basin as shown in the Reference column of the attached table. Emission factors with an asterisk (*) are not published in the EPA AP-42. These emission factors are determined using the agreed control efficiencies that were established during rule development and also are listed in the Reference column.

Facility is encouraged to apply specific parameters that are applicable to its operations to calculate emissions from the equipment/processes including the results from approved source tests and efficiencies of the add-on control equipment. Supporting documents must be submitted with the annual emission report to show the use of such parameters or source test results in calculating annual emissions.

In the absence of specific parameters and/or source tests, facility can calculate its annual emissions using the factors provided in the attached table and the following equation.

$$\boxed{E = TP \times EF}$$

Where: E = Emission (tons/year)

TP = Annual Throughput

EF = Emission Factor

The unit for TP in this equation must be consistent with the unit of EF. For example, if EF is in pound per ton of material transferred (lb/ton), then TP must be tons of transferred material. For unique emission sources, additional data must be used in determining the factor (EF or TP) before it can be used in emission calculation as discussed in the following notes:

Note 1: For mining/quarrying, **emission factor** is expressed in pound per blast (lb/blast) and is calculated as:

$$\boxed{EF = 0.000014 \times A^{1.5}}$$

Where: A = Total horizontal blasted area in squared foot (ft^2), provided that the blast depth is less than 70 ft.

In this case, the throughput (TP) is number of blast per year.

Note 2: For road emissions (E) caused by vehicle traffic, the **throughput** is expressed in annual vehicle miles traveled (VMT) as follows:

$$\mathrm{TP} = \mathrm{VMT} = \mathrm{Road\ Length} \times \left(\frac{\#\ \mathrm{Truck\ Trips}}{\mathrm{Day}}\right) \times \left(\frac{\#\ \mathrm{Days}}{\mathrm{Year}}\right) \times \left(\frac{1\,\mathrm{Mile}}{5{,}280\,\mathrm{ft}}\right)$$

Where: Road Length = One-way distance in feet (ft) of paved or unpaved road within the facility, used by haul trucks and non-haul trucks.

\# Truck Trips = the number of roundtrips the vehicle made.

Definitions: Haul Road: an unpaved road used by haul trucks to carry materials from the quarry to the unloading/processing area within the facility.

Non-Haul Road: unpaved and/or paved road used by non-haul trucks to carry materials from one location to another location within the facility, usually between the facility's entrance/exit to loading/unloading/processing areas.

Note 3: In addition to PM emissions, VOC emissions are also expected from asphalt product during loading out and silo filling operations. **Emission factor** (lb/ton of product loaded) is expressed in as follows:

ASPHALT LOAD-OUT

$$\mathrm{EF_{PM}} = 0.000181 + 0.00141(-\mathrm{V})e^{((0.0251)\times(T+460)-20.43)}$$
$$\mathrm{EF_{VOC}} = 0.0172(-\mathrm{V})e^{((0.0251)\times(T+460)-20.43)}$$

SILO FILLING

$$\mathrm{EF_{PM}} = 0.000332 + 0.00105(-\mathrm{V})e^{((0.0251)\times(T+460)-20.43)}$$
$$\mathrm{EF_{VOC}} = 0.0504(-\mathrm{V})e^{((0.0251)\times(T+460)-20.43)}$$

Where: V = Asphalt Volatility (in negative %); (Example -2.5%)

T = Asphalt Product Mix Temperature (degree F)

Operation/Emission Sources	Emission Factor UNCONTROLLED	Emission Factor ***CONTROLLED***	Unit	References And Assumptions
ROAD EMISSIONS FROM VEHICLE TRAFFIC				
• **PAVED ROAD**				Chapter 13.2.1, Equation 1
	Aggregate / Crushed Material Plants			Assumptions:
$E = VMT \times k \times \left(\frac{sL}{2}\right)^{a} \times \left(\frac{W}{3}\right)^{b}$	EF = 11.65	*EF = 2.33**	lb/VMT	k = 0.082, a = 0.65, b = 1.5
				Aggregate / Crushed Material $sL = 53\ g/m^2$
Where: E = PM emissions	**Hot Mix Asphalt Plants**			Hot Mix Asphalt
TP = VMT = annual vehicle mile traveled (see **Note 2**)	EF = 14.73	*EF = 2.95**	lb/VMT	$sL = 76\ g/m^2$
				Cement / Concrete / Others $sL = 11\ g/m^2$
$EF = k \times \left(\frac{sL}{2}\right)^{a} \times \left(\frac{W}{3}\right)^{b}$	**Concrete Batching**			W_{Loaded} = 30 tons
	EF = 4.91	*EF = 0.98**	lb/VMT	$W_{Unloaded}$ = 5 tons
k = particle size multiplier				$W_{\text{Unloaded for concrete Batching}}$ = 12 tons
a, b = constants				
sL = road surface silt loading (g/m^2)	**Cement/Other Plants**			Control Efficiency for chemical stabilizer = 80%
W = average weight (tons) of the vehicle	EF = 4.19	*EF = 0.84**	lb/VMT	

Operation/Emission Sources	Emission Factor UNCONTROLLED	<u>*CONTROLLED*</u>	Unit	References And Assumptions
• **UNPAVED ROAD** $$E = VMT \times k \times \left(\frac{S}{12}\right)^a \times \left(\frac{W}{3}\right)^b$$ Where: E = PM emissions TP = VMT = annual vehicle mile traveled (see **Note 2**) $$EF = k \times \left(\frac{S}{12}\right)^a \times \left(\frac{W}{3}\right)^b$$ k = particle size multiplier a, b = constants S = surface material silt content (%) W = average weight (tons) of the vehicle	**Aggregate Plants** HAUL VEHICLE EF = 16.36 NON-HAUL VEHICLE EF = 8.79 **Other Plant** HAUL VEHICLE EF = 14.66 NON-HAUL VEHICLE EF = 5.26	 <u>*EF = 3.27**</u> <u>*EF = 1.76**</u> <u>*EF = 2.93**</u> <u>*EF =1.05**</u>	 lb/VMT lb/VMT lb/VMT lb/VMT	Assumptions: k = 4.9, a = 0.7, b = 0.45 HAUL W_{Loaded} = 120 tons $W_{Unloaded}$ = 45 tons $S_{Aggregate}$ = 8.3% S_{Others} = 7.1% NON-HAUL W_{Loaded} = 30 tons $W_{Unloaded}$ = 5 tons $S_{Aggregate}$ = 10% S_{Others} = 4.8 % Control Efficiency for chemical stabilizer = 80%
<u>**OPEN STORAGE PILE**</u> TP = annual tonnage of stored material = amount of material loaded into, or out of, the pile	EF = 0.33	<u>*EF = 0.0165**</u>	lb/ton	Chapter 11.19.1, Final Report, Table 4-1 Control Efficiency = 95%

Operation/Emission Sources	Emission Factor UNCONTROLLED	 ***CONTROLLED***	Unit	References And Assumptions
MINING/QUARRYING				
• **DRILLING** TP = number of hole drilled	EF = 1.3		lb/hole	Chapter 11.9, Table 11.9-4
• **BLASTING** (see **Note 1**) TP = number of blast	EF = 0.000014 (A) $^{1.5}$		lb/blast	Chapter 11.9, Table 11.9-1
LOADING / UNLOADING				
• **CONVEYOR TRANSFER POINT** For a system of multiple transfer points, this EF must be multiplied by the number of transfer points (where materials drop from one point to another). Refer to Rule 1157 definition for more detail.	**Aggregate/Crushed Miscellaneous Base/ Asphalt Plants**			
	EF = 0.003	*EF = 0.00014*	lb/ton	Chapter 11.19.2, Table 11.19.2-2
	Concrete Batching and Others			
	SAND:			
	EF = 0.0021	*EF = 0.00011**	lb/ton	Chapter 11.12, Table 11.12-2 Control Efficiency = 95%
	AGGREGATE:			
	EF = 0.0069	*EF = 0.00035**	lb/ton	

Operation/Emission Sources	Emission Factor UNCONTROLLED	*CONTROLLED*	Unit	References And Assumptions
• **WEIGHT HOPPER / SURGE BIN**	EF = 0.0051	*EF = 0.00026**	lb/ton	Chapter 11.12, Table 11.12-2 Control Efficiency = 95%
• **SILOS**				
Cement	EF = 0.72	*EF = 0.00099*	lb/ton	Chapter 11.12, Table 11.12-2
Cement Supplements (Fly Ash)	EF = 3.14	*EF = 0.0089*	lb/ton	
• **CONCRETE LOADING (Truck Mix)**	EF = 0.995	*EF = 0.0568*	lb/ton	Chapter 11.12, Table 11.12-2
• **CONCRETE LOADING (Central Mix)**	EF = 0.544	*EF = 0.0173*	lb/ton	Chapter 11.12, Table 11.12-2
• **ASPHALT PRODUCTS LOAD OUT** (see **Note 3)**		**PM:** *EF = 0.00052* **VOC:** *EF = 0.0042*	lb/ton lb/ton	Chapter 11.1, Table 11.1-14 V=-0.5, T=325 ^{o}F
• **ASPHALT SILO FILLING** (see **Note 3)**		**PM:** *EF = 0.00059* **VOC:** *EF = 0.0122*	lb/ton lb/ton	Chapter 11.1, Table 11.1-14 V=-0.5, T=325 ^{o}F

Operation/Emission Sources	Emission Factor UNCONTROLLED	*CONTROLLED*	Unit	References And Assumptions
CRUSHING				
• **PRIMARY CRUSHER**	EF = 0.014*	*EF = 0.00031*	lb/ton	Chapter 11.6, Table 11.6-4 Control Efficiency = 97.8%
• **TERTIARY CRUSHER**	EF = 0.0054	*EF = 0.0012*	lb/ton	Chapter 11.19.2, Table 11.19.2-2
• **FINE CRUSHER**	EF = 0.039	*EF = 0.003*	lb/ton	Chapter 11.19.2, Table 11.19.2-2
SCREENING				
• **COARSE**	EF = 0.025	*EF = 0.0022*	lb/ton	Chapter 11.19.2, Table 11.19.2-2
• **FINE**	EF = 0.30	*EF = 0.0036*	lb/ton	Chapter 11.19.2, Table 11.19.2-2
• **SAND**	EF = 0.21*	*EF = 0.0083*	lb/ton	Chapter 11.19.1, Table 11.19.1-1 Control Efficiency = 96.1%

Operation/Emission Sources	Emission Factor UNCONTROLLED	Emission Factor *CONTROLLED*	Unit	References And Assumptions
GRINDING	EF = 8.5	*EF = 0.0062*	lb/ton	Chapter 11.3, Table 11.3-2
CEMENT MILLING				
Raw Mill	EF = 1.2*	*EF = 0.012*	lb/ton	Chapter 11.6, Table 11.6-4
Finish Grinding Mill	EF = 0.8*	*EF = 0.008*	lb/ton	Control Efficiency = 99%
OTHER PROCESS/EQUIPMENT				
• **DRYER**				
SAND and GRAVEL	EF = 2.0	*EF = 0.039*	lb/ton	Chapter 11.19.1, Table 11.19.1-1
BATCH MIX ASPHALT	EF = 32	*EF = 0.042*	lb/ton	Chapter 11.1, Table 11.1-1
DRUM MIX ASPHALT	EF = 28	*EF = 0.033*	lb/ton	Chapter 11.1, Table 11.1-3
BRICK MANUFACTURING	EF = 0.187		lb/ton	Chapter 11.3., Table 11.3-1
• **KILNS**				
BRICK	EF = 0.96		lb/ton	Chapter 11.3., Table 11.3-1
CEMENT	EF = 109*	*EF = 1.09*	lb/ton	Chapter 11.6, Table 11.6-2
CLINKER COOLER	EF = 14.7 *	*EF = 0.147*	lb/ton	Control Efficiency = 99%

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