APPENDIX E

Air Quality Appendix

Appendix E-1

TABLE E-1 RECOMMENDED AB32 GREENHOUSE GAS MEASURES TO BE INITIATED BY CARB BETWEEN 2007 AND 2012

ID #	Sector	Strategy Name
1	Fuels	Above Ground Storage Tanks
2	Transportation	Diesel – Offroad equipment (non-agricultural)
3	Forestry	Forestry protocol endorsement
4	Transportation	Diesel – Port trucks
5	Transportation	Diesel – Vessel main engine fuel specifictions
6	Transportation	Diesel – Commercial harbor craft
7	Transportation	Green ports
8	Agriculture	Manure management (methane digester protocol)
9	Education	Local gov. Greenhouse Gas (GHG) reduction guidance / protocols
10	Education	Business GHG reduction guidance / protocols
11	Energy Efficiency	Cool communities program
12	Commerical	Reduce high Global Warming Potential (GWP) GHGs in products
13	Commercial	Reduction of PFCs from semiconductor industry
14	Transportation	SmartWay truck efficiency
15	Transportation	Low Carbon Fuel Standard (LCFS)
16	Transportation	Reduction of HFC-134a from DIY Motor Vehicle AC servicing
17	Waste	Improved landfill gas capture
18	Fuels	Gasoline disperser hose replacement
19	Fules	Portable outboard marine tanks
20	Transportation	Standards for off-cycle driving conditions
21	Transportation	Diesel – Privately owned on-road trucks
22	Transportation	Anti-idling enforcement
23	Commercial	SF_6 reductions from the non-electric sector
24	Transportation	Tire inflation program
25	Transportation	Cool automobile paints
26	Cement	Cement (A): Blended cements
27	Cement	Cement (B): Energy efficiency of California cement facilities
28	Transportation	Ban on HFC release from Motor Vehcile AC service / dismantling
29	Transportation	Diesel – offroad equipment (agricultural)
30	Transportation	Add AC leak tightness test and repair to Smog Check
31	Agriculture	Research on GHG reductions from nitrogen land applications
32	Commercial	Specifications for commercial refrigeration
33	Oil and Gas	Reduction in venting / leaks from oil and gas systems
34	Transportation	Requirement of low-GWP GHGs for new Motor Vehicle ACs
35	Transportation	Hybridization of medium and heavy-duty diesel vehicles
36	Electricity	Reduction of SF_6 in electricity generation
37	Commercial	High GWP refrigerant tracking, reporting and recovery program
38	Commercial	Foam recovery / destruction program
39	Fire Suppression	Alternative suppressants in fire protection systems
40	Transportation	Strengthen light-duty vehicle standards
41	Transportation	Truck stop electrification with incentives for truckers
42	Transportation	Diesel – Vessel speed reductions
43	Transportation	Transportation refrigeration – electric standby
44	Agriculture	Electrification of stationary agricultural engines

SOURCE: California Air Resources Board, September 2007a. Draft List of Early Action Measures To Reduce Greenhouse Gas Emissions In California Recommended For Board Consideration.

Appendix E-2

Crushed Stone Processing

Rock and crushed stone products are loosened by drilling and blasting, loaded by front-end loader into large haul trucks that transport the material to the processing operations. Processing operations include crushing, screening, size classification, material handling and storage operations. All of these processes can be large sources of PM10 emissions, if uncontrolled.

Quarried stone is dumped into hopper feeders, usually a vibrating grizzly type, or onto screens. The feeder or screens separate large stones from finer rocks that do not require primary crushing, thus, reducing the load to the primary crusher. Jaw or impactor crushers are usually used for initial reduction. The crusher product, larger diameter stones, and the grizzly undersize material are discharged onto a belt conveyor and usually are conveyed to a surge pile for temporary storage, or are sold as coarse aggregates.

The stone from the surge pile is conveyed to a vibrating inclined screen. This unit separates oversized rock from the smaller stone. The undersize material from the vibrating screen is considered to be a product stream and is transported to a storage pile and sold as base material. The stone that is too large to pass through the top deck of the screen is processed in the secondary crusher. Cone crushers are commonly used for secondary crushing (although impact crushers are sometimes used), which typically reduces material to about 1 to 4 inches. The material from the second level of the screen bypasses the secondary crusher because it is sufficiently small for the last crushing step. The output from the secondary crusher and the material from the secondary screen are transported by conveyor to the tertiary circuit, which includes a sizing screen and a tertiary crusher.

Tertiary crushing is usually performed using cone crushers or other impact crushers. Oversize material from the top deck of the sizing screen is fed to the tertiary crusher. The tertiary crusher output, which is typically about one inch, is returned to the sizing screen. Various product streams with different size gradations are separated in the screening operation. The products are conveyed or trucked directly to finished product bins, open area stockpiles, or to other processing systems such as washing, air separators, and screens and classifiers (for the production of manufactured sand).

Sand is also manufactured. This is a small-sized rock product with a maximum size of 3/16th inch. Crushed stone from the tertiary sizing screen is sized in a vibrating inclined screen (fines screen) with relatively small mesh sizes. Oversize material is processed in a cone crusher adjusted to produce small diameter material. The output is then returned to the fines screen for resizing. Facilities that use wet suppression systems (spray nozzles) to maintain relatively high material moisture contents can effectively control PM emissions throughout the process.

Air emissions were determined for the operation of the crushed stone processing units. The air emission calculations accounted for the proposed production level, the number, types, and size of equipment, and the type of material processed and emission controls, if any. The emission factors were determined using the methodology found in Section 11.19 of EPA's Compilation of Air

Pollutant Emission Factors (AP-42) (EPA, 2006a). **Table AQ-1** presents the emission factors for the stone processing operations. A substantial portion of the air emissions from gravel processing consists of heavy particles that may settle out within the plant area. The stacker belts (a total of four) have air emissions controls applied to them as does the plate feeder, the three crushers (one jaw and two cone), and the triple screen. Emissions are based on a production level of 300 cy per hour, 3,600 cy per day, and 570,000 cy per year.

TABLE AQ-1
EMISSION FACTORS FOR AGGREGATE PROCESSING

Emission Point	Number of Points	Uncontrolled Emission Factor (lbs/ton of material)	Controlled Emission Factor (lbs/ton of material)
Stacker Belt	4	0.0014	0.000048
Crushers	3	0.0024	0.00059
Screens (Three Deck)	3	0.015	0.00084
Plate Feeder	1	---	0.00010
Truck Unloading/Loading	3	0.000116	---

SOURCE: EPA, 2006a.

Fugitive sources include the transfer of sand and aggregate, truck loading, mixer loading, vehicle traffic, and wind erosion from aggregate storage piles. The amount of fugitive emissions generated during the transfer of aggregate depends primarily on the surface moisture content of these materials.

Blasting Operations

Occasionally, rock is encountered that is too hard to push put of the hill with large equipment. In this case, the rock must be blasted with dynamite in order to fracture it and push it out of the hill. Twenty to 25 holes, approximately 40 feet deep are drilled into the rock and set charges to blast the rock. The charges are detonated sequentially over a time span of approximately 100 milliseconds to fracture the rock in place and allow the machinery to push it out. Usually only one or two blasts occur per month. Blasting is limited to daytime hours. The emission factors were calculated using the methodology found in the *Sonoma County Aggregate Resources Management Plan and Environmental Impact Report* (Sonoma County, 1994). The emission factor for the quantity of emissions (in pounds) per blast event is estimated using the following equation:

$$EF \quad = \quad 0.2 * 961\,(A)^{0.8} / [(D)^{1.8}\,(M)^{1.9}]$$

where:

EF = emission factor (lb emissions/blast)
A = blast area (100 square feet)
D = depth of blast (40 feet)
M = moisture content (1.0 %)

Based on available data, the emission factor for blasting operations is 10 pounds of PM10 per blast.

MSHA rules require the use water injection when drilling to control drilling dust. Standard blasting practices using sequential delay timing schemes to generate effective rock fragmentation and vibration control will also minimize blasting dust. Quarry operators usually remove loose overburden to prevent dilution of mined rock, which also lessens the amount of fine material that can become airborne by blasting. If needed, during dry summer periods, water can also be sprayed onto blast areas to further mitigate dust. If these standard practices are committed to by the applicant and rigorously applied, it is unlikely that airborne dust from blasting will be a cause of concern[1].

Handling and Storage

Fugitive particulate matter emissions are expected from the handling and storage of raw materials from quarry processing. The methodology for the calculation of particulate emissions from the handling and storage of raw materials is described in AP-42 Section 13.2.4 (EPA, 2006b) for aggregate handling and storage piles. The quantity of dust emissions from aggregate handling and storage operations varies with the volume of aggregate passing through the storage cycle. The emission factor for the quantity of emissions per quantity of material is estimated using the following equation:

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

where:

EF = emission factor (lb emissions/ton material)
k = particulate size multiplier (PM10 = 0.35)
U = mean wind speed (5.5 mph)
M = material moisture content (0.7 %)

Based on available data, the emission factor for handling and storage activities is 0.0055 pounds of PM10 per ton of material processed (uncontrolled) and 0.00138 pounds of PM10 per ton of material processed (controlled). Weather data (wind speed) from http://www.wrcc.dri.edu/summary for Santa Rosa, California. To account for emission controls, a control efficiency of 75 percent was applied.

Wind Erosion

In addition to emissions from the handling of storage piles, EPA provides a methodology for calculating emissions from wind erosion of storage piles as documented in AP-42 Section 13.2.5 (EPA, 2006c). The emission factor for wind-generated particulate emissions is dependent on the frequency of disturbance of the storage pile and is expressed in units of grams per square meter (g/m^2) per year. The following equations were used to calculate the emission factor.

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[1] *Assessment of Rock Blasting Impacts and Recommended Practices for Proposed Roblar Quarry,* Revey Associates, Inc, November 2006.

$$EF = k \sum_{i=1}^{N} P_i$$

$$P_i = 58(u^\bullet - u_t^\bullet)^2 + 25(u^\bullet - u_t^\bullet); P_i = 0 \ \ for \ u^\bullet \le u_t^\bullet$$

$$u^\bullet = 0.4\, u_{10} / \ln(z / zo)$$

where:

EF = emission factor ($g/m^2/yr$)
k = aerodynamic particle size multiplier (0.5) dimensionless
P = erosion potential (g/m^2)
N = number of disturbances (20 disturbances per year)
$u^\bullet$ = friction velocity (m/s)
$u_t^\bullet$ = threshold friction velocity (1.02 m/s) (AP42, 1995)
u_{10} = fastest mile wind speed (33 mph) for Santa Rosa, California
z = 10 m
zo = 0.1 m)

The basis of this methodology is that wind-blown dust from exposed areas will occur only when two conditions are met: the surface of the exposed area is disturbed and winds occur in excess of a threshold wind speed. Once the two conditions have been met, the emission factor is used to determine how much dust is generated. No more wind erosion occurs until the surface is again disturbed and the wind again exceeds the threshold speed. The calculation assumes the storage piles will be disturbed daily, when the 2-minute wind speed exceeds the threshold velocity of 23 mph. Based on meteorological data from Santa Rosa during June 2002 through May 2003[2], this occurred 20 days during the period.

Based on available data, the emission factor for handling and storage activities is 5.25 grams of PM10 per square meter of stockpile (uncontrolled) and 1.28 grams per square meter of stockpile (controlled). To account for emission controls, a control efficiency of 75 percent was applied.

Unpaved Roads

When a vehicle travels over an unpaved road, the force of the wheels on the road surface causes pulverization of surface material. Particles are lifted and dropped from the rolling wheels, and the road surface is exposed to strong air currents in turbulent shear with the surface. The turbulent wake behind the vehicle continues to act on the road surface after the vehicle has passed. The

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[2] http://www.wrh.noaa.gov/total_forecast/index.php?wfo=mtr&zone=caz506&fire=caz205&county=cac097

emission factors were calculated using the methodology found in Section 13.2, Unpaved Roads of the EPA's AP-42 (EPA, 2006d). The equation for developing the emission factor is:

$$EF \quad = \quad k\,(S/12)^{a}(W/3)^{b}\,[(365-p)/365]\,(1-CE)$$

where:

k (PM_{10}) = 1.5 (empirical constant)
S = Silt content of 10% (use whole number value)
W = 34 tons Mean vehicle weight of 34 tons, the average of empty and full
p = Number of days with measurable precipitation (74 days)
a = 0.9 (empirical constant)
b = 0.45 (empirical constant)
CE = Control efficiency rate of 75% (empirical constant)

Based on available data, the emission factor for unpaved roads is 3.80 pounds of PM_{10} per vehicle mile traveled (uncontrolled) and 0.757 pounds of PM10 per vehicle mile traveled (controlled). To account for emission controls, a control efficiency of 75 percent was applied. The number of days with measurable precipitation in Santa Rosa, California, were acquired from the Western Regional Climate Center's website, http://www.wrcc.dri.edu/. The project condition provides for 478 daily and 50,148 annual vehicle trips; each vehicle is presumed to be traveling a distance of one-sixteenth of a mile on an unpaved circulation area.

Diesel Generator

Since extending an electrical supply line to the site would be cost-prohibitive, a generator would supply the power for the processing plant. The generator would be diesel-powered and rated at 1006 horsepower.

All reciprocating internal combustion engines operate by the same basic process. A combustible mixture is first compressed in a small volume between the head of a piston and its surrounding cylinder. The mixture is then ignited, and the resulting high-pressure products of combustion push the piston through the cylinder. This movement is converted from linear to rotary motion by a crankshaft. The piston returns, pushing out exhaust gases, and the cycle is repeated. The emission factors were based on information contained within the manufacturer's specification sheet and EPA's AP-42 Section 3.4 (EPA, 1996).

Nonroad Equipment and Mobile Vehicles

The types of non-road equipment and motor vehicles at the project site would include loaders, dozers, and off-highway trucks (such as water trucks, rock trucks), haul trucks, pickup trucks, and employee vehicles. Emission factors for all equipment except haul trucks and employee vehicles were obtained from the California Air Resources Board's (CARB) OFFROAD model (CARB, 2006a) and its documentation and the databases prepared in its support. Emission factors for each equipment type were applied to the anticipated equipment work output (horsepower-hours of expected equipment use). Equipment horsepower, model year, expected lifetime, and hours of operations were provided. The conservative assumption was made that all equipment would be operated simultaneously. Equipment was assumed to operate at the excavation pit and/or the processing plant as provided.

Emission factors for haul trucks and employee vehicles were obtained from the CARB EMFAC2007 (CARB, 2006b) model. The haul trucks were assumed to travel 24 miles each way between the facility and the aggregate markets. **Table AQ-2** presents the non-road equipment usage data. **Table AQ-3** presents the emission factors used for non-road equipment and motor vehicles. Of note, the emission factor account for equipment deterioration rates as equipment gets older. That is, a model year 2010 will have a higher emission rate in 2012 than in 2011.

TABLE AQ-2
SUMMARY DATA FOR NON-ROAD EQUIPMENT

Equipment Type	Model Year	Quantity	Load Factor	Daily Hours	Annual Hours	Average Size (horsepower)
Dozer	2003	1	0.59	10	2000	500
Dozer	2003	1	0.59	10	2000	470
Dozer (Winter Work)	2003	1	0.59	8	64	470
Loader	2003	1	0.55	10	2000	430
Loader	2003	2	0.55	10	2000	430
Loader (Winter Work)	2003	1	0.55	8	320	430
Water Truck	2003	1	0.57	10	2000	300
Rock Truck	2003	2	0.57	10	400	355

[a] Per piece of equipment

SOURCE: Roblar Road Quarry, 2006; CARB 2006a

TABLE AQ-3
EMISSION FACTORS FOR NON-ROAD EQUIPMENT AND MOTOR VEHICLES
IN 2007, 2016, AND 2027

Equipment Type	Units	Reactive Organic Gases	Carbon Monoxide	Nitrogen Dioxide	PM10
2007					
Dozer	g/hp-hr	0.27	0.66	2.75	0.08
Loader	g/hp-hr	0.19	0.58	2.45	0.07
Off-Highway Truck	g/hp-hr	0.28	0.65	2.70	0.08
Diesel Haul Trucks	g/mile	0.875	4.79	16.8	0.656
Employee Vehicles	g/mile	0.180	4.28	0.417	0.0310
2016					
Dozer	g/hp-hr	0.29	0.67	2.79	0.08
Loader	g/hp-hr	0.27	0.62	2.59	0.08
Off-Highway Truck	g/hp-hr	0.28	0.65	2.70	0.08
Diesel Haul Trucks	g/mile	0.440	2.11	6.44	0.269
Employee Vehicles	g/mile	0.035	1.51	0.136	0.030
2027					
Dozer	g/hp-hr	0.29	0.67	2.79	0.08
Loader	g/hp-hr	0.26	0.61	2.52	0.08
Off-Highway Truck	g/hp-hr	0.28	0.65	2.70	0.08
Diesel Haul Trucks	g/mile	0.251	1.13	2.60	0.148
Employee Vehicles	g/mile	0.0100	0.683	0.054	0.0300

PM_{10} = Particulate matter and particulate matter less than 10 micrometers in aerodynamic diameter

SOURCE: California Air Resource Board. 2006a. EMFAC2007 Version 2.3 and 2006b. OFFROAD2007, November 2006.

2. Dispersion Modeling Analysis

Dispersion is the process by which atmospheric pollutants disseminate due to wind and vertical stability. The results of a dispersion analysis are used to assess pollutant concentrations at or near an emission source. The results of an analysis allow predicted concentrations of pollutants to be compared directly to air quality standards and other criteria such as health risks based on modeled concentrations. Dispersion modeling allows one to assess future impacts when new state and federal regulations for diesel trucks are implemented.

A rising pollutant plume reacts with the environment in several ways before it levels off. First, the plume's own turbulence interacts with atmospheric turbulence to entrain ambient air. This mixing process reduces and eventually eliminates the density and momentum differences that cause the plume to rise. Second, the wind transports the plume during its rise and entrainment process. Higher winds mix the plume more rapidly, resulting in a lower final rise. Third, the plume interacts with the vertical temperature stratification of the atmosphere, rising as a result of buoyancy in the unstable-to-neutrally stratified mixed layer. However, after the plume encounters the mixing lid and the stably stratified air above, its vertical motion is dampened.

Molecules of gas or small particles injected into the atmosphere will separate from each other as they are acted on by turbulent eddies. The Gaussian mathematical model simulates the dispersion of the gas or particles within the atmosphere. The formulation of the Gaussian model is based on the following assumptions:

- The predictions are not time-dependent (all conditions remain unchanged with time)
- The wind speed and direction are uniform, both horizontally and vertically, throughout the region of concern
- The rate of diffusion is not a function of position
- Diffusion in the direction of the transporting wind is negligible when compared to the transport flow

The Gaussian dispersion model algorithm provides a simple analytical method of estimating downwind concentrations, where concentration is a function of several basic elements:

- Initial plume height (sum of the physical stack height and the plume rise)
- The source emission rate
- The horizontal and vertical plume distribution (based on atmospheric stability)
- The wind speed at source height
- The height of the receptor
- The off-centerline of the receptor
- The downwind distance from the source to the receptor

2.1 Dispersion Modeling Approach

Equipment and vehicles producing DPM emissions include mining equipment such as loaders, dozers, generator, and haul trucks. This section presents the methodology used for the refined dispersion modeling analysis of onsite equipment. This section addresses all of the fundamental components of an air dispersion modeling analysis including:

- Model selection and options
- Receptor spacing and location
- Meteorological data
- Source release characteristics

The dispersion modeling analysis estimated the ambient DPM concentrations resulting from project emissions and then determined the incremental cancer risk.

2.1.1 Model Selection and Options

The Industrial Source Complex-3 model (Version 02035) was used for the modeling analysis. This model is an appropriate choice for this analysis because it covers simple, intermediate, and complex terrain and can predict both short-term and long-term (annual) average concentrations. The model was run using the regulatory default options (stack-tip downwash, buoyancy-induced dispersion, final plume rise), default wind speed profile categories, default potential temperature gradients, no deposition or depletion of particulate matter, and no pollutant decay. Based on observations of the area and accepted methodologies (Auer, 1978) surrounding the project site, rural dispersion coefficients were applied.

2.1.2 Receptor Locations

Sensitive receptors such as residences, schools, and outdoor recreational areas near the proposed project were chosen as the receptors to be analyzed. A total of seven receptors were analyzed. Receptors were placed at a height of 1.8 meters (typical breathing height). Terrain elevations for receptor locations were used (i.e., complex terrain) based on available USGS information for the area.

2.1.3 Meteorological Data

The rate at which emissions are dispersed in the atmosphere depends upon the intensity of the ambient turbulence, the wind velocity, the position relative to obstacles in the flow field, and any dilutions attributable to the source itself. The most important factor leading to plume spread in the atmosphere is the amount of ambient turbulence. In a stable atmosphere, the horizontal and vertical turbulence is very limited. The plume remains near its emission height and undergoes minimal mixing. This situation is common during the nighttime and early morning hours. If the layer below the plume height becomes neutral to unstable, the plume mixes rapidly to the surface. This is known as a fumigation condition and can cause high concentrations. This occurs for short duration during the early morning. As heating of the surface persists, a fully unstable mixing layer develops, and the plume loops up and down in response to large-scale convective eddies. A neutral-stability atmosphere yields moderate amounts of turbulence and results in a cone-shaped plume. Finally, if an inversion is present below the emission height, a lofting condition exists and the plume is cut off from ground-level impacts.

Stability class frequencies were calculated from the deviation of the horizontal wind direction. This method was used to categorize the stability class as a function of wind speed and time of day. Stability classes range from extremely unstable (A) to moderately stable (F). These classes are used in dispersion models to estimate how much a plume will spread over time and space. In general, the more stable the atmosphere, the less potential for plume spread, creating higher plume concentrations.

Surface meteorological data and upper air meteorological (mixing height) data from Valley Ford and Oakland, California[3], respectively, were used for the modeling analysis. Meteorological data were obtained from BAAQMD and used for modeling impacts of the proposed project. Data from 2000 through 2003 were used and the meteorological year with the worst-case results was reported.

2.1.4 Source Release Characteristics

Onsite equipment was treated as area sources located within the property boundary of operations within the mining phases. Annual DPM emission rates were based on exhaust PM10 emissions from diesel onsite equipment and operational information. Emission rates were based on the CARB’s OFFROAD2007 and EMFAC2007 emission models and reflect promulgated regulations concerning on-road and off-road vehicles and equipment. Operational information (types of equipment, equipment size, and hours of operation) was provided. The DPM emissions are approximately 96 percent of the emissions of exhaust PM2.5 from diesel-powered equipment (per EPA guidance); while PM2.5 is approximately 97 percent of the PM10 emissions. These sources were treated as area sources with a release height of 3.1 meters.

Source exhaust parameters for the diesel generator were assumed to be 6.1 meters in height, 718 degrees Kelvin for exhaust temperature, 120 meters per second for exhaust velocity, and a stack diameter of 0.20 meters (based on manufacturer specifications). The generator was assumed to be within the center of the processing plant.

To predict ambient concentrations of pollutants generated by vehicular traffic, emissions from vehicle exhaust systems were estimated with the CARB’s emission factor model, EMFAC2007. It was assumed that the haul trucks traveling to and from the project site would primarily be diesel-powered heavy-heavy-duty trucks; although a portion of the fleet is medium-heavy duty. Emission factors for haul trucks were obtained from the EMFAC2007 model. Ambient conditions assumed a temperature of 85 degrees Fahrenheit (ºF) and a humidity of 50 percent). Of note, DPM emission factors are not affected by meteorological conditions. The DPM dispersion modeling analysis used emission factors representing free flowing and idling vehicles. Emissions in future years were calculated by EMFAC2002, assuming the phasing in of new regulations and using default scrappage factors. Emission factors were based on a vehicle speed of 35 miles per hour. Emission factors for all other conditions were based on a vehicle speed equal to the speed limit.

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[3] http://ws1.baaqmd.gov/metdata/valley_ford.htm)

Terrain elevations for emission source locations were used (i.e., complex terrain) based on available USGS information for the area.

3. Health Risk Assessment Calculations

The principal issues related to health risks from the project pertain to emissions of toxic substances from the exhaust of diesel trucks and equipment. The incremental risks were determined for these sources of toxic air contaminants as described above and summed to obtain an estimated total incremental carcinogenic health risk. The health risk assessment was conducted according to methodologies present in BAAQMD's Health Risk Screening Analysis Guidelines (BAAQMD, 2005).

In accordance with California Office of Environmental Health Hazard Assessment (OEHHA) guidelines (CalEPA, 2003), this was accomplished by applying the highest estimated concentrations of DPM at the receptors analyzed to the established cancer risk estimates and acceptable reference concentrations (RfC) for non-cancer health effects. The HHRA for this project utilized CARB Hotspot Analysis and Reporting Program (HARP)[4] to determine the cancer risks and non-cancer health effects. HARP is a computer software package that combines the tools of emission inventory database, facility prioritization, air dispersion modeling, and risk assessment analysis.

The cancer risk is the probability of an individual developing cancer as a result of exposure to HAPs. The cancer risk based on a one-year exposure can be estimated by utilizing the cancer potency factor (mg/kg-day), the annual average concentration (μg/m^3), and the lifetime exposure adjustment.

The cancer risks are assumed to occur exclusively through the inhalation pathway; therefore, the cancer risks can be estimated from the following equation:

$$\text{Dose} = \sum C \bullet \text{DBR} \bullet \text{EF} \bullet \text{ED} \bullet (10^{-6})/(\text{AT})$$

Where:

Dose	Dose through Inhalation (mg/kg-day)
C	Annual average concentration (μg/m^3) (from previous equation) during the 70 year exposure period
DBR	Daily Breathing Rate (L/kg-day)
EF	Exposure Frequency (days/year)
ED	Exposure Duration (years)
AT	Averaging Period over which exposure is averaged (25,550 days or 70 years)

$$\text{Cancer Risk} = \text{Dose (mg/kg-day)} \bullet \text{Cancer Potency (kg-day/mg)} \bullet (10^{6})$$

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[4] On December 9, 2006 after a one year grandfathering period, the AERMOD model replaced ISC3 as EPA's preferred regulatory model (EPA, 2005). The current version of HARP (Version 1.3) (CARB, 2003) uses the ISC3 dispersion tool. CARB has recognized this disconnection with EPA's preferred regulatory model and has developed a Converter (to converts air dispersion files (e.g., AERMOD and ISC3) into text files that can be imported into the HARP) and it was released to the public as a beta version on April 30, 2007.

The Hazard Index is an expression used for the potential for non-cancer health effects. The relationship for the non-cancer health effects is given by the annual concentration ($\mu g/m^3$) and the Reference Exposure Level ($\mu g/m^3$). The chronic reference exposure level for DPM was established by the California OEHHA as 5 $\mu g/m^3$.

The relationship for the non-cancer health effects is given by the following equation:

$$HI = C/REL$$

where,

HI_{DPM}	Hazard index; an expression of the potential for non-cancer health effects.
C_{DPM}	Annual average DPM concentration ($\mu g/m^3$) during the 70 year exposure period
REL_{DPM}	Reference exposure level (REL); the concentration at which no adverse health effects are anticipated.

The cancer risk and health index are determined by pollutant and then totaled for comparison with the significance thresholds.

4. References

Auer, 1978. *Correlation of Land Use and Cover with Meteorological Anomalies*, August H. Auer, Jr., American Meteorological Society, *Journal of Applied Meteorology*, Vol. 17, pp. 636-643 (http://ams.allenpress.com/archive/1520-0450/17/5/pdf/i1520-0450-17-5-636.pdf), May 1978.

Bay Area Air Quality Management District, *BAAQMD Health Risk Screening Analysis Guidelines (http://www.baaqmd.gov/pmt/air_toxics/risk_procedures_policies/hrsa_guidelines.pdf)*, June 2005.

California Air Resource Board. 2000. *Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles (http://www.arb.ca.gov/diesel/documents/rrpfinal.pdf)*. October 2000.

California Air Resources Board. 2003. HARP Users Guide (http://www.arb.ca.gov/toxics/harp/harpug.htm). December 2003.

California Air Resource Board. 2006a. OFFROAD2007 (http://www.arb.ca.gov/msei/offroad/offroad.htm), November 1, 2006.

California Air Resource Board. 2006b. EMFAC2007 Version 2.3 (http://www.arb.ca.gov/msei/onroad/downloads/docs/user_guide_emfac2007.pdf), November 1, 2006.

California Environmental Protection Agency, Office of Environmental Health Hazard Assessment, 2003, *Air Toxics Hot Spots Program Risk Assessment Guidelines*, Parts I-IV and Appendices (http://www.oehha.ca.gov/air/hot_spots/index.html), August 2003.

Environmental Protection Agency. 1996. Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: *Stationary Point and Area Sources*, Section 3.4 Large Stationary Diesel Engines (http://www.epa.gov/ttn/chief/ap42/ch03/final/c03s04.pdf), October 1996.

Environmental Protection Agency. 2002. Health Assessment Document for Diesel Engine Exhaust (EPA/600/8-90/057F) (http://www.epa.gov/ttn/atw/dieselfinal.pdf), May 2002.

Environmental Protection Agency, 2005. *Guideline on Air Quality Models (Revised, including Supplements)*, EPA-450/2-78-027R (http://www.epa.gov/scram001/guidance/guide/appw_05.pdf), U.S. Environmental Protection Agency, Office of Air and Radiation, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina, November 9, 2005.

Environmental Protection Agency. 2006a. Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: *Stationary Point and Area Sources*, Section 11.19.2 Crushed Stone Processing (http://www.epa.gov/ttn/chief/ap42/ch11/final/c11s19-1.pdf), November 2006.

Environmental Protection Agency. 2006b. Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: *Stationary Point and Area Sources*, Section 13.2.4 Aggregate Handling and Storage Piles (http://www.epa.gov/ttn/chief/ap42/ch13/final/c13s0204.pdf), November 2006.

Environmental Protection Agency. 2006c. Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: *Stationary Point and Area Sources*, Section 13.2.5 Industrial Wind Erosion (http://www.epa.gov/ttn/chief/ap42/ch13/final/c13s0205.pdf), November 2006.

Environmental Protection Agency. 2006d. Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: *Stationary Point and Area Sources*, Section 13.2.2 Unpaved Roads (http://www.epa.gov/ttn/chief/ap42/ch13/final/c13s0202.pdf), November 2006.

Sonoma County Aggregate Resource Management Plan and Environmental Impact Report (http://www.sonoma-county.org/prmd/docs/gp/98gp-06.htm). November 1994.

Western Regional Climate Center, 2007. http://www.wrcc.dri.edu/summary.