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AIR QUALITY ANALYSIS METHODOLOGIES

This appendix provides the methodologies that were used to analyze potential air quality impacts associated with the proposed Chevron El Segundo Refinery Heavy Crude Project, described in Section 2 of the Final EIR, and with the project alternatives described in Section 5 of the Final EIR. This appendix begins with a discussion of the methodologies used to calculate construction and operational emissions. Procedures used for ambient air quality modeling to calculate impacts of increases in PM10 emissions from the proposed project are then presented, followed by the human health risk assessment procedures. Spreadsheets that provide details of the emissions calculations are attached as well as computer model inputs and outputs from the PM10 ambient air modeling and the health risk assessments.

B.1 CONSTRUCTION EMISSIONS CALCULATIONS

Construction emissions can be distinguished as either onsite or offsite. Onsite emissions generated during construction principally consist of exhaust emissions (CO, VOC, NO_X, SO_X, and PM10) from construction equipment, fugitive dust (PM10) from grading and excavation, and VOC from painting and asphaltic paving. Additionally, Chevron proposes to operate a portable heater to heat-treat the proposed replacement Coker Main Fractionator column to relieve stress in the column after constructing it on-site. Offsite emissions during the construction phase normally consist of exhaust emissions and entrained paved road dust from worker commute trips and material delivery trips.

B.1.1 Construction Equipment Exhaust Emission Calculations

The combustion of fuel to provide power for the operation of various construction activities and equipment results in the generation of CO, VOC NO_X, SO_X, and PM10 emissions. The following predictive emission equation was used to calculate exhaust emissions from each type of construction equipment:

$$\text{Exhaust Emissions}_{i,j}\ (\text{lb/day}) = EF_{C,i,j} \times T_{H,j} \qquad \text{(EQ. B.1-1)}$$

where:

$EF_{C,i,j}$ = Emission factor for specific air contaminant i from construction equipment type j (lb/hr)

$T_{H,j}$ = Daily operating time for equipment of type j (hr/day)

The exhaust emission factors used for the calculations of CO, VOC, NO_x and PM10 are composite horsepower-based off-road emission factors for 2006 developed for the SCAQMD by the California Air Resources Board (CARB) from its OFF-ROAD Model. The composite off-road emission factors were derived based on equipment category (tractor, dozer, scraper, etc.), and average equipment age and horsepower rating within horsepower ranges for the year. The emission factors developed by CARB for the SCAQMD for 2006 are listed in Table 41 of Attachment B.1 and can also be downloaded from http://www.aqmd.gov/ceqa/hdbk.html/offroadEF05_20.xls.

The exhaust emission factors used to calculate SO_x emissions were calculated using the following equation:

$$EF_{CS,j}\ (lb/hr) = HP_j \times LF_j \times BSFC_j \times FS \times 2 \qquad \text{(EQ. B.1-2)}$$

where:

$EF_{CS,j}$ = Emission factor for SO_x from construction equipment type j (lb/hr)

HP_j = Horsepower rating for equipment of type j (hp)

LF_j = Load factor for equipment of type j (average operating hp / rated hp)

BSFC = Brake specific fuel consumption for equipment of type j (lb fuel/hp-hr)

FS = Fuel sulfur content (lb sulfur/lb fuel)

2 = Pounds SO_x (as sulfur dioxide) per pound sulfur

Equation B.1-2 is based on the assumption that all of the sulfur in the fuel is oxidized in the combustion process and emitted as sulfur dioxide (SO_2). Equipment load factors and brake specific fuel consumption data were obtained from documentation for the CARB OFF-ROAD Model (file MO99_32.5.xls, extracted from file mo9932.zip, downloaded from http://www.arb.ca.gov/msei/off-road/mo9932.zip). The sulfur content of diesel fuel was assumed to be at the limit of 0.0015 percent specified in SCAQMD Rule 431.2 - Sulfur Content of Liquid Fuels.

The types of construction equipment and the maximum daily operating time for each type of equipment during each construction month were estimated by Chevron's engineering contractor for the proposed project, as well as the project alternatives. This information was prepared separately for each project component: the No. 4 Crude Unit, the Coker, and the No. 6 H_2S Plant. Emission factors for CO, VOC, NO_x and PM10 based on the data in Table 41 of Attachment B.1 were prepared for the specified equipment and are provided in Table 40 of Attachment B.1. SO_x emission factors are also calculated and listed in Table 40 of Attachment B.1

The anticipated construction equipment usage and maximum daily emissions by month are listed in Tables 5-B through 5-G for the proposed modifications to the No. 4 Crude Unit, Tables 6-B through 6-G for the proposed modifications to the Coker, and in Tables 7-B through 7-G for the proposed modifications to the No. 6 H_2S Plant. Tables 25-B through 25-G and 35-B through 35-G provide this information for Alternatives 1 and 2, respectively.

B.1.2 Portable Heater Emission Calculations

The combustion of natural gas in the portable heater that is proposed to be used to relieve stress in the replacement Coker Main Fractionator column will result in the generation of CO, VOC NO_X, SO_X, and PM10 emissions. The following emission equation was used to calculate emissions from this portable heater:

$$Emissions_i \text{ (lb/day)} = EF_{H,i} \times T_{Hj} \qquad \text{(EQ. B.1-3)}$$

where:

$EF_{H,i}$ = Emission factor for specific air contaminant i from the portable heater (lb/hr)

T_H = Daily operating time for the portable heater (hr/day)

Results of measurements of CO and NO_x emissions from the portable heater at full rated heat input, reported as pounds per hour, conducted by GE Energy Management Services, Inc. during May 2004, were used for the CO and NO_x emission factors for the calculations. VOC and PM10 emission factors from Table 1.4-2 in Section 1.4, "Natural Gas Combustion" (July 1998) of the U.S. Environmental Protection Agency's "Compilation of Air Pollutant Emission Factors" (AP-42), expressed as pounds per million British thermal Units (MMBtu) fuel heat input, were multiplied by the portable heater input rating of 10 MMBtu per hour to calculate the VOC and PM10 emission factors. The SO_x emission factor was calculated from the natural gas sulfur limit of 16 parts per million by volume (ppmv) specified in SCAQMD Rule 431.1 - Sulfur Content of Gaseous Fuels, assuming a fuel heat input rate of 10 MMBtu/hr and a natural gas heating value of 1,020 Btu/standard cubic foot. The emission factors for the portable heater are listed in Table 44 of Attachment B.1.

Chevron anticipates that the portable heater will be operated for three to four days during either June or July 2007. To calculate maximum daily emissions from the portable heater, it was conservatively assumed that the portable heater would be operated 24 hours on at least one day during each of these two months. The resulting maximum daily emissions from the portable heater are listed in Table 20 of Attachment B.1.

Chevron anticipates that the portable heater will not be operated for Alternative 1. Therefore, there would be no emissions associated with the portable heater for Alternative 1. This is reflected in Table 30 of Attachment B.1.

B.1.3 Motor Vehicle Exhaust Emission Calculations

The combustion of fuel in motor vehicle engines results in the generation of CO, VOC NO_X, SO_X, and PM10 emissions. The following predictive emission equation was used to calculate exhaust emissions from both on-site and off-site motor vehicles:

$$\text{Exhaust Emissions}_{i,j}\ (\text{lb/day}) = EF_{V,i,j} \times N_{V,j} \times D_j \qquad \text{(EQ. B.1-4)}$$

where:

$EF_{V,i,j}$ = Emission factor for specific air contaminant i from motor vehicle type j (lb/mi)

$N_{V,j}$ = Number of motor vehicles of type j

D_j = Distance traveled each day by motor vehicles of type j (mi/day)

The emission factors were compiled by the SCAQMD by running the California Air Resources Board's EMFAC2002 (version 2.2) Burden Model. A weighted average of vehicle types was used to calculate emission factors for passenger vehicles, and emission factors for heavy heavy-duty diesel trucks were used for delivery trucks. The emission factors account for the emissions from start, running and idling exhaust. In addition, the VOC emission factors take into account diurnal, hot soak, running and resting emissions, and PM10 emission factors take into account tire and brake wear. The motor vehicle exhaust emission factors are listed in Table 42-A of Attachment B.1.

Chevron's engineering contractor estimated the number and length of daily on-site and off-site motor vehicle trips by trucks to deliver materials and supplies, remove construction debris, etc., by construction month. The anticipated number of construction workers during each construction month was used to calculate the number of construction worker commute trips, assuming each worker would drive separately to and from the off-site parking facility each day. This assumption overestimates the number of trips, since it is likely that some workers will carpool. This information was prepared separately for each project component: No. 4 Crude Unit, Coker, and No. 6 H_2S Plant, as well as for each of the two alternatives. Additionally, Chevron proposes to use 40-passenger shuttle buses to transport construction workers between the off-site parking facility and the refinery. The number of daily shuttle bus round trips was calculated by dividing the number of construction workers for each project component by 40, rounding up to the next whole number, and then multiplying by two to account for one round trip at the beginning and at the end of each construction shift.

The anticipated number of motor vehicles and the resulting emissions by month are listed in Tables 8-B through 8-H of Attachment B.1 for the proposed modifications to the No. 4 Crude Unit, Tables 9-B through 9-H Attachment B.1 for the proposed modifications to the Coker, and in Tables 10-B through 10-H Attachment B.1 for the proposed modifications to the No. 6 H_2S Plant. This information is in Tables 26-B through 26-H Attachment B.1 for Alternative 1 and in Tables 36-B through 36-H of Attachment B.1 for Alternative 2.

B.1.4 Motor Vehicle Entrained Paved Road Dust Emission Calculations

Vehicle travel on paved roads generates fugitive PM10 emissions by entrainment of dust on the roads. It should be noted that all motor vehicle travel during construction of the proposed project will be on paved roads. The following predictive emission equation was used to calculate exhaust emissions from both on-site and off-site motor vehicles:

$$\text{Entrained Dust PM10 Emissions}_j \text{ (lb/day)} = EF_{D,j} \times N_{V,j} \times D_j \quad \text{(EQ. B.1-5)}$$

where:

$EF_{D,j}$ = Emission factor for entrained road dust PM10 from motor vehicle type j (lb/mi)

$N_{V,j}$ = Number of motor vehicles of type j

D_j = Distance traveled each day by motor vehicles of type j (mi/day)

The emission factor was calculated from the following equation from CARB Emission Inventory Methodology 7.9, "Entrained Paved Road Dust" (1997):

$$EF_{D,j} \text{ (lb/mi)} = 7.26 / 453.6 \times (sL_j/2)^{0.65} \times (W_j/3)^{1.5} \quad \text{(EQ. B.1-6)}$$

where:

7.26 = A constant for PM10 emissions (g/mi)

453.6 = Factor to convert from grams to pounds (g/lb)

sL_j = Silt loading on roads traveled by motor vehicle of type j (g/m^2)

W_j = Average weight of vehicles on roads traveled by vehicles of type j (tons)

The silt loadings were taken from Table 3 of CARB Emission Inventory Methodology 7.9. As indicated in Table 42-B of Attachment B.1, on-site motor vehicles were assumed to travel on paved roads and areas with silt loadings equivalent to local roads, and off-site motor vehicles were assumed to travel on roads with silt loadings equivalent to collector roads.

Weights of on-site refinery vehicles traveling on roads were based on vehicle class. The average weight of vehicles on roads traveled by off-site motor vehicles was assumed to be 2.7 tons, as

listed in Table 3 of CARB Emission Inventory Methodology 7.9 for Los Angeles County. The calculated entrained paved road dust emission factors are in Table 42-B of Attachment B.1.

Maximum daily motor vehicle unpaved road dust entrainment emissions are listed for both on-site and off-site motor vehicles by construction month in Table 8-I of Attachment B.1 for the proposed No. 4 Crude Unit modifications, Table 9-I of Attachment B.1 for the proposed Coker modifications, and in Table 10-I of Attachment B.1 for the proposed No. 6 H_2S Plant modifications. Tables 26-I and 36-I of Attachment B.1 list these values for Alternative 1 and Alternative 2, respectively.

B.1.5 Excavation Fugitive PM10 Emission Calculations

Excavation for foundations for new and modified equipment during construction of the proposed project will generate fugitive PM10 emissions from soil handling (i.e., dropping) and from wind erosion of temporary storage piles. Although fugitive dust emissions from construction activities are temporary, they may have an impact on local air quality. Fugitive dust emissions often vary substantially from day to day, depending on the level of activity, the specific operations, and the prevailing meteorological conditions. The following methodologies provide the predictive emission equations, emission factors, and default values used to calculate fugitive dust emissions for the project.

Construction contractors will comply with SCAQMD Rule 403 – Fugitive Dust, by watering the site two times per day, reducing the uncontrolled on-site fugitive dust emissions by 50 percent.

Emissions from Soil Handling

Fugitive PM10 emissions are generated during excavation when excavated material is dropped onto the ground at the side of the excavation location or dropped into trucks for removal from the site. The following equation was used to estimate these emissions:

$$\text{Emissions (lb/day)} = EF_S \times V_s \qquad \text{(EQ. B.1-7)}$$

where:

EF_S = Controlled PM10 emission factor for soil dropping (lb/yd^3)

V_S = Volume of soil handled (yd^3/day)

The controlled emission factor was calculated from:

$$EF_S \text{ (lb/yd}^3\text{)} = 0.0011 \times (U/5)^{1.3} / (M/2)^{1.4} \times D \times N_D \times (1\text{-}CE_{403}/100) \qquad \text{(EQ. B.1-8)}$$

where:

U = Mean wind speed (mph)

M = Soil moisture content (percent)

D = Soil density (tons/yd^3)

N_D = Number of times soil is dropped

CE_{403} = Control efficiency from complying with SCAQMD Rule 403 (percent)

Source: Equation 1, Section 13.2.4, US EPA Compilation of Air Pollutant Emission Factors (AP-42), January 1995.

The mean wind speed was assumed to be the default value of 12 mph, from Table 9-9-G of the SCAQMD CEQA Handbook (1993). The moisture content was assumed to be 15 percent, from "Open Fugitive Dust PM10 Control Strategies Study," Midwest Research Institute, October 12, 1990, for moist conditions. Soil density was assumed to be 1.215 tons per cubic yard, from Table 2.46, Handbook of Solid Waste Management. It was conservatively assumed that soil would be dropped four times: 1) onto the ground at the side of the excavation; 2) onto a temporary storage pile; 3) into a truck; and 4) out of the truck. The control efficiency from complying with SCAQMD Rule 403 was assumed to be 50 percent. The emission factor is listed in Table 43 of Attachment B.1.

Chevron's engineering contractor estimated the dimensions (length, width and depth) and resulting volumes of areas that are anticipated to be excavated for construction of foundations for new and modified equipment of the proposed project, as well as the two alternatives. The anticipated schedule for constructing the foundations was used to calculate the amount of soil that will be excavated during each construction month. The maximum daily excavation volume during each construction month was estimated to be 10 percent of the monthly total.

A total of 400 cubic yards of soil is anticipated to be excavated during construction of the proposed No. 4 Crude Unit modifications. Maximum daily excavation volumes and PM10 emissions from soil handling during each construction month are listed in Tables 11-A and 11-B of Attachment B.1, respectively, for the No. 4 Crude Unit modifications.

A total of 3,647 cubic yards of soil is anticipated to be excavated during construction of the proposed Coker modifications. Maximum daily excavation volumes and PM10 emissions from soil handling during each construction month are listed in Tables 12-A and 12-B of Attachment B.1, respectively, for the Coker modifications.

A total of 1,110 cubic yards of soil is anticipated to be excavated during construction of the proposed No. 6 H_2S Plant modifications. Maximum daily excavation volumes and PM10 emissions from soil handling during each construction month are listed in Tables 13-A and 13-B of Attachment B.1, respectively, for the No. 6 H_2S Plant modifications.

Construction of proposed modifications to the Coker for Alternative 1 is anticipated to require excavation of 300 cubic yards less soil than for the proposed project. Maximum daily excavation volumes and PM10 emissions from soil handling during each construction month for the proposed Coker modifications under Alternative 1 are listed in Tables 27-A and 27-B of Attachment B.1, respectively.

An additional 1,500 cubic yards of soil is anticipated to be excavated during construction of the proposed crude oil storage tank modifications under Alternative 2. Maximum daily excavation volumes and PM10 emissions from soil handling during each construction month for proposed modifications to crude oil storage tanks are listed in Tables 37-A and 37-B of Attachment B.1, respectively, for Alternative 2.

Wind Erosion from Temporary Storage Piles

Wind erosion of temporary soil storage piles during excavation generates fugitive PM10 emissions. The following equation was used to estimate these emissions:

$$\text{Emissions (lb/day)} = EF_W \times A \qquad \text{(EQ. B.1-9)}$$

where:

EF_W = Controlled PM10 emission factor for storage pile wind erosion (lb/acre-day)

A = Temporary storage pile surface area (acres)

The controlled emission factor was calculated from:

$$EF_W \text{ (lb/acre-day)} = 0.85 \times (s/1.5) \times (365-p/235) \times (U_{12}/15) \times (1-CE_{403}/100) \qquad \text{(EQ. B.1-10)}$$

where:

s = Soil silt content (percent)

p = Number of days per year with precipitation of 0.01 inches or more

U_{12} = Percentage of time unobstructed wind speed exceeds 12 mph

CE_{403} = Control efficiency from complying with SCAQMD Rule 403 (percent)

Source: US EPA Fugitive Dust Background Document and Technical Information Document for Best Available Control Measures, 1992

The storage pile silt contents were assumed to be 7.5 percent, as listed in Table A9-9-F-1 of the SCAQMD CEQA Air Quality Handbook for overburden. The number of days with precipitation was conservatively assumed to be zero, and the percentage of the time that the wind speeds exceeds 12 mph was conservatively assumed to be 100 percent. The control efficiency from

complying with SCAQMD Rule 403 was assumed to be 50 percent. The controlled emission factor is listed in Table 43 of Attachment B.1.

The maximum daily surface area of temporary storage piles was estimated by assuming that the storage piles would be three feet tall, square in shape, and flat on the top. The surface areas, in acres, were then calculating by dividing the surface areas, in square feet, by 43,560 square feet per acre.

The maximum surface areas of temporary storage piles during each construction month and PM10 emissions from storage pile wind erosion during each construction month are listed in Tables 11-A and 11-B of Attachment B.1, respectively, for the proposed No. 4 Crude Unit modifications, in Tables 12-A and 12-B for the proposed Coker modifications, in Tables 13-A .and 13-B for the proposed No. 6 H_2S Plant modifications, and in Tables 37-A and 37-B for Alternative 2. Storage pile surface areas and emissions for Alternative 1 are the same as for the proposed project.

B.1.6 Painting VOC Emission Calculations

The application of architectural surface coatings (painting) generates VOC emissions when organic solvents in the coating evaporate as the coating dries. The following equation was used to estimate VOC emissions from architectural coatings:

$$\text{Emissions (lb/day)} = C \times V \qquad \text{(EQ. B.1-11)}$$

where:

C = VOC content of coating (lb/gal)

V = Amount of coating applied (gal/day)

A VOC content of 2.09 lb/gal (250 g/l) was assumed, based on the VOC limit specified in SCAQMD Rule 1113 - Architectural Coatings for an industrial maintenance coating. It should be noted that Rule 1113 specifies a limit of 0.84 lb/gal (100 g/l) for industrial maintenance coatings beginning July 1, 2006, which is when construction of the proposed project is anticipated to start. However, Rule 1113 allows a coating that is manufactured prior to the effective date of the applicable limit specified in the Table of Standards, and that has a VOC content above that limit , to be sold, supplied, offered for sale, or applied for up to three years after the specified effective date. Therefore, it was conservatively assumed that the coatings used for construction of the proposed project would meet the VOC-content limit currently in effect.

Chevron's engineering contractor estimated the surface areas of equipment to be coated during each construction month and the resulting anticipated monthly usage of surface coatings for the

proposed project, as well as for each of the two alternatives. The maximum daily coating usage during each construction month was estimated to be one-eighth (12.5 percent) of the monthly total.

Maximum daily surface coating usage and VOC emissions during each construction month are listed in Table 14 of Attachment B.1 for the proposed modifications to the No. 4 Crude Unit, in Table 15 of Attachment B.1 for the proposed modifications to the Coker, and in Table 16 of Attachment B.1 for the proposed modifications to the No. 6 H_2S Plant. Tables 28 and 38 of Attachment B.1 provide these values for Alternative 1 and Alternative 2, respectively.

B.1.7 Asphaltic Paving VOC Emission Calculations

Paving areas with asphalt generates VOC emissions as the asphalt cures. The following equation was used to estimate daily VOC emissions from asphaltic paving:

$$\text{Emissions (lb/day)} = 2.62 \times A \qquad \text{(EQ. B.1-12)}$$

where:

A = Area paved (acres/day)

Source: URBEMIS 2002 User's Guide, 2005

Chevron's engineering contractor estimated the dimensions (length and width) and resulting surface areas of areas that are anticipated to be paved with asphalt for the proposed project and the alternatives. The anticipated schedule for paving was used to calculate the area that will be paved during each construction month. The maximum daily paving during each construction month was estimated to be 25 percent of the monthly total.

No paving is anticipated during construction of the proposed modifications for No. 4 Crude Unit. This is reflected in Table 17 of Attachment B.1 for the No. 4 Crude Unit.

A total of 11,720 square feet is anticipated to be paved during construction of the proposed Coker modifications. Maximum daily paving areas and VOC emissions from asphaltic paving during each construction month are listed in Table 18 of Attachment B.1 for the Coker modifications.

A total of 1,875 square feet is anticipated to be paved during construction of the proposed No. 6 H_2S Plant modifications. Maximum daily paving areas and VOC emissions from asphaltic paving during each construction month are listed in Table 19 of Attachment B.1 for the No. 6 H_2S Plant modifications.

Construction of proposed modifications to the Coker for Alternative 1 is anticipated to require 1,000 square feet less asphaltic paving than the proposed project. Maximum daily paving areas and VOC emissions from asphaltic paving during each construction month for the proposed Coker modifications under Alternative 1 are listed in Table 29 of Attachment B.1.

No paving is anticipated during construction of the proposed crude oil storage tank modifications under Alternative 2. This is reflected in Table 39 of Attachment B.1.

B.1.8 Peak Daily Construction Emission Calculations

Daily emissions from construction equipment exhaust, on-site motor vehicle exhaust and entrained dust, grading and excavation, asphaltic paving, painting, and off-site motor vehicle exhaust and entrained dust during each construction month were calculated using the procedures described in the preceding subsections. Total daily emissions of each criteria pollutant (CO, VOC, NO_x, SO_x and PM10) during each month were then calculated by summing the daily emissions from the various emission sources. Peak daily emissions of each criteria pollutant were then determined from the daily emissions during each construction month.

Peak daily construction emissions for the proposed project are listed in Table 1 of Attachment B.1. Maximum daily CO, VOC, NO_x, SO_x and PM10 emissions are listed by emission source during each construction month in Tables 2-A through 2-E of Attachment B.1, respectively.

Peak daily construction emissions for Alternative 1 are listed in Table 21 of Attachment B.1. Maximum daily CO, VOC, NO_x, SO_x and PM10 emissions are listed by emission source during each construction month in Tables 22-A through 22-E of Attachment B.1, respectively.

Peak daily construction emissions for Alternative 2 are listed in Table 31 of Attachment B.1. Maximum daily CO, VOC, NO_x, SO_x and PM10 emissions are listed by emission source during each construction month in Tables 32-A through 32-E of Attachment B.1, respectively.

B.1.9 Mitigated Peak Daily Construction Emission Calculations

As presented in Section 4.1.1 of the Final EIR, peak daily construction emissions of CO, VOC, NO_x and PM10 exceed the SCAQMD CEQA significance criteria, and feasible mitigation measures to reduce emissions of these pollutants during the construction phase of the proposed project were identified. Mitigated daily emissions during each construction month were calculated by determining the emission reductions that would be achieved by the mitigation measures and subtracting them from unmitigated construction emissions. Total mitigated daily emissions during each month were then calculated by summing the mitigated daily emissions from the various emission sources. Peak daily mitigated emissions of each criteria pollutant were then determined from the mitigated daily emissions during each construction month.

Mitigated peak daily construction emissions for the proposed project are listed in Table 3 of Attachment B.1. Maximum mitigated daily CO, VOC, NO_x, SO_x and PM10 emissions are listed by emission source during each construction month in Tables 4-A through 4-E of Attachment B.1, respectively.

Mitigated peak daily construction emissions for Alternative 1 are listed in Table 23 of Attachment B.1. Maximum mitigated daily CO, VOC, NO_x, SO_x and PM10 emissions are listed by emission source during each construction month in Tables 24-A through 24-E of Attachment B.1, respectively.

Mitigated peak daily construction emissions for Alternative 2 are listed in Table 33 of Attachment B.1. Maximum mitigated daily CO, VOC, NO_x, SO_x and PM10 emissions are listed by emission source during each construction month in Tables 34-A through 34-E of Attachment B.1, respectively.

B.2 CONSTRUCTION LOCALIZED AIR QUALITY IMPACTS EVALUATION

The SCAQMD staff has developed a localized significance threshold (LST) methodology and mass rate look-up tables by source receptor area (SRA) that can be used to determine whether or not a project may generate significant adverse localized CO, NO_x or PM10 air quality impacts (see http://www.aqmd.gov/ceqa/handbook/LST/LST.html). LSTs represent the maximum emissions from a project that will not cause or contribute to an exceedance of the most stringent applicable federal or state ambient air quality standard, and are developed based on the ambient concentrations of that pollutant for each source receptor area.

LSTs are derived using one of three methodologies depending upon the attainment status of the pollutant. For attainment pollutants, NO_2 and CO_2, the mass rate LSTs are derived using an air quality dispersion model to back-calculate the emissions per day that would cause or contribute to a violation of any AAQS for a particular SRA. The most stringent standard for NO_2 is the 1-hour state standard of 25 parts per hundred million (pphm); and for CO it is the 1-hour and 8-hour state standards of nine parts per million (ppm) and 20 ppm, respectively.

LSTs were developed based upon the size or total area of the emissions source, the ambient air quality in each SRA in which the emission source is located, and the distance to the sensitive receptor. LSTs for NO_2 and CO are derived by adding the incremental emission impacts from the project activity to the peak background NO_2 and CO concentrations and comparing the total concentration to the most stringent ambient air quality standards. Background criteria pollutant concentrations are represented by the highest measured pollutant concentration in the last three years at the air quality monitoring station nearest to the proposed project site.

Construction PM10 LSTs are developed using a dispersion model to back-calculate the emissions necessary to exceed a concentration equivalent to 50 micrograms per cubic meter (µg/m3) averaged over five hours, which is the control requirement in Rule 403. The equivalent concentration for developing PM10 LSTs is 10.4 $\mu g/m^3$, which is a 24-hour average.

Peak daily construction emissions were compared with the LSTs to evaluate the potential for emissions during construction of the proposed project to cause significant localized CO, NO_2 or PM10 impacts. Because the No. 4 Crude Unit is close to the No. 6 H_2S Plant (see Figure 2-3 for the locations of the proposed modifications), emissions from construction of the proposed modifications to these two units were combined for the analysis. Because the Coker is approximately 500 meters from the No. 6 H_2S Plant and the Coker, it was analyzed separately. Daily on-site unmitigated CO, NO_x and PM10 construction emissions are listed by month in Tables 46-A, 46-B and 46-C, respectively, of Attachment B.1, and mitigated emissions are listed in Tables 48-A, 48-B and 48-C of Attachment B.1.

The mass rate LSTs depend on the size of the construction project, in acres, and on the distance from the construction project to sensitive receptors. LSTs were calculated by SCAQMD staff for project sizes of one, two and five acres. The approximate areas of the No. 4 Crude Unit, the No. 6 H_2S Plant and the Coker are 3.6 acres, 2.4 acres and 3.0 acres, respectively. Because the LSTs decrease with increasing size, the LSTs corresponding to a two-acre area were used. Although the combined areas of the No. 4 Crude Unit and the No. 6 H_2S Plant exceed five acres, maximum daily combined construction emissions for the proposed modifications to these two areas occur after construction for the No. 6 H_2S Plant modifications have been completed. Therefore, the 3.6 acre area of the No. 4 Crude Unit is the appropriate area to consider for the analysis.

LSTs were calculated by SCAQMD staff for receptor distances of 25, 50, 100, 200 and 500 meters. Interpolation was used to calculate the LSTs for the analyses. The maximum unmitigated on-site daily emissions and comparisons with the CO, NO_x and PM10 LSTs are listed in Tables 45-A, 45-B and 45-C, respectively, of B.1, and maximum mitigated on-site emissions and the comparisons with the LSTs are in Tables 47-A, 47-B and 47-C of Attachment B.1.

B.3 OPERATIONAL CRITERIA POLLUTANT EMISSION CALCULATIONS

After construction of the proposed project is completed, changes in direct operational emissions of criteria pollutants will be generated by the modifications to refinery equipment. Additionally, changes in indirect operational criteria pollutant and TAC emissions will be generated by increased truck trips to export petroleum coke and sulfur from the refinery and by increased marine tanker deliveries of crude oil to the Chevron El Segundo Marine Terminal.

B.3.1 Direct Operational Criteria Pollutant Emission Calculations

Changes in peak daily direct operational criteria pollutant emissions include changes in fugitive VOC emissions resulting from changes in the number and types of components, such as valves, pump and flanges, in refinery equipment process streams; increases in VOC and PM10 emissions resulting from an increase in the daily number of coke drum depressurization operations; and an increase in PM10 emissions from Cooling Tower No. 9 caused by an increase in the circulating water flow rate.

B.3.1.1 Fugitive VOC Emissions Calculations from Process Stream Components

Most elements of the proposed project, such as distillation columns, function as sealed systems. However, leaks through fittings in process streams containing organic compounds that enter and leave sealed systems generate fugitive VOC emissions. The emission rate depends on the type of component and on the type of stream. For example, the emission rate for a flange in a light-liquid process stream with a relatively high vapor pressure is higher than the emission rate for a flange in a heavy-liquid process stream with a relatively low vapor pressure. These fugitive VOC emissions were calculated by the following equation:

$$\text{Emissions (lb/day)} = EF_{FV,i,j} \times N_{i,j} / 365 \qquad \text{(EQ. B.2-1)}$$

where:

$EF_{V,i}$ = Fugitive VOC emission factor for component of type i (valve, flange, pump, etc.) for process stream of type j (fuel gas, light liquid, heavy liquid, etc. (lb/year)

$N_{i,j}$ = Number of components of type i for process stream of type j

365 = Days per year

The proposed modifications to the No. 4 Crude Unit, the Coker and the Depropanizer will include removal of some existing components and the addition of new components. The proposed modifications to the No. 6 H_2S plant include the addition of new components but not the removal of existing components. Equation B.2-1 was applied to existing components that will be removed to calculate the resulting decrease in fugitive VOC emissions and to new components that will be installed to calculate the resulting increase in fugitive VOC emissions. The net change in fugitive VOC emissions was calculated by subtracting the decreases from the increases. The emission factors, numbers of components to be removed and added, and the resulting VOC emissions are listed in Tables 2, 3, 4, and 5 of Attachment B.2 for the proposed modifications to the No. 4 Crude Unit, the Coker, the Depropanizer, and the No. 6 H_2S Plant, respectively.

The emission factors, numbers of components to be removed and added, and the resulting VOC emissions are listed in Table 10 of Attachment B.2 for Alternative 1 and in Tables 12 and 13 of Attachment B.2 for Alternative 2.

B.3.1.2 VOC and PM10 Emissions from Coke Drum Depressurization

The Coker coke drums are vented to the atmosphere when they are depressurized. Currently, the refinery depressurizes a maximum three coke drums every 15 hours, which corresponds to 4.8 depressurization operations in a 24-hour period (3 operations / 15 hours x 24 hours). Proposed modifications to the coke drums will decrease the coke drum cycle time to 12 hours, which will increase the maximum number of depressurization operations during a 24-hour period to six (3 operations / 12 hours x 24 hours). Thus, the proposed project will increase the maximum number of daily depressurization cycles by 1.2 (6 cycles / 24 hours – 4.8 cycles / 24 hours).

The SCAQMD measured emissions during a coke drum depressurization operation in January 2003 (SCAQMD, 2004). SCAQMD Method 5.1 was used to measure PM10 emissions. A footnote to Table 2 in the source test report indicated that the condensable "organic portion of the SCAQMD Method 5.1 sample meets both the SCAQMD Rule 102 definitions for PM and VOC." Because the condensable organic portion met the definition for VOC, the analysis of emissions during coke drum depressurization in the Draft EIR included these emissions in the calculation of VOC emissions, rather than in the calculation of PM10 emissions. During the permitting process for the proposed modifications to the coke drums, subsequent to release of the Draft EIR, the SCAQMD concluded that the condensable portion of the SCAQMD Method 5.1 sample should be included in the calculation of PM10 emissions. The calculation of the increase in PM10 emissions from the increase in daily coke drum depressurization operations in the Draft EIR has been modified in this Final EIR to reflect this change. This modification does not change the conclusion in the Draft EIR that operation of the proposed project will not cause significant adverse air quality impacts.

Adding the 12.5 pounds per event of condensable emissions from the SCAQMD Method 5.1 sample to the 1.25 pounds per event of solid PM10 emissions from the Method 5.1 sample gives a total of 13.75 pounds per event of PM10 emissions. Thus, the peak daily increase in PM10 emissions associated with the increase of 1.2 coke drum depressurization operations per day during operation of the proposed project is 16.5 pounds per day (13.75 pounds per depressurization x 1.2 depressurizations per day).

Additionally, the analysis of VOC emissions from coke drum depressurization has been modified in this Final EIR from the Draft EIR, because the condensable organic portion of the Method 5.1 source test sample is no longer considered to contribute to VOC emissions. The VOC emissions during a coke drum depressurization operation were reduced from 23.66 pounds per

depressurization, as provided in the Draft EIR, to 11.16 pounds per depressurization, as listed in Table 2 of the January 2003 source test report for gaseous VOC. The increase in peak daily VOC emissions from the increase in coke drum depressurization operations decreased from 28.4 pounds per day, as listed in Table 4.1-7 of the Draft EIR, to 13.4 pounds per day (11.16 pounds per depressurization x 1.2 depressurizations per day). The emission calculations are in Table 6 of Attachment B.2.

B.3.1.3 PM10 Emission Calculation from Cooling Tower No. 9

A portion of the circulating water in cooling towers is released to the atmosphere as droplets, which is called cooling tower drift. These droplets contain sold materials, such as minerals, that are dissolved in the circulating water. Solid particles remain in the atmosphere when the droplets evaporate. The proposed increase in the circulating water flow rate in Cooling Tower No. 9 will cause an increase in the drift rate, which will generate an increase in PM10 emissions. The increase in PM10 emissions from the cooling tower was calculated from the following equation:

$$\text{Emissions (lb/day)} = Q_W \times 1{,}440 \times D_f \times W_D \times \text{TDS} / 1{,}000{,}000 \qquad \text{(EQ. B.2-2)}$$

where:

Q_W = Cooling tower circulating water flow rate (gal/min)

1,440 = Minutes per day

D_f = Fraction of circulating water emitted as drift

W_D = Density of water (lb/gal)

TDS = Total dissolved solid concentration in circulating water (parts per million by weight)

1,000,000 = Factor to convert parts per million by weight to pounds per pound

Chevron proposes to increase the Cooling Tower No. 9 circulating water rate by 13,500 gal/min, from 14,000 gal/min to 27,500 gal/min. The cooling tower circulating water drift fraction was assumed to be 0.0002 (0.02 percent) from Table 13.4-1 of AP-42 Section 13.4, "Wet Cooling Towers," (January 1995). Chevron controls the TDS in the circulating water to maintain a maximum value of 3,900 parts per million by weight. The calculation of the resulting increase in PM10 emissions from Cooling Tower No. 9 is in Table 7 of Attachment B.2.

B.3.2 Indirect Operational Criteria Pollutant Emission Calculations

Changes in indirect operational criteria pollutant emissions include emissions from additional daily truck trips to export petroleum coke and sulfur from the refinery and changes in emissions from changes in the numbers of vessels delivering crude oil and importing and exporting intermediate products to and from the El Segundo Marine Terminal (ESMT). Operation of the proposed project will not require additional refinery employees. Therefore, there will not be additional operational indirect emissions from an increase in employee commuting trips.

B.3.2.1 Petroleum Coke and Sulfur Export Truck Criteria Pollutant Emissions

The proposed increase in petroleum coke production resulting from the increased Coker throughput will increase peak daily truck trips to export the petroleum coke from the refinery, which will increase indirect peak daily emissions. Although the proposed project will increase average daily sulfur production by 19 tons per day, the daily quantity of sulfur exported from the refinery is determined by market demand for the sulfur, rather than by daily production. The proposed project is not expected to alter market demand for elemental sulfur on a daily basis. Therefore, the proposed project is not anticipated to change the maximum daily number of trips to export sulfur from the refinery.

The following equation was used to calculate the number of additional truck trips to export the petroleum coke:

$$\text{Trips (number/day)} = Q_E / C_T \qquad \text{(EQ. B.2-3)}$$

where:

Q_E = Increase in quantity exported (tons/day)

C_T = Export truck payload capacity (tons)

The increase in petroleum coke production is anticipated to be 510 tons/day. The calculation of the additional export truck trips and the associated emissions is in Table 8 of Attachment B.2.

The majority of the petroleum coke exported from the refinery currently goes to the Port of Los Angeles. However, the Los Angeles Terminal may close in the future, and all of the petroleum coke from the refinery would be exported to the Port of Long Beach Terminal. Sulfur is exported from the refinery to chemical manufacturing facilities in the vicinity of the Port of Los Angeles. The one-way travel distance to either location from the refinery is approximately 20 miles.

Exhaust emissions from these additional truck trips were calculated using Equation B.1-4, and fugitive PM10 emissions from entrained road dust were calculated using Equation B.1-5. Truck

exhaust emission factors and entrained paved road PM10 emission factors are provided in Table 34 of Attachment B.2. Exhaust emission factors for calendar year 2006 were used to calculate emissions from the additional petroleum coke export truck trips in the Draft EIR. However, operation of the proposed project, including the additional export truck trips, will begin in 2008. Therefore, the calculations in the Draft EIR have been revised in this Final EIR to use exhaust emission factors for calendar year 2008 to calculate the increase in emissions from the additional petroleum coke export truck trips. The calculations of daily export truck exhaust and entrained road dust emissions are in Table 8 of Attachment B.2.

B.3.2.2 Crude Oil Marine Tanker Emission Calculations

In response to a comment from the Port of Los Angeles (see response to comment 3-10 in Appendix F.6), Chevron has provided more detailed information on the overall effects of the proposed project, which allows a more refined analysis of the information contained in the Draft EIR regarding marine vessel emissions. The Draft EIR was based on a worst-case analysis which analyzed only increases in ship calls associated with the increase in imports of heavy crude oil. In fact, the additional ship calls associated with the increase in imports of heavy crude oil will be offset to some extent by a reduction in ship calls associated with the import and export of other materials. In addition to increasing marine crude oil tanker calls at the ESMT, operation of the proposed project will also reduce the quantities of some products that are imported into and exported from the ESMT as explained in the following paragraphs.

The analysis in the Draft EIR assumed that the crude oil marine tankers would have capacities between 350,000 and 500,000 barrels and that 15 additional annual heavy crude oil deliveries would occur during operation of the proposed project. Chevron currently anticipates that the capacities of the crude oil marine tankers will be approximately 700,000 barrels, and that nine additional crude oil marine tanker deliveries will occur during operation of the proposed project.

Currently, a portion of the vacuum residuum produced by the Crude Units is not processed by the Coker but is instead blended with other materials to produce high-sulfur fuel oil (HSFO) or Bunker Fuel. The proposed increase in the Coker capacity will allow Chevron to increase the amount of vacuum residuum that is processed by the Coker and reduce the amounts of HSFO and Bunker Fuel that are produced and exported. This reduction in exports is anticipated to reduce the number of ship calls and barge calls at the ESMT to export HSFO and Bunker Fuel by nine ship calls per year and 13 barge calls per year.

Chevron currently imports vacuum gas oil into the refinery by marine tanker through the ESMT for processing in the Fluid Catalytic Cracking Unit. The proposed increase in Coker capacity will increase the amount of vacuum gas oil produced at the refinery, which will reduce the amount that needs to be imported. This reduction in vacuum gas oil imports is anticipated to reduce the

number of marine tanker calls at the ESMT by seven ship calls per year during operation of the proposed project. Chevron also anticipates that the proposed increase in Coker capacity will lead to excess light gas oil production, which will be exported from the refinery, leading to an increase of seven ship calls per year to export light gas oil.

Although the annual number of ship calls may change, the ESMT has two berths and can only accommodate two marine tankers at one time. The time required to load and offload crude oil and other products from the tankers that currently call at the EMST, as well as from tankers that are anticipated to transport heavy crude oil to the EMST and to export light gas oil from the ESMT after implementation of the proposed project, exceeds 24 hours. Therefore, the maximum number of marine tankers calling at the ESMT during a single 24-hour period will not change as a result of implementing the proposed project, and peak daily emissions from marine tankers calling on the ESMT will not increase. However, changes in annual emissions anticipated to be generated within California Coastal Waters (as defined in the California Code of Regulations (CCR), Title 17, Section 70500(b)(1)) by the changes in marine vessel trips were calculated.

The route followed by the crude oil tankers from the boundary of California Coastal Waters to the ESMT is shown in Figure B-1. For the purpose of this analysis, the additional crude oil marine tanker trips were assumed to originate to the south of California and to enter California Coastal Waters offshore from the California-Mexico border. The tankers enter the California Coastal Waters at cruise speed. They maintain cruise speed until they slow to 12 knots (kts) when they enter an Air Quality Compliance Zone that extends in an arc 40 nautical miles (nm) from Point Fermin Light. (Since the release of the Draft EIR, Chevron has modified the proposed project to require reducing the marine vessel speed to 12 kts an additional 20 nm from Point Fermin Light for a total of 40 nm from Point Fermin Light.) They maintain the 12 kts speed until they reach the Pilot Boarding Area, approximately 3 nm from the ESMT. They then maneuver at a speed of 3 kts or less, usually with tug boat assistance, from the Pilot Boarding Area to the berth at the ESMT. They reverse this routing when leaving the ESMT. They reverse this routing when leaving the ESMT. For the purpose of the revised analysis in this Final EIR it was assumed that the other types of marine import and export marine tankers affected by the proposed project will spend approximately the same amount of time at these various speeds as the crude oil marine tankers.

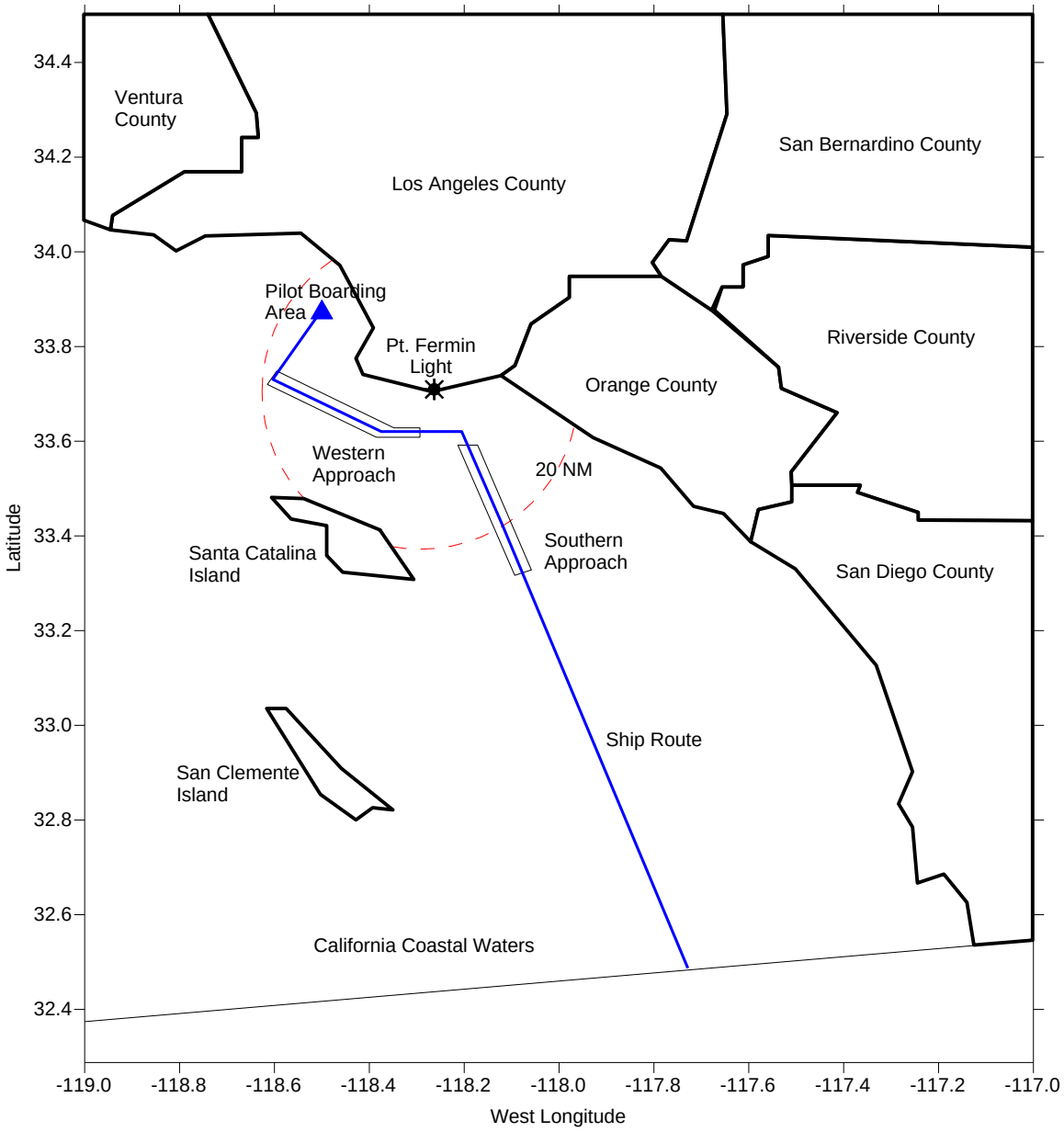


Figure B-1. Crude Oil Tanker Route from Southern Border of California Coastal Waters to the ESMT

Barges that currently export HSFO and Bunker Fuel from the ESMT were assumed to travel at 3 kts for 3 nm between the ESMT and the Pilot Boarding Area, at 12 kts for 30 nm from the Pilot Boarding Area to the Precautionary Area outside the Port of Los Angeles, and at 3 kts for 4 nm to berth in the Port of Los Angeles.

Marine vessel emission rates (pounds per hour) depend on the type of propulsion system (primarily motorships, with diesel engines, and steamships, with diesel-fueled boilers), engine size (i.e., power rating) and engine load (i.e., engine power output as a percent of rated power). Engine size varies with the size of the vessel, and engine load varies with ship speed. Thus, marine vessel emissions while in transit to and from the ESMT during a ship call depend on the tanker size and on the amount of time spent during operations at different speeds.

While moored at the ESMT, motorships operate auxiliary engines and boilers to provide power for lights, ventilation, etc., and steam for hot water and to keep fuel from solidifying. Motorship tankers also use auxiliary engines to power cargo offloading pumps. Steamships use their main boilers while moored at the ESMT, rather than auxiliary engines. These activities that occur while moored are called "hoteling." Total emissions from hoteling activities during a ship call depend on the total amount of time that the tanker is moored at the ESMT.

Subsequent to release of the Draft EIR, Chevron determined that all of the ships that will be affected by the proposed project are motorships.

In 1996, ARCADIS Geraghty & Miller (formerly Acurex Environmental) prepared 1993 and projected-future-year inventories of emissions from marine vessels in the South Coast Air Basin for the SCAQMD. ARCADIS Geraghty & Miller updated the data in the earlier report during 1999 to include a 1997 base year and emissions projected to occur in 2000, 2010 and 2020. Both the original and the updated report evaluated typical engine sizes by vessel type (tanker, bulk carrier, etc.), propulsion system (motorship or steamship) and vessel size. They also evaluated engine loads at various speeds and the emission factors associated with those speeds, as well as emission rates during hotelling. The results from the 1999 update were used to calculate the potential annual emissions associated with the additional marine tanker crude oil deliveries to the ESMT.

The following equation was used to calculate emissions from the marine tanker main engines while in transit to and from the ESMT:

$$\text{Main Engine Transit Emissions (lb/call)} = \Sigma_j EF_{ST,i,j} \times P_{S,j} \times T_{ST,j} \times 0.746 / 453.6 \quad \text{(EQ. B.2-4)}$$

where:

$EF_{ST,i,j}$ = Tanker main engine emission factor for pollutant i at speed j (g/kW-hr)

$P_{S,j}$ = Maine engine power output at ship speed j (hp)

$T_{ST,j}$ = Time at speed j (hr)

0.746 = Factor to convert hp to kW (kw/hp)

453.6 = Factor to convert g to lb (g/lb)

Motorship auxiliary engine and auxiliary boiler emissions were calculated using:

$$\text{Auxiliary Engine/Boiler Emissions (lb/call)} = \Sigma_j EF_{SA,i,j} \times T_{SA,j} \quad \text{(EQ. B.2-5)}$$

where:

$EF_{SAi,j}$ = Motor ship auxiliary engine or boiler emission factor for pollutant i in mode j (cruising, maneuvering, hotelling) (lb/hr)

$T_{SA,j}$ = Time spent in mode j (hr)

Steamship boiler emissions during hotelling were calculated using:

$$\text{Steamship Boiler Hotelling Emissions (lb/call)} = EF_{SBH,i} \times T_H \quad \text{(EQ. B.2-6)}$$

where:

EF_{SBHi} = Steamship boiler emission factor for pollutant i while hotelling (lb/hr)

T_H = Time spent hotelling (hr)

The emission factors presented by ARCADIS Geraghty & Miller for marine tankers are in Tables 31-A and 31-B of Attachment B.2.

Main engine power output at a particular speed depends on ship size. ARCADIS Geraghty & Miller classified ships into ranges of "design categories" that depend on ship cargo capacity and service speed. However, service speed for a particular type of ship (tanker, bulk carrier, etc.) and propulsion system (motorship or steamship) generally also depends on cargo capacity. Therefore, the design category for a particular ship of a particular type can be determined from its cargo capacity, which is expressed as deadweight tons (DWT).

The anticipated crude oil capacity of the additional marine tankers is 700,000 barrels. The capacity in DWT for a 700,000 barrel crude tanker is approximately 107,310 tons (700,000 barrels x 42 gal/barrel x 7.3 lb/gal / 2,000 lb/ton). For tankers, this capacity corresponds to the design category range 800-1000, which includes motorship tankers from 107,700 to 150,600 DWT. The

capacity of marine tankers that currently import vacuum gas oil to the refinery is also approximately 700,000 barrels. The capacities of the tankers that currently export HSFO and Bunker Fuel from the refinery and that are anticipated to export light gas oil from the refinery during operation of the proposed project are approximately 150,000 barrels, or approximately 23,000 DWT. This capacity corresponds to the design category range 200-400.

Main engine power output for motorship tankers in design categories 800-1000 (the additional crude oil import and current vacuum gas oil import tankers) from ARCADIS Geraghty & Miller during the three transit "operating modes" (cruise to AQCZ, cruise in AQCZ to Pilot Boarding Area, and maneuvering from Pilot Boarding Area to Berth) are in Tables 26-B and 27B of Attachment B.2. These values in units of hp are converted to units of kw-hr in Tables 26-C and 27C of Attachment B.2. The corresponding data for motorship tankers in design categories 200-400 (the additional light gas oil and current HSFO and Bunker Fuel export tankers) are in Tables 28-B, 28-C, 29-B and 29-C of Attachment B.2.

The time spent at each speed during transit to and from the ESMT was calculated by dividing the distance traveled at each speed by the speed. ARCADIS Geraghty & Miller present ship cruise speeds, categorized by type of ship, propulsion system and design category. These cruise speeds were used to calculate the travel time by crude oil tankers from the border of California Coastal Waters to the AQCZ. The speed limits of 12 kts inside the AQCZ and 3 kts between the Pilot Boarding Area and the ESMT were used to calculate travel times for those portions of the ship calls. The estimated distances traveled and times spent at various speeds by the tankers calling on the ESMT are listed in Tables 26-A through 30-A of Attachment B.2.

Vessels remain at the ESMT for 12 to 60 hours, with an average of 30 hours. Therefore, the 15 additional crude oil tankers were assumed to hotel at the ESMT an average of 30 hours each.

Marine tanker emissions during a ship call were calculated for motorships and are shown in Tables 26-D through 29-D of Attachment B.2.

ARCADIS Geraghty & Miller do not provide detailed information on emissions from tugboats. Therefore, data from the Mobil Torrance Refinery Reformulated Fuels Project Volume VII – Revised Draft EIR was used to estimate tug boat emissions during marine tanker ship calls. This Revised Draft EIR provided estimates of the annual emissions from tug boats associated with marine tankers delivering MTBE, as well as the number of ship calls, number of tug boats, and the tug boat operating time. These data were used to estimate the hourly emissions from each tug boat, as shown in Table 26-E through 29-Eof attachment B.2. Tug boat emissions during each ship call were then estimated by multiplying these hourly emissions by the maneuvering time and by the number of tug boats used during each ship call, which was assumed to be two.

Total annual emissions, including both crude oil tanker and tugboat emissions, from the marine tankers are in Tables 26-F through 30-F of Attachment B.2.

The barges that are currently used to export HSFO and Bunker Fuel from the ESMT are twoed by tug boats. The calculation of the decrease in emissions that will occur from the elimination of 13 barge trips during operation of the proposed project is in Tables 30-A and 30-B of Attachment B.2.

The net changes in annual total and hoteling marine vessel emissions during operation of the proposed project are summarized in Tables 25-A and 25-B of Attachment B.2.

B.3.3 Net Change in Peak Daily Operational Emissions

Peak daily operational criteria pollutant emissions for the proposed project are summarized in Table 1 of Attachment B.2. Peak daily operational criteria pollutant emissions for Alternative 1 and Alternative 2 are summarized in Tables 9 and 11, respectively, of Attachment B.2

B.4 OPERATIONAL TOXIC AIR CONTAMINANT EMISSION CALCULATIONS

Changes in direct operational toxic air contaminant (TAC) emissions include changes in fugitive TAC emissions resulting from changes in the number and types of components in refinery equipment process streams that contain TACs; and an increase in TAC emissions from Cooling Tower No. 9 caused by an increase in the circulating water flow rate. Changes in indirect TAC emissions include diesel exhaust particulate matter generated by the 22 additional daily truck trips to export petroleum coke and sulfur and the 15 additional annual crude oil marine tanker deliveries of crude oil.

B.4.1 Direct Operational Toxic Air Contaminant Emission Calculations

B.4.1.1 Fugitive TAC Emission Calculations from Process Components

Toxic air contaminant (TAC) emissions from changes in the number and types of components in process streams were calculated from the following equation:

$$\text{Emissions (lb/yr)} = C_{i,j} \times VOC_j \times 365 \qquad \text{(EQ. B.3-1)}$$

where:

$C_{i,j}$ = Concentration of TAC i in fugitive VOC emissions from refinery unit j (wt. fraction)

VOC_j = Increase in fugitive VOC emissions from refinery unit j (lb/day)

365 = Days per year

Concentrations of TACs in fugitive emissions from the No. 4 Crude Unit, the Coker and the Deporpanizer from the 1999 AB2588 health risk assessment from the Chevron El Segundo Refinery were used to calculate changes in TAC emissions from the proposed modifications to those units. Chevron provided estimates of concentrations of TACs in the proposed new processes streams at the No. 6 H_2S Plant.

The proposed modifications to the No. 6 H_2S Plant include new components in acid gas and sour water process streams. Acid gas contains H_2S and sour water contains H_2S and ammonia (NH_3), which are TACs, but they only contain negligible concentrations of organic compounds. Fugitive H_2S and NH_3 emissions from the proposed new components in acid gas and sour water service were calculated by multiplying the component leak rates by the H_2S and NH_3 concentrations in the process streams. For components in acid gas service, the leak rates were assumed to be equal to the fugitive VOC emission factors for components in hydrocarbon gas or vapor service. This assumed leak rate is conservatively high, because the acid gas streams contain approximately 93 percent H_2S, which has a low odor threshold. Because the odor threshold for H_2S is extremely low, leaks from components in acid gas service will be identified and repaired quickly by refinery personnel. Leak rates for components in sour water service were assumed to be equal to the fugitive VOC emission factors for components in light-liquid service.

Calculations of fugitive TAC emissions are shown in Tables 15, 16, 17 and 18 of Attachment B.2 for the No. 4 Crude Unit, the Coker, the Depropanizer, and the No. 6 H_2S Plant, respectively. Calculations of fugitive TAC emissions are shown in Table 21 of Attachment B.2 for Alternative 1 and in Tables 23 and 24 of Attachment B.2 for Alternative 2.

B.4.1.2 TAC Emission Calculations from Cooling Tower No. 9

Some of the metals dissolved in the Cooling Tower No. 9 circulating water are TACs and will be contained in the PM10 emitted by the cooling tower. The change in emissions of these TACs resulting from the proposed increase in circulating water flow rate was calculated from:

$$\text{Emissions (lb/yr)} = C_i \times PM10_C \times 365 \qquad \text{(EQ. B.3-2)}$$

where:

C_i = Concentration of TAC i in dissolved solids in cooling tower recirculating water (wt. fraction)

$PM10_C$ = Increase in PM10 emissions from cooling tower (lb/day)

365 = Days per year

The results of an August 25, 2005, analysis of the chemical composition of the cooling tower circulating water were used to calculate the weight fractions of TACs in the total dissolved solids. The TAC weight fractions and the resulting increases in emissions are in Table 19-A of Attachment B.2.

Additionally, chloroform will be formed from the chlorine that Chevron adds to the cooling tower circulating water, in the form of sodium hypochlorite, as a biocide. Chevron will increase the amount of sodium hypochlorite used to treat the proposed increase in cooling water circulating flow rate.

In the final report of a study of chloroform emissions and concentrations in the South Coast Air Basin conducted for the California Air Resources Board, Rogozen et al.[1] used results from chloroform measurements at eight cooling towers to develop an emission factor of 0.0034 lb chloroform per lb. chlorine added. The following equation was used to calculate the increase in chloroform emissions from the cooling tower:

$$\text{Emissions (lb/yr)} = EF_{T,Ch} \times Q_W \times A_H \times D_H \times C_H / 100 \times 0.95 \times 12 \qquad \text{(EQ. B.3-3)}$$

where:

$EF_{T,Ch}$ = Emissions factor for chloroform from cooling towers (lb chloroform/lb chlorine added)

Q_W = Increase cooling tower circulating water flow rate (gal/min)

A_H = Sodium hypochlorite solution addition rate (gal/month added per gal/min circulating water rate)

D_H = Sodium hypochlorite solution density (lb/gal)

C_H = Sodium hypochlorite concentration (wt. percent)

100 = Factor to convert wt. percent to wt. fraction

0.95 = Pounds chlorine equivalent/lb sodium hypochlorite

12 = Months/year

[1] Rogozen, M.B. et al., Sources and Concentrations of Chloroform Emissions in the South Coast Air Basin, Final report to California Air Resources Board, Contract A4-115-32, April 8, 1988.

Chevron currently uses 900 gal/month of 12.5 percent sodium hypochlorite solution to treat the current 14,000 gal/min circulating water flow, which corresponds to 0.064 gal/month of sodium hypochlorite per gal/min circulating water flow rate for A_H in Equation B.3-3. The calculation of the increase in chloroform emissions from Cooling Tower No. 9 from the proposed project is in Table 19-B of Attachment B.2.

B.4.2 Net Change in Direct Operational TAC Emission Calculations

The net change in direct operational TAC emissions for the proposed project is summarized in Table 14 of Attachment B.2. The net change in operational TAC emissions for Alternative 1 and for Alternative 2 are shown in Tables 20 and 22, respectively, of Attachment B.2.

B.4.3 Indirect Operational Toxic Air Contaminant Emission Calculations

All PM10 emissions from diesel combustion are assumed to be toxic DPM emissions. Therefore, the increase in annual DPM emissions from the additional petroleum coke and sulfur export truck trips and the additional crude oil marine tanker calls at the ESMT were assumed to be equal to the exhaust PM10 emissions.

The calculation of peak daily exhaust PM10 emissions from petroleum coke export truck trips was described previously. The peak daily emissions were multiplied by 365 days per year to calculate annual emissions, which are listed in Table 32 of Attachment B.2. The calculation of annual exhaust PM10 emissions from the additional crude oil marine tanker calls was also described previously, and these emissions are also listed in Table 32 of Attachment B.2.

The proposed project is anticipated to increase average daily sulfur production by 19 tons per day, which corresponds to an increase of 6,935 tons per year. The capacity of a sulfur export truck is approximately 26 tons. Therefore, the proposed project will lead to an additional 267 trips per year to export sulfur from the refinery. Sulfur exported from the refinery is currently sold to chemical manufacturing facilities located in the vicinity of the Port of Los Angeles, and the one-way travel distance for sulfur-export truck trips is approximately the same as the distance for petroleum coke export truck trips (20 miles). Exhaust emissions from these additional truck trips were calculated using the same methodologies that were used to calculate emissions from petroleum coke export trucks and from off-site motor vehicles during the construction phase for the proposed project (see Table 4.1-3) and are listed in Table 33 of Attachment B.2.

B.5 PM10 AMBIENT AIR QUALITY IMPACTS MODELING

Atmospheric dispersion modeling was conducted to determine the localized ambient air quality impacts from increases in direct PM10 emissions due to the proposed project at the refinery.

PM10 emissions are the only direct criteria pollutant emissions that will increase and that require modeling per SCAQMD Rule 1303 to determine impacts on ambient air quality.

The atmospheric dispersion modeling methodology used for the project follows generally accepted modeling practice and the modeling guidelines of both the U.S. EPA and the SCAQMD. Dispersion modeling was performed using the Industrial Source Complex Short-Term 3 (ISCST3) dispersion model (Version 02035). Modeling input and output files are provided electronically in Attachment B.3.

Model Selection

The dispersion modeling methodology used follows U.S. EPA and SCAQMD guidelines. The ISCST3 model (Version 02035) is n U.S. EPA model used for simulating the transport and dispersion of emissions in areas of both simple, complex, and intermediate terrain. Simple terrain, for air quality modeling purposes, is defined as a region where the heights of release of all emission sources are above the elevation of surrounding terrain. Complex terrain is defined as those areas where nearby terrain elevations exceed the release height of emissions from one or more sources. Intermediate terrain is that which falls between simple and complex terrain. Simple terrain exists in the vicinity of the refinery.

Modeling Options

The options used in the ISCST3 dispersion modeling are summarized in Table B.4-1. U.S. EPA regulatory default modeling options were selected except for the calm processing option. Since the meteorological data set developed by the SCAQMD is based on hourly average wind measurements, rather than airport observations that represent averages of just a few minutes, the SCAQMD's modeling guidance requires that this modeling option not be used.

Table B.4-1
ISCST3 Modeling Options Selected

Model Option Keyword	Description
CONC	Compute Concentration
URBAN	Use Urban Dispersion Coefficients
NOCALM	Do Not Invoke Calm Processing Option for Meteorological Data
By default, the following options were not selected: GRDRIS, NOSTD, NOBID, MSGPRO, NOSMPL, NOCMPL	

Meteorological Data

The SCAQMD has established a standard set of meteorological data files for use in Basin air quality modeling. For the area in which the refinery is located, the SCAQMD requires the use of its Lennox 1981 meteorological data file, which is consistent with the data used for previous air quality and health risk assessment modeling studies at the refinery. To ensure consistency with this prior modeling methodology, and SCAQMD guidance, the 1981 Lennox meteorological data set was used for this modeling at the refinery.

In the Lennox data set, the surface wind speeds and directions were collected at the SCAQMD's Lennox monitoring station, while the upper air sounding data used to estimate hourly mixing heights were gathered at Los Angeles International Airport. Temperatures and sky observation (used for stability classification) were taken from Los Angeles International Airport data.

Receptors

The ISCST3 modeling options followed SCAQMD modeling guidance. The building wake parameters for the cooling tower were computed using the EPA BPIP model (version 95086). Gridded receptors with a spacing of 100 meters were placed along the boundaries of the refinery to a distance of 300 meters. No receptors were placed within the Refinery property line.

Source Parameters

Table B.4-2 summarizes the source parameters for the cooling tower and for the coke drum depressurization stack. Cooling Tower No. 9 consists of six individual cells, 18 feet (5.49 meters) in diameter, in a linear array aligned north-south. The cell centers are approximately 12 meters apart. Because adjacent cells of the cooling tower are located less than a cell diameter apart, common modeling practice is to merge the flow and simulate adjacent cells as a single source with the exhaust velocity of a single cell but with a diameter that results in an area equal to the sum of the areas of the adjacent cells. This modeling approach accounts for the merging of adjacent individual plumes upon release and the resulting enhanced plume rise due to the combined momentum flux and buoyancy flux of the adjacent plumes. Therefore, the six cells of Cooling Tower No. 9 were modeled as two separate merged sources, each source representing the three adjacent cells on each end of the tower. Each source was modeled as having one half of the total PM10 emissions from the cooling tower.

Table B.4-2
Point Source Locations and Parameters Used in PM10 Modeling

Source	PM10 Emission Rate (g/s)	UTM X [m]	UTM Y [m]		Release Height Above Ground Level [m]	Temp (°K)	Dia (m)	Vel (m/s)
Cooling Tower, North Cells	0.332	369882	3752820		17.37	308	9.50	11.3
Cooling Tower, South Cells	0.332	369882	3752784		17.37	308	9.50	11.3
Coke Drum Depressur-ization Stack	0.0867	369688	3752712		43.8	389	0.36	70.0

Results

The maximum modeled 24-hour impact at the property boundary is 2.2 $\mu g/m^3$ and the annual impact is 0.37 $\mu g/m^3$.

B.6 HEALTH RISK ASSESSMENTS

Health risk assessments procedures for SCAQMD Rule 1401 were followed to evaluate potential health risks from the proposed increases in direct TAC emissions from the refinery. The facility health risks were evaluated using the HARP model. Additionally, health risk assessments were conducted to evaluate potential health risks from increases in indirect diesel exhaust particulate matter emissions from petroleum coke and sulfur export trucks and from crude oil marine tankers.

B.6.1 Refinery Health Risk Assessment

The health risk assessment (HRA) for the increases in direct TAC emissions from the refinery evaluated potential health risks from increased emissions of both carcinogenic and non-carcinogenic TACs. Health risks from carcinogenic TACs were evaluated by calculating the maximum incremental cancer risk (MICR), which is the increased probability of contracting cancer from exposure to the maximum off-site concentrations of carcinogenic TACs.

Health risks from non-carcinogenic TACs were evaluated by calculating chronic hazard indices (HIs) for TACs that can cause adverse health effects through long-term (i.e., lifetime) exposure and acute hazard indices for TACs that can cause adverse health effects through short-term (i.e., one hour) exposure. Hazard indices are calculated by first dividing the estimated off-site concentration of individual TACs by a reference exposure level (REL) for the TAC to calculate a hazard quotient (HQ) for each TAC. The REL is a concentration that has been determined not to cause adverse health effects. The HI is calculated as the sum of the HQs for the individual TACs. Because different TACs can cause adverse effects on different target organs, such as the nervous system or the liver, the HIs are calculated for each target organ by summing the HQs for the TACs that can affect each organ. If the HI for a target organ is less than one, the TAC emissions are not expected to cause adverse health effects for that target organ.

The methodology used in the HRA followed the *Air Toxics Hot Spots Program Risk Assessment Guidelines, The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments*, developed by the California Office of Environmental Health Hazard Assessment (OEHHA), as specified in the SCAQMD guidance for conducting a Tier 4 HRA to comply with Rule 1401. The HRA was performed using the CARB HARP model (version 1.2a) that implements the OEHHA guidance. The cancer potency factors and reference exposure levels (RELs) used are consistent with the current values as determined by OEHHA. Modeling input and output files are provided electronically in Attachment B.3.

Four sources of TAC emissions were modeled in HARP. Fugitive emissions from the Coker, the No. 4 Crude Unit, and the No. 6 H_2S plant were modeled as area sources, because the components that cause the fugitive emissions are located throughout the units. TAC emissions

from Cooling Tower No. 9 were modeled as a point source, because the emissions emanate from distinct locations. HARP was run with default parameters. The ARB-recommended derived-adjusted cancer risk assessment option was selected. Given the urban, industrial location of the refinery, the only exposure routes considered in the risk assessment were inhalation, dermal exposure, soil ingestion, and mother's milk. Modeling input and output files are provided electronically in Attachment B.3.

The ISCST3 model is integral to HARP. The meteorological data, model options and receptor network that were used for the PM10 ambient air quality impacts modeling described in Section B.4 were also used for the HRA modeling. Gridded receptors with a spacing of 100 meters were placed along the north and southeast boundaries of the refinery to a distance of 400 meters. Outside the fine grid, a coarse grid with 500 meter spacing was placed surrounding the entire facility. The receptor grid used was the same receptor grid used for the prior AB2588 modeling for the refinery. No receptors were placed within the Refinery property line. Terrain heights for all receptors were obtained from the refinery HRA.

Only TACs identified in the OEHHA HRA guidance with cancer potency values or non-carcinogenic RELs were included in the HRA. The TACs that were modeled are listed in Table B.5-1.

The use of the OEHHA guidelines results in a worst-case analysis for cancer risks, because the theoretical incremental cancer risk estimated in the HRA using HARP for nearby residents is based on the assumption that these individuals are being continuously exposed to air pollutants emitted from routine operations for 24 hours per day, 365 days per year, for 70 years at the same location. For off-site workers, the risk is estimated assuming exposure for 40 years instead of 70 years. Actual risks are likely to be substantially lower than the calculated risks estimated using the OEHHA guidelines and could even approach zero.

Table B.5-1
TACs Modeled in the Health Risk Assessment

Pollutant	CAS	Cancer	Chronic	Acute
1,3-Butadiene	106990	X	X	
Acetaldehyde	75070	X	X	
Benz[a]anthracene	56553	X		
Benzo[a]Pyrene	50328	X		
Benzo[b]fluoranthene	205992	X		
Benzo[k]fluoranthene	207089	X		
Benzene	71432	X	X	X
Chlorine	7782505		X	X
Chloroform	67663	X	X	X
Copper	7440508		X	X
Cr(VI)	1854029	X	X	
Diethanolamine	111422		X	
Formaldehyde	50000	X	X	X
H_2S	7783064		X	X
Indeno[1,2,3-cd]pyrene	193395	X		
Manganese	7439965		X	
Mercury	7439976		X	X
m-Xylene	108383			X
Naphthalene	91203	X	X	
NH_3	7664417		X	X
Nickel	7440020	X	X	X
Phenol	108952		X	X
Sulfates	9960		X	X
Sulfuric Acid	7664939		X	X
Toluene	108883		X	X
Xylenes	1210		X	X
Zinc	7440666		X	

Source Parameters

Modeling was performed using five sources consisting of one point source, three area sources composed of components with fugitive emissions, and one project alternative area source composed of storage tank fugitive emissions. The three project area sources were modeled as rectangular area sources. The project alternative source was also modeled as a rectangular area source. Table B.5-2 lists modeling parameters for the point source, and Table B.5-3 lists modeling parameters for the area sources. The coordinates listed in Table B.5-2 are the first vertex of the rectangle, the center of the tank, or the location of the point source. The emission rate used in HARP is the emission rate per square meter of surface area.

Table B.5-2
Point Source Location and Parameters Used in HRA Modeling

Model ID/Equipment	UTM X [m]	UTM Y [m]	Stack Base Elev MSL [ft]	Release Height AGL [m]	Temp [°K]	Vel [m/s]	Dia [m]
S003/Cooling Tower 9	369,888	3,752,622	108	17.4	308	10.9	5.49
Note: MSL = mean sea level; AGL = above ground level							

Table B.5-3
Area Source Locations and Parameters Used in HRA

Model ID/Equipment	UTM X [m]	UTM Y [m]	Elev MSL [ft]	Release Height AGL [m]	X Len [m]	Y Len [m]	Q [g/s-m^2]
S001/Coker Fugitives	369,647	3,752681	96	2	108	108	8.54E-05
S002/No. 4 Crude Unit Fugitives	369,536	3,753,425	101	2	200	71	7.04E-05
S006/No. 6 H_2S Plant Fugitives	369,891	3,75,3325	96	2	26	14	2.81E-03
Alternative 2: S004/Tanks 1002 and 1006	369,502	3,752,065	82	19.5	70	70	2.03E-04
Note: MSL = mean sea level; AGL = above ground level							

B.6.2 Export Truck Health Risk Assessment

Subsequent to release of the Draft EIR, the calculations of emissions from trucks exporting petroleum coke and sulfur from the refinery during operation of the proposed project were revised to use exhaust emission factors for calendar year 2008, the year operation of the proposed project will begin, instead of exhaust emission factors for calendar year 2006. The use of the 2008 emission factors reduced the exhaust PM10 emissions from the trucks somewhat, which will lead to lower health risks than the risks presented in the following discussion.

The proposed project will result in approximately 20 additional trucks trips per day transporting petroleum coke to the Port of Long Beach or the Port of Los Angeles and 2 additional truck trips per day transporting sulfur to facilities in the vicinity of the Port of Los Angeles. The trucks

transporting the petroleum coke and sulfur will be diesel fueled and will emit diesel particulate matter (DPM), classified as a carcinogenic TAC by the State of California. Therefore, a health risk assessment of the potential incremental cancer risk to residential populations along the truck transport route from the increase in export truck traffic was performed.

Currently, the majority of the petroleum coke is exported from the refinery to the Port of Los Angeles. However, when the Los Angeles Terminal closes in the future, all petroleum coke export will be through the Long Beach Terminal. For the purpose of assessing potential long-term cancer risk due to the increase in export truck DPM emissions, all petroleum coke export trucks were assumed to transport petroleum coke from the refinery to the Port of Long Beach while the sulfur export trucks were assumed to transport the sulfur to the vicinity of the Port of Los Angeles.

The route taken by an individual truck is assumed to be from refinery Gate 2 on El Segundo Boulevard east to Interstate 405, then south on Interstate 405. At Interstate 110, the sulfur export trucks will head south on Interstate 110 to the vicinity of the Port of Los Angeles. The petroleum coke export trucks will continue on Interstate 405 to Interstate 710, where they will head south on Interstate 710 to Pico Drive at the Port of Long Beach. Figure B-2 presents the truck routes modeled for this study. The Gate 2 exit is assumed because this maximizes the traffic on El Segundo Boulevard north of the refinery. The modeled truck route is approximately 19 miles (31 kilometers) long to the Port of Long Beach and slightly shorter to the Port of Los Angeles.

The export truck emissions were modeled using the ISCST3 model following SCAQMD-approved methodology. Modeling input and output files are provided electronically in Attachment B.3. The option switches of NOCALM (no calm wind processing) and NOSTD (no stack tip downwash) were implemented, as was the URBAN switch for the use of urban dispersion coefficients. The terrain option for FLAT terrain was selected. The NOSTD option had no effect on the modeling as only volume sources were used to simulate the truck sources.

Because of the length of the transport route from the refinery to the export terminals, different SCAQMD meteorological data sets are representative of the start and end of the truck route. The Lennox data set is appropriate for simulating emissions during the first part of the truck route, while the Long Beach data set is appropriate for simulating emissions in the latter part of the truck route. Because of the difficulty in determining the appropriate meteorological data set to apply at intermediate points along the truck route, modeling was performed using both data sets for all receptors, and the highest modeled concentration from either run was selected for estimating the potential cancer risk from the export truck DPM emissions.

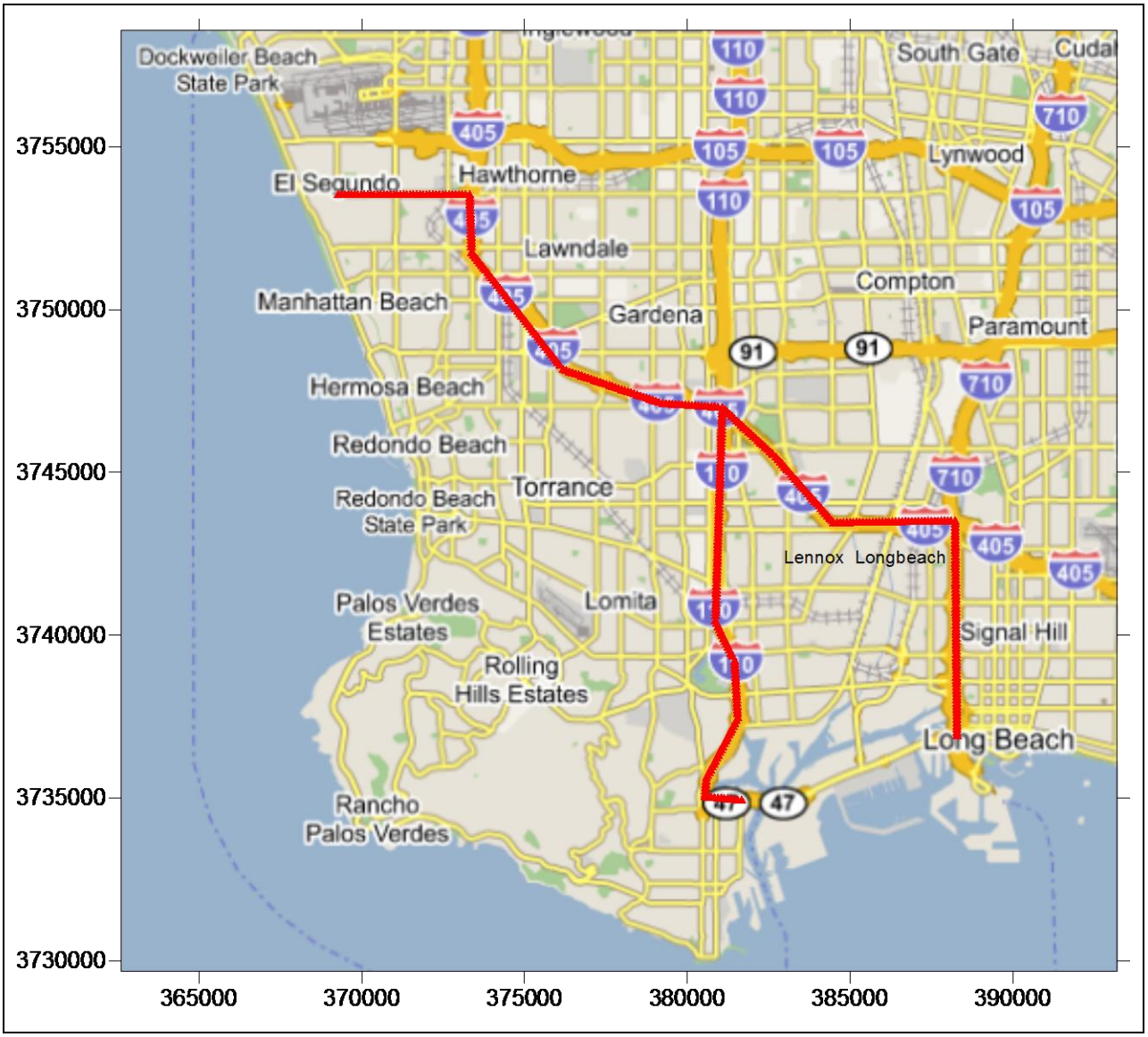
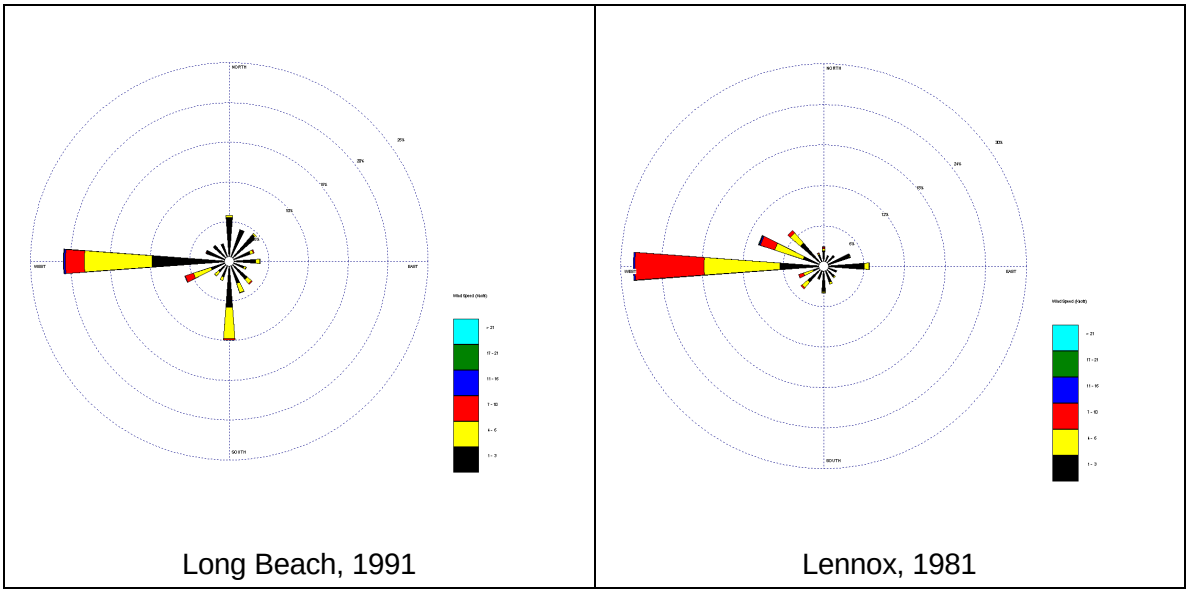


Figure B-2. Truck Route Modeled for Petroleum Coke and Sulfur Transport to the Port of Long Beach

Wind Roses for Lennox and Long Beach for 1981 created from the SCAQMD modeling data sets are shown in Figure B-3. Both data sets have a predominant westerly (from the west) wind, with slightly higher speeds apparent at Lennox. There are more southerly winds at Long Beach.



Long Beach, 1991 | Lennox, 1981

Figure B-3. Wind Roses for Long Beach and Lennox, 1981, from SCAQMD Modeling Datasets.

The truck route was simulated with ISCST3 as a series of volume sources spaced 100 meters (m) apart. A source spacing of 100 m was chosen because it is twice the assumed average 50 m width of the roadway along the truck route. El Segundo Boulevard will likely be less than 50 m wide while sections of Interstate 110, 405, and 710 may be wider. Assuming a source spacing of 100 meters, a total of 440 volume sources were used to represent emissions along the truck routes.

The estimated DPM (PM10) emission rate from an individual export truck is 0.331 grams/mile (g/mi). There are three segments of the truck transport routes with different numbers of daily export truck trips: all 22 trucks travel between the refinery and the intersection of the Interstate 405 and 110 freeways; two sulfur export trucks travel south on the Interstate 110 freeway from the Interstate 405/Interstate 110 intersection, and 20 petroleum coke export trucks travel south on Interstate 405 from the Interstate 405/Interstate 110 intersection. These differences in the number of export truck trips lead to differences in the volume source emission rates used in the modeling for the three segments. The volume-source emission rate corresponding to a single daily truck trip is computed below. The volume-source emission rates two, 20, and 22 export truck trips per day listed in Table B.5-4.

ER_{source} = 0.331 g/mi-source x 1 trucks/day x day/24 hr x hr/3600 sec x mi/5280 ft x 3.28 ft/m x 100 m/source

= 2.38×10^{-7} (g/sec)/(source-truck)

Table B.5-4
Export Truck Modeling Volume Source Emission Rates

Number of Trucks per Day	Highway Segment	Unit Emission Rate (g/sec) / (source-truck)	Volume Source Emission Rate (g/sec) / (source)
22	Refinery to I-110	2.38×10^{-7}	5.24×10^{-6}
20	I-110 to POLB	2.38×10^{-7}	4.76×10^{-6}
2	I-110 to POLA	2.38×10^{-7}	4.76×10^{-7}

The height of the emissions from each volume source was assumed to be 13 feet (4.0 m), approximately the height of the exhaust of a truck. The initial horizontal and vertical plume standard deviations were computed following guidance from Table 3-1 of the ISCST3 User's Guide. For the horizontal standard deviation, the source-to-source spacing of 100 m was divided by 2.15 to yield 46.5 m. For the vertical standard deviation, the truck cab top was assumed equal to exhaust height, and the standard deviation was estimated as the cab height of 4 m divided by 2.15 to yield 1.86 m. The use of the truck cab top for estimating the vertical standard deviation is conservative (i.e., likely under estimates the true value) because it does not account for any increase in vertical dispersion produced by the mechanical wake of moving vehicles in multiple adjacent lanes of traffic.

Receptors with a spacing of 100 m were place along the entire truck route. The grid was placed around the transport route beginning approximately 50 meters from the centerline of the roadway and extending out to 350 m (i.e., three rows of receptors following the roadway beginning approximately 50 m from the centerline). A total of 2,689 receptors were modeled.

The maximum annual DPM concentration occurred with the Long Beach meteorological data set, in the first row of receptors, approximately 50 m from the highway centerline, on the northeast side of the intersection of Interstate 110 and Interstate 405. The peak exposure location is not a residential receptor location. The maximum annual concentration of DPM was 0.00183 $\mu g/m^3$ at this receptor.

The inhalation unit risk factor for DPM established by the State of California (ARB, 2003) is 3.00×10^{-4} $(\mu g/m^3)^{-1}$. This inhalation risk factor represents the potential for contracting cancer due to continuous inhalation exposure over a 70-year lifetime. Applying this inhalation unit risk factor to

the modeled maximum DPM concentration from the export trucks yields a peak 70-year residential cancer risk of 0.55×10^{-6} (0.55 per million).

B.6.3 Marine Crude Oil Tanker Health Risk Assessment

As discussed in Section B.3.2.2, Chevron has provided more detailed information on the overall effects of the proposed project, which allowed a more refined analysis of the information contained in the Draft EIR regarding marine vessel emissions. This refined analysis resulted in a smaller anticipated increase in DPM emissions from marine vessels during operation of the proposed project than was presented in the Draft EIR. Therefore, the health risks from marine vessel DPM emissions during operation of the proposed project will be lower than presented in the following discussion from the Draft EIR Appendix B.

The proposed project will result in 15 additional crude oil marine tanker deliveries to the off-shore ESMT. These marine tankers will be diesel fueled and will emit DPM. Therefore, a health risk assessment of the potential incremental cancer risk to on-shore residential populations from the increase in crude oil marine tanker deliveries was performed.

The marine tankers emit particulate matter while in transit to and from the ESMT and while moored at the terminal. The distance traveled by the marine tankers within California Coastal Waters while in transit to the ESMT is more than 100 nm, as indicated in Table 34 of Attachment B.1. Therefore, DPM emissions from the tankers while in transit will be dispersed over an extensive area. However, the tankers will be at a single location while moored at the ESMT. Therefore, the health risk assessment evaluated potential impacts from DPM emissions during hoteling.

Modeling of emissions from the marine tankers was conducted using the Offshore and Coastal Dispersion Model (OCD), version 5, which is specifically designed to account for the potentially differences between over-water and over-land dispersion characteristics, which are not incorporated into the ISCST3 model. Modeling input and output files are provided electronically in Attachment B.3.

Meteorological Data

The OCD model requires over-water meteorological data (from a buoy) as well as over-land meteorological data. For this analysis, data from buoy station 46056, located off the coast of Redondo Beach, CA, for 1996 was chosen. The 1996 data set was the most complete of the most recent data available (1991-1999), with over 98 percent data capture. Hourly wind speed, wind direction, air temperature, and surface water temperature were formatted for use in OCD. Occasional missing data (with three or less consecutive hours missing) were filled by interpolation. Wind speeds and wind directions missing for more than three consecutive hours

were not filled, as OCD uses over-land wind data if no over-water data is available. Air temperature and surface water temperature missing for more than three consecutive hours were also filled using interpolation, as these parameters change very little from hour to hour.

Surface data from the National Weather Service station at Los Angeles International Airport (LAX) for 1996 was processed with concurrent twice-daily mixing height data from Miramar, CA using PCRAMMET to format the data for use in OCD. Surface data from LAX for 1996 are more than 99 percent complete, with the exception of wind direction, which is 94 percent complete. Missing wind direction data were only filled where buoy wind data were also missing, because the OCD model only uses over-land wind data if over-water wind data are unavailable. Missing wind directions for a two-hour period on November 30 and for one hour on December 31 were the only surface data filled. While another five-hour period on December 31 was missing from both LAX and the buoy, it was left missing, as five or more consecutive hours should not be manually filled. Mixing height data are 100 percent complete.

Receptors

A polar receptor grid consisting of a total of 29 radials was developed for locations from the shoreline to approximately five km inland. A radial perpendicular to the shoreline was first developed, then 14 radials (spaced every five degrees) were place on either side of the first radial. Receptors were spaced at 500 m along every radial, extending at least five km inland (with respect to the source). Additional receptors were also placed along the shoreline, so that spacing between each of the receptors was less than 500 m. Figure B-4 displays the modeled stack location and receptor locations used in this analysis.

The OCD model requires a ground elevation for each receptor as well as a "terrain elevation toward which the source to receptor is aligned." This terrain elevation is equivalent to the critical hill height elevation that the AERMAP receptor processor produces. Therefore, AERMAP was used along with 30-m Digital Elevation Model (DEM) data to determine the appropriate receptor input data for OCD.

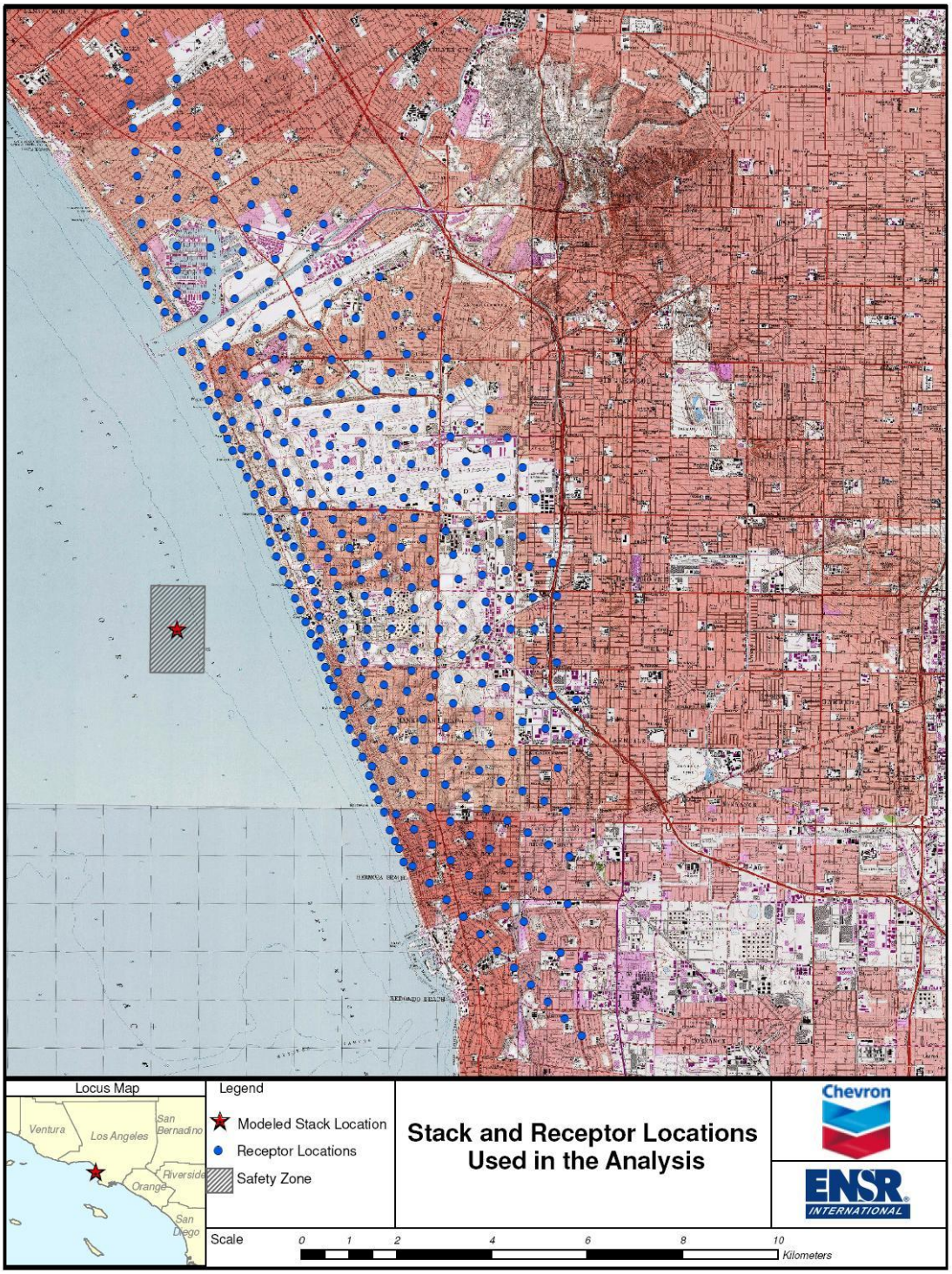


Figure B-4. Source and Receptor Locations for Marine Tanker Health Risk Assessment

Source Data

PM10 emissions produced by the tanker while docked at the offshore terminal were modeled. Stack parameters corresponding to the ship hoteling/offloading were assumed to be similar to that used in a study of diesel particulate matter conducted by CARB.[2] Stack parameters and PM10 emission rates used in the modeling are shown in Table B.5-5.

Table B.5-5
Crude Oil Marine Tanker Stack Parameters

Location[a]		Total Stack Height (m)	Ship Deck Height above Water[b]	Stack Height above Platform	Diameter (m)[c]	Exhaust Temperature (^oK)[c]	Exit Velocity (m/s)[c]
UTMX (m)	UTMY (m)						
365615	3752739	43.0	15.0	28.0	0.5	618	16.0

[a] Center of ESMT mooring area
[b] Assumption, derived from tanker photographs
[c] Stack parameters assumed to be equal to hoteling parameters listed in Table 6 (pg. 28) of: http://www.arb.ca.gov/msprog/offroad/marinevess/documents/100305draftexposrep.pdf

The stack was assumed to be located approximately in the center of the terminal mooring area. The OCD model requires a base elevation for the stack location. For this analysis, the base elevation was assumed to be equal to the deck height of the tanker above water. Based on photographs of Chevron tankers, as well as ship information available from http://www.hamworthy.com/docGallery/24.PDF, the deck height of the tanker was estimated to be approximately 15 m above water. OCD also requires the dimensions of any structure or obstacle near the stack that could cause downwash. Dimensions of the highest tier of the tanker, located next to the stack, were input to OCD. A height of 25 m above the deck and a width of 35 m were estimated for this tier from example tanker photos and the above online reference.

Modeling Results

The OCD model was run with a unit (1 g/s) emission rate to obtain normalized concentrations. The annual-average concentrations predicted by OCD with the 1 g/s emission rate are shown in Figure B-5. This figure shows that the maximum on-shore normalized annual average

[2] "Diesel Particulate Matter Exposure Assessment Study for the Ports of Los Angeles and Long Beach", California Environmental Protection Agency, Air Resources Board, October 2005. See Table 6 pg. 28.

concentration is 0.29 µg/m^3. The annual PM10 emissions from the 15 additional crude oil marine tankers during hoteling is 1,229 pounds per year, as listed in Table 39 of Attachment B.1, which is equivalent to 0.018 g/s (1,229 lb/yr x 453.6 g/lb / 8,760 hr/hr / 3,600 sec/hr). Thus, the maximum annual average on-shore PM10 concentration resulting from hoteling emissions from the additional crude oil tankers would be 5.2 x 10^{-3} µg/m^3. Multiplying this annual-average concentration by the DPM unit risk factor of 3.0 x 10^{-4} (µg/m^3)$^{-1}$ results in an incremental cancer risk of 1.6 x 10^{-6} (1.6 in a million).

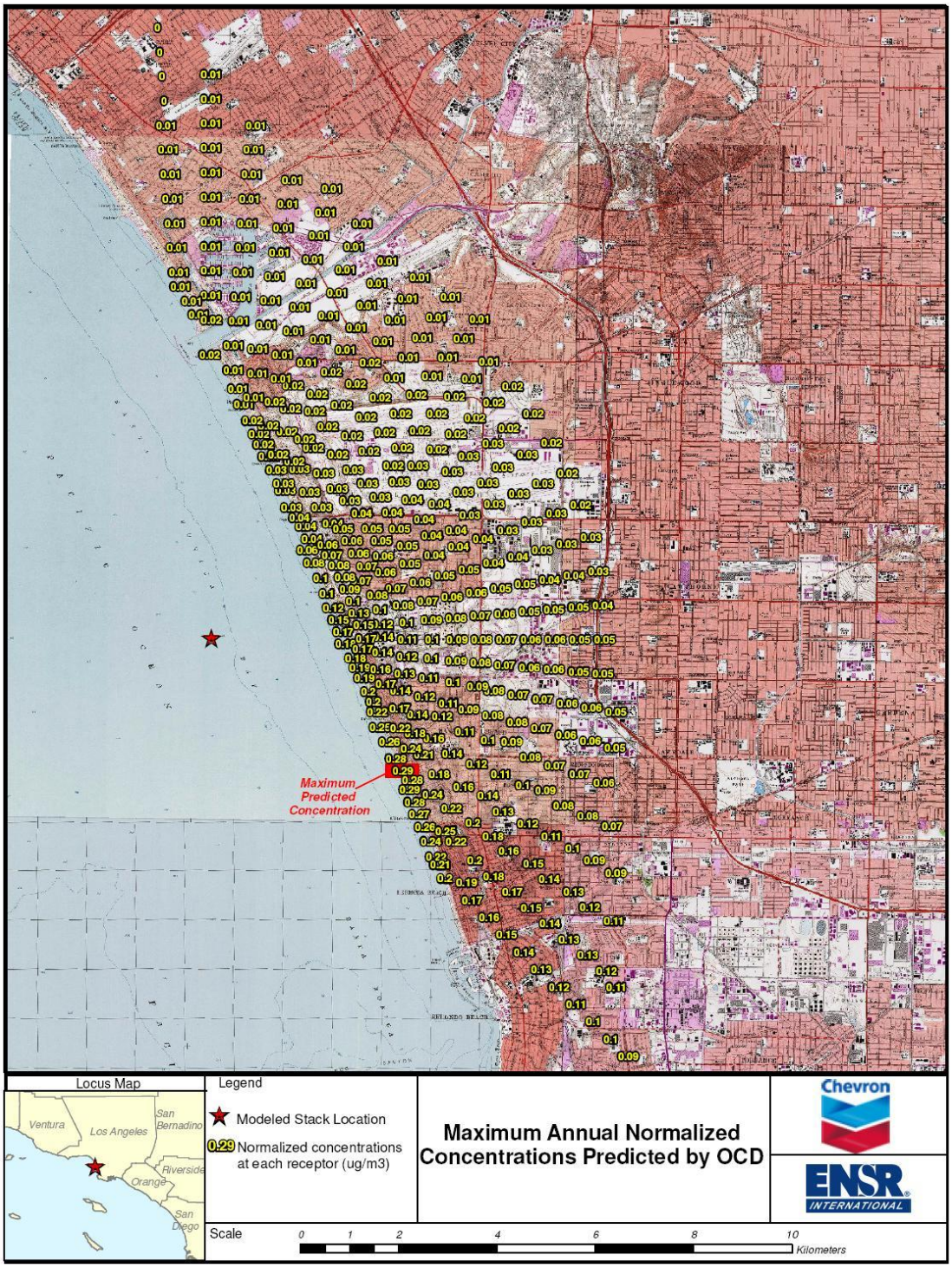


Figure B-5. Annual Average PM10 Concentrations from OCD Modeling of 1 g/s Emission Rate from Crude Oil Marine Tankers