

**APPENDIX D**

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***Health Risk Assessment***

# J House Environmental, Inc.

Site Assessment ♦ Remediation ♦ Safety Risk Analysis

May 10, 2007

Ms. Christine Kronenberg  
EIP Associates  
1200 2<sup>nd</sup> Street  
Sacramento, CA 95814

## **Project Screening for Sensitive Land Uses Adjacent to Major Roadways Delta Shores Planned Development, Sacramento, California**

Dear Ms. Kronenberg,

J House Environmental, Inc. is pleased to present this Project Screening for Sensitive Land Uses Adjacent to Major Roadways. This screening level health risk assessment addresses potential cancer risk from diesel particulate matter (PM) attributable to roadway traffic in proximity to the Delta Shores planned development in Sacramento, California. This project screening has been conducted in accordance with the Sacramento Metropolitan Air Quality Management District (SMAQMD) January 2007 *Recommended Protocol for Evaluating the Location of Sensitive Land Uses Adjacent to Major Roadways*.

### **Project Description**

The Delta Shores planned development is an 800-acre project that includes residential use, commercial use, parks and open space, two public elementary schools and public facilities (i.e. fire station, water tank and electrical facilities). The project site is located in South Sacramento, along Interstate 5 (I-5). Approximately 120 acres of the planned development is located west of I-5; the remaining approximately 680 acres is located on the east side of I-5. A vicinity map and a site map are presented in Figure 1 and Figure 2, respectively.

### **Background**

In April 2005, the California Air Resources Board (ARB) issued a guidance document on air quality and land use entitled *Air Quality and Land Use Handbook: A Community Health Perspective*. This document recommends that a health risk assessment be conducted for sensitive land uses planned within 500 feet of a freeway or other high traffic roadway.

SMAQMD has developed a methodology to assist land use decision makers in siting new residential projects and other sensitive land uses in proximity to freeways and other high traffic volume roadways, as presented in the January 2007 document *Recommended Protocol for Evaluating the Location of Sensitive Land Uses Adjacent to Major Roadways*. The methodology sets forth a process to evaluate potential cancer risk posed by PM, which ARB has listed as a

toxic air contaminant. Since the land use plan for Delta Shores includes residential land use within 500 feet of I-5, the City of Sacramento requires that the planned development be evaluated in accordance with the SMAQMD methodology to estimate the potential cancer risk due to PM.

### **Project Screening**

As indicated on Figures 1 and 2, I-5 is oriented in a general north-south direction in the vicinity of the Delta Shores planned development. Therefore, Table 2 of the SMAQMD protocol document applies to this project screening (see Attachment B).

Medium density residential use areas are planned within 500 feet east of I-5, in the northern portion of Delta Shores. Low density and medium density residential use areas are planned within 500 feet west of I-5. As shown on Figure 2, the closest residential sensitive receptor east of I-5 is 117-feet from the edge of the nearest northbound I-5 traffic lane. The closest residential sensitive receptor west of I-5 is 127-feet from the edge of the nearest southbound I-5 traffic lane (see Figure 2). A receptor distance of 100 feet is used in this project screening. This provides a conservative estimate of potential cancer risk, since the sensitive residential receptors will actually be located at distances greater than 100 feet.

The nearest freeway interchange to the project site is the Pocket/Meadowview Roads interchange (Sacramento County Milepost 16.15), located approximately 1 mile north of the Delta Shores planned development (see Figure 1). The Laguna Boulevard interchange (Sacramento County Milepost 12.04) is located approximately 2 miles south of the Delta Shores planned development. California Department of Transportation (Caltrans) 2005 traffic counts show a peak hour traffic volume of 9,100 vehicles per hour at the Pocket/Meadowview Roads interchange and a peak hour traffic volume of 6,500 vehicles per hour at the Laguna Boulevard interchange. A peak hour traffic volume of 12,000 vehicles per hour is used in this project screening. This provides a conservative estimate of potential cancer risk, since the Caltrans data show lower peak hour traffic volumes along the portion of I-5 adjacent to the Delta Shores planned development (see Figure 1).

As indicated in the SMAQMD screening table for diesel PM cancer risk east and west of a north-south roadway (Table 2, Attachment B), the estimated incremental cancer risk for residential receptors east (downwind) of I-5 is 354 per million. This level is below the SMAQMD evaluation criterion of 446 per million, at which a site specific health risk assessment is recommended. Therefore, no further roadway air quality analysis is recommended to address health risks to residential receptors in the portion of the Delta Shores planned development located east of I-5.

The screening table shows an estimated incremental cancer risk for residential receptors west (upwind) of I-5 of 189 per million. Since this level is below the SMAQMD evaluation criterion of 446 per million, no further roadway air quality analysis is recommended to address health risks to residential receptors in the portion of the Delta Shores planned development located west of I-5.

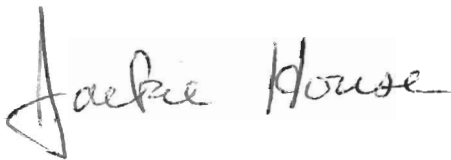
Ms. Christine Kronenberg  
Project Screening for Sensitive Land Uses Adjacent to Major Roadways  
May 10, 2007  
Page 3 of 3

### Summary and Conclusions

Results of this Project Screening for Sensitive Land Uses Adjacent to Major Roadways show that the estimated incremental cancer risk to sensitive receptors (residences) within the Delta Shores planned development is below the SMAQMD evaluation criterion at which a site specific health risk assessment is recommended. Therefore, in accordance with the methodology set forth in the SMAQMD January 2007 *Recommended Protocol for Evaluating the Location of Sensitive Land Uses Adjacent to Major Roadways*, no further roadway air quality analysis is recommended to address health risks.

This assessment is based on the March 2006 Schematic Land Use Plan for the Delta Shores planned development, which shows no residential use within 100 feet of the nearest freeway traffic lane. If final development plans include residential lots or any other sensitive receptors (schools and school yards, day care centers, parks and playgrounds, hospitals and medical facilities) within 100 feet of the nearest freeway traffic lane, additional evaluation may be required.

Sincerely,

A handwritten signature in black ink that reads "Jackie House". The signature is written in a cursive style with a large, stylized initial "J".

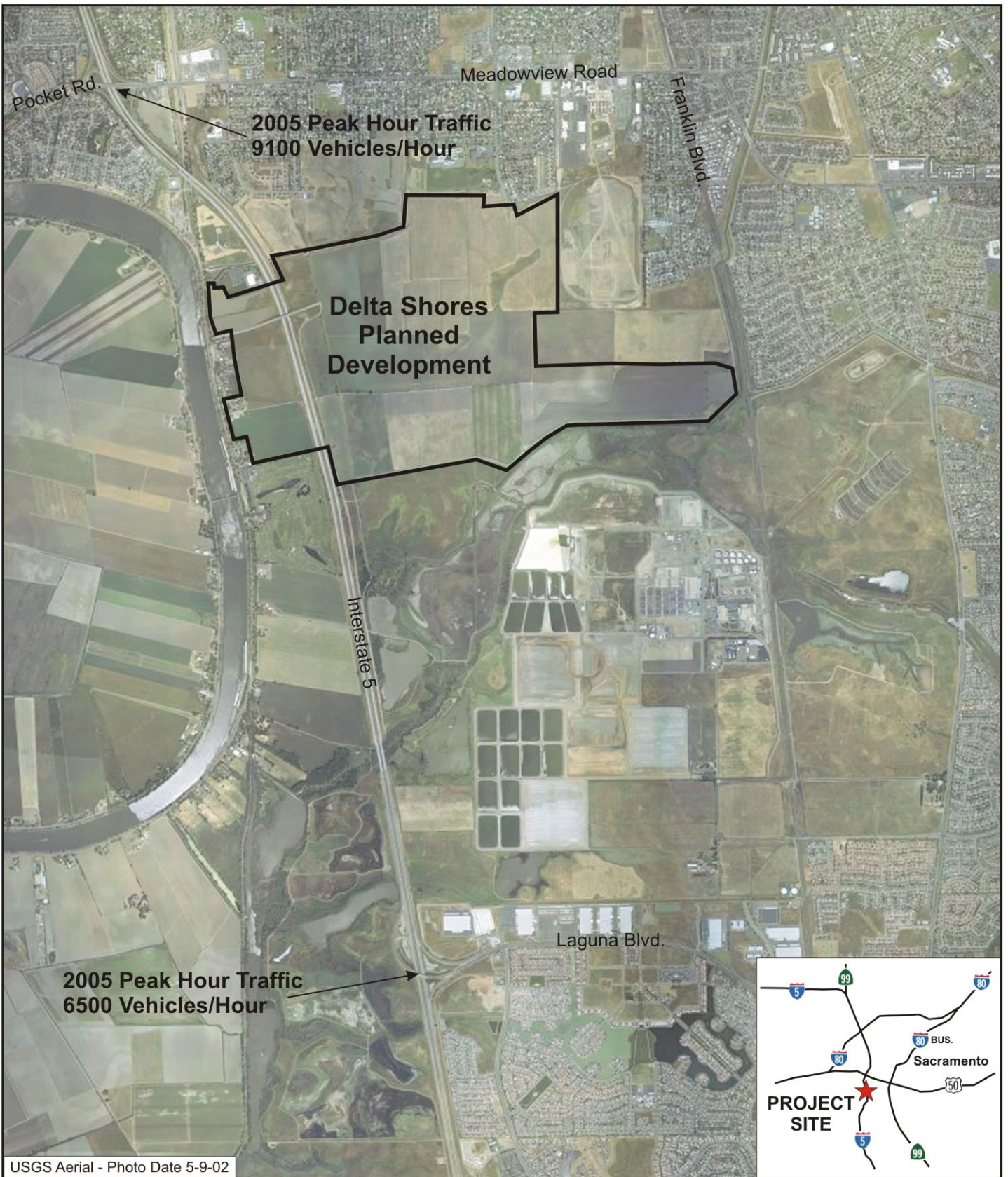
Jackie House, President  
J House Environmental, Inc.

Attachment A	Figures
Attachment B	Project Screening Table

**ATTACHMENT A**

**FIGURES**

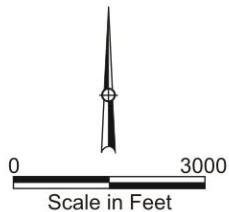




USGS Aerial - Photo Date 5-9-02

**J House Environmental, Inc.**  
 Site Assessment ♦ Remediation ♦ Safety Risk Analysis

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**Figure 1**

**VICINITY MAP**

*Delta Shores Planned Development  
 Sacramento, California*

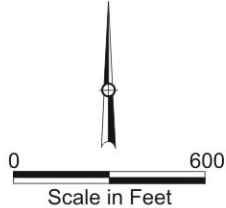




Source: Schematic Land Use Plan, EDAW|AECOM, March 2006

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Map Date: 5-10-07

No Public Access Barrier (TBD)

## Figure 2

# SITE MAP

*Delta Shores Planned Development  
 Sacramento, California*

**ATTACHMENT B**  
**PROJECT SCREENING TABLE**



Sacramento Metropolitan Air Quality Management District  
 Draft Recommended Protocol for Evaluating the Location of Sensitive Land Uses  
 Adjacent to Major Roadways

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**Table 2: Diesel PM Cancer Risk (Potential Incremental Cancer Cases per Million People) East and West of a North-South Roadway**

<b>PROJECTS EAST AND WEST OF A NORTH-SOUTH ROADWAY Version 1.0</b>								
Peak Hour Traffic (vehicle/hr)	Receptor Distance from Edge of Nearest Travel Lane (feet)							
	10	25	50	100	200	300	400	500
Incremental Cancer Risk Per Million: East (downwind)								
4000	249	213	168	117	75	57	45	36
8000	495	423	336	237	150	111	90	72
12000	744	636	504	354	225	168	132	111
16000	990	849	672	474	303	222	177	147
20000	1239	1062	840	591	378	279	222	183
24000	1488	1272	1008	711	453	336	267	219
Incremental Cancer Risk Per Million: West (upwind)								
4000	159	123	93	63	39	27	21	18
8000	315	249	183	126	78	57	45	36
12000	474	375	276	189	117	87	69	54
16000	633	501	369	252	156	114	90	75
20000	792	627	459	315	198	144	114	93
24000	948	750	552	378	237	174	135	111

**HEALTH RISK ASSESSMENT**  
**for**  
**DELTA SHORES PROJECT**

**Prepared for:**

Law Offices of Gregory D. Thatch  
1731 I Street  
Sacramento, CA 95814

**Prepared by:**

Impact Sciences, Inc.  
Air Quality Technical Services Group  
3256 Penryn Road, Suite 220  
Loomis, California 95650

**July 2007**

## SUMMARY

Delta Shores is a mixed-use, master planned community proposed within an undeveloped portion of the City of Sacramento. The development would be located adjacent to Interstate 5, and would include residential housing within 500 feet of the freeway. The primary sources of toxic air contaminants (TACs) at the project site include heavy-duty diesel trucks and diesel-fueled automobiles traveling along Interstate 5.

This assessment evaluates the health impacts of diesel exhaust particulate matter (DPM) emitted by these sources. The most current activity level of Interstate 5 at the project's location, as documented by Caltrans, was used to evaluate its impact on future residents of the proposed project. Although it is anticipated that traffic on Interstate 5 will increase with time, the traffic volumes used in this assessment are the best estimate of current vehicle activity occurring adjacent to the project site. Furthermore, emissions of DPM from motor vehicles will tend to decrease over time.

The Sacramento Metropolitan Air Quality Management District (SMAQMD) has prepared the *Recommended Protocol for Evaluating the Location of Sensitive Land Uses Adjacent to Major Roadways* to analyze the impact of line sources (e.g., roadways, freeways) on adjacent sensitive receptors. The Protocol recommends the use of the line source model CAL3QHCR. The Protocol suggests using a cancer risk of 446 in 1 million as the evaluation criterion for emissions from major roadways. It should be noted that the evaluation criterion does *not* represent a "safe" risk level or regulatory threshold; it is simply the level at which the potential cancer risk would be reduced by 70 percent relative to the highest estimated cancer risk near major roadways in Sacramento County. Further, with respect to the Protocol, it is the level at which a site-specific health risk assessment is recommended.

The assessment finds the maximum cancer risk to be 168 in 1 million. The cancer risk associated with motor vehicle DPM from the adjacent Interstate 5 would be less than the evaluation criterion recommended in the Protocol. This finding does not necessarily indicate that impacts would be less than significant for purpose of an analysis prepared in accordance with the California Environmental Quality Act. Instead, it acknowledges that impacts at the project's boundary would be less than 70 percent of the maximum risk estimated from the edge of the any major roadway in Sacramento County. Therefore, the impacts would be consistent with the guidance described for sensitive land uses in the California Air Resources Board's *Air Quality and Land Use Handbook- A Community Health Perspective*.

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## 1.0 INTRODUCTION

### 1.1 Project Description

The Delta Shores project is a mixed-use, master planned community proposed in the southern portion of the City of Sacramento. The proposed plan would develop approximately 800 acres of currently vacant land. The proposed project would include approximately 4,600 to 5,900 homes, approximately 126 acres of park and open space, and two mixed-use retail centers to serve the proposed and surrounding residents. The project site is generally located between Meadowview Road and Laguna Boulevard along Interstate 5. Traffic along Interstate 5 includes vehicles that emit toxic air contaminants (TACs) from diesel-fueled motor vehicles. The anticipated buildout date, 2015, was used to perform this assessment.

The proposed project would include residential homes adjacent to the existing Interstate 5 Freeway to the east and west. A large amount of daily traffic would travel along this segment of Interstate 5, which would impact the proposed project by exposing residents to various concentrations of diesel exhaust particulate matter (DPM). This analysis evaluates the ambient levels of DPM that would be emitted from vehicles traveling on Interstate 5 and quantifies the potential health risks in the vicinity of the project site.<sup>1</sup>

### 1.2 Evaluation Criterion

For this analysis, air quality impacts were analyzed using the Sacramento Metropolitan Air Quality Management District's (SMAQMD) *Recommended Protocol for Evaluating the Location of Sensitive Land Uses Adjacent to Major Roadways* (Protocol).<sup>2</sup> The Protocol provides a methodology for the assessment and disclosure of potential cancer risk from DPM resulting from sensitive land uses (i.e., residential homes) being located adjacent to major roadways. The SMAQMD recommends using the Protocol for projects that would develop sensitive land uses near major roadways. The Protocol does not distinguish between acceptable and unacceptable projects or significant and less than significant environmental impacts using a threshold, but rather the Protocol is intended to assess the relationship between potential cancer risk from DPM exposure and distance from the roadway.

The evaluation criterion is based on traffic related studies conducted by the California Air Resources Board (CARB) of PM concentrations at various distances from roadways. The guidance document *Air Quality and Land Use Handbook: A Community Health Perspective* recommends that sensitive receptors be

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<sup>1</sup> Diesel exhaust particulate matter – a toxic air contaminant – emitted by diesel mobile equipment and trucks has been evaluated for these sources.

<sup>2</sup> Sacramento Metropolitan Air Quality Management District. *Recommended Protocol for Evaluating the Location of Sensitive Land Uses Adjacent to Major Roadways*. January 2007.

sited no closer than 500 feet from a freeway or other high traffic roadways.<sup>3</sup> The recommendation was based on studies that showed a 70-percent decrease in PM concentrations approximately 500 feet from the roadway. The SMAQMD has determined the evaluation criterion, a cancer risk of 446 in 1 million, by determining the risk level corresponding to a 70-percent reduction from the highest risk calculated at 10 feet from the edge of the nearest travel lane to the nearest receptor for the highest peak traffic volume reported by Caltrans for Sacramento County (24,000 vehicle per hour) east (downwind) of a north-south roadway. If the cancer risk at the location of the proposed residents is less than the evaluation criterion, the project was considered to be consistent with the CARB handbook by providing a sufficient buffer to achieve a 70 percent reduction of the maximum cancer risk in the County.

## 2.0 SOURCE DESCRIPTION

**Figure 1, Project Location**, shows the location of the proposed Delta Shores project and the segment of Interstate 5 along which the proposed project is located. The project is adjacent to Interstate 5 between Meadowview Road and Laguna Boulevard. The source area for DPM emissions for this assessment is Interstate 5. General activity in the source area includes movement of diesel-fueled vehicles (primarily trucks).

## 3.0 ACTIVITY DATA

Caltrans provides peak traffic volume for specific roadway segments along state and federal highways. As mentioned above, the proposed project is generally located adjacent to Interstate 5 between Meadowview Road and Laguna Boulevard. The peak hourly traffic volume for this segment of Interstate 5 was used to estimate cancer risk in the assessment. The maximum hourly traveled trips through this segment of Interstate 5 were obtained from Caltrans. Based on the most current traffic data available from Caltrans, it was assumed that a maximum of 9,100 trips would pass through the project's segment of Interstate 5 in an hour.<sup>4</sup> The remaining hourly trip rates were calculated using relative vehicle miles traveled (VMT), which is discussed further below.

The CARB motor vehicle emissions inventory model, EMFAC2007, was used to calculate hourly relative VMT and PM10 emissions rates in grams per vehicle mile traveled within Sacramento County in 2015. EMFAC2007 can generate the total vehicle miles traveled in each hour of the day within a specific county

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<sup>3</sup> California Air Resources Board, *Air Quality and Land Use Handbook: A Community Health Perspective*, April 2005, p. 10.

<sup>4</sup> Caltrans. Traffic and Vehicles Data Systems Units: 2006 AADT. [Online] May 29, 2007 <<http://www.dot.ca.gov/hq/traffops/saferesr/trafdata/>>



- Project Boundary
- City Boundary
- Creeks

NOT TO SCALE

SOURCE: Impact Sciences Inc. - July 2007

FIGURE 1

# Project Location



for a specific year. In addition, EMFAC2007 can generate the total tons of PM<sub>10</sub> emitted per hour within a specific county. For the purpose of this analysis, all PM<sub>10</sub> emitted was assumed to be DPM for a conservative estimate.

#### 4.0 CALCULATION OF EMISSIONS

The line source model, CAL3QHCR,<sup>5</sup> requires source data to be in the format of hourly traffic volume and PM<sub>10</sub> emission rates per hour. The activity data described above were obtained from Caltrans and EMFAC2007 and converted to appropriate units for input into CAL3QHCR. The conversion methods are described below.

#### 4.1 Relative VMT/Hourly Traffic Volume

Relative VMT was calculated using information provided by EMFAC2007. EMFAC2007 can generate the total vehicle miles traveled for each hour of the day within a specific county. For this assessment, Sacramento County was used, pursuant to the Protocol. The analysis year 2015, the anticipated buildout year for the proposed project, was used to generate VMT. The maximum hourly VMT per day was used to standardize the VMT of all other hourly VMTs (i.e., each hour of VMT was divided by the maximum hourly VMT such that the maximum hourly VMT has a value of one). The resultant was an hourly ratio of vehicle miles traveled in each hour and the maximum hourly VMT in a day, or relative VMT. **Table 1, Relative VMT, Traffic Volume, and PM<sub>10</sub> Emission Rates**, shows the relative VMT for each hour of the day. As shown in **Table 1**, the maximum vehicle-miles traveled would occur in hour 17, and have a relative VMT of one. The total vehicles traveling along the project segment of Interstate 5 per hour was calculated by multiplying the relative VMT for that specific hour by the maximum hourly trips within the segment (9,100 trips) of Interstate 5 provided by Caltrans.

$$\text{Hourly VMT (VMT/hour)} \div \text{Maximum Hourly VMT (VMT/hour)} = \text{Relative VMT}$$

$$\text{Relative VMT per Hour} \times \text{Maximum Hourly Trips (trips)} = \text{Trips/Hour}$$

#### 4.2 PM<sub>10</sub> Emission Rates

The Protocol recommends calculating the PM<sub>10</sub> emission rate for each hour of the day. Emission rates were calculated by dividing total PM<sub>10</sub> emissions generated in Sacramento County per hour (in tons per hour) by total vehicle miles traveled in Sacramento County per hour to obtain tons of PM<sub>10</sub> per vehicle

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<sup>5</sup> CAL3QHCR is a refined version of the original CALINE (California Line Source Dispersion Model) that was developed as a modeling tool to predict roadside CO concentrations. CAL3QHCR can also be used to estimate PM<sub>10</sub> concentrations at defined receptor locations by processing hourly meteorological data over a year, hourly emissions, and traffic volumes.

mile traveled in the year 2015. Units were then converted to grams of PM<sub>10</sub> per vehicle mile traveled for input into the CAL3QHCR model using the following equations.

$$\text{Total Hourly Emissions (tons/hour)} \div \text{Total Hourly VMT (VMT/hour)} = \text{Emission Rate (tons/VMT)}$$

$$\text{Emission Rate (tons/VMT)} \times 2000 \text{ lb/ton} \times 453.6 \text{ gram/lb} = \text{Emission Rate (grams/VMT)}$$

**Table 1**  
**Relative VMT, Traffic Volume, and PM<sub>10</sub> Emission Rates**

Time of Day	Relative VMT	Traffic (vehicles/hr)	PM <sub>10</sub> Emission Rate (gram/VMT)
Hr 00	0.149	1,360	0.0423
Hr 01	0.060	545	0.0527
Hr 02	0.069	624	0.0461
Hr 03	0.039	358	0.1606
Hr 04	0.067	612	0.0470
Hr 05	0.121	1,097	0.0524
Hr 06	0.467	4,250	0.0338
Hr 07	0.940	8,558	0.0235
Hr 08	0.887	8,070	0.0249
Hr 09	0.559	5,087	0.0339
Hr 10	0.587	5,341	0.0323
Hr 11	0.735	6,685	0.0301
Hr 12	0.759	6,903	0.0250
Hr 13	0.749	6,812	0.0253
Hr 14	0.859	7,819	0.0221
Hr 15	0.874	7,956	0.0217
Hr 16	0.920	8,374	0.0240
Hr 17	1.000	9,100	0.0221
Hr 18	0.693	6,304	0.0182
Hr 19	0.518	4,710	0.0183
Hr 20	0.398	3,626	0.0238
Hr 21	0.406	3,696	0.0233
Hr 22	0.303	2,761	0.0208
Hr 23	0.228	2,079	0.0277

*Sources:*

*EMFAC2007 Burden output for emissions within Sacramento Metropolitan AQMD 2010.*

*Caltrans. Traffic and Vehicles Data Systems Unit: 2006 AADT. [Online] May 29, 2007*

*<http://www.dot.ca.gov/hq/traffops/saferesr/trafdata/>.*

The SMAQMD has recommended the use of the line source model CAL3QHCR to evaluate air quality impacts of DPM from major roadways and freeways. CAL3QHCR can calculate diesel particulate matter (i.e., PM<sub>10</sub>) concentrations at user-specified distances from the nearest traveled roadway. The Protocol suggests using the following default control parameters:

- Averaging time: 60 minutes
- Settling velocity: 0 cm/sec
- Deposition velocity: 0 cm/sec
- Form of traffic volume, emission rate data: one week of hourly data
- Hourly ambient background concentration: microgram per cubic meter ( $\mu\text{g}/\text{m}^3$ )

In addition, the default parameters suggested by the Protocol, the following parameters were chosen to describe the appropriate conditions for the proposed project:

- Surface roughness: 108 for single family uses
- Site setting: Urban
- Roadway height indicator: AG (at grade)
- Roadway height: 0 (i.e., at grade)

Meteorological data from a monitoring station located at the Sacramento Executive Airport for January 1, 1987 to December 31, 1987, were used for the surface conditions while data from a monitoring station located at Oakland International Airport for the same period were used for the upper air conditions in CAL3QHCR. The Protocol specifically recommends calendar year 1987 for dispersion modeling analyses because the risk values generated from the 1987 meteorological data tend to produce the average of all five years used for dispersion modeling analysis in the Sacramento region, and CAL3QHCR only accepts one year of meteorological data. Both monitoring stations were operated in accordance with U.S. Environmental Protection Agency (U.S. EPA) and CARB protocols during the given time frame. The SMAQMD supplies data files containing hourly meteorological data for 1987.

The Sacramento meteorological monitoring site is approximately 2.5 miles north of the proposed project site and is the closest surface meteorological monitoring station to the project area. The Oakland meteorological monitoring site is approximately 63 miles southwest of the proposed expansion site and is the closest upper air meteorological monitoring station to the project area.

## 6.0

### RECEPTORS USED FOR EVALUATING MODELED IMPACTS

The nearest residences, which are considered “sensitive receptors,”<sup>6</sup> would be located parallel with Interstate 5 on the project site. The locations of the closest proposed residential units, as provided by MSA Engineering, Inc., are 126 feet and 119 feet to the east and west, respectively, from the nearest traveled lane. Several other residences would be located along Interstate 5; however, these two distances represent the closest proposed residential units. Typically, the closest receptor to the source will be exposed to the highest modeled concentration and associated potential cancer risk. The location of these residences is shown in **Figure 2, Location of Sensitive Receptors to the East of Interstate 5** and **Figure 3, Location of Sensitive Receptors to the West of Interstate 5**.

A discrete receptor was placed at each of the proposed residences identified above for a total of two residential receptors representing the boundary of the project site to east and west. In addition, pursuant to the Protocol, receptors were placed at standard distances 10, 25, 50, 100, 200, 300, 400, and 500 feet from the roadway to east and west. This was done to evaluate impacts on either side of Interstate 5. The prevailing winds in the area blow from the west to the east; however, the closest sensitive receptor would be located to the west of Interstate 5. The Protocol suggests using the distance from the “nearest travel lane”; however, Interstate 5 at this segment contains a shoulder lane approximately 12 feet in width. The standard receptor distances, along with the distances to the project boundary were modeled as the distance from the edge of the shoulder lane. Therefore, the closest sensitive receptors would be located 114 and 107 feet to the east and west, respectively, from the roadway for the purposes of the CAL3QHCR model. The receptor distances were designed to cover potential area where receptors could be exposed to pollutants associated with the Interstate 5. Sensitive receptors are not likely to be located within the shoulder lane.

## 7.0

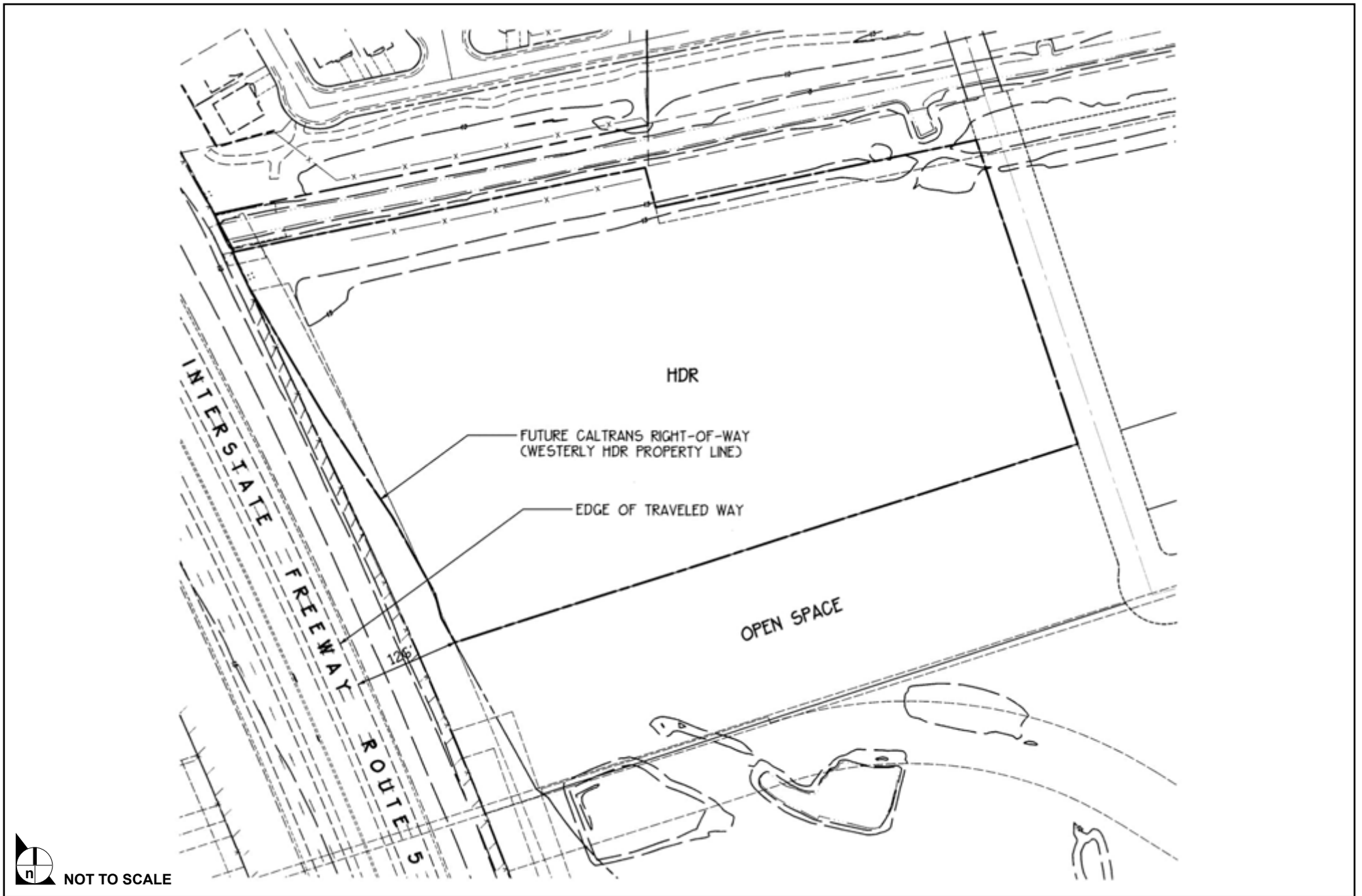
### EVALUATION OF HEALTH IMPACTS

The health impacts were determined using the modeled diesel particulate matter concentration and the California Environmental Protection Agency Office of Environmental Health Hazard Assessment (OEHHA) established cancer risk factor for diesel particulate matter. The maximally impacted residential receptors were determined using the distance provided by MSA Engineering, Inc. Although potential receptors located 10, 25, 50, and 100 feet from the roadway would be exposed to a higher concentration of DPM, residential units would not be developed within those areas.

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<sup>6</sup> Sensitive receptors are facilities that house or attract children, the elderly, people with illnesses, or others who are especially sensitive to the effects of air pollutants. Hospitals, schools, convalescent facilities, and residential areas are examples of sensitive receptors (Sacramento Metropolitan Air Quality Management District, *Guide to Air Quality Assessment in Sacramento County*, July 2004, p. 2-5).

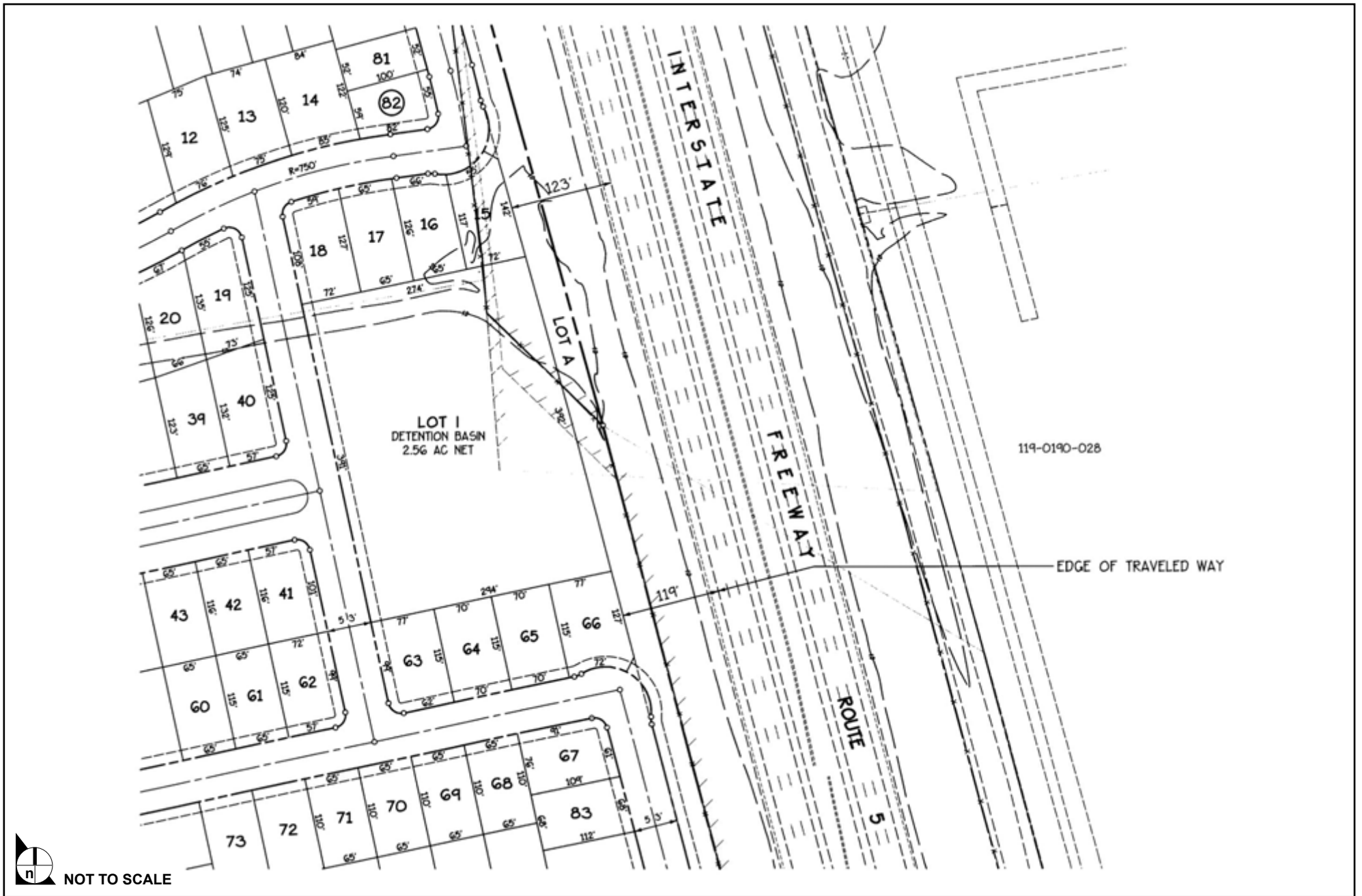




SOURCE: MSA Engineering, Inc. – May 2007

FIGURE 2

Location of Sensitive Receptors to the East of Interstate 5



SOURCE: MSA Engineering, Inc. – May 2007

FIGURE 3

Location of Sensitive Receptors to the West of Interstate 5

## 7.1 Cancer Risk

The cancer risk calculations were performed by multiplying the predicted DPM concentrations from CAL3QHCR by the OEHHA DPM unit risk factor. The unit risk factor incorporates many worst-case assumptions including a constant exposure to diesel particulate matter for 24 hours a day over a 70-year life span. The exposure and risk equations used to calculate the cancer risk at residential receptors are taken from the Protocol.

The Unit Risk Value for DPM recommended by the Scientific Review Panel is  $3.0 \times 10^{-4}$  per microgram per cubic meter ( $\mu\text{g}/\text{m}^3$ ). The Unit Risk Value means that for receptors with an annual average concentration of  $1 \mu\text{g}/\text{m}^3$  in the ambient air, the probability of contracting cancer over a 70-year lifetime of exposure is 300 in 1 million. This Unit Risk Value considers exposure via inhalation only. The Unit Risk Value also assumes that a person is exposed continuously for 70 years. This approach is intended to result in conservative (i.e., health protective) estimates of health impacts and is used for the sensitive receptors previously identified.

The following equation was used to calculate the cancer risk due to inhalation using the modeled DPM concentrations:<sup>7</sup>

$$\text{DPM Concentration} \times \text{Unit Risk Factor for DPM} \times (1 \times 10^6) = \text{Cancer risk in 1 million}$$

**Table 2, Summary of Maximum Modeled Cancer Risks due to the Interstate 5 Traffic**, shows the maximum cancer risk due to DPM emissions at the two nearest residential receptors to the east and west. It should be noted that these cancer risks reflect the maximum annual average concentrations from activities discussed in **Section 3.0, Activity Data**. Based on a lifetime exposure of 70 years, the cancer risks at the nearest residential receptors to the east and west are less than the SMAQMD evaluation criterion of 446 in 1 million for cancer impacts.

## 8.0 CONCLUSION

The results determined in this analysis reflect reasonable estimates of mobile source emissions over the project life, available meteorological data in the vicinity of the project site, available terrain data in the vicinity of the project site, and the use of currently approved air quality models. While traffic along Interstate 5 will continue to increase with the addition of the proposed project, diesel vehicles will

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<sup>7</sup> Sacramento Metropolitan Air Quality Management District, *Recommended Protocol for Evaluating the Location of Sensitive Land Uses Adjacent to Major Roadways*, January 2007.

**Table 2**  
**Summary of Maximum Modeled Net Cancer Risks**  
**due to the Interstate 5 Traffic**

Distance from Roadway (feet)	Annual Average DPM Concentration ( $\mu\text{g}/\text{m}^3$ )	Cancer Risk Based on 70-Year Exposure (cancer risk in 1 million)
<b>East of Interstate 5 (downwind)</b>		
10	1.16	348
25	1.01	303
50	0.83	249
100	0.60	180
114 (Nearest receptor)	0.56	168
200	0.39	117
300	0.29	87
400	0.23	69
500	0.19	57
<b>West of Interstate 5 (upwind)</b>		
10	0.71	213
25	0.58	174
50	0.43	129
100	0.30	90
107 (Nearest receptor)	0.29	87
200	0.19	57
300	0.14	42
400	0.11	33
500	0.09	27

*Source: Impact Sciences, Inc.*

continue to become cleaner with time. Therefore, this health risk assessment portrays a representative picture of the health impacts that might occur as a result of implementation of the proposed project. Given the limits of available tools for such an analysis, the actual impacts may vary from the estimates in this assessment. However, the combined use of the CAL3QHCR line source model and the health impact calculations required by the OEHHA and the SMAQMD tend to overpredict impacts, such that they produce conservative (health-protective) results. Accordingly, the health impacts are not expected to be higher than those estimated in this assessment.

Based on this analysis, the maximum cancer risk the nearest proposed residents would be exposed to, when adjusted for a lifetime of exposure, would be 168 in 1 million. This value is less than the SMAQMD evaluation criterion of incremental cancer risk of 446 in 1 million.



It should be noted that these health impacts do not fully reflect the reductions in diesel emissions from trucks and diesel-fueled automobiles that will occur over the lifetime of the project. These sources of DPM are subject to increasingly stringent emission standards, many of which will take effect in the next 10 years. In addition, it is likely that some of the older diesel vehicles on the road would be replaced with newer, lower emitting units over the life of the project. Furthermore, the activity levels (e.g., number of trips) used in this assessment represent the best current estimate of the peak number of trips in a day; the actual levels will be lower for much of the time. Accordingly, the actual health impacts over the length of the project will be less than those presented in this assessment.

**APPENDIX A**

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**Emission Calculations**

**Peak Hourly Traffic Volume**

**9100** vehicles/hr

Time of day	Relative VMT	Traffic veh/hr
Hr 00	0.149	1360
Hr 01	0.060	545
Hr 02	0.069	624
Hr 03	0.039	358
Hr 04	0.067	612
Hr 05	0.121	1097
Hr 06	0.467	4250
Hr 07	0.940	8558
Hr 08	0.887	8070
Hr 09	0.559	5087
Hr 10	0.587	5341
Hr 11	0.735	6685
Hr 12	0.759	6903
Hr 13	0.749	6812
Hr 14	0.859	7819
Hr 15	0.874	7956
Hr 16	0.920	8374
Hr 17	1.000	9100
Hr 18	0.693	6304
Hr 19	0.518	4710
Hr 20	0.398	3626
Hr 21	0.406	3696
Hr 22	0.303	2761
Hr 23	0.228	2079

Time of day	PM10 emission rate g/vehicle-mile	VMT	tons/hr
Hr 00	0.0423	429	0.02
Hr 01	0.0527	172	0.01
Hr 02	0.0461	197	0.01
Hr 03	0.1606	113	0.02
Hr 04	0.0470	193	0.01
Hr 05	0.0524	346	0.02
Hr 06	0.0338	1341	0.05
Hr 07	0.0235	2700	0.07
Hr 08	0.0249	2546	0.07
Hr 09	0.0339	1605	0.06
Hr 10	0.0323	1685	0.06
Hr 11	0.0301	2109	0.07
Hr 12	0.0250	2178	0.06
Hr 13	0.0253	2149	0.06
Hr 14	0.0221	2467	0.06
Hr 15	0.0217	2510	0.06
Hr 16	0.0240	2642	0.07
Hr 17	0.0221	2871	0.07
Hr 18	0.0182	1989	0.04
Hr 19	0.0183	1486	0.03
Hr 20	0.0238	1144	0.03
Hr 21	0.0233	1166	0.03
Hr 22	0.0208	871	0.02
Hr 23	0.0277	656	0.02





**APPENDIX B**

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**CAL3QHCR Output File**

DATE : 6/12/ 7  
 TIME : 16:14:53

JOB: Delta Shores I-5 HRA

RUN: Interstate Freeway Route 5

=====  
 General Information  
 =====

Run start date: 1/ 1/15 Julian: 1  
 end date: 12/31/15 Julian: 365

A Tier 2 approach was used for input data preparation.  
 The MODE flag has been set to P for calculating PM averages.  
 Ambient background concentrations are included in the averages below.

Site & Meteorological Constants

-----  
 VS = 0.0 CM/S VD = 0.0 CM/S Z0 = 108. CM ATIM = 60.  
 Met. Sfc. Sta. Id & Yr = 23232 87  
 Upper Air Sta. Id & Yr = 23230 87

CAUTION: The input years for the Run and Meteorological data  
 differ. The respective values are: 15 and 87.

Urban mixing heights were processed.

In 2015, Julian day 1 is a Thursday.

The patterns from the input file  
 have been assigned as follows:

- Pattern # 1 is assigned to Monday.
- Pattern # 1 is assigned to Tuesday.
- Pattern # 1 is assigned to Wednesday.
- Pattern # 1 is assigned to Thursday.
- Pattern # 1 is assigned to Friday.
- Pattern # 1 is assigned to Saturday.
- Pattern # 1 is assigned to Sunday.

Link Data Constants - (Variable data in \*.LNK file)

-----

LINK DESCRIPTION	*	LINK COORDINATES (FT)				*	LENGTH (FT)	BRG (DEG)	TYPE	H (FT)	W (FT)	NLANS
		X1	Y1	X2	Y2							
1. Interstate 5	*	0.0	-5000.0	0.0	5000.0	*	10000.	360.	AG	0.0	172.0	

-----



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JOB: Delta Shores I-5 HRA

RUN: Interstate Freeway Route 5

Receptor Data

RECEPTOR	*	COORDINATES (FT)		
		X	Y	Z
1. REC E1 (10 ft)	*	86.0	0.0	6.0
2. REC E2 (25 ft)	*	101.0	0.0	6.0
3. REC E3 (50 ft)	*	126.0	0.0	6.0
4. REC E4 (100 ft)	*	176.0	0.0	6.0
5. REC E5 (Boundary)	*	190.0	0.0	6.0
6. REC E6 (200 ft)	*	276.0	0.0	6.0
7. REC E7 (300 ft)	*	376.0	0.0	6.0
8. REC E8 (400 ft)	*	476.0	0.0	6.0
9. REC E9 (500 ft)	*	576.0	0.0	6.0
10. REC W1 (10 ft)	*	-86.0	0.0	6.0
11. REC W2 (25 ft)	*	-101.0	0.0	6.0
12. REC W3 (50 ft)	*	-126.0	0.0	6.0
13. REC W4 (100 ft)	*	-176.0	0.0	6.0
14. REC W5 (Boundary)	*	-183.0	0.0	6.0
15. REC W6 (200 ft)	*	-276.0	0.0	6.0
16. REC W7 (300 ft)	*	-376.0	0.0	6.0
17. REC W8 (400 ft)	*	-476.0	0.0	6.0
18. REC W9 (500 ft)	*	-576.0	0.0	6.0

Model Results

Remarks : In search of the wind direction corresponding to the maximum concentration, only the first direction, of the directions with the same maximum concentrations, is indicated as the maximum.

\* MAXIMUM HOURLY CONCENTRATIONS WITH ANY AMBIENT BACKGROUND CONCENTRATIONS (BKG) ADDED  
 \* (MICROGRAMS/M\*\*3)

	REC1	REC2	REC3	REC4	REC5	REC6	REC7	REC8	REC9	REC10
MAX+BKG *	6.3	5.5	4.5	3.3	3.1	2.3	1.8	1.5	1.3	5.7
- BKG *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MAX *	6.3	5.5	4.5	3.3	3.1	2.3	1.8	1.5	1.3	5.7
WIND DIR*	345	345	345	207	207	207	207	207	207	169
JULIAN *	295	295	295	328	328	328	328	328	328	37
HOUR *	14	14	14	18	18	18	18	18	18	8

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JOB: Delta Shores I-5 HRA

RUN: Interstate Freeway Route 5

\* MAXIMUM HOURLY CONCENTRATIONS WITH ANY AMBIENT BACKGROUND CONCENTRATIONS (BKG) ADDED  
 \* (MICROGRAMS/M\*\*3)  
 \* REC11 REC12 REC13 REC14 REC15 REC16 REC17 REC18

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MAX+BKG *	5.0	3.9	2.8	2.7	1.9	1.5	1.2	1.1
- BKG *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

---

MAX *	5.0	3.9	2.8	2.7	1.9	1.5	1.2	1.1
WIND DIR*	169	169	146	146	169	169	169	116
JULIAN *	37	37	321	321	37	37	37	37
HOURL *	8	8	14	14	8	8	8	4

THE HIGHEST CONCENTRATION OF 6.30 UG/M\*\*3 OCCURRED AT RECEPTOR REC1 .

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JOB: Delta Shores I-5 HRA

RUN: Interstate Freeway Route 5

=====  
 Output Section  
 =====

## NOTES PERTAINING TO THE REPORT

1. THE HIGHEST AVERAGE IN EACH OF THE FIRST TWO COLUMNS OF EACH TABLE BELOW ARE SUFFIXED BY AN ASTERISK (\*). FOR PM OUTPUT, THERE IS ONLY ONE COLUMN AND ASTERISK FOR THE ANNUAL AVERAGE/PERIOD OF CONCERN TABLE.
2. THE NUMBERS IN PARENTHESES ARE THE JULIAN DAY AND ENDING HOUR FOR THE PRECEDING AVERAGE.
3. THE NUMBER OF CALM HOURS USED IN PRODUCING EACH AVERAGE ARE PREFIXED BY A C.

## PRIMARY AND SECONDARY AVERAGES.

FIVE HIGHEST 24-HOUR END-TO-END AVERAGE CONCENTRATIONS IN MICROGRAMS/M\*\*3  
 INCLUDING AMBIENT BACKGROUND CONCENTRATIONS.

Reptr No.	Highest Ending			Second Highest Ending			Third Highest Ending			Fourth Highest Ending			Fifth Highest Ending		
	Conc	Day Hr	Calm	Conc	Day Hr	Calm	Conc	Day Hr	Calm	Conc	Day Hr	Calm	Conc	Day Hr	Calm
1	2.15*	(310,24)	C 7	2.07*	(322,24)	C 3	2.02	(325,24)	C 4	2.02	( 39,24)	C 5	1.88	(355,24)	C10
2	1.83	(310,24)	C 7	1.78	( 39,24)	C 5	1.78	(325,24)	C 4	1.77	(322,24)	C 3	1.70	(355,24)	C10
3	1.47	(325,24)	C 4	1.46	(355,24)	C10	1.44	( 39,24)	C 5	1.42	(310,24)	C 7	1.40	(322,24)	C 3
4	1.07	(355,24)	C10	1.06	(325,24)	C 4	1.04	( 39,24)	C 5	1.02	(214,24)	C 6	1.02	(310,24)	C 7
5	1.02	(355,24)	C10	0.99	(325,24)	C 4	0.97	( 39,24)	C 5	0.94	(310,24)	C 7	0.94	(214,24)	C 6
6	0.73	(325,24)	C 4	0.72	(355,24)	C10	0.68	( 39,24)	C 5	0.67	(310,24)	C 7	0.66	(214,24)	C 6
7	0.56	(355,24)	C10	0.54	(325,24)	C 4	0.51	( 39,24)	C 5	0.50	(268,24)	C 6	0.49	(310,24)	C 7
8	0.45	(355,24)	C10	0.44	(325,24)	C 4	0.41	( 39,24)	C 5	0.39	(214,24)	C 6	0.39	(268,24)	C 6
9	0.39	(355,24)	C10	0.37	(325,24)	C 4	0.35	( 34,24)	C 4	0.34	(214,24)	C 6	0.34	(364,24)	C 3
10	1.74	( 5,24)	C 5	1.66	( 1,24)	C 5	1.66	( 29,24)	C 7	1.65	(309,24)	C 8	1.64	( 17,24)	C 5
11	1.52	( 5,24)	C 5	1.50	( 1,24)	C 5	1.49	( 33,24)	C 5	1.49	( 29,24)	C 7	1.47	(348,24)	C 4
12	1.32	( 33,24)	C 5	1.29	(348,24)	C 4	1.24	(359,24)	C 3	1.23	( 29,24)	C 7	1.22	( 5,24)	C 5
13	1.04	( 33,24)	C 5	0.99	(348,24)	C 4	0.94	(359,24)	C 3	0.90	( 29,24)	C 7	0.88	( 5,24)	C 5
14	1.01	( 33,24)	C 5	0.96	(348,24)	C 4	0.93	(359,24)	C 3	0.88	( 29,24)	C 7	0.85	( 1,24)	C 5
15	0.72	( 33,24)	C 5	0.67	(348,24)	C 4	0.64	(359,24)	C 3	0.61	( 29,24)	C 7	0.61	(338,24)	C 8
16	0.55	( 33,24)	C 5	0.50	(348,24)	C 4	0.49	(359,24)	C 3	0.48	(338,24)	C 8	0.46	( 29,24)	C 7
17	0.46	( 33,24)	C 5	0.43	(348,24)	C 4	0.39	(359,24)	C 3	0.39	(338,24)	C 8	0.36	(344,24)	C 1
18	0.39	( 33,24)	C 5	0.37	(348,24)	C 4	0.33	(338,24)	C 8	0.33	(359,24)	C 3	0.30	( 61,24)	C 0

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JOB: Delta Shores I-5 HRA

RUN: Interstate Freeway Route 5

THE HIGHEST ANNUAL AVERAGE CONCENTRATIONS  
 IN MICROGRAMS/M\*\*3  
 INCLUDING AMBIENT BACKGROUND CONCENTRATIONS.

Receptor Number	Maximum Conc	Ending Day Hr	Calm
1	1.16*	(365,24)	C1887
2	1.01	(365,24)	C1887
3	0.83	(365,24)	C1887
4	0.60	(365,24)	C1887
5	0.56	(365,24)	C1887
6	0.39	(365,24)	C1887
7	0.29	(365,24)	C1887
8	0.23	(365,24)	C1887
9	0.19	(365,24)	C1887
10	0.71	(365,24)	C1887
11	0.58	(365,24)	C1887
12	0.43	(365,24)	C1887
13	0.30	(365,24)	C1887
14	0.29	(365,24)	C1887
15	0.19	(365,24)	C1887
16	0.14	(365,24)	C1887
17	0.11	(365,24)	C1887
18	0.09	(365,24)	C1887

MAXIMUM 24-HOUR AVERAGED LINK CONTRIBUTIONS  
 IN MICROGRAMS/M\*\*3  
 INCLUDING AMBIENT BACKGROUND CONCENTRATIONS.

Rcptr No.	Total Conc	Ending Day Hr	Ambient Backgnd	Total Link	Link +1
1	2.15	(310,24)	0.00	2.15	2.15
2	1.83	(310,24)	0.00	1.83	1.83
3	1.47	(325,24)	0.00	1.47	1.47
4	1.07	(355,24)	0.00	1.07	1.07
5	1.02	(355,24)	0.00	1.02	1.02
6	0.73	(325,24)	0.00	0.73	0.73
7	0.56	(355,24)	0.00	0.56	0.56
8	0.45	(355,24)	0.00	0.45	0.45
9	0.39	(355,24)	0.00	0.39	0.39
10	1.74	( 5,24)	0.00	1.74	1.74
11	1.52	( 5,24)	0.00	1.52	1.52
12	1.32	( 33,24)	0.00	1.32	1.32
13	1.04	( 33,24)	0.00	1.04	1.04
14	1.01	( 33,24)	0.00	1.01	1.01
15	0.72	( 33,24)	0.00	0.72	0.72
16	0.55	( 33,24)	0.00	0.55	0.55
17	0.46	( 33,24)	0.00	0.46	0.46
18	0.39	( 33,24)	0.00	0.39	0.39

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JOB: Delta Shores I-5 HRA

RUN: Interstate Freeway Route 5

## LINK CONTRIBUTION TABLES

SECOND HIGHEST 24-HOUR AVERAGED LINK CONTRIBUTIONS  
 IN MICROGRAMS/M\*\*3  
 INCLUDING AMBIENT BACKGROUND CONCENTRATIONS.

Rcptr No.	Total Conc	Ending Day Hr	Ambient Backgnd	Total Link	Link +1
1	2.07	(322,24)	0.00	2.07	2.07
2	1.78	( 39,24)	0.00	1.78	1.78
3	1.46	(355,24)	0.00	1.46	1.46
4	1.06	(325,24)	0.00	1.06	1.06
5	0.99	(325,24)	0.00	0.99	0.99
6	0.72	(355,24)	0.00	0.72	0.72
7	0.54	(325,24)	0.00	0.54	0.54
8	0.44	(325,24)	0.00	0.44	0.44
9	0.37	(325,24)	0.00	0.37	0.37
10	1.66	( 1,24)	0.00	1.66	1.66
11	1.50	( 1,24)	0.00	1.50	1.50
12	1.29	(348,24)	0.00	1.29	1.29
13	0.99	(348,24)	0.00	0.99	0.99
14	0.96	(348,24)	0.00	0.96	0.96
15	0.67	(348,24)	0.00	0.67	0.67
16	0.50	(348,24)	0.00	0.50	0.50
17	0.43	(348,24)	0.00	0.43	0.43
18	0.37	(348,24)	0.00	0.37	0.37

MAXIMUM ANNUAL AVERAGED LINK CONTRIBUTIONS  
 IN MICROGRAMS/M\*\*3  
 INCLUDING AMBIENT BACKGROUND CONCENTRATIONS.

Rcptr No.	Total Conc	Ending Day Hr	Ambient Backgnd	Total Link	Link +1
1	1.16	(365,24)	0.00	1.16	1.16
2	1.01	(365,24)	0.00	1.01	1.01
3	0.83	(365,24)	0.00	0.83	0.83
4	0.60	(365,24)	0.00	0.60	0.60
5	0.56	(365,24)	0.00	0.56	0.56
6	0.39	(365,24)	0.00	0.39	0.39
7	0.29	(365,24)	0.00	0.29	0.29
8	0.23	(365,24)	0.00	0.23	0.23
9	0.19	(365,24)	0.00	0.19	0.19
10	0.71	(365,24)	0.00	0.71	0.71
11	0.58	(365,24)	0.00	0.58	0.58
12	0.43	(365,24)	0.00	0.43	0.43
13	0.30	(365,24)	0.00	0.30	0.30
14	0.29	(365,24)	0.00	0.29	0.29
15	0.19	(365,24)	0.00	0.19	0.19
16	0.14	(365,24)	0.00	0.14	0.14
17	0.11	(365,24)	0.00	0.11	0.11
18	0.09	(365,24)	0.00	0.09	0.09

DATE : 6/12/ 7  
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JOB: Delta Shores I-5 HRA

RUN: Interstate Freeway Route 5

CALM DURATION FREQUENCY

Hours of Consecutive Calm Winds	Frequency of Occurrence	(Julian day/hour ending) of Significant Occurrences
1	290	( 2,11)( 3,17)( 5, 2)( 6,18)( 7, 8)( 10, 3)( 10,24)( 11, 7)( 11,22)( 13, 1) ( 13, 5)( 14, 4)( 14,21)( 18, 4)( 20,21)( 21,13)( 22, 4)( 22,15)( 23,12)( 24,24) ( 25, 8)( 25,16)( 25,22)( 26, 1)( 26, 6)( 26,21)( 27, 2)( 28, 1)( 30, 8)( 30,24) ( 31, 2)( 31, 8)( 31,14)( 32, 6)( 32, 9)( 36,16)( 39,24)( 40, 5)( 40, 8)( 40,12) ( 40,16)( 41, 2)( 41, 5)( 41, 7)( 42,15)( 45,12)( 45,18)( 48, 5)( 48, 8)( 48,18) ( 48,20)( 52,20)( 53,12)( 55,13)( 55,20)( 56,11)( 58, 8)( 58,12)( 58,17)( 59, 8) ( 59,15)( 59,19)( 60, 6)( 60, 8)( 60,14)( 63, 3)( 63,14)( 64,21)( 66,20)( 67, 7) ( 67, 9)( 67,11)( 68,13)( 68,15)( 68,22)( 69, 7)( 70, 8)( 70,22)( 74, 1)( 74, 4) ( 75,20)( 78,20)( 81, 9)( 82,21)( 83, 5)( 84,20)( 84,23)( 85,19)( 85,21)( 88,12) ( 90,15)( 91, 3)( 91, 5)( 93, 6)( 95,22)( 96, 8)(103,20)(103,23)(104,23)(110, 4) (110,15)(110,17)(111, 9)(111,14)(112, 3)(112, 6)(112,14)(114,15)(115, 5)(115,22) (116, 9)(117, 5)(117, 8)(117,10)(119,23)(122, 3)(122,22)(123,14)(123,23)(124, 6) (124,11)(124,13)(125, 8)(125,10)(125,13)(126, 9)(126,18)(127,20)(128, 1)(128, 3) (128, 5)(129, 6)(129, 9)(129,22)(130, 6)(131, 5)(132, 6)(133, 1)(140,11)(151,15) (152,21)(153,20)(156,12)(156,24)(157, 3)(157,15)(158, 4)(158, 7)(158,13)(159, 2) (161, 9)(163, 2)(163, 5)(163, 7)(163,24)(169,13)(175, 7)(176, 8)(176,13)(189, 9) (190, 3)(190, 8)(195, 7)(195,10)(203,16)(208,10)(212, 8)(212,23)(213,13)(213,19) (214,18)(215,13)(215,22)(217, 9)(217,11)(227, 8)(227,10)(227,12)(227,23)(228,11) (228,14)(229,14)(232,13)(234, 6)(235, 8)(235,17)(236, 4)(236,11)(236,13)(237, 4) (237,12)(237,23)(240,18)(240,21)(242,14)(242,16)(243, 1)(244,14)(245, 3)(245,11) (245,21)(248, 7)(248,10)(248,12)(248,24)(249, 2)(250,24)(253, 7)(253, 9)(257,16) (259, 7)(259,21)(261, 3)(261, 8)(261,13)(261,15)(262,21)(263,18)(264,14)(264,17) (264,23)(268,10)(268,15)(268,20)(269,18)(271,12)(275,14)(276,14)(277, 9)(279,24) (283, 6)(284,15)(286,13)(286,18)(287,12)(287,22)(288,14)(291,12)(292,22)(294, 5) (294,20)(295, 7)(296,20)(297,11)(298,12)(301,18)(306,13)(306,16)(310,20)(312,11) (312,14)(312,20)(313, 2)(313,21)(316,17)(317,20)(319,11)(319,18)(319,22)(320,20) (320,24)(321,16)(322, 1)(323,16)(323,18)(326,11)(326,14)(332, 3)(333,10)(333,15) (333,23)(336,22)(337, 8)(338,13)(341, 7)(344,19)(349, 9)(349,23)(350, 5)(352,11) (354, 9)(355, 3)(356,14)(360,14)(360,18)(361, 2)(361,13)(362, 1)(363, 9)(365,16) (
2	116	( 1,24)( 2,20)( 4,12)( 6, 8)( 7,17)( 8,13)( 10,16)( 10,22)( 12,12)( 26, 9) ( 27, 9)( 29, 8)( 34,21)( 35,14)( 37,10)( 40,23)( 41,20)( 42, 8)( 45,10)( 48,23) ( 51,21)( 53, 8)( 54,23)( 55, 2)( 56, 4)( 57,19)( 59,13)( 62, 3)( 62, 8)( 66, 2) ( 66, 8)( 68,20)( 78, 9)( 79, 1)( 79, 4)( 82,13)( 83, 2)( 85,12)( 90,24)( 93,24) ( 99, 7)(106,12)(111,17)(115,18)(117,15)(125,20)(127, 7)(127,13)(129, 1)(129, 4) (157,12)(163,22)(174, 7)(187, 9)(188, 9)(190, 6)(212,20)(214, 1)(215, 3)(216, 4) (216,10)(228, 6)(228,17)(229,11)(235,11)(236, 8)(239, 7)(240,15)(244, 6)(244,24) (250,19)(251, 4)(258, 3)(259,19)(261,11)(262,13)(273,24)(275, 4)(275,24)(283,13) (285, 6)(285, 9)(286, 6)(287, 6)(290, 2)(290, 6)(294,15)(298,22)(300, 8)(301,12) (302, 3)(302, 6)(304,18)(304,24)(306,10)(312,18)(312,23)(317,23)(320,10)(320,14) (322, 4)(323,12)(324,24)(326,17)(331,14)(331,24)(337,22)(338, 2)(338,20)(348, 7) (348,24)(353,19)(355, 6)(360, 2)(361,16)(363,22) (
3	64	( 1, 4)( 4, 1)( 7, 1)( 11, 4)( 14, 8)( 17, 8)( 18, 1)( 23,19)( 25,20)( 27, 6) ( 28,21)( 37, 7)( 37,16)( 38, 3)( 45, 2)( 55, 6)( 63, 1)( 65,22)( 89,21)( 91,11) (103,18)(104,10)(114, 8)(116, 6)(122, 7)(124,20)(127, 2)(127,17)(131, 9)(133, 5) (188, 5)(200,11)(212, 5)(239,16)(240, 2)(241,23)(258, 7)(258,11)(260,14)(260,18) (266, 8)(273,19)(279,15)(283,10)(295,19)(298, 6)(298,10)(298,19)(301,16)(308,14) (308,24)(309,18)(311,15)(316,14)(320, 5)(320,18)(331,10)(337,19)(338,24)(341,19) (355,18)(355,23)(359, 5)(364, 4) (
4	46	( 4, 8)( 5, 8)( 9,14)( 10,13)( 18, 9)( 21, 4)( 21,21)( 22, 2)( 23, 8)( 37,21) ( 38,24)( 39,22)( 45, 7)( 46,24)( 56, 1)( 58,24)( 59, 6)( 62,19)( 76, 3)( 79,10) (102,24)(104, 4)(105, 4)(110,11)(111,23)(153, 2)(153, 7)(214, 6)(237, 9)(250,16) (251, 9)(262,18)(286,11)(287,18)(289, 5)(294,10)(301, 9)(301,23)(306, 7)(308,19) (313, 7)(319, 9)(319,16)(323,23)(328, 6)(352,20) (
5	21	( 11,19)( 33,23)( 63, 9)( 65,11)( 78, 6)( 90,21)( 99, 3)(110,23)(134, 7)(215,10) (240, 9)(245, 9)(263,24)(275,21)(293,10)(296, 3)(299, 6)(303,10)(306,23)(330,10) (331,21) (
6	14	( 12, 9)( 22,11)( 53, 3)( 90,12)( 94, 7)( 98, 8)(111, 7)(158, 1)(265,13)(288,21) (295, 5)(301, 3)(332,11)(332,21) (
7	11	( 29, 5)( 68, 7)( 90, 5)(242,11)(259, 1)(275,12)(276, 8)(281, 8)(307, 7)(316, 8) (327,22) (
8	10	( 8,10)( 18,22)( 37, 3)(235, 6)(288,11)(289,14)(289,23)(297, 7)(310, 3)(354, 7) (
9	10	( 9,24)( 81, 7)(103,14)(125, 6)(126, 6)(298, 2)(315,24)(323, 9)(326, 5)(360,12) (
10	6	( 97, 9)(213,10)(264,11)(270,10)(274,13)(292,16)
11	5	(106, 5)(241,10)(263, 9)(269, 8)(355, 1)
12	4	( 9, 8)( 43, 7)(260,10)(292, 5)
13	5	( 35,11)( 89, 7)(203,10)(300, 5)(314,11)
14	4	(262,10)(273, 7)(311,11)(352, 8)
15	2	(277, 7)(291, 8)
16	2	(312, 8)(327,10)
17	4	(272,10)(278,10)(308, 7)(331, 6)
18	2	(252, 7)(304, 7)
19	2	( 36,12)(279,11)
20	1	(271, 7)
22	1	(315,14)
23	1	(284,13)

Program terminated normally