APPENDIX 4.3

AIR QUALITY

Air Quality Emission Calculations

Flying J Travel Plaza
Operational Emissions Summary/Total

Emissions Category	(lbs/day)				
	ROG	**NO_x**	**CO**	**SO_x**	**PM_{10}**
Stationary and Area Sources					
Gasoline Dispensing	9.63	0	0	0	0
Natural Gas	0.13	1.86	0.74	0	0.00
Architectural Coatings	0.16	0	0	0	0
Landscape Maintenance	0.21	0.02	1.60	0.00	0.00
Diesel Fuel Storage and Dispensing	0.38	0.00	0.00	0.00	0.00
Total Area	10.51	1.88	2.35	0.00	0.01
Off-Site Traveling Sources					
Off-site Driving	4.19	19.19	65.47	0.07	0.57
Off-Site TRU Traveling (I-80 West)	0.15	0.84	0.58	0.00	0.08
Off-Site TRU Traveling (I-80 East)	0.05	0.29	0.20	0.00	0.03
Total Off-Site Traveling	4.40	20.32	66.26	0.07	0.67
On-Site Traveling Sources					
On-site Driving	1.05	8.58	8.00	0.01	0.29
On-Site TRU Traveling	0.15	0.86	0.60	0.00	0.08
Total On-Site Traveling	1.20	9.44	8.59	0.01	0.37
Engine Running Emissions					
TRU Idling	9.83	55.13	38.15	0.17	4.96
Central Engine Idling	0.50	7.22	3.00	0.00	0.13
APU Idling	0.80	11.31	4.98	0.15	0.70
Total Engine Running	11.14	73.67	46.13	0.33	5.78
Total Operational Emissions (lbs/day)	**27.25**	**105.30**	**123.32**	**0.42**	**6.83**

Flying J Travel Plaza
Area Source Calculations from URBEMIS2002

Natural Gas (Area Source)

Proposed Facility	Total Square Footage/ Units (F)	Natural Gas Usage Rate (G)	Total Daily Emissions (lbs/day) CO	ROG	NO_x	PM_{10}
Flying J	17638	6790	0.74	0.13	1.86	0.003

H Factor	lbs/MMfoot^3
CO	40
ROG	7.26
NOx	100
PM10	0.18

Load Factor 0.114

Note: Load factor was determined by averaging the ratios of actual monthly natural gas usage to potential natural gas usage for a year in a similar Flying J Travel Plaza

Architectural Coatings (Construction Emissions)

ROG (lbs/day)	29.66	Note: Added to ROG construction emissions for 2007
Percent Painted	100%	
Factor	0.0185	
Building Sq Ft	17638	
Days to Paint	22	

Architectural Coatings Repainting (Area Source)

ROG (lbs/day)	0.16
Percent Painted	10%
Factor	0.0116
Building Sq Ft	17638
Days to Paint	264

Landscape Maintenance (Area Source)

Pollutant	1989	2007	2010	2007 Commercial Emission Factors (lbs/business unit)	Business Units	Total Emissions (lbs/day)
ROG	0.1750	0.0520	0.0315	0.0520	4	0.208
CO	1.1490	0.4007	0.2760	0.4007	4	1.603
NO_x	0.0070	0.0053	0.0050	0.0053	4	0.021
PM_{10}	0.0041	0.0009	0.0004	0.0009	4	0.004
SO_x	0.0001	0.0001	0.0001	0.0001	4	0.000

Note: URBEMIS2002 provides emission factors for 1989 and 2010. Emission factors for 2007 were manually interpolated as performed in URBEMIS2002

Total Area Source Emissions

	(lbs/day) ROG	NO_x	CO	SO_x	PM_{10}
Natural Gas	0.13	1.86	0.74	0	0.003
Architectural Coatings	0.16	0	0	0	0
Landscape Maintenance	0.208	0.021	1.603	0.000	0.004
Total	**0.50**	**1.88**	**2.35**	**0.00**	**0.01**

Flying J Travel Plaza
Gasoline Dispensing Tank Emissions (Unleaded Premium)

Losses	Factor (lbs ROG/1000 gallon)	Throughput (gallons/year)	Total Loss (lbs/yr)
Breathing	0.06	3,139,656	188.38
Working	0.48	3,139,656	1507.03
Vehicle Filling	0.58	3,139,656	1821.00
Total ROG Loss			**3516.41**

lbs ROG/day	**9.63**

Note: Pounds of ROG per day was calculated by dividing pounds of ROG per year by 365 operating days

Factors from ARB Area Source Methodology: California Air Resources Board. "Gasoline Dispensing Facility – Petroleum Marketing", Area Source Methodologies, Section 4, June 2004 [Online] December 19, 2005

Main Site for Emission Factors	http://www.arb.ca.gov/ei/areasrc/arbpetprodmarkpm.htm
Breathing & Working File	http://www.arb.ca.gov/ei/areasrc/districtmeth/BayArea/C67.pdf
Vehicle Filling File	http://www.arb.ca.gov/ei/areasrc/districtmeth/BayArea/C7578.pdf

Flying J Travel Plaza
Off-Site Motor Vehicle Emissions (25 mph)

Category		Units		ROG	NO_x	CO	SO_x	PM_{10}
Automobile/Light-Duty Trucks								
I-80 West	Vehicle Class		LDA/LDT					
	Round Trips/Day		649					
	One-Way Trip Length	miles	0.396					
	Emission Factor	g/mi		0.30	0.51	5.85	0.005	0.021
	Annual Emissions	lb/day		0.342	0.579	6.631	0.006	0.023
		tons/day		0.000	0.000	0.003	0.000	0.000
Automobile/Light-Duty Trucks								
I-80 East	Vehicle Class		LDA/LDT					
	Round Trips/Day		649					
	One-Way Trip Length	miles	0.136					
	Emission Factor	g/mi		0.30	0.51	5.85	0.005	0.021
	Annual Emissions	lb/day		0.118	0.199	2.277	0.002	0.008
		tons/day		0.000	0.000	0.001	0.000	0.000
Medium-Duty/Light-Heavy-Duty Trucks								
I-80 West	Vehicle Class		MDV/LHDT					
	Round Trips/Day		28					
	One-Way Trip Length	miles	0.396					
	Emission Factor	g/mi		0.48	1.31	7.21	0.01	0.04
	Annual Emissions	lbs/day		0.023	0.064	0.353	0.000	0.002
		tons/day		0.000	0.000	0.000	0.000	0.000
Medium-Duty/Light-Heavy-Duty Trucks								
I-80 West	Vehicle Class		MDV/LHDT					
	Round Trips/Day		28					
	One-Way Trip Length	miles	0.136					
	Emission Factor	g/mi		0.48	1.31	7.21	0.01	0.04
	Annual Emissions	lbs/day		0.008	0.022	0.121	0.000	0.001
		tons/day		0.000	0.000	0.000	0.000	0.000
Heavy-Heavy-Duty Trucks								
I-80 West	Vehicle Class		HHDT					
	Round Trips/Day		270					
	One-Way Trip Length	miles	0.544					
	Emission Factor	g/mi		1.13	14.14	6.02	0.02	0.37
	Annual Emissions	lbs/day		0.731	9.160	3.898	0.014	0.237
		tons/day		0.000	0.005	0.002	0.000	0.000
Heavy-Heavy-Duty Trucks								
I-80 East	Vehicle Class		HHDT					
	Round Trips/Day		270					
	One-Way Trip Length	miles	0.284					
	Emission Factor	g/mi		1.13	14.14	6.02	0.02	0.37
	Annual Emissions	lbs/day		0.382	4.782	2.035	0.007	0.124
		tons/day		0.000	0.002	0.001	0.000	0.000
Local Automobile/Light-Duty Trucks	Vehicle Class		LDA/LDT					
	Round Trips/Day		68					
	One-Way Trip Length	miles	6.6					
	Emission Factor	g/mi		0.30	0.51	5.85	0.00	0.021
	Annual Emissions	lbs/day		0.598	1.012	11.580	0.010	0.041
		tons/day		0.000	0.001	0.006	0.000	0.000
Employee Vehicles	Vehicle Class		LDA/LDT					
	Round Trips/Day		89					
	One-Way Trip Length	miles	16.8					
	Emission Factor	g/mi		0.30	0.51	5.85	0.00	0.02
	Annual Emissions	lbs/day		1.992	3.370	38.579	0.033	0.136
		tons/day		0.001	0.002	0.019	0.000	0.000
Total	Daily Emissions	lbs/day		4.19	19.19	65.47	0.07	0.57
		tons/day		0.002	0.010	0.033	0.000	0.000

Flying J Travel Plaza
On-Site Motor Vehicle Emissions (10 mph)

Category		Units		ROG	NOx	CO	SOx	PM10
Freeway Automobile/Light-Duty Trucks	Vehicle Class		LDA/LDT					
	Round Trips/Day		1297					
	One-Way Trip Length	miles	0.055					
	Emission Factor	g/mi		0.59	0.68	7.92	0.01	0.054
	Annual Emissions	lbs/day		0.184	0.214	2.492	0.003	0.017
		tons/day		0.000	0.000	0.001	0.000	0.000
Freeway Medium-Duty/Light-Heavy-Duty Trucks	Vehicle Class		MDV/LHDT					
	Round Trips/Day		55					
	One-Way Trip Length	miles	0.0625					
	Emission Factor	g/mi		0.89	1.73	10.09	0.01	0.08
	Annual Emissions	lbs/day		0.013	0.026	0.153	0.000	0.001
		tons/day		0.000	0.000	0.000	0.000	0.000
Freeway Heavy-Heavy-Duty Trucks	Vehicle Class		HHDT					
	Round Trips/Day		540					
	One-Way Trip Length	miles	0.17					
	Emission Factor	g/mi		2.08	20.57	12.90	0.02	0.67
	Annual Emissions	lbs/day		0.841	8.324	5.220	0.009	0.273
		tons/day		0.000	0.004	0.003	0.000	0.000
Local Automobile/Light-Duty Trucks	Vehicle Class		LDA/LDT					
	Round Trips/Day		68					
	One-Way Trip Length	miles	0.055					
	Emission Factor	g/mi		0.59	0.68	7.92	0.01	0.054
	Annual Emissions	lbs/day		0.010	0.011	0.131	0.000	0.001
		tons/day		0.000	0.000	0.000	0.000	0.000
Total	Daily Emissions	lbs/day		1.05	8.58	8.00	0.01	0.29
		tons/day		0.001	0.004	0.004	0.000	0.000

Flying J Travel Plaza
On-Site TRU Running Emissions

TRU Idle Time Per Day

Trucks	Amount of Idle (hr)	Total Time (hr)	
15	2	30	
23	10	230	
151	1	151	
		411	**Total**

Pollutant Emissions

Pollutant	Emission Factor (g/hp-hr)	Time (hr)	Horsepower (hp)	Load Factor	On/Off Cycle Factor	lbs/day
ROG	1.17	411	35	0.53	0.50	9.83
NO_x	6.56	411	35	0.53	0.50	55.13
CO	4.54	411	35	0.53	0.50	38.15
PM	0.59	411	35	0.53	0.50	4.96
*PM	0.22	411	35	0.53	0.50	1.85

*PM = Low Emission Performance Standard to be implemented in 2008
Interpolated for MY2000 25hp and MY2000 50 hp, then interpolated for 35 hp engines.

Sulfur Dioxide Emissions

Emission Factor (lbs/hp-hr)	SO_x mw/S mw Ratio	Time (hr)	Horsepower (hp)	Sulfur content (ultralow standard)	lbs/day
0.4	2	411	35	0.000015	0.17

TRU Characteristics

Average Horsepower	35
Load Factor	0.53
On/Off Factor	0.5
Average model Year	2000

TRU Distribution

Heavy Duty Trucks	540	
Refrigerated (35%)	189	
Resting TRUs (20%)	38	
Non-rest TRUs	151	
Night Stay (10 hr)	23	60% of stop/idle
Day Stay (2 hr)	15	40% of stop/idle

Emission Factors from OFFROAD Modeling Change Technical Memo: Revisions to the Diesel Transport Refrigeration Units Inventory Appendix D Attachment A, CARB
http://www.arb.ca.gov/regact/trude03/appd.pdf

TRU Low Emission Standard from "Airborne Toxic Control Measure (ATCM) for In-Use Diesel-Fueled Transport Refrigeration Units (TRU) and TRU Generator Sets, and Facilities Where TRUs Operate", CARB
http://www.arb.ca.gov/regact/trude03/fro1.pdf

Flying J Travel Plaza
On and Off-Site TRU Running Emissions

OFF-SITE EMISSIONS

Direction	Number of Trucks	Driving Time (hr)	Round Trip	Time (hr)	
80 East	95	0.011	2	2.16	
80 West	95	0.022	2	4.13	
				6.29	**Total Time**

Pollutant Emissions (Eastbound off-ramp to facility)

Pollutant	Emission Factor (g/hp-hr)	Time (hr)	Horsepower (hp)	Load Factor	On/Off Cycle Factor	lbs/day
ROG	1.17	2.16	35	0.53	0.50	0.05
NO_x	6.56	2.16	35	0.53	0.50	0.29
CO	4.54	2.16	35	0.53	0.50	0.20
PM	0.59	2.16	35	0.53	0.50	0.03
*PM	0.22	2.16	35	0.53	0.50	0.01

Pollutant Emissions (Westbound off-ramp to facility)

Pollutant	Emission Factor (g/hp-hr)	Time (hr)	Horsepower (hp)	Load Factor	On/Off Cycle Factor	lbs/day
ROG	1.17	4.13	35	0.53	0.5	0.15
NO_x	6.56	4.13	35	0.53	0.5	0.84
CO	4.54	4.13	35	0.53	0.5	0.58
PM	0.59	4.13	35	0.53	0.5	0.08
*PM	0.22	4.13	35	0.53	0.5	0.03

Emission factors were interpolated for MY2000 25 hp and MY2000 50 hp, then interpolated for 35 hp engines.
*PM = Low Emission Performance Standard to be implemented in 2008

Sulfur Dioxide Emissions

Truck Direction	Emission Factor (lbs/hp-hr)	SO_x mw/ S mw	Time (hr)	Horsepower (hp)	Sulfur content (ultralow standard)	lbs/day
80 East	0.4	2	2.16	35	0.000015	0.0009
80 West	0.4	2	4.13	35	0.000015	0.0017

ON-SITE EMISSIONS

Number of Trucks	Time Driving (hr)	Round Trip	Total Time (hr)
189	0.017	2	6.426

Pollutant Emissions

Pollutant	Emission Factor (g/hp-hr)	Time (hr)	Horsepower (hp)	Load Factor	On/Off Cycle Factor	lbs/day
ROG	1.17	6.426	35	0.53	0.50	0.15
NO_x	6.56	6.426	35	0.53	0.50	0.86
CO	4.54	6.426	35	0.53	0.50	0.60
PM	0.59	6.426	35	0.53	0.50	0.08
*PM	0.22	6.426	35	0.53	0.50	0.03

Sulfur Dioxide Emissions

Emission Factor (lbs/hp-hr)	SO_x mw/ S mw	Time (hr)	Horsepower (hp)	Sulfur content (ultralow standard)	lbs/day
0.4	2	6.43	35	0.000015	0.0027

Emission Factors from OFFROAD Modeling Change Technical Memo: Revisions to the Diesel Transport Refrigeration Units Inventory Appendix D Attachment A, viewed on November 28, 2005 CARB
http://www.arb.ca.gov/regact/trude03/appd.pdf

TRU Low Emission Standard from "Airborne Toxic Control Measure (ATCM) for In-Use Diesel-Fueled Transport Refrigeration Units (TRU) and TRU Generator Sets, and Facilities Where TRUs Operate" November 17, 2004 ARB
http://www.arb.ca.gov/regact/trude03/fro1.pdf

Flying J Travel Plaza
On-Site APU Running Emissions

APU Run Time Per Day

Trucks	Amount of Idle (hr)	Total Time (hr)	
22	2	44	
32	10	320	
		364	**Total**

Pollutant Emissions

Pollutant	Emission Rate (g/hr)	Time (hr)	lbs/day
ROG	1.0	364	0.80
CO	6.2	364	4.98
PM	0.87	364	0.70
NO_x	14.1	364	11.31

NMHC + NO_X	15.1 g/hr
NO_x	14.1 g/hr
NMHC (ROG)	1.0 g/hr

Sulfur Dioxide Emissions

Emission Factor (lbs/hp-hr)	SO_x mw/ S mw Ratio	Time (hr)	Horsepower (hp)	Sulfur content (ultralow standard)	lbs/day
0.4	2	364	35	0.000015	0.15

APU Distribution

Stop & Idle Trucks with APUs	54
Night Stay (10 hr)	32
Day Stay (2 hr)	22

APU Emission Factors from "Initial Statement of Reasons: Notice of Public Hearing to Consider Requirements to Reduce Idling Emissions from New and In-Use Trucks, Beginning 2008" viewed on February 25, 2006
http://www.arb.ca.gov/regact/hdvidle/isor.pdf

Flying J Travel Plaza
On-Site Heavy-Heavy-Duty Truck Engine Idling Emissions

Truck Engine Idle Time Per Day

Trucks	Amount of Idle (hr)	Total Time (hr)
540	0.08	45

Pollutant	Emission Factor (g/hr)	Time (hr)	lbs/day
ROG	5.05	45	0.50
CO	30.21	45	3.00
NO_x	72.81	45	7.22
PM_{10}	1.27	45	0.13
SO_x	0.04	45	0.00

Notes:
Emission factor generated using EMFAC2002, assuming 60ºF and 50% humidity at 0 mph in Yolo County.

Health Risk Assessment

HEALTH RISK ASSESSMENT

FOR THE

FLYING J TRAVEL PLAZA

Prepared for:

City of Dixon
600 East A Street
Dixon, CA 95620-3697

Prepared by:

Impact Sciences, Inc.
2101 Webster Street, Suite 1825
Oakland, California 94612

April 2006

SUMMARY

Flying J Travel Plaza proposes to construct a new truck stop and travel plaza on a currently undeveloped area located in the northeast portion of the City of Dixon. The project site is located in the City of Dixon along Interstate 80 near the intersection of Pedrick Road and Professional Drive. Currently, the project site is surrounded by agricultural fields; however, the adjacent areas on the western and the southwestern sides across Interstate 80 are zoned as highway commercial (HC).

This assessment evaluates the health impacts due to diesel particulate matter emitted by heavy-heavy-duty diesel trucks, diesel-powered transport refrigeration units, diesel-powered auxiliary power units, medium-duty/light-heavy-duty diesel trucks, and diesel automobiles/light-duty trucks associated with the operation of the proposed Flying J Travel Plaza. Heavy-heavy-duty diesel trucks and other vehicles would visit the Travel Plaza using Pedrick Road and Professional Drive. A scenario was created using information provided by the applicant to represent a typical day of operation in the buildout year of 2007.

The Yolo-Solano Air Quality Management District (YSAQMD) recommends the following significance criteria for health risk assessments:

- Criterion 1: a greater than 10 in one million (10×10^{-6}) lifetime probability of contracting cancer; and

- Criterion 2: a health hazard index of 1.0 for evaluating the noncarcinogenic effects of toxic air contaminants.

Using the YSAQMD's thresholds of significance, the health risk assessment finds that the maximum anticipated cancer risks associated with the project are 3.0 in one million at the residential receptor and 38 in one million at the workplace receptors. The assessment also finds that the chronic hazard indices for noncancer health impacts are well below 1.0 at the maximally exposed receptors. No elementary schools, high schools, senior care centers, and hospitals were identified in the 2.4-kilometer distance from the property boundary. No cancer risk above the 10-in-one-million criterion was found at a residential receptor. The cancer risk associated with the project at the workplace is greater than the significance criteria and is, therefore, significant.

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HEALTH RISK ASSESSMENT

for the

FLYING J TRAVEL PLAZA

1.0 INTRODUCTION

On August 27, 1998, the California Air Resources Board (ARB) designated particulate emissions from diesel-fueled engines as a toxic air contaminant (TAC). The proposed Flying J Travel Plaza (Travel Plaza) will result in activity of incoming diesel trucks and automobiles in the project area. Consequently, the project's vicinity will experience a rise in the concentration level of diesel particulate matter (DPM) and its associated health effects.

1.1 Thresholds of Significance

The Yolo-Solano Air Quality Management District (YSAQMD) *Air Quality Handbook*[1] recommends a lifetime probability of contracting cancer greater than 10 in one million (10×10^{-6}) as a significance threshold for evaluating cancer impacts from toxic air contaminants. The *Air Quality Handbook* further identifies a health hazard index of 1.0 as an additional significance threshold for evaluating noncarcinogenic effects of toxic air contaminants. The project's estimated health impacts will be evaluated with respect to these criteria.

This analysis evaluates the new ambient levels of DPM that would result from the proposed project and quantifies the potential health risk in the vicinity of the Travel Plaza due to the project's operations. A quantified health risk assessment for both cancer risk and noncarcinogenic effects from DPM is presented below.

1 Yolo-Solano Air Quality Management District, *Air Quality Handbook*, December 2002.

2.0 SOURCE DESCRIPTIONS

2.1 Travel Plaza Operations

Figure 1, Source Locations, shows the project site and the three main emission sources used in this assessment.[2] The following three areas were identified for analysis of the proposed operations as sources of DPM emissions based on the description of the project:

1. Roadways (Pedrick Road and Professional Drive) on which heavy-heavy-duty trucks, some of which pull trailers equipped with transport refrigeration units (TRUs),[3] medium-duty/light-heavy-duty trucks, and automobiles/light-duty trucks exit Interstate 80 (I-80) and drive to the Travel Plaza; [4]

2. The Travel Plaza's parking lot where heavy-heavy-duty trucks and other diesel-fueled vehicles would drive to find parking locations and fueling; and

3. Parking spaces where heavy-heavy-duty trucks, TRUs, and auxiliary power units (APU)[5] would operate during truck driver rest periods.

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2 The areas depicted in the figure are the area and point sources used in the dispersion model. See **Modeling Approach** for a further description of these sources.

3 Transport refrigeration units are diesel-powered engines installed in long-haul trailers to maintain proper storage conditions while transporting goods.

4 Crane Transportation Group, the traffic consultant for the Environmental Impact Report, estimated trips to and from the Travel Plaza by (a) automobiles, pickups, and recreational vehicles, (b) trucks with three or four axles, and (c) trucks with more that four axles. For the purpose of this health risk assessment, these groups of vehicles were assumed to consist of the following vehicle classes as designated by the California Air Resources Board in EMFAC2002: (a) automobiles (LDA) and light-duty trucks (LDT), (b) medium-duty vehicles (MDV) and light-heavy-duty trucks (LHDT), and (c) heavy-heavy-duty trucks (HHDT), respectively.

5 Auxiliary power units are diesel-powered engines that provide power to operate vehicle accessories such as air conditioning, heating, and electronic equipment.

Figure 1
Source Locations

3.0 ACTIVITY DATA

3.1 Proposed Operations

Heavy-Heavy-Duty Diesel Trucks

Under the proposed project, heavy-heavy-duty diesel trucks would stop at the Travel Plaza by taking the Pedrick Road exit off I-80. Trucks would then travel south on Pedrick Road until reaching Professional Drive, approximately 0.54 miles and 0.28 miles from the I-80 West and I-80 East off-ramps, respectively. After traveling west on Professional Drive, heavy-heavy-duty trucks would then turn into the parking lot of the Travel Plaza where they would park and/or fuel, driving an average distance of 0.17 miles.

Crane Transportation Group and the applicant provided information regarding the distribution of vehicle classes visiting the Travel Plaza, percentage of TRU-equipped trucks, percentage of APU-equipped trucks, and resting period distribution. According to the applicant, 540 heavy-heavy-duty trucks would stop at the Travel Plaza per day. From the applicant's observations of a similar Flying J Travel Plaza near Ripon, California, about 20 percent (108 trucks) of the heavy-heavy-duty trucks would stop and rest for more than one hour. Truck drivers that park and rest for more than one hour are assumed to stay for either a two-hour (daytime) or 10-hour (nighttime) period, based on the observations at the Ripon Travel Plaza.

During resting periods, associated TRUs would operate continuously to provide proper storage conditions for transported goods. TRUs are diesel engines; therefore, their operation represents a source of DPM. The applicant has indicated that 35 percent (189 trucks) of all heavy-heavy-duty trucks would haul a TRU-equipped trailer. At many truck stops, drivers idle the main truck engine to provide comfortable resting conditions; however, the applicant has proposed that the Dixon Travel Plaza will be a "no idling" facility. Accordingly, vehicles visiting the facility will not be permitted to idle their engines for more than five minutes while on-site.

Flying J has instituted a program to supply APUs to trucks,[6] and APUs are available for aftermarket installation by other vendors. Increased usage of APUs and other alternative power sources are expected to increase due to the proposed ARB regulation governing idling of diesel-fueled commercial vehicles. The applicant has estimated that 50 percent of heavy-heavy-duty diesel trucks coming to the Travel Plaza would operate an APU if they stayed for the driver to rest. Drivers fulfilling their rest period would be allowed to use their APU to provide power for comfort equipment such as air conditioning, heating, ventilation, and electronic accessories. APUs are also diesel engines, therefore, DPM emissions will be generated as a result of their operation. The balance of the trucks would either use an electrical hookup,

6 A description of the APU available from Flying J may be found at http://www.fjesolutions.com/.

with the Travel Plaza supplying the electricity, or weather conditions would be moderate enough that heating or cooling would not be necessary. For the purposes of this analysis, all main heavy-heavy-duty truck engines are assumed to idle for the maximum allowable time of five minutes.

According to the applicant's observation of other Travel Plazas, of the drivers staying for more than one hour, 40 percent of the truck drivers would rest for a two-hour period, and 60 percent would rest for a 10-hour period. During resting periods, DPM emissions would be generated from TRUs continuously operating. Thirty-eight trucks hauling a TRU-equipped trailer would stop and rest at the proposed project for more than one hour. The remaining trucks hauling a TRU-equipped trailer (151 trucks) stopping, but not completing a resting period, would park and shutoff their main engine while drivers use the facilities at the Travel Plaza. Nonetheless, the trailers would contain a TRU, which would operate throughout their stay. Trucks hauling TRU-equipped trailers that park, but are not resting, were assumed to stay for 60 minutes while drivers use the facilities (i.e., food, shower, laundry, entertainment). In order to provide cab comfort for the driver, 50 percent (54 trucks) of the trucks staying for more than one hour would use an APU that would also generate DPM emissions. The same split (40 percent for two hours and 60 percent for 10 hours) of resting time for TRUs was assumed for APU equipped trucks. Trucks equipped with an APU, but not fulfilling a resting period would not use their APU. The remaining 351 trucks (without TRUs) would park on-site, shut off their engines, and use the facilities at the Travel Plaza for a given amount of time, which is assumed to be one hour. All trucks leaving the Travel Plaza would exit back to the freeway using the same route from which they came. A summary of heavy-heavy-duty truck, TRU-equipped trailer, and APU activity per day is provided below:

- 540 heavy-heavy-duty trucks idling main engine for 5 minutes each
- 432 heavy-heavy-duty trucks stay for one hour or less
- 108 heavy-heavy-duty trucks stay for more than on hour
- 23 TRU-equipped trailers resting for 10 hours
- 15 TRU-equipped trailers resting for two hours
- 151 TRU-equipped trailers stopping for 1 hour (non-rest)
- 32 APU-equipped heavy-heavy-duty trucks resting for 10 hours
- 22 APU-equipped heavy-heavy-duty trucks resting for two hours

Automobiles/Light-Duty Trucks and Medium-Duty/Light-Heavy-Duty Trucks

In addition to heavy-heavy-duty trucks, the Travel Plaza would also be visited by diesel fueled automobiles/light-duty trucks and diesel-fueled medium-duty/light-heavy-duty trucks. Using

information provided by Crane Transportation Group and EMFAC2002 diesel vehicle distribution data, the number of diesel-fueled automobiles/light-duty trucks and medium-duty/light-heavy-duty trucks visiting the Travel Plaza per day were calculated. Out of 2,730 passenger cars estimated to use the Travel Plaza per day, 19 diesel automobiles/light-duty trucks, and 14 diesel medium-duty/light-heavy-duty trucks, would visit the Travel Plaza per day. Automobiles/light-duty trucks and medium-duty/light-heavy-duty trucks would enter the Travel Plaza using a separate entrance from heavy-heavy-duty trucks. From the I-80 off-ramps, these vehicles would travel 0.14 miles and 0.40 miles to the Travel Plaza entrance coming from I-80 East and I-80 West, respectively. While on-site, automobiles/light-duty trucks would travel an average distance of 0.055 miles to reach a parking location. The designated parking area for medium-duty/light-heavy-duty trucks would be farther away from the entrance; these vehicles would travel an average distance of 0.063 miles to reach a parking location. Once automobiles/light-duty trucks and medium-duty/light-heavy-duty trucks have reached their parking location, they would shutoff their vehicles immediately. Drivers would then use the facilities for an unspecified amount of time. No idling emissions would be associated with diesel automobiles/light-duty trucks or diesel medium-duty/light-heavy-duty truck visits. When leaving the Travel Plaza, these vehicles would exit back to the freeway using the same path from which they came.

4.0 CALCULATION OF EMISSIONS

The DPM factors for all vehicles were determined using the ARB vehicle emission inventory program, EMFAC2002. The heavy-heavy-duty trucks stopping at the Travel Plaza were represented by the heavy-heavy-duty (HHDT) truck vehicle class in EMFAC2002. A combination of vehicle classes from EMFAC2002 was used to represent the automobiles/light-duty trucks and medium-duty/light-heavy-duty trucks. Automobiles/light-duty trucks were modeled in EMFAC2002 as a combination of the light-duty automobile (LDA) and light-duty truck (LDT) vehicle class. The medium-duty/light-heavy-duty trucks were represented as a combination of the medium-duty vehicle (MDV) and light heavy-duty truck (LHDT) vehicle classes in EMFAC2002. EMFAC2002 can generate total emissions and total vehicle-miles traveled (VMT) for a motor vehicle class within an air basin for a particular study year. For this analysis, Yolo County was selected. The motor vehicle emissions inventory for calendar year 2007 was generated based on the assumption that the facility would be built out and would be operating by 2007. EMFAC2002 can generate total emissions and total VMT per day for specific vehicle speeds. Since each of the three area sources would entail different traveling speeds, a different vehicle speed was selected to determine emission factors for each particular area source. Emission factors for TRUs and APUs (see Sections 4.4 and 4.5) were obtained from studies published by the ARB.

4.1 Off-Site Traveling Emissions (Roadways)

An inventory of PM_{10} emissions corresponding to a vehicle speed of 25 miles per hour within Yolo County in 2007 was used to generate emission factors for off-site travel. A speed of 25 miles per hour is the vehicle speed at which heavy-heavy-duty trucks, automobiles/light-duty trucks, and medium-duty/light-heavy-duty trucks were assumed to drive from the I-80 off-ramps to the Travel Plaza entrance. The EMFAC2002 PM_{10} emission inventory results for each vehicle class in tons per day was divided by the daily VMT for that vehicle class to generate DPM emission factors, expressed in grams per mile. The measured distance for heavy-heavy-duty trucks from Pedrick Road exit to the Travel Plaza's entrance is 0.284 miles coming from I-80 East, and 0.544 miles coming from I-80 West. Diesel automobiles/light-duty trucks and medium-duty/light-heavy-duty trucks would use a separate entrance; therefore, their off-site traveling distance would be different. All vehicles other than heavy-heavy-duty trucks would travel a measured distance of 0.136 miles and 0.396 miles coming from I-80 East and I-80 West, respectively, to the Travel Plaza entrance.

The emission factor for each vehicle class was then multiplied by the distance from the I-80 off-ramps to the Travel Plaza entrance for vehicles coming from I-80 West and I-80 East. Emissions from eastbound and westbound vehicles were calculated separately due to different trip distances, and then combined to represent total roadway emissions. All vehicles would exit the Travel Plaza back to I-80 using nearly the

same route from which they came; therefore, roadway emissions for each direction were multiplied by two to represent the arrival and departure trip. The annual off-site heavy-heavy-duty truck, automobile/light-duty truck, and medium-duty/light-heavy-duty truck off-site traveling emissions were calculated using the following equations:

Trips/day × One-way Trip Distance (miles) × 2 × Emissions Factor (g/mi) ÷ 453.6 g/lb = Pounds/day

Pounds/day × 365 days/year = Pounds/year

4.2 On-Site Traveling Emissions (Parking Lot)

Similar to the roadway emission calculations, an emissions inventory of PM_{10} from EMFAC2002 corresponding to a vehicle speed of 10 miles per hour within Yolo County in 2007 was used to generate on-site emission factors. Ten miles per hour is the assumed speed at which all vehicles would travel from the entrance of the Travel Plaza to their parking space. The EMFAC2002 PM_{10} emission results for each vehicle class in tons per day were divided by the daily VMT to calculate the DPM emissions factors, expressed in grams per mile. Each vehicle class has a designated parking area; therefore, each vehicle class would travel a different distance to reach their appointed parking location. The distances to each vehicle class' designated parking location were measured and averaged according to furthest, nearest, and midpoint parking spot. The average distance a heavy-heavy-duty truck would travel to reach a parking location is 0.17 miles. Automobiles/light-duty trucks and medium-duty/light-heavy-duty trucks would travel an average distance of 0.055 miles and 0.063 miles, respectively.

The on-site vehicle emission factor was multiplied by the average distance from the Travel Plaza entrance to a parking space. The average distance was multiplied by two to represent the incoming and outgoing trip since vehicles would leave the facility using the same path as they entered. The annual on-site vehicle emissions were calculated using the following equations:

Trips/day × One-way Trip Distance (miles) × 2 × Emissions Factor (g/mi) ÷ 453.6 g/lb = Pounds/day

Pounds/day × 365 days/year = Pounds/year

4.3 Truck Engine Idling Emissions

Truck engine idling emissions for the HHDT were obtained using the ARB emission inventory program, EMFAC2002. An inventory corresponding to only HHDT (all diesel-fueled engines) traveling at a vehicle speed of zero miles per hour to simulate idling was used to generate emission factors for heavy-heavy-duty truck engine idling on-site. The EMFAC2002 emission results for the HHDT vehicle class traveling at zero miles per hour were expressed in grams per hour.

As mentioned in the Section 3.1, the proposed project will be a "no idling facility", meaning vehicles will not be allowed to idle their engine for more than five minutes when not involved in operational activities. For the purposes of this analysis, each heavy-heavy-duty truck was assumed to idle for the maximum five minutes. The total heavy-heavy-duty truck engine idling time from all heavy-heavy-duty trucks per day was multiplied by the idling emission factor to generate grams of DPM per day, which was then converted into pounds per day. The daily truck engine emissions were then multiplied by 365 to represent a full year of idling emissions. The annual truck engine emissions were calculated using the following equations:

$$\text{Total Idling Time (hours/day)} \times \text{Emission Factor (g/hr)} \div 453.6 \text{ g/lb} = \text{Pounds/day}$$

$$\text{Pounds/day} \times 365 \text{ days/year} = \text{Pounds/year}$$

4.4 TRU Operating Emissions

The TRU operating emission factors were determined from the ARB's *OFFROAD Modeling Change Technical Memo,* Revisions to the Diesel Transport Refrigeration Units Inventory, Appendix D, Attachment A.[7] At full project build out, the average model year of TRUs coming to the Travel Plaza is assumed to be 2000 (seven years older than the current year).[8] The average TRU horsepower for long-haul trailers was determined to be 35 horsepower.[9] Emission rate values, expressed in grams per horsepower-hour, from the ARB Technical Memo were interpolated to emulate 2000 model year TRUs rated at 35 horsepower. A load factor of 0.53 was also incorporated into the TRU emission calculations to represent the average capacity at which TRUs operate.[10] TRUs are designed to maintain the proper temperature inside the cargo trailer. Once the programmed conditions have been achieved, the TRU would not operate at full capacity, but only enough to maintain proper conditions. In addition to variable operating capacities, TRUs also have an on/off cycle where they shut off temporarily in order to conserve fuel and energy. The average on/off cycle can range from 30 to 80 percent, however, for the purposes of this analysis, an average value of 50% was used to calculate TRU emissions.[11]

The total TRU operating time per day was multiplied by the average horsepower, load factor, on/off cycle factor, and emission factor to obtain grams of DPM per day. The total amount was then converted

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7 California Air Resources Board. "Revisions to the Diesel Transport Refrigeration Units Inventory, Appendix D, Attachment A", OFFROAD Modeling Change Technical Memo, October 2003 [Online] November 28, 2005 <http://www.arb.ca.gov/regact/trude03/appd.pdf>

8 Personal communication with Rod Hill, ARB, and George Lu, Impact Sciences, November 29, 2005.

9 Ibid.

10 Personal communication with Ronald Ray, Carrier Transicold, and George Lu, Impact Sciences, February 8, 2006.

11 Ibid.

to pounds per day and multiplied by 365 to obtain pounds per year. The annual TRU idling emissions were calculated using the following equation:

$$\text{Emission Factor (g/hp-hr)} \times \text{Average Horsepower (hp)} \times \text{Load Factor x On/Off Cycle Factor}$$

$$\times \text{Total Idling Time (hours/day)} \div 453.6 \text{ g/lb} = \text{Pounds/day}$$

$$\text{Pounds/day} \times 365 \text{ days/year} = \text{Pounds/year}$$

In 2008, the ARB will begin enforcing the new low emission performance standard for TRUs as a part of their Airborne Toxic Control Measure (ATCM) for In-Use Diesel-Fueled TRUs. Model year 2001 and older TRUs must comply with the low emission standard of 0.22 grams PM per horsepower-hour by December 2008. By 2010, the ultra-low emission standard of 0.02 grams PM per horsepower-hour will be required for 2003 model year TRUs. Subsequent model year TRUs will be given seven years after their model year to comply with the ultra-low emission standard. Full compliance with the ultra-low emission standard is expected by 2020. The HRA is based on a 70-year exposure period, during a large majority of the TRUs would be in full compliance with the ultra-low emission standard. For purposes of this analysis, the first two years of operation are assumed to operate under current standards. The subsequent years would be modeled assuming full compliance with the low-emission standard. This provides a conservative estimate of DPM emissions associated with TRUs. In reality, TRU emission standards would continue to decrease, or gradually be replaced by lower emitting technology during the 70-year period.

4.5 APU Operating Emissions

In order to provide cab comfort during resting periods, a portion of the heavy-heavy-duty diesel trucks would be equipped with auxiliary power units (APUs). APUs are also fueled by diesel; however, APUs use approximately 0.08 to 0.3 gallons of fuel per hour compared to the main truck engine idling usage rate of 1 gallon per hour.[12] APUs provide electrical power to the cab to operate the necessary comfort equipment such as air conditioning, heating, ventilation, and driver accessories. As estimated by the applicant, 50 percent of the heavy-heavy-duty diesel trucks visiting the Travel Plaza would operate an APU during the driver resting period. The balance of the truck comfort systems would either be operated by electric power or the weather conditions would be moderate enough so that auxiliary heating or cooling would not be necessary. Drivers would only operate their APUs as an alternative to truck engine idling while resting for the two- or 10-hour rest period. Emission factors for APUs were obtained from the ARB's *Initial Statement of Reasons for Requirements to Reduce Idling Emissions from New*

12 California Air Resources Board. "Appendix E: Alternatives to Primary Engine Idling", Initial Statement of Reasons for the ATCM to Limit Diesel Fueled Commercial Motor Vehicle Idling, July 2004 [Online] February 23, 2006 <http://www.arb.ca.gov/regact/idling/isorappe.pdf>

and In-Use Trucks.[13] Emissions factors were presented in this document in grams of pollutant per hour. The total APU operating time per day was multiplied by the emission factor to generate grams of DPM per day. The daily APU emissions were then multiplied by 365 to represent a full year of APU operating emissions. APU emissions were calculated using the following equation:

$$\text{Emission factor (grams/hr)} \times \text{Total Resting Time per year (hr/day)} \div 453.6 \text{ g/lb} = \text{Pounds/day}$$

$$\text{Pounds/day} \times 365 \text{ days/year} = \text{Pounds/year}$$

Currently, the ARB along with various industries are developing technology that use fuel cells to convert gasoline or diesel fuel's chemical energy into useful electrical energy. These future technologies, coupled with stricter APU emission standards, would reduce emission rates from APUs during the course of the 70-year HRA analysis. In addition, as on- and off-board electrification becomes more economically feasible, the Travel Plaza and patron trucks would begin to invest into those technologies, thereby further reducing air emissions. Therefore, the assumptions used in this analysis provide a conservative estimate of potential air emissions. In reality, new technology over the 70-year period would lower the emission rates of APUs and gradually replace APUs with lower emitting technology such as electrification.

4.6 Off-Site TRU Traveling Emissions

TRU emission factors for trucks traveling from the freeway to the proposed project were estimated using the same methods and emission factors for on-site TRU operation. Trucks were assumed to travel an average speed of 25 miles per hour along Pedrick Road and Professional Drive. The total travel distance for trucks coming from I-80 West off-ramp and I-80 East off-ramp is 0.544 miles and 0.284 miles, respectively. The time spent traveling along Pedrick Road and Professional Drive was calculated by dividing the total distance, 0.544 or 0.284 miles by the average traveling speed, 25 miles per hour. Using the assumptions for distance traveled and speed, the time heavy-heavy-duty diesel trucks would drive on Pedrick Road and Professional Drive were calculated. Heavy-heavy-duty trucks would drive for 0.011 and 0.022 hours on the roads leading to the Travel Plaza entrance coming from I-80 East and I-80 West, respectively. The TRU emissions associated with off-site travel were multiplied by the same load factor and on/off cycle factor as the on-site TRU emissions.

The total number of trucks with TRU-equipped trailers coming from I-80 East and I-80 West were multiplied by the corresponding time traveled along the off-site roads, average horsepower, load factor, emission factor, and on/off cycle factor. The result, in grams of pollutant, was converted to pounds and

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13 California Air Resources Board. "Notice of Public Hearing to Consider Requirements to Reduce Idling Emissions From New and In-use Trucks, Beginning in 2008", Initial Statement of Reasons, September 2005 [Online] February 25, 2006 <http://www.arb.ca.gov/regact/hdvidle/isor.pdf>

multiplied by two to represent the arrival and departure trip. The annual TRU emissions generated during the off-site travel were calculated using the following equation:

$$\text{Emission factor (g/hp-hr)} \times \text{Average Horsepower (hp)} \times \text{Off-site Travel Time (hr/day)} \times 2 \times \text{Load Factor}$$

$$\times \text{On/Off Cycle Factor} \div 453.6 \text{ g/lb} = \text{Pounds/day}$$

$$\text{Pounds/day} \times 365 \text{ days/year} = \text{Pounds/year}$$

4.7 On-Site TRU Traveling Emissions

While trucks are driving to a parking location within the Travel Plaza, their associated TRU would generate DPM emissions. The same TRU emission factors used for off-site traveling were used to calculate on-site TRU traveling emissions. Similar to the off-site TRU traveling emissions, the average distance a heavy-heavy-duty truck drives to a parking space was divided by the average speed at which trucks were assumed to drive on-site (10 mph) to obtain total driving time on-site. The total time driven on site was multiplied by two to represent the arrival and departure trip. The on-site driving time was then multiplied by the emission factor, average horsepower, load factor, and on/off cycle factor to obtain grams of pollutant. The total emissions in grams were then converted to pounds. The annual on-site TRU traveling emissions were calculated using the following equation:

$$\text{Emission factor (g/hp-hr)} \times \text{Average Horsepower (hp)} \times \text{On-site Travel Time (hr/day)} \times 2 \times \text{Load Factor}$$

$$\times \text{On/Off Cycle Factor} \div 453.6 \text{ g/lb} = \text{lbs/day}$$

$$\text{Pounds/day x 365 days/year} = \text{Pounds/year}$$

The resulting calculated emissions from the area sources associated with proposed operations are summarized in **Table 1, Summary of Daily and Annual Diesel Exhaust Particulate Emissions from Travel Plaza Operations**. Detailed emission calculations are provided in **Attachment A** to this health risk assessment.

Table 1
Summary of Daily and Annual
Diesel Exhaust Particulate Emissions from Travel Plaza Operations

Source	Emissions	
	Pounds/day	Pounds/year
On-site		
Truck engine idling	0.13	46.06
Heavy-heavy-duty trucks (driving)	0.28	100.88
TRUs (current)	4.99	1,819.29
TRUs (future)	1.86	678.38
APUs	0.70	254.82
Automobiles/light-duty trucks and Medium-duty/light-heavy-duty trucks	0.0013	0.48
Off-site		
Heavy-heavy-duty trucks (driving)	0.37	133.68
TRUs (current)	0.11	37.21
TRUs (future)	0.04	13.87
Automobiles/light-duty trucks and Medium-duty/light-heavy-duty trucks	0.004	1.35

Source: Impact Sciences, Inc.

5.0 MODELING METHODOLOGY

The ARB's Hotspots Analysis and Reporting Program (HARP) was used to model the air quality impacts of DPM emissions from the Travel Plaza annual operations and calculate the health impacts associated with them. This model incorporates a version of the U.S. Environmental Protection Agency-approved Industrial Source Complex – Short Term (ISCST3) model. The ISCST3 model can estimate the air quality impacts of single or multiple sources using actual meteorological conditions.

The model was configured with the following control parameters:

- Modeling switches: regulatory default;
- Averaging period: annual (period); and
- Choice of dispersion coefficients based upon land-use type: rural.

Meteorological data from the Sacramento Executive Airport for 1984 to 1987 was used in ISCST3 (data for 1988 are not available from the ARB website for the HARP model). The average concentrations over this four-year period were used to calculate the health impacts. Rural dispersion coefficients were selected because the area surrounding the Travel Plaza consists of relatively low buildings and lightly developed land uses. The Sacramento Executive Airport meteorological monitoring site is about 18 miles northeast of the Travel Plaza and is the closest meteorological monitoring station to the project area. A wind rose illustrating prevailing wind speeds and directions during 1984 to 1987 is shown in **Figure 2, Wind Rose for the Sacramento Executive Airport Monitoring Station**.

Sources of emissions from heavy-heavy-duty diesel trucks, APUs, automobiles/light-duty trucks, medium-duty/light-heavy-duty trucks, and TRUs were modeled using the area source option in HARP. Because of the aspect ratio (ratio of the length to width) for an area source is limited in ISCST3 to 10:1, the linear areas were simulated by a series of area sources. The off-site sources of emissions (to/from I-80 from/to Travel Plaza) associated with heavy-heavy-duty truck sources include both the truck engines and the continuously operating TRUs, and the sources of roadway emissions from light-duty automobiles/trucks and medium-duty/light-heavy-duty trucks include only diesel vehicle emissions. These off-site emissions were modeled as a series of area sources (30 feet x 300 feet) extended over Pedrick Road and Professional Drive. The truck engine and TRU emissions from heavy-heavy-duty trucks driving on site to a parking space were modeled as seven different area sources. The on-site driving area sources were positioned over the pathways where trucks would be designated to drive to their parking spaces and fueling facility. The truck engine and TRU emissions from parked and idling

trucks were modeled as 10 different area sources covering the parking spaces. The source characteristics for modeling each of these sources are described in additional detail below.

Travel Plaza (On-Site) (Heavy-Heavy-Duty Trucks with TRUs)	
Number of Area Sources:	7
Width of Area Sources:	35.86 meters to 218.34 meters (117.64 feet to 716.33 feet)
Length of Area Sources:	32.67 meters to 91.64 meters (107.19 feet to 300.65 feet)
Release Height (Heavy-Heavy-Duty Trucks and TRUs):	4.15 meters (13.62 feet) (nominal height of exhaust stack above ground level per ARB risk assessment scenarios)

Travel Plaza (On-Site) (Automobiles/Light-Duty Trucks and Medium-Duty/Light-Heavy-Duty Trucks)	
Number of Area Sources:	2
Width of Area Sources:	49.35 meters to 102.8 meters (161.9 feet to 337.28 feet)
Length of Area Sources:	69.22 meters to 78.13 meters (227.1 feet to 256.33 feet)
Release Height (Automobiles/Light-Duty Trucks):	0.5 meters (1.64 feet)
Release Height (Medium-Duty/Light-Heavy-Duty Trucks):	0.5 meters (1.64 feet)

Travel Plaza Parking Spaces (Heavy-Heavy-Duty Trucks with TRUs)	
Number of Area Sources:	10
Width of Area Source:	21.86 meters to 60.81 meters (71.72 feet to 199.52 feet)
Length of Area Source:	21.74 meters to 154.76 meters (71.32 feet to 507.73 feet)
Release Height (Heavy-Heavy-Duty Trucks and TRUs):	4.15 meters (13.62 feet) (nominal height of exhaust stack above ground level per ARB risk assessment scenarios)
Release Height (APUs):	0.5 meters (1.64 feet)[14]

14 According to Jeff Foote, Flying J, and David Ray, Carrier Transicold, the APUs exhaust is approximately one to two feet above the ground, depending on the configuration. A typical release height of 0.5 meters was assumed for the APUs.

Figure 2
Wind Rose for the Sacramento Executive Airport Monitoring Station

Pedrick Road and Professional Drive (Off-Site)	
Number of Area Sources:	12
Width of Area Sources:	9.14 meters to 91.44 meters (30 feet to 300 feet)
Length of Area Sources:	9.14 meters to 91.44 meters (30 feet to 300 feet)
Release Height (Heavy-Heavy-Duty Trucks and TRUs):	4.15 meters (13.62 feet) (nominal height of exhaust stack above ground level per ARB risk assessment scenarios)
Release Height (Automobiles/Light-Duty Trucks and Medium-Duty/Light-Heavy-Duty Trucks):	0.5 meters (1.64 feet)

The emissions are intermittent for the most part, which ISCST3 cannot readily evaluate, and the health impacts of concern are based on annual averages. Therefore, the annual emissions in **Table 1** were annualized by multiplying the emission rate in pounds per hour by 453.6 grams per pound and dividing those emission rates by 8,760 hours per year and 3,600 seconds per hour by HARP.

6.0 RECEPTORS USED FOR EVALUATING MODELED IMPACTS

The project site is located in an undeveloped area in the City of Dixon within the Northeast Quadrant Specific Plan area. There are few existing workplaces near the site; however, much of the local area is zoned for future commercial and industrial development. There are no residential neighborhoods contiguous to the Travel Plaza. The city's main residential area lies southwest of the project site and is not in proximity to the proposed project.

The YSAQMD *Air Quality Handbook* recommends that sensitive receptors be evaluated in an air quality impact analysis. The *Air Quality Handbook* defines sensitive receptors as "People, or facilities that generally house people (schools, hospitals, residences, etc.), that may experience adverse effects from unhealthful concentrations of air pollutants." For the purpose of this assessment, potential sensitive receptors included schools, childcare centers, and hospitals.

No elementary schools, high schools, senior care centers, and hospitals were identified in the 2.4-kilometer distance from the property of the Travel Plaza. A Cartesian grid was spaced at 100-meter intervals up to 2,400 meters (2.4 kilometers) from the Travel Plaza (as measured from the property of the Travel Plaza). The overall receptor grid was designed to cover areas of existing and future off-site residential exposure, areas of commercial/industrial development to allow assessment of potential

workplace exposure, and potential exposure to other sensitive receptors listed in the *Air Quality Handbook*.

7.0 EVALUATION OF HEALTH IMPACTS

The Unit Risk Value for DPM recommended by the Scientific Review Panel is 3.0×10^{-4} per microgram per cubic meter ($\mu g/m^3$).[15] This value corresponds to a Cancer Potency Factor of 1.1 per milligram/kilogram (body weight) per day (mg/kg-day), which is the value used in the cancer risk calculations in HARP. The Unit Risk Value means that for receptors with an annual average concentration of 1 $\mu g/m^3$ in the ambient air, the probability of contracting cancer over a 70-year lifetime of exposure is 300 in one million. This Unit Risk Value considers exposure via inhalation only. The potential exposure through other pathways (e.g., ingestion) requires substance and site-specific data, and the specific parameters for diesel exhaust are not known for these pathways.[16] 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 cancer risk calculations were performed by HARP. The following equations are used within HARP to calculate the cancer risk due to inhalation using the modeled DPM concentrations:[17]

- **Risk** = Dose-inhalation * Inhalation potency factor (Equation 1)

  where:

- **Inhalation potency factor** = 1.1 (milligram per kilogram per day)$^{-1}$ (for diesel particulate matter)
- **Dose Inhalation** = C_{air} * DBR * A * EF * ED * 10^{-6} / AT (Equation 2)

  where:

C_{air} = concentration in microgram per cubic meter

DBR = breathing rate in liter per kilogram of body weight per day

A = inhalation absorption factor (1 for DPM)

EF = exposure frequency in days per year

ED = exposure duration in years

AT = averaging time period over which exposure is averaged in days (25,550 days for 70 years)

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15 California Air Resources Board and Office of Environmental Health Hazard Assessment, *Initial Statement of Reasons for Rulemaking, Proposed Identification of Diesel Exhaust as a Toxic Air Contaminant*, June 1998.

16 California Air Resources Board, *Report to the Air Resources Board on the Proposed Identification of Diesel Exhaust as a Toxic Air Contaminant, Part A Exposure Assessment (as approved by the Scientific Review Panel)*, April 1998.

17 California Environmental Protection Agency Office of Environmental Health Hazard Assessment, *Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments*, August 2003.

In accordance with ARB policy,[18] a breathing rate equal to the 80th percentile should be used in a single point risk management decisions, such as those subject to a threshold or standard, for which the cancer risk is entirely associated with inhalation and residential cancer risk are being evaluated. These two criteria are met for this assessment. Thus, a breathing rate of 302 liter per kilogram of body weight per day was used by HARP for the residential cancer risk calculations.

For workplace receptors, the modeled results from HARP are first adjusted to reflect the actual operating hours of the off-site facilities. This adjustment is necessary because HARP calculates annual average concentrations assuming the emissions occur 24 hours per day and seven days per week. The exposure periods for workplace receptors are different than those for residential receptors. Specifically, the default values in HARP are 245 days per year and 40 years per lifetime in Equation 2 above.

Table 2, Summary of Maximum Modeled Cancer Risks of Diesel Particulate Matter from the Travel Plaza Operations, shows the maximum modeled cancer risk for each receptor-type resulting from the project-related DPM emissions.

Table 2
Summary of Maximum Modeled
Cancer Risks of Diesel Particulate Matter from the Travel Plaza Operations

Receptor	Cancer Risk
Residential[1]	3.0×10^{-6}
Workplace[2]	38×10^{-6}

Source: Impact Sciences.
[1] *Maximum impact occurred at the receptor located on south side of the property near Vaughn Road, which is zoned as AG (Agricultural)*
[2] *Maximum impact occurred at the receptor located on northwest side of the property across Interstate 80, which is zoned as HC (Highway Commercial)*

18 California Air Resources Board and Office of Environmental Health Hazard Assessment, *Recommended Interim Risk Management Policy for Inhalation-Based Residential Cancer Risk*, October 9, 2003.

Figure 3, Modeled Impacts of Diesel Exhaust Particulates for Residential Receptors, illustrates the potential risks for residential receptors due to DPM from the proposed operation of the Travel Plaza. Figure 3 shows the isopleth (a line of constant modeled excess cancer risk) that represents an estimated cancer risk of 10 in one million for residential receptors. Note, however, that there are no residences in the area bounded by the 10 in one million isopleths. The nearest residence was found to the southwest of the Travel Plaza across Interstate 80 on Hess Lane. Moreover, per Solano County General Plan[19] and the City of Dixon Northeast Quadrant Specific Plan,[20] the land parcels located on southern and southwestern sides of the Travel Plaza may be used for the light industrial and commercial purposes and the land parcels located on the northwestern side may be used for highway commercial uses. Therefore, these areas were not considered as potential residences.

Figure 4, Modeled Impacts of Diesel Exhaust Particulates for Workplace Receptors, illustrates the potential risks for workplace receptors due to DPM from the proposed operation of the Travel Plaza. **Figure 4** shows the isopleth that represents an estimated cancer risk of 10 in one million for workplace receptors. Note, however, that there are no workplaces in the area bounded by the 10 in one million isopleths at present. However, these areas were considered as potential workplaces for this analysis per Solano County General Plan and the City of Dixon Northeast Quadrant Specific Plan. The values shown in **Table 2** also show that the cancer risk at the maximally exposed workplace receptor as a result of the proposed project is more than 10 in one million, and therefore, this impact is significant.

In addition to the potential cancer risk, DPM has chronic (i.e., long-term) noncancer health impacts. The chronic noncancer inhalation hazard indices for the proposed project were calculated within HARP by dividing the modeled annual average concentrations of the DPM by the Reference Exposure Level (REL). The California Environmental Protection Agency's Office of Environmental Health Hazard Assessment (OEHHA) has recommended an ambient concentration of 5 micrograms per cubic meter ($\mu g/m^3$) as the chronic inhalation REL for diesel exhaust. The REL is the concentration at or below which no adverse health effects are anticipated. No inhalation REL for acute (i.e., short-term) effects has been determined by the OEHHA.

The maximum chronic hazard indices at selected receptors are shown in **Table 3, Summary of Maximum Noncancer Health Impacts of Diesel Particulate Matter from the Travel Plaza Operations**. The chronic hazard indices at the points of maximum impact are much less than the YSAQMD significance threshold of 1.0 for noncancer health impacts. The areas of maximum noncancer impact occurred in the same locations as those described above for the cancer risks.

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19 Solano County Land Use and Circulation Element, Solano County General Plan, Fairfield, CA, July 1999.

20 Dixon 1993 General Plan, Dixon, CA. Amended March 2000.

Figure 3
Modeled Impacts of Diesel Exhaust Particulates for Residential Receptors

Figure 4
Modeled Impacts of Diesel Exhaust Particulates for Workplace Receptors

Table 3
Summary of Maximum Noncancer Health Impacts
of Diesel Particulate Matter from the Travel Plaza Operations

Receptor	Chronic Hazard Index
Residential[1]	0.0019
Workplace[2]	0.12

Source: Impact Sciences.
[1] *Maximum impact occurred at the receptor located on south side of the property near Vaughn Road, which is zoned as AG (Agricultural).*
[2] *Maximum impact occurred at the receptor located on northwest side of the property across Interstate 80, which is zoned as HC (Highway Commercial).*

8.0 CONCLUSIONS

Based on this analysis, the health impacts resulting from the proposed Travel Plaza project would exceed the YSAQMD significance criteria of an incremental cancer risk of 10 in one million since the maximum anticipated cancer risk is 38 in one million at a workplace. In addition, the chronic hazard indices for noncancer health impacts are well below the significance threshold of 1.0 at the maximally exposed receptors. It should be noted that these health impacts do not reflect the reductions in diesel emissions from trucks, automobiles, TRUs, and APUs that will occur over the lifetime of the project. Sources of DPM, in particular heavy-heavy-duty trucks, are subject to increasingly stringent emission standards, many of which will take effect in the next 10 years. Furthermore, the activity levels (e.g., number of heavy-heavy-duty trucks, TRUs, and APUs etc.) used in this assessment represent the highest levels anticipated over the life of the project; the actual levels will be lower for many years as the operations expand and may never been achieved. Accordingly, the actual health impacts over the length of the project will be much less than those presented in this assessment.

Flying J Truck Travel Plaza
DPM Emissions by Source

Source	lbs PM/day	lb PM/year
Truck Idling Emissions		
Truck Idling Emissions	1.26E-01	46.06
TRU Idling Emissions (up to 2008)	4.96E+00	1809.79
TRU Idling Emissions (after 2008)	1.85E+00	674.84
Average TRU Idling Emissions	1.94E+00	707.26
Total	**2.06E+00**	**753.32**
APU Emissions		
APU Idling Emissions	6.98E-01	254.82
Truck On-Site Emissions		
Truck On-Site Emissions	2.76E-01	100.88
TRU On-Site Emissions (up to 2008)	2.60E-02	9.50
TRU On-Site Emissions (after 2008)	9.71E-03	3.54
Average TRU Travelling Emissions	1.02E-02	3.71
Total	**2.87E-01**	**104.59**
Truck Off-Site Emissions (Eastbound)		
Truck Off-Site Emissions	1.26E-01	45.85
TRU Off-Site Emissions (up to 2008)	2.60E-02	9.50
TRU Off-Site Emissions (after 2008)	9.71E-03	3.54
Average TRU Travelling Emissions	1.02E-02	3.71
Total	**1.36E-01**	**49.57**
Truck Off-Site Emissions (Westbound)		
Truck Off-Site Emissions	2.41E-01	87.83
TRU Off-Site Emissions (up to 2008)	7.59E-02	27.71
TRU Off-Site Emissions (after 2008)	2.83E-02	10.33
Average TRU Travelling Emissions	2.97E-02	10.83
Total	**2.70E-01**	**98.66**
Auto On-Site Emissions		
LDA/LDT On-Site Emissions	7.92E-04	0.29
MDV/LHDT On-Site Emissions	5.15E-04	0.19
Total	**1.31E-03**	**0.48**
Auto Off-Site Emissions (Eastbound)		
LDA/LDT Off-Site Emissions	6.12E-04	0.22
MDV/LHDT Off-Site Emissions	3.36E-04	0.12
Total	**9.48E-04**	**0.35**
Auto Off-Site Emissions (Westbound)		
LDA/LDT Off-Site Emissions	1.78E-03	0.65
MDV/LHDT Off-Site Emissions	9.78E-04	0.36
Total	**2.76E-03**	**1.01**

Flying J Travel Plaza

Total Diesel Particulate Matter (DPM) Emissions

On-Site Sources	**lbs PM/day**	**lb PM/year**
HHDT	0.2764	100.88
LDA/LDT	0.0008	0.29
MDV/LHDT	0.0005	0.19
TRUs (current emission)	4.96	1,809.79
TRUs (low emission)	1.85	674.84
On-site TRU Travel (current emissions)	0.03	9.50
On-Site TRU Travel (low emissions)	0.01	3.54
Truck Engine Idle	0.13	46.06
APU Idling	0.70	254.82
Total On-Site	6.09	2,221.53
Total On-Site (low emission)	2.96	1,080.62

Off-Site Sources	**lbs PM/day**	**lb PM/year**
HHDT 80 West	0.24	87.83
HHDT 80 East	0.13	45.85
LDA/LDT 80 West	0.002	0.65
LDA/LDT 80 East	0.001	0.22
MDV/LHDT 80 West	0.001	0.36
MDV/LHDT 80 East	0.000	0.12
Off-site TRU Travel (current emission) from 80 W	0.08	27.71
Off-site TRU Travel (low emission) from 80 W	0.03	10.33
Off-site TRU Travel (current emission) from 80 E	0.03	9.50
Off-site TRU Travel (low emission) from 80E	0.01	3.54
Total Off Site	0.4459	162.75
Total Off-Site (low emission)	0.3983	145.37
Total On-Site and Off-Site (current emission)	6.53	2,384.28
Total On-Site and Off-Site (low emission)	3.36	1,225.99

Flying J Travel Plaza
Visitor Motor Vehicle Emissions

Category		Units		PM_{10}
FREEWAY TRIPS				
I-80 West Trucks	Vehicle Class		HHDT	
	Trips per Day		270	
	One-Way Trip Length	miles	0.544	
	Emission Factor	g/mi		0.37
	Annual Emissions	lb/day		0.241
		ton/yr		
I-80 East Trucks	Vehicle Class		HHDT	
	Trips per Day		270	
	One-Way Trip Length	miles	0.284	
	Emission Factor	g/mi		0.37
	Annual Emissions	lb/day		0.126
		ton/yr		
On Site Trucks	Vehicle Class		HHDT	
	Trips per Day		540	
	One-Way Trip Length	miles	0.17	
	Emission Factor	g/mi		0.68
	Annual Emissions	lb/day		0.276
		ton/yr		
I-80 West Autos	Vehicle Class		LDA/LDT	
	Trips per Day		9	
	One-Way Trip Length	miles	0.396	
	Emission Factor	g/mi		0.11
	Annual Emissions	lb/day		0.002
		ton/yr		
I-80 East Autos	Vehicle Class		LDA/LDT	
	Trips per Day		9	
	One-Way Trip Length	miles	0.136	
	Emission Factor	g/mi		0.11
	Annual Emissions	lb/day		0.001
		ton/yr		
On-Site Autos	Vehicle Class		LDA/LDT	
	Trips per Day		18	
	One-Way Trip Length	miles	0.055	
	Emission Factor	g/mi		0.18
	Annual Emissions	lb/day		0.001
		ton/yr		
I-80 West 3/4 Axles Trucks	Vehicle Class		MDV/LHDT	
	Trips per Day		7	
	One-Way Trip Length	miles	0.396	
	Emission Factor	g/mi		0.08
	Annual Emissions	lb/day		0.001
		ton/yr		
I-80 East 3/4 Axles Trucks	Vehicle Class		MDV/LHDT	
	Trips per Day		7	
	One-Way Trip Length	miles	0.136	
	Emission Factor	g/mi		0.08
	Annual Emissions	lb/day		0.000
		ton/yr		
On-Site 3/4 Axles Trucks	Vehicle Class		MDV/LHDT	
	Trips per Day		14	
	One-Way Trip Length	miles	0.0625	
	Emission Factor	g/mi		0.13
	Annual Emissions	lb/day		0.001
		ton/yr		
LOCAL TRIPS				
Dixon Autos	Vehicle Class		LDA/LDT	
	Trips per Day			
	One-Way Trip Length	miles	6.6	
	Emission Factor	g/mi		0.11
	Annual Emissions	lb/day		0.000
		ton/yr		
On-Site Dixon Autos	Vehicle Class		LDA/LDT	
	Trips per Day			
	One-Way Trip Length	miles	0.055	
	Emission Factor	g/mi		0.18
	Annual Emissions	lb/day		0.00000
		ton/yr		
Dixon 3/4 Axle Trucks	Vehicle Class		MDV/LHDT	
	Trips per Day			
	One-Way Trip Length	miles	6.6	
	Emission Factor	g/mi		0.08
	Annual Emissions	lb/day		0.000
		ton/yr		
On-Site Dixon 3/4 Axle Tr	Vehicle Class		MDV/LHDT	
	Trips per Day			
	One-Way Trip Length	miles	0.0625	
	Emission Factor	g/mi		0.13
	Annual Emissions	lb/day		0.000
		ton/yr		
Total Emissions		**lbs/day**		**0.65**

% LDA diesel	0.23%
% LDT1 diesel	2.71%
% LDT2 diesel	1.02%
% MDV diesel	2.63%
% LHDT1 diesel	20.00%
% LHDT2 diesel	50.00%
% LDA/LDT diesel	**1.32%**
% LHDT/MDV diesel	**24.21%**

2007 EMFAC2002 Results
Yolo County - Diesel Vehicle PM Emissions

Particulate Matter

25 mph		Light-Duty Autos	Light Duty Trucks 1	Light-Duty Trucks 2	Light-Duty Trucks	Light-Duty Autos/Trucks	Medium-Duty Trucks	Light HD Diesel Trucks 1	Light HD Diesel Trucks 2	Light HD Diesel Trucks	Medium HD Diesel Trucks	Medium Duty /Light HD Diesel Trucks	Heavy HD Diesel Trucks
VMT	1000 mi/day	6	26	8	34	40	9	16	9	25	135	34	376
PM	tons/day	0.001	0.003	0.001	0.004	0.005	0.001	0.001	0.001	0.002	0.053	0.003	0.154
	g/mi	0.15	0.10	0.11	0.11	0.11	0.10	0.06	0.10	0.07	0.36	0.08	0.37

Particulate Matter

10 mph		Light-Duty Autos	Light Duty Trucks 1	Light-Duty Trucks 2	Light-Duty Trucks	Light-Duty utos and Truck	Medium-Duty Trucks	Light HD Diesel Trucks 1	Light HD Diesel Trucks 2	Light HD Diesel Trucks	Medium HD Diesel Trucks	Medium Duty /Light HD Diesel Trucks	Heavy HD Diesel Trucks
VMT	1000 mi/day	6	26	8	34	40	9	16	9	25	135	34	376
PM	tons/day	0.002	0.005	0.001	0.006	0.008	0.001	0.002	0.002	0.004	0.099	0.005	0.283
	g/mi	0.30	0.17	0.11	0.16	0.18	0.10	0.11	0.20	0.15	0.67	0.13	0.68

Flying J Travel Plaza
On-Site TRU Running Emissions

TRU Idle Time Per Day			
Trucks	**Amount of Idle (hr)**	**Total Time**	
15	2	30	
23	10	230	
151	1	151	
		411	**Total Hours**

Pollutant Emissions

Pollutant	**Emission Factor (g/hp-hr)**	**Time (hr)**	**Horsepower (hp)**	**Load Factor**	**On/Off Cycle Factor**	**lbs/day**
PM	0.59	411	35	0.53	0.50	4.96
*PM	0.22	411	35	0.53	0.50	1.85

*PM = Low Emission Performance Standard to be implemented in 2008
Interpolated for MY2000 25hp and MY2000 50 hp, then interpolated for 35 hp engines.

TRU Characteristics

Average Horsepower	35
Load Factor	0.53
On/Off Factor	0.5
Average model Year	2000

TRU Distribution

Heavy Duty Trucks	540	
Refrigerated (35%)	189	
Resting TRUs (20%)	38	
Non-rest TRUs	151	
Night Stay (10 hr)	23	60% of stop/idle
Day Stay (2 hr)	15	40% of stop/idle

Emission Factors from OFFROAD Modeling Change Technical Memo: Revisions to the Diesel Transport Refrigeration Units Inventory Appendix D Attachment A, CARB
http://www.arb.ca.gov/regact/trude03/appd.pdf

TRU Low Emission Standard from "Airborne Toxic Control Measure (ATCM) for In-Use Diesel-Fueled Transport Refrigeration Units (TRU) and TRU Generator Sets, and Facilities Where TRUs Operate", CARB
http://www.arb.ca.gov/regact/trude03/fro1.pdf

Flying J Travel Plaza

Off-Site TRU Running Emissions

Off-Site Emissions

Direction	Number of Trucks	Driving Time (hr)	Round Trip	Time (hr)	
80 East	95	0.011	2	2.16	
80 West	95	0.022	2	4.13	
				6.29	**Total Time**

Pollutant Emissions (Eastbound Off-ramp to facility)

Pollutant	Emission Factor (g/hp-hr)	Time (hr)	Horsepower (hp)	Load Factor	On/Off Cycle Factor	lbs/day
PM	0.59	2.16	35	0.53	0.50	0.03
*PM	0.22	2.16	35	0.53	0.50	0.01

Pollutant Emissions (Westbound Off-ramp to facility)

Pollutant	Emission Factor (g/hp-hr)	Time (hr)	Horsepower (hp)	Load Factor	On/Off Cycle Factor	lbs/day
PM	0.59	4.13	35	0.53	0.5	0.08
*PM	0.22	4.13	35	0.53	0.5	0.03

Emission factors were interpolated for MY2000 25 hp and MY2000 50 hp, then interpolated for 35 hp engines.
*PM = Low Emission Performance Standard to be implemented in 2008

On-Site Emissions

Number of Trucks	Time Driving (hr)	Round Trip	Total Time (hr)
189	0.017	2	6.426

Pollutant Emissions

Pollutant	Emission Factor (g/hp-hr)	Time (hr)	Horsepower (hp)	Load Factor	On/Off Cycle Factor	lbs/day
PM	0.59	6.426	35	0.53	0.50	0.08
*PM	0.22	6.426	35	0.53	0.50	0.03

Emission Factors from OFFROAD Modeling Change Technical Memo: Revisions to the Diesel Transport Refrigeration Units Inventory Appendix D Attachment A, viewed on November 28 2005 CARB
http://www.arb.ca.gov/regact/trude03/appd.pdf

TRU Low Emission Standard from "Airborne Toxic Control Measure (ATCM) for In-Use Diesel-Fueled Transport Refrigeration Units (TRU) and TRU Generator Sets, and Facilities Where TRUs Operate" November 17, 2004 ARB
http://www.arb.ca.gov/regact/trude03/fro1.pdf

Flying J Travel Plaza

Truck Engine Idling Emissions

Truck Engine Idle Time Per Day

Trucks	Amount of Idle (hr)	Total Time
540	0.083	45

Pollutant	Emission Factor (g/hr)	Time (hr)	lbs/day
PM	1.27	45	0.13

Notes:
Emission factor generated using EMFAC2002, assuming 60ºF and 50% humidity at 0 mph in Yolo County.

Flying J Travel Plaza

On-Site APU Running Emissions

Trucks	APU Run Time Per Day Amount of Idle (hr)	Total Time	
22	2	44	
32	10	320	
		364	**Total Hours**

Pollutant	Pollutant Emissions Emission Rate (g/hr)	Time (hr)	lbs/day
PM	0.87	364	0.70

APU Distribution

Stop & Idle Trucks with APUs	54
Night Stay (10 hr)	32
Day Stay (2 hr)	22

Notes:

APU Emission factors from "Initial Statement of Reasons: Notice of Public Hearing to Consider Requirements to Reduce Idling Emissions from New and In-Use Trucks, Beginning 2008" viewed on February 25, 2006 http://www.arb.ca.gov/regact/hdvidle/isor.pdf