Mobile Source Air Toxic (MSAT) Analysis Case Study—State Route 57/State Route 60 Confluence at Grand Avenue, California

1.0 Description and Overview of Proposed Project

The City of Industry, California, the California Department of Transportation (Caltrans), and the Federal Highway Administration (FHWA) proposed freeway improvements to the State Route (SR) 57/SR 60 confluence at the Grand Avenue interchange in Los Angeles County, California. The proposed project was subject to both the California Environmental Quality Act (CEQA) and the Federal National Environmental Policy Act (NEPA). Caltrans served as the lead agency under both CEQA and NEPA. The regional vicinity of this project is shown in figure 1.

SR 57 is a major north/south freeway, serving the cities and communities of the Greater Los Angeles area. SR 60 is a major east/west freeway that serves the cities and communities on the east side of the Los Angeles metropolitan area and on the south side of the San Gabriel Valley. There is a gap in SR 57 at its junction with SR 60. SR 57 terminates at the west end of the confluence with SR 60. SR 60, which carries traffic from both freeways, maintains six lanes in each direction under Grand Avenue. SR 57 resumes at the split with SR 60 at the east end of the confluence near Diamond Bar Boulevard. The length of the combined mainline for SR 57/SR 60 is about 2.5 miles.

Improvements to the SR 57/SR 60 confluence were needed to improve safety and operational deficiencies at the Grand Avenue interchange. By 2037, freeway operations were forecasted to deteriorate to an estimated level of service (LOS) of F on the mainline of the SR 57/SR 60 confluence in both the westbound and eastbound directions, with volumes 10 to 25 percent higher than existing volumes along the SR 60 mainline and in the recently constructed HOV lanes. The primary objectives of the project were to:

- Relieve congestion and delays on Grand Avenue from Golden Springs Drive to the interchange at SR 60;
- Relieve congestion and delays at the Grand Avenue interchange;
- Relieve congestion and delays on the SR 57/SR 60 freeway mainline; and
- Improve safety by reducing weaving movements and increasing weaving distances along the SR 57/SR 60 confluence.

Under the proposed Build Alternative, the existing eastbound on- and off-ramps at Grand Avenue would be reconfigured and relocated approximately 500 feet south of the existing intersection. A new eastbound auxiliary lane would be added and would connect to the new connector that bypasses the north/east SR 57/SR 60 interchange. The existing Grand Avenue overcrossing would be replaced by a new structure over SR 60 and widened to accommodate eight through lanes and a center divider/median. A longer span would be required to accommodate the third SR 57 through lane and the loop on-ramp auxiliary lane. (Caltrans 2013)

The Finding of No Significant Impact (FONSI) for Alternative 3 (as described in the FEIR and as the Build Alternative here) was signed on December 11, 2013. (Caltrans 2013)

2.0 Need for Quantitative MSAT Analysis

The Interagency Consultation Group (ICG) for this project included representatives from the City of Industry, Caltrans headquarters, District 7, FHWA, the South Coast Air Quality Management District (SCAQMD), EPA Region 9, and other agencies. This group was consulted for the air quality analysis for this project due to the area's PM status.

The project team performed an analysis of average daily traffic (ADT) on the mainline roads, ramps, and nearby arterials to determine whether the project meets the following FHWA criteria for a project with higher potential effects:

"Create new or add significant capacity to urban highways such as interstates, urban arterials, or urban collector-distributor routes with traffic volumes where the AADT is projected to be in the range of 140,000 to 150,000 or greater by the design-year; and also, Proposed to be located in proximity to populated areas." (FHWA 2009)

In addition to the Federal criteria, California has its own criteria for determining when a project is considered to have higher potential MSAT effects. California considers freeway projects and high-traffic roads (urban roads with 100,000 vehicles per day or rural roads with 50,000 vehicles per day) located 500 to 1,000 feet from sensitive land uses (residences, schools, daycare centers, playgrounds, and medical facilities) to have higher potential MSAT effects. (California Air Resources Board 2005)

Based on the traffic analysis performed for this project, the mainline ADT on SR 57 is expected to reach 117,500 to 141,300 vehicles per day by 2017 and to reach 132,700 to 146,300 vehicles per day by 2037 in the Build Alternative, depending on the road segment. Similarly, the mainline ADT for SR 60 is projected to range from 132,100 to 248,000 vehicles per day in 2017 and from 147,900 to 299,900 vehicles per day in 2037, under the Build Alternative. Thus, the 140,000 threshold is exceeded on all but one road segment in the 2037 horizon year with the Build Alternative, with volumes generally increasing above the no-build volumes. In addition, the project is proposed to be located in proximity to populated areas, including schools and residential areas. As a result, the proposed project warranted a quantitative MSAT analysis under both the FHWA and California criterion.

Source: Caltrans 2013.

Figure 1. Regional vicinity—
State Route 57/State Route 60 confluence at Grand Avenue Project.

3.0 Projected Emissions

The air quality analysis for this project was completed in 2012 with construction of the proposed project expected to begin in the fall of 2014 and to be completed by the fall of 2017. Thus, the project team modeled 2017 as the interim project-year and 2037 was modeled as the design-year. MSAT emissions were evaluated for a base year of 2009, the No-Build and Build Alternatives for 2017, and the No-Build and Build Alternatives for 2037. Table 1 presents the MSAT emission results for each of these scenarios. This table also shows the percentage change in daily emissions from the existing 2009 scenario to the 2017 and 2037 Build Alternative scenarios.

Table 1. Daily project area mobile source air toxic emissions—existing and projected.

	Daily Project Area Mobile Source Air Toxic Emissions (grams per day)					Percent Change	
Pollutant	**2009**	**2017 No-Build Alternative**	**2017 Build Alternative**	**2037 No-Build Alternative**	**2037 Build Alternative**	**2009 to 2037 Build Alternative**	**2037 No-Build to 2037 Build Alternative**
Acrolein	768	342	348	209	223	-71%	6.7%
Benzene	17,841	8,873	8,721	5,422	5,514	-69%	1.7%
1, 3–Butadiene	3,425	1,549	1,575	944	1,002	-71%	6.1%
Diesel PM	40,395	22,810	23,749	11,277	11,624	-71%	3.1%
Formaldehyde	20,291	10,840	10,670	6,066	5,994	-70%	-1.2%
Naphthalene	7,593	6,903	6,816	7,023	6,906	-9%	-1.7%
Polycyclic Organic Matter	1,033	955	944	982	966	-6%	-1.6%
Daily VMT	3,611,333	3,796,197	3,803,708	4,230,956	4,230,237	17%	0.0%

Source: Caltrans 2013. Percentage change values calculated by SC&A.

4.0 Methodology

Development of Affected Network

The traffic network included in the MSAT analysis for this project is shown in the area highlighted in red in figure 2. The area modeled was the same for all pollutants. The analysis area was selected by the project analysts to include any surface streets that would be expected to show a significant change in traffic volumes between the scenarios, in addition to the freeway and ramp links affected by this project.

CT-EMFAC Analysis

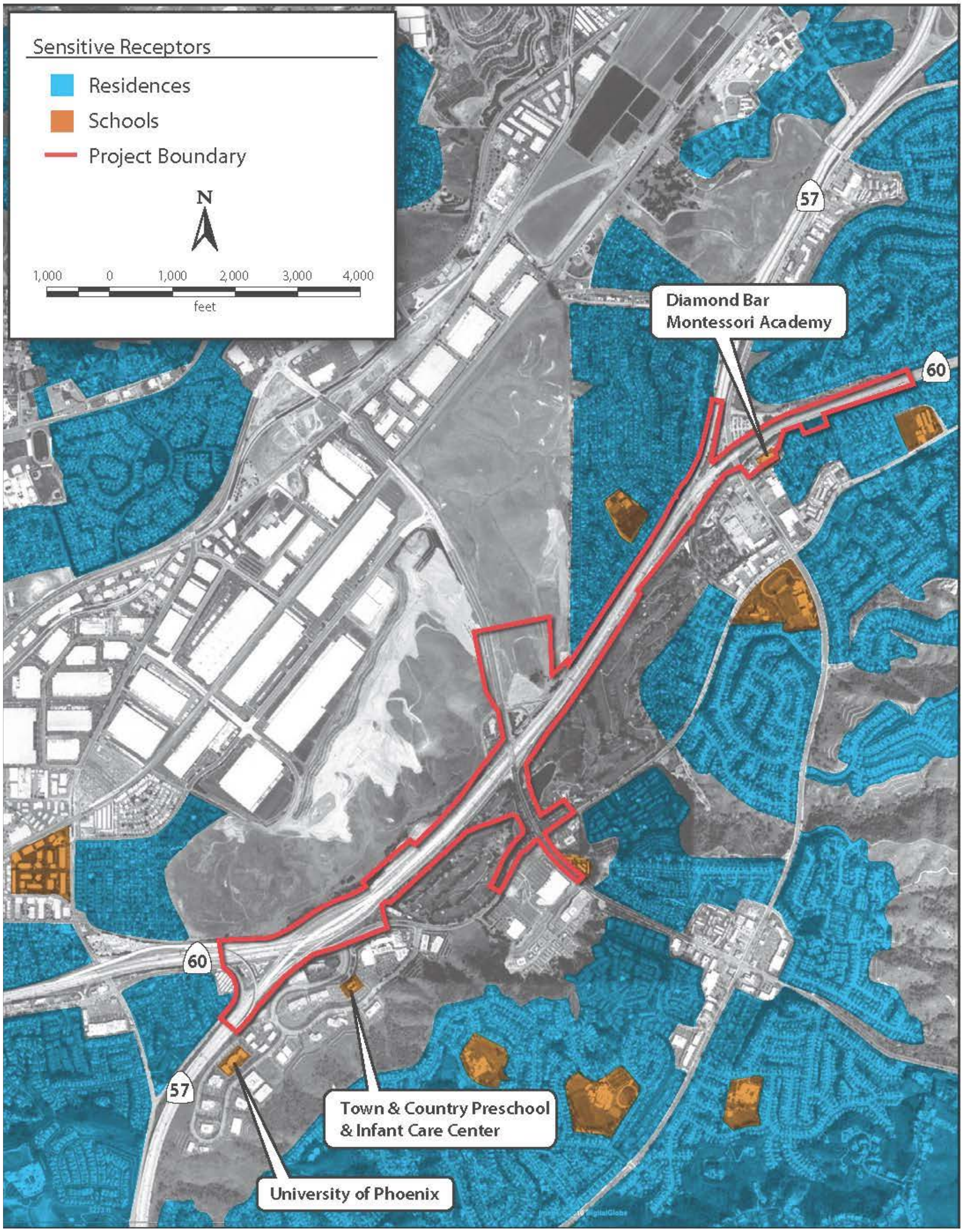
Since this analysis was for a project located in California, a specialized version of California's EMFAC model was used to calculate MSAT emissions. CT-EMFAC was developed for Caltrans for use in project-level emissions modeling. The version used in this project was CT-EMFAC version 4.1. (STI 2010) This version uses emission factor information from the California Air Resources Board (CARB) EMFAC2007 on-road emission model along with MSAT speciation factors provided by CARB.

Project-specific inputs to CT-EMFAC include vehicle miles traveled (VMT) totals in each of 16 speed bins (with each bin covering a 5 mph range of speeds) for the peak and off-peak periods, county, air basin, analysis year, season (summer, winter, or annual), and the percentage of truck traffic in the peak and off-peak periods. (In CT-EMFAC, medium-duty and larger vehicles are considered trucks; all other vehicles are considered nontrucks.) The temperature, humidity, and fleet mix are not entered by the user, but are based on the specified season, county, air basin, and analysis year included as inputs to the model run. Within CT-EMFAC, the age distribution and vehicle type mix differ by county and air district.

For this analysis, Los Angeles County and the South Coast Air Quality Management District were selected, along with a selection of Annual for the season. Analysis years of 2009, 2017, and 2037 were selected and both a Build and No-Build Alternative were modeled in 2017 and 2037. In all scenarios, the truck percentage for both the peak and off-peak periods was set at eight percent, which is the CT-EMFAC default value. Annual Average conditions (temperature, humidity, and fleet mix) were modeled with activity representing an average day. The average day VMT inputs were developed by weighting together the average weekday and average weekend day VMT by speed distributions. These average weekday and weekend distributions of VMT by speed bin were developed from the traffic modeling performed for this project. Changes in link-level travel speeds resulting from the Build Alternative (as compared to the No-Build speeds which were obtained from regional modeling) were estimated at the local level using microsimulation modeling. (Caltrans 2013) Only peak hours were modeled in these speed analyses. VMT during off-peak hours was assumed to be at free flow speeds. For this analysis, the peak period included the hours from 6 a.m. to 9 a.m. and from 4 p.m. to 8 p.m. All other hours were considered off-peak.

Table 2 shows the modeled VMT by speed bin for the peak periods for each year and scenario. Comparable data are shown in table 3 for the off-peak periods. These are the VMT by speed data that were included as input to CT-EMFAC. The VMT in these tables include vehicle travel on all of the freeway links, ramps, and arterial links that are included in the modeled project area.

Naphthalene and polycyclic organic matter (POM) were not calculated within CT-EMFAC. Emissions from these pollutants were calculated by the project air quality team following CARB guidance based on speciation of other pollutants.



Source: Caltrans 2013.

Figure 2.
California State Route 57/State Route 60 project boundary.

Table 2. California State Route 57/State Route 60 project area vehicle miles traveled and speed data—peak period.

Speed Bin	Actual Bin	2009 Existing VMT	2009 Existing %	2017 No Build VMT	2017 No Build %	2017 Build Alternative VMT	2017 Build Alternative %	2037 No Build VMT	2037 No Build %	2037 Build Alternative VMT	2037 Build Alternative %
5	0.0–4.99	0	0	0	0	0	0	6,039	<1	0	0
10	5.0–9.99	2,814	<1	2,522	<1	2,511	<1	8,747	<1	4,521	<1
15	10.0–14.99	3,232	<1	21,568	1	22,489	1	55,454	2	33,509	1
20	15.0–19.99	46,377	2	150,887	8	32,010	2	159,645	7	59,534	3
25	20.0–24.99	106,642	6	126,771	6	125,782	6	295,064	13	222,194	10
30	25.0–29.99	368,227	20	448,362	22	422,302	21	447,627	20	443,609	19
35	30.0–34.99	371,147	20	283,481	14	231,124	11	362,647	16	203,107	9
40	35.0–39.99	159,467	9	197,935	10	89,865	4	146,199	6	202,994	9
45	40.0–44.99	19,543	1	10,455	1	102,150	5	150,401	7	14,247	1
50	45.0–49.99	24,463	1	142,576	7	53,187	3	97,595	4	63,553	3
55	50.0–54.99	62,650	3	32,471	2	0	0	10,695	<1	0	0
60	55.0–59.99	45,646	2	7,880	<1	–	0	53,008	2	341,243	15
65	60.0–64.99	659,186	35	573,658	29	964,275	47	501,568	22	748,087	32
70	65.0–69.99	0	0	0	0	0	0	0	0	0	0
75	70.0–74.99	0	0	0	0	0	0	0	0	0	0
	Total	**1,869,394**		**1,998,566**		**2,045,695**		**2,294,689**		**2,336,598**	

Table 3. California State Route 57/State Route 60 project area vehicle miles traveled and speed data—off-peak period.

Speed Bin	Actual Bin	2009 Existing		2017 No Build		2017 Build Alternative		2037 No Build		2037 Build Alternative	
		VMT	%	VMT	%	VMT	%	VMT	%		%
5	0.0–4.99	0	0	0	0	0	0	0	0	0	0
10	5.0–9.99	0	0	0	0	0	0	0	0	0	0
15	10.0–14.99	0	0	0	0	0	0	4,026	<1	4,034	<1
20	15.0–19.99	3,637	<1	145,192	8	3,773	<1	34,482	2	10,194	1
25	20.0–24.99	21,809	1	25,866	1	24,384	1	51,634	3	85,413	5
30	25.0–29.99	61,906	4	87,722	5	73,525	4	74,687	4	119,086	6
35	30.0–34.99	152,281	9	195,665	11	150,997	9	264,736	14	248,128	13
40	35.0–39.99	233,981	13	410,173	23	251,493	14	574,954	30	264,961	14
45	40.0–44.99	132,693	8	106,582	6	98,222	6	128,833	7	97,491	5
50	45.0–49.99	9,438	1	138,674	8	50,807	3	0	0	0	0
55	50.0–54.99	81,400	5	33,570	2	32,452	2	82,067	4	0	0
60	55.0–59.99	149,112	9	7,730	<1	176,535	10	0	0	254,867	13
65	60.0–64.99	895,682	51	646,456	36	895,826	51	720,849	37	809,465	43
70	65.0–69.99	0	0	0	0	0	0	0	0	0	0
75	70.0–74.99	0	0	0	0	0	0	0	0	0	0
	Total	**1,741,939**	**100**	**1,797,630**	**100**	**1,758,014**	**100**	**1,936,268**	**100**	**1,893,639**	**100**

5.0 Analysis Findings and Conclusions

An evaluation of MSAT emissions was performed for existing conditions (2009), the interim year (2017), and the design year (2037), resulting in the MSAT emissions for the Build and No-Build Alternatives analyzed, as shown in table 1. Table 1 shows that emissions of all MSAT pollutants are expected to decrease significantly below existing conditions (2009) under the Build Alternative in the interim year (2017) and the design year (2037), even as VMT increases by 17 percent from 2009 to the 2037 Build Alternative.

The results in table 1 also show that implementation of the Build Alternative would result in slight increases in diesel PM, acrolein, and butadiene in the interim year (2017) and design year (2037) and in benzene in the design year when compared with the No-Build Alternative. These increases occur in 2037 even though VMT slightly decreases from the No-Build to the Build Alternative. The project team explains this result as follows: "A parabolic relationship is typically observed between emission rates and vehicle speeds when speeds are from 0 to 25 mi/h or above 55 mi/h; the lowest rates are typically observed at 45 mi/h. Compared with the No-Build Alternative, implementation of either build alternative would result in a significantly higher proportion of VMT occurring above the 55 mi/h speed bin at horizon-year 2037. As a result, the emissions decreases typically observed with VMT reductions are masked by the higher proportion of vehicles traveling above 55 mi/h." (Caltrans 2013)

In addition, the project team observed that the traffic impact analysis conducted for the project suggests that the proposed improvements in the Build Alternative would result in some arterial surface street VMT shifting to the freeway, when compared to the No-Build Alternative. This shift to the freeway is noteworthy because surface street MSAT emissions occur near sensitive receptors. This led the project team to conclude that "MSAT exposure at sensitive receptors may be reduced under the build alternatives compared with the No-Build Alternative." (Caltrans 2013)

6.0 Lessons Learned

Caltrans' air quality consultants for this project developed a work plan that showed how they were planning to perform the air quality analysis and indicated what they needed from the traffic analysis. The MSAT analysis plan followed the 2009 FHWA Interim Guidance. Caltrans guidance was followed for the analysis of the other pollutants. The air quality analysts provided input to the traffic study in order to obtain the traffic inputs that were needed for the air quality analyses. The traffic analysis was performed by a separate firm.

The air quality analysts believe the importance of obtaining the appropriate traffic data for project-level analysis needs to be stressed. In order to get the speed profiles needed for CT-EMFAC for these types of project-level analyses, it is important to have the traffic consultants perform the extra simulation modeling that is needed to capture speed changes between scenarios. Specialized traffic models are often needed to do this for project-level analyses. Although the regional traffic model was used in this analysis for No-Build scenario, microsimulation modeling was needed to obtain congested travel speeds with the Build Alternative. VMT by travel speed also was needed to model criteria pollutants in the air quality analysis for this project to fulfill CEQA requirements. One of the key challenges of this project was in communicating the traffic data requirements of the air quality analysis to the traffic consultants. (Cooper 2016)

Using CT-EMFAC, the air quality analysts were able to model emissions from MSATs simultaneously with the needed criteria pollutant and greenhouse gas emissions. Thus, the incremental burden of meeting the NEPA and CEQA MSAT requirements was the analysis to determine whether a quantitative MSAT analysis would be required for this project. This analysis showed that a quantitative MSAT analysis should be performed for this project.

7.0 References

STI 2010: "CT_EMFAC Version 4.1," prepared by Sonoma Technology, Inc., September 20, 2010.

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Caltrans 2013: "State Route 57/State Route 60 Confluence at Grand Avenue Project Final Environmental Impact Report/Finding of No Significant Impact and Programmatic Section 4(f) Evaluation," State of California Department of Transportation, December 2013, available at http://www.dot.ca.gov/dist07/resources/envdocs/docs/279100_FinalEIR-FONSI_December_2013_Approved.pdf.

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