Draft Environmental Impact Report

Appendix

Transportation

Pacheco Reservoir Expansion Project

November 2021

Contents

Attachments

Abbreviations and Acronyms

HCM	highway capacity manual
LOS	level of significance
SR 152	State Route 152

Attachment A – Caltrans Performance Measurement System Data

SR 152 - HOURLY VOLUMES

PeMS VDS No	Location	12:00:00 AM	1:00:00 AM	2:00:00 AM	3:00:00 AM	4:00:00 AM	5:00:00 AM	6:00:00 AM	7:00:00 AM	8:00:00 AM	9:00:00 AM	10:00:00 AM	11:00:00 AM	12:00:00 PM	1:00:00 PM	2:00:00 PM	3:00:00 PM	4:00:00 PM	5:00:00 PM	6:00:00 PM	7:00:00 PM	8:00:00 PM	9:00:00 PM	10:00:00 PM	11:00:00 PM
1008810	Eastbound SR 152, west of 33	243	203	133	129	138	219	328	461	496	593	659	805	856	973	1,235	1,513	1,557	1,510	1,392	1,321	1,030	743	469	321
1008910	Westbound SR 152, west of 33	451	293	365	1,018	1,849	1,643	1,318	1,047	841	858	736	779	778	677	696	708	725	656	541	419	411	365	243	210
Total		694	496	498	**1,147**	1,987	1,862	1,646	1,508	1,337	1,451	1,395	1,584	1,634	1,650	1,931	2,221	2,282	2,166	1,933	1,740	1,441	1,108	712	531
	Percentage Distr	*2%*	*1%*	*1%*	*3%*	*6%*	*5%*	*5%*	*4%*	*4%*	*4%*	*4%*	*5%*	*5%*	*5%*	*6%*	*6%*	*7%*	*6%*	*6%*	*5%*	*4%*	*3%*	*2%*	*2%*
	Directional Distr	*35%*	*41%*	*27%*	*11%*	*7%*	*12%*	*20%*	*31%*	*37%*	*41%*	*47%*	*51%*	*52%*	*59%*	*64%*	*68%*	*68%*	*70%*	*72%*	*76%*	*71%*	*67%*	*66%*	*60%*
	PHF Distribution							***88%***												***89%***					

FUTURE VOLUMES (based on 5% per year growth factor)

Direction	Year	12:00:00 AM	1:00:00 AM	2:00:00 AM	3:00:00 AM	4:00:00 AM	5:00:00 AM	6:00:00 AM	7:00:00 AM	8:00:00 AM	9:00:00 AM	10:00:00 AM	11:00:00 AM	12:00:00 PM	1:00:00 PM	2:00:00 PM	3:00:00 PM	4:00:00 PM	5:00:00 PM	6:00:00 PM	7:00:00 PM	8:00:00 PM	9:00:00 PM	10:00:00 PM	11:00:00 PM
EASTBOUND + WESTBOUND	2024	868	620	623	1,434	2,484	2,328	2,058	1885	1,671	1,814	1,744	1,980	2,043	2,063	2,414	2,776	2,853	2,708	2,416	2,175	1,801	1,385	890	664
	2025	902	645	647	1,491	2,583	2,421	2,140	1,960	1,738	1,886	1,814	2,059	2,124	2,145	2,510	2,887	2,967	2,816	2,513	2,262	1,873	1,440	926	690
	2026	937	670	672	1,548	2,682	2,514	2,222	2,036	1,805	1,959	1,883	2,138	2,206	2,228	2,607	2,998	3,081	2,924	2,610	2,349	1,945	1,496	961	717
	2027	972	694	697	1,606	2,782	2,607	2,304	2,111	1,872	2,031	1,953	2,218	2,288	2,310	2,703	3,109	3,195	3,032	2,706	2,436	2,017	1,551	997	743
	2028	1,006	719	722	1,663	2,881	2,700	2,387	2,187	1,939	2,104	2,023	2,297	2,369	2,393	2,800	3,220	3,309	3,141	2,803	2,523	2,089	1,607	1,032	770
	2029	1,041	744	747	1,721	2,981	2,793	2,469	2,262	2,006	2,177	2,093	2,376	2,451	2,475	2,897	3,332	3,423	3,249	2,900	2,610	2,162	1,662	1,068	797
	2030	1,076	769	772	1,778	3,080	2,886	2,551	2,337	2,072	2,249	2,162	2,455	2,533	2,558	2,993	3,443	3,537	3,357	2,996	2,697	2,234	1,717	1,104	823
	2031	1,110	794	797	1,835	3,179	2,979	2,634	2,413	2,139	2,322	2,232	2,534	2,614	2,640	3,090	3,554	3,651	3,466	3,093	2,784	2,306	1,773	1,139	850

Direction	Year	12:00:00 AM	1:00:00 AM	2:00:00 AM	3:00:00 AM	4:00:00 AM	5:00:00 AM	6:00:00 AM	7:00:00 AM	8:00:00 AM	9:00:00 AM	10:00:00 AM	11:00:00 AM	12:00:00 PM	1:00:00 PM	2:00:00 PM	3:00:00 PM	4:00:00 PM	5:00:00 PM	6:00:00 PM	7:00:00 PM	8:00:00 PM	9:00:00 PM	10:00:00 PM	11:00:00 PM
EASTBOUND	2024	304	254	166	161	173	274	410	576	620	741	824	1,006	1,070	1,216	1,544	1,891	1,946	1,888	1,740	1,651	1,288	929	586	401
	2025	316	264	173	168	179	285	426	599	645	771	857	1,047	1,113	1,265	1,606	1,967	2,024	1,963	1,810	1,717	1,339	966	610	417
	2026	328	274	180	174	186	296	443	622	670	801	890	1,087	1,156	1,314	1,667	2,043	2,102	2,039	1,879	1,783	1,391	1,003	633	433
	2027	340	284	186	181	193	307	459	645	694	830	923	1,127	1,198	1,362	1,729	2,118	2,180	2,114	1,949	1,849	1,442	1,040	657	449
	2028	352	294	193	187	200	318	476	668	719	860	956	1,167	1,241	1,411	1,791	2,194	2,258	2,190	2,018	1,915	1,494	1,077	680	465
	2029	365	305	200	194	207	329	492	692	744	890	989	1,208	1,284	1,460	1,853	2,270	2,336	2,265	2,088	1,982	1,545	1,115	704	482
	2030	377	315	206	200	214	339	508	715	769	919	1,021	1,248	1,327	1,508	1,914	2,345	2,413	2,341	2,158	2,048	1,597	1,152	727	498
	2031	389	325	213	206	221	350	525	738	794	949	1,054	1,288	1,370	1,557	1,976	2,421	2,491	2,416	2,227	2,114	1,648	1,189	750	514

Direction	Year	12:00:00 AM	1:00:00 AM	2:00:00 AM	3:00:00 AM	4:00:00 AM	5:00:00 AM	6:00:00 AM	7:00:00 AM	8:00:00 AM	9:00:00 AM	10:00:00 AM	11:00:00 AM	12:00:00 PM	1:00:00 PM	2:00:00 PM	3:00:00 PM	4:00:00 PM	5:00:00 PM	6:00:00 PM	7:00:00 PM	8:00:00 PM	9:00:00 PM	10:00:00 PM	11:00:00 PM
WESTBOUND	2024	564	366	456	1,273	2,311	2,054	1,648	1,309	1,051	1,073	920	974	973	846	870	885	906	820	676	524	514	456	304	263
	2025	586	381	475	1,323	2,404	2,136	1,713	1,361	1,093	1,115	957	1,013	1,011	880	905	920	943	853	703	545	534	475	316	273
	2026	609	396	493	1,374	2,496	2,218	1,779	1,413	1,135	1,158	994	1,052	1,050	914	940	956	979	886	730	566	555	493	328	284
	2027	631	410	511	1,425	2,589	2,300	1,845	1,466	1,177	1,201	1,030	1,091	1,089	948	974	991	1,015	918	757	587	575	511	340	294
	2028	654	425	529	1,476	2,681	2,382	1,911	1,518	1,219	1,244	1,067	1,130	1,128	982	1,009	1,027	1,051	951	784	608	596	529	352	305
	2029	677	440	548	1,527	2,774	2,465	1,977	1,571	1,262	1,287	1,104	1,169	1,167	1,016	1,044	1,062	1,088	984	812	629	617	548	365	315
	2030	699	454	566	1,578	2,866	2,547	2,043	1,623	1,304	1,330	1,141	1,207	1,206	1,049	1,079	1,097	1,124	1,017	839	649	637	566	377	326
	2031	722	469	584	1,629	2,958	2,629	2,109	1,675	1,346	1,373	1,178	1,246	1,245	1,083	1,114	1,133	1,160	1,050	866	670	658	584	389	336

MAXIMUM

GROWTH RATE CALCULATION

					12:00:00 AM	1:00:00 AM	2:00:00 AM	3:00:00 AM	4:00:00 AM	5:00:00 AM	6:00:00 AM	7:00:00 AM	8:00:00 AM	9:00:00 AM	10:00:00 AM	11:00:00 AM	12:00:00 PM	1:00:00 PM	2:00:00 PM	3:00:00 PM	4:00:00 PM	5:00:00 PM	6:00:00 PM	7:00:00 PM	8:00:00 PM	9:00:00 PM	10:00:00 PM	11:00:00 PM	
Eastbound SR 152, west of 33	09/01/2019 - 09/30/2019	Tue, Wed and Thu		1008810	243	203	133	129	138	219	328	461	496	593	659	805	856	973	1235	1513	1557	1510	1392	1321	1030	743	469	321	
Westbound SR 152, west of 33				1008910	451	293	365	1018	1849	1643	1318	1047	841	858	736	779	778	677	696	708	725	656	541	419	411	365	243	210	
			Total		694	496	498	1147	1987	1862	1646	1508	1337	1451	1395	1584	1634	1650	1931	2221	2282	2166	1933	1740	1441	1108	712	531	34954
	09/01/2014 - 09/30/2014			1008810	167	111	116	205	100	285	254	367	446	531	591	628	625	703	769	989	1163	1288	1043	829	623	530	341	236	
				1008910	362	260	182	364	1021	1369	1144	751	725	645	644	615	581	612	611	648	608	573	458	374	307	287	225	170	
			Total		529	371	298	569	1121	1654	1398	1118	1171	1176	1235	1243	1206	1315	1380	1637	1771	1861	1501	1203	930	817	566	406	26476
			5 years Growth		31%	34%	67%	102%	77%	13%	18%	35%	14%	23%	13%	27%	35%	25%	40%	36%	29%	16%	29%	45%	55%	36%	26%	31%	32%
			Annual Growth		6%	7%	13%	20%	15%	3%	4%	7%	3%	5%	3%	5%	7%	5%	8%	7%	6%	3%	6%	9%	11%	7%	5%	6%	6%
			Peak Hour Growth						6%											5%									

Used a 5 percent growth rate per year for the future years to account for the volume loss in 2020 and 2021 due to COVID 19

Attachment B – Caltrans Census Truck AADT

2018 Daily Truck Traffic

				L		VEHICLE	TRUCK	TRUCK		TRUCK	AADT	TOTAL	%	TRUCK	AADT		EAL	YEAR
152	04	SCL	M10.277	B	GILROY, JCT. RTE. 101	41800	2893	6.92	1,776	304	182	631	61.39	10.51	6.30	21.80	328	01V
152	04	SCL	R21.977	A	JCT. RTE. 156 SOUTH	42300	7199	17.02	1,138	191	136	5,733	15.81	2.65	1.89	79.63	2,016	98V
152	04	SCL	R21.977	B	JCT. RTE. 156 SOUTH	27800	3344	12.03	494	79	51	2,717	14.76	2.37	1.53	81.26	952	98V
152	04	SCL	R26.309	A	PACHECO CREEK BRIDGE	41800	6346	15.18	2,086	199	105	3,956	32.87	3.14	1.65	62.34	1,443	18V
152	04	SCL	R26.77	O	PACHECO CREEK BRIDGE	41800	5438	13.01	1,243	177	93	3,925	22.86	3.25	1.71	72.17	1,400	16V
152	04	SCL	5.03	B	WATSONVILLE RD	6700	288	4.30	242	19	7	21	83.90	6.60	2.30	7.20	18	98E
152	04	SCL	9.43	B	MONTEREY ST	20000	622	3.11	410	75	35	102	65.87	12.11	5.69	16.33	61	01V
152	04	SCL	R9.914	A	GILROY, JCT. RTE. 101	29000	2700	9.31	721	216	65	1,698	26.71	8.00	2.40	62.89	627	01V

Attachment C – Pacheco Reservoir Expansion Project Construction Trucks & Autos Trip Estimates

Dam Alternatives	Roadway Alternative	Peak Year	Total Yearly Dump Truck and Flat Bed	Daily Dump Truck and Flat Bed	Daily Dump Truck and Flat Bed (Peak Placement)	Total Yearly Equip Mob/Demob	Daily Equip Mob/Demob	Daily Water Trucks	Peak Daily Traffic Materials & Equipment Vehicles	Daily Workers
US 140 TAF HFD	2A	4	11022	48	180	22	0.1	25	205	410
US 140 TAF EFD	2B	4	16612	98	163	279	1.1	0	164	625
US 96 TAF EFD	1B	4	15308	90	150	279	1.1	0	151	585
DS 140 TAF HFD	1A	6	11591	50	189	20	0.1	30	219	410
DS 140 TAF EFD	2A	4	17217	101	169	314	1.3	0	170	680

Assumptions

Assume dump trucks and flatbed trucks delivering during dam placement months for earthfill and hardfill, respectively
Assume 230 work days February - December
Assume 170 work days April - November
Peak placement for hardfill = 15,000 CY / 4,000 CY = 3.75 multiplier
Peak placement for earthfill = 40,000 CY / 24,000 CY = 1.67 multiplier
Assume equipment mob occurring evenly throughout the year
Assume 250 work days in a year
Daily workers from "worker trips" spreadsheet
Workers includes construction workers, construction manager, Valley Water staff, etc.
Water trucks assumed for hardfill options during removal and replacement of Pacheco Conduit

Traffic Assumptions

1. Majority of the workers are expected to be vanpooling or carpooling. Hence, the following assumptions are made:

Vehicle Occupancy	Proportion	Number of Workers	Number of Vehicles
Vanpool (5 person per vehicle)	25%	170	34
Carpool (two person per vehicle)	65%	442	221
SOVs (1 per person vehicle)	10%	68	68
		Total	**323**

2. Total one-way worker trips = 323 & Total round worker trips = 646 trips
3. Material and equipment trucks arrive evenly throughout two, ten hour shifts.
4. 60% of workers on 10 hour day shift (6am to 4pm) and 40% of workers on 10 hour night shift (6pm to 4am)
5. Assume 10% of workers from day shift will overlap with workers from night shift to hand off work activities

Project Trip Generation - PREP Preliminary Traffic Analysis - Proposed Alternative

Trips	Daily Trips	One-Way Trips	AM Peak Hour			PM Peak Hour		
			In	Out	Total	In	Out	Total
Construction Trucks Trips	410	205	10	11	21	11	10	21
Worker Trips	390	195	117	8	125	0	105	105

Notes:

1. Year 4 is expected to have the highest yearly traffic for the Downstream Earthfill Dam
2. Peak Daily Traffic for Year 4 is estimated to be 800 round trips/day
3. Among the 800 Trips/Day, 410 round trips were from construction trucks and 390 round trips were from Worker vehicles.
4. Construction Truck trips were distributed throughout the day equally (20 hours).
5. For worker trips, two 10 hours shift were assumed. Shift 1 - 6:00 AM - 4:00 PM and Shift 2 - 6:00 PM - 4:00 AM
6. 60 percent trips arrive during Shift 1 and 40 percent during Shift 2.
7. 10% of workers from day shift will overlap with workers from night shift to hand off work activities and vice-versa.
8. During the AM peak hour, 100 percent of the Trips come in from Shift 1 and 10 percent of the trips exit out from Shift 2.
9. During the PM peak hour, 0 percent of the Trips come in from Shift 2 and 90 percent of the trips exit out from Shift 1.
10. Peak Hour is assumed to be 5 to 6 AM in the morning and 4 to 5 PM in the evening.

Traffic Assumptions

AM Shift

1. 100% come in at 5 to 6 AM
2. 0% come in at 6 to 7 AM
3. 90% exit at 4 to 5 PM
4. 10% exit at 5 to 6 PM

PM Shift

1. 0% come in at 4 to 5 PM
2. 100% come in at 5 to 6 PM
3. 90% exit at 4 to 5 AM
4. 10% exit at 5 to 6 AM

Project Trip Generation - PREP Preliminary Traffic Analysis - Alternative A

Trips	Daily Trips	One-Way Trips	AM Peak Hour			PM Peak Hour		
			In	Out	Total	In	Out	Total
Construction Trucks Trips	329	164	8	9	17	9	8	17
Worker Trips	594	297	178	12	190	0	160	160

Notes:

1. Year 4 is expected to have the highest yearly traffic for the Downstream Earthfill Dam
2. Peak Daily Traffic for Year 4 is estimated to be 923 round trips/day
3. Among the 923 Trips/Day, 329 round trips were from construction trucks and 594 round trips were from Worker vehicles.
4. Construction Truck trips were distributed throughout the day equally (20 hours).
5. For worker trips, two 10 hours shift were assumed. Shift 1 - 6:00 AM - 4:00 PM and Shift 2 - 6:00 PM - 4:00 AM
6. 60 percent trips arrive during Shift 1 and 40 percent during Shift 2.
7. 10% of workers from day shift will overlap with workers from night shift to hand off work activities and vice-versa.
8. During the AM peak hour, 100 percent of the Trips come in from Shift 1 and 10 percent of the trips exit out from Shift 2.
9. During the PM peak hour, 0 percent of the Trips come in from Shift 2 and 90 percent of the trips exit out from Shift 1.
10. Peak Hour is assumed to be 5 to 6 AM in the morning and 4 to 5 PM in the evening.

Traffic Assumptions

AM Shift

1. 100% come in at 5 to 6 AM
2. 0% come in at 6 to 7 AM
3. 90% exit at 4 to 5 PM
4. 10% exit at 5 to 6 PM

PM Shift

1. 0% come in at 4 to 5 PM
2. 100% come in at 5 to 6 PM
3. 90% exit at 4 to 5 AM
4. 10% exit at 5 to 6 AM

Project Trip Generation - PREP Preliminary Traffic Analysis - Alternative B

Trips	Daily Trips	One-Way Trips	AM Peak Hour			PM Peak Hour		
			In	Out	Total	In	Out	Total
Construction Trucks Trips	303	151	8	8	16	8	8	16
Worker Trips	556	278	167	11	178	0	150	150

Notes:

1. Year 4 is expected to have the highest yearly traffic for the Downstream Earthfill Dam
2. Peak Daily Traffic for Year 4 is estimated to be 859 round trips/day
3. Among the 859 Trips/Day, 303 round trips were from construction trucks and 556 round trips were from Worker vehicles.
4. Construction Truck trips were distributed throughout the day equally (20 hours).
5. For worker trips, two 10 hours shift were assumed. Shift 1 - 6:00 AM - 4:00 PM and Shift 2 - 6:00 PM - 4:00 AM
6. 60 percent trips arrive during Shift 1 and 40 percent during Shift 2.
7. 10% of workers from day shift will overlap with workers from night shift to hand off work activities and vice-versa.
8. During the AM peak hour, 100 percent of the Trips come in from Shift 1 and 10 percent of the trips exit out from Shift 2.
9. During the PM peak hour, 0 percent of the Trips come in from Shift 2 and 90 percent of the trips exit out from Shift 1.
10. Peak Hour is assumed to be 5 to 6 AM in the morning and 4 to 5 PM in the evening.

Traffic Assumptions

AM Shift

1. 100% come in at 5 to 6 AM
2. 0% come in at 6 to 7 AM
3. 90% exit at 4 to 5 PM
4. 10% exit at 5 to 6 PM

PM Shift

1. 0% come in at 4 to 5 PM
2. 100% come in at 5 to 6 PM
3. 90% exit at 4 to 5 AM
4. 10% exit at 5 to 6 AM

Project Trip Generation - PREP Preliminary Traffic Analysis - Alternative C

Trips	Daily Trips	One-Way Trips	AM Peak Hour			PM Peak Hour		
			In	Out	Total	In	Out	Total
Construction Trucks Trips	438	219	11	11	22	11	11	22
Worker Trips	390	195	117	8	125	0	105	105

Notes:

1. Year 4 is expected to have the highest yearly traffic for the Downstream Earthfill Dam
2. Peak Daily Traffic for Year 4 is estimated to be 828 round trips/day
3. Among the 828 Trips/Day, 438 round trips were from construction trucks and 390 round trips were from Worker vehicles.
4. Construction Truck trips were distributed throughout the day equally (20 hours).
5. For worker trips, two 10 hours shift were assumed. Shift 1 - 6:00 AM - 4:00 PM and Shift 2 - 6:00 PM - 4:00 AM
6. 60 percent trips arrive during Shift 1 and 40 percent during Shift 2.
7. 10% of workers from day shift will overlap with workers from night shift to hand off work activities and vice-versa.
8. During the AM peak hour, 100 percent of the Trips come in from Shift 1 and 10 percent of the trips exit out from Shift 2.
9. During the PM peak hour, 0 percent of the Trips come in from Shift 2 and 90 percent of the trips exit out from Shift 1.
10. Peak Hour is assumed to be 5 to 6 AM in the morning and 4 to 5 PM in the evening.

Traffic Assumptions

AM Shift

1. 100% come in at 5 to 6 AM
2. 0% come in at 6 to 7 AM
3. 90% exit at 4 to 5 PM
4. 10% exit at 5 to 6 PM

PM Shift

1. 0% come in at 4 to 5 PM
2. 100% come in at 5 to 6 PM
3. 90% exit at 4 to 5 AM
4. 10% exit at 5 to 6 AM

Project Trip Generation - PREP Preliminary Traffic Analysis - Alternative D

Trips	Daily Trips	One-Way Trips	AM Peak Hour			PM Peak Hour		
			In	Out	Total	In	Out	Total
Construction Trucks Trips	340.00	170.00	9	9	18	9	9	18
Worker Trips	646.00	323.00	194	13	207	0	174	174

Notes:

1. Year 6 is expected to have the highest yearly traffic for the Downstream Earthfill Dam
2. Peak Daily Traffic for Year 6 is estimated to be 986 round trips/day
3. Among the 986 Trips/Day, 340 round trips were from construction trucks and 646 round trips were from Worker vehicles.
4. Construction Truck trips were distributed throughout the day equally (20 hours).
5. For worker trips, two 10 hours shift were assumed. Shift 1 - 6:00 AM - 4:00 PM and Shift 2 - 6:00 PM - 4:00 AM
6. 60 percent trips arrive during Shift 1 and 40 percent during Shift 2.
7. 10% of workers from day shift will overlap with workers from night shift to hand off work activities and vice-versa.
8. During the AM peak hour, 100 percent of the Trips come in from Shift 1 and 10 percent of the trips exit out from Shift 2.
9. During the PM peak hour, 0 percent of the Trips come in from Shift 2 and 90 percent of the trips exit out from Shift 1.
10. Peak Hour is assumed to be 5 to 6 AM in the morning and 4 to 5 PM in the evening.

Traffic Assumptions

AM Shift

1. 100% come in at 5 to 6 AM
2. 0% come in at 6 to 7 AM
3. 90% exit at 4 to 5 PM
4. 10% exit at 5 to 6 PM

PM Shift

1. 0% come in at 4 to 5 PM
2. 100% come in at 5 to 6 PM
3. 90% exit at 4 to 5 AM
4. 10% exit at 5 to 6 AM

Attachment D – HCM Level of Service Methodology and Synchro LOS Reports

Level of Service Methodology

Intersection operating conditions and level of service (LOS) were evaluated for the weekday AM and PM peak hour. LOS was evaluated for the existing conditions (2019), future (2027) no-project conditions, and future (2027) build-out/project conditions. The future no-project condition serves as a base for comparison, which assumes the traffic patterns continue to be the same as that of the existing conditions with an increase in the traffic projected based on a growth factor obtained from historical data.

Intersection Measure of Effectiveness

Santa Clara County, Valley Transportation Authority, and Caltrans use the LOS metric as a measure of effectiveness to understand how the transportation network functions, as well as a means for measuring compliance with established local transportation measures. While "vehicles miles traveled" has replaced LOS as the metric for assessing the California Environmental Quality Act impacts on transportation, the LOS calculations provide familiar information and are presented here for information purposes and use by the transportation agencies. Trafficware's Synchro 10 software package was used in the evaluation of the intersection. Synchro utilizes the 2000 Highway Capacity Manual (HCM) methodology in calculating intersection LOS and vehicle delay (measured in seconds per vehicle). Sim Traffic average and 95th percentile queues were also used for the evaluation of the intersection's operation and performance.

Vehicle Delay

Vehicle (control) delay is the primary measure of performance in the HCM. It includes the time lost due to acceleration and deceleration of a vehicle, in addition to the stopped time of a vehicle due to a traffic control device. The delay-based operations analysis uses various intersection characteristics (e.g., traffic volumes, lane geometry, signal control, and signal phasing/timing) to estimate the average control delay experienced by motorists at an intersection. The HCM methodology qualitatively characterizes traffic conditions based on the delay value, ranging from LOS – LOS A to LOS F. LOS A indicates free-flow traffic conditions with little or no delay experienced by motorists and LOS F indicates congested conditions where traffic flows exceed design capacity and may result in long delays. Caltrans aims to maintain a target LOS at the transition between LOS C and LOS D on state highway facilities; however, Caltrans acknowledges that this may not always be feasible and if an existing state highway facility is operating at less than the appropriate target LOS, the existing LOS should be maintained (Caltrans 2002).

For signalized intersections, the methodology determines the capacity of each lane group approaching the intersection and calculates an average delay (in seconds per vehicle) for each of the various movements at the intersection. A combined weighted delay and LOS are presented for each intersection. For unsignalized intersections with one-way, two-way, or all-way stop control, intersection LOS and delay are typically reported for the worst stop-controlled approach (or yield movement). Intersection LOS criteria for signalized and unsignalized intersections are summarized in Table 1-1.

Table 1-1. Intersection Level of Service Criteria – Vehicle Delay

Level of Service	Average Delay (seconds / vehicle)		Description
	Signalized	Unsignalized	
A	≤ 10.0	≤ 10.0	Little or no traffic delay
B	> 10.0 and ≤ 20.0	> 10.0 and ≤ 15.0	Minimal traffic delay
C	> 20.0 and ≤ 35.0	> 15.0 and ≤ 25.0	Average traffic delay
D	> 35.0 and ≤ 55.0	> 25.0 and ≤ 35.0	Long traffic delay
E	> 55.0 and ≤ 80.0	> 35.0 and ≤ 50.0	Very long traffic delay
F	> 80.0	> 50.0	Extreme traffic delay

Source: Transportation Research Board, Highway Capacity Manual, 2000.

Level of Service of State Route 152/Kaiser-Aetna Road Intersection During Project Construction

The construction period would last approximately 7.2 years and would impose a far greater number of trips on State Route (SR 152) than the post construction period, when there would be few periodic trips for inspection and maintenance. As a result, the calculations of LOS have been prepared only for the construction period.

To derive the LOS for the AM and PM peak hours (5:00 – 6:00[1] AM and 4:00 – 5:00 PM, respectively), the construction schedule, phasing, and activities were reviewed to identify the construction year with the maximum number of truck trips and construction workers. Table 1-2 shows the estimated maximum number of trips during the AM and PM hours based on the construction year with the maximum number of truck trips and construction workers. Construction worker trips account for approximately two-thirds of the daily trips, but more than 90 percent of the peak hour trips at the SR 152/Kaiser-Aetna Road intersection. This demand on the intersection was evaluated with the intersection improvements proposed for each alternative, as presented in the *Alternatives Development and Project Description Appendix*.

Table 1-2. Peak Construction Trip Generation at the SR 152/Kaiser-Aetna Road Intersection

Trips	Daily Round Trips[1]	AM Peak Hour[1]			PM Peak Hour[1]		
		In	Out	Total[2]	In	Out	Total[2]
Construction Trucks Trips	340	9	9	18	9	9	18
Worker Trips	646	194	13	207	0	174	174
Total Trips	986	203	22	225	9	183	192

Notes:

[1] Additional information on peak construction trip generation at SR 152/Kaiser-Aetna Road intersection is provided in the Air Quality and Greenhouse Gas Emissions Appendix.

[2] Peak construction trips presented here are for the action alternative with the greatest number of truck and construction worker trips (Alternative D). For purposes of calculating the LOS, this alternative would have the greatest impact at the SR 152/Kaiser-Aetna Road intersection. Using this alternative provides a conservative analysis for the other action alternatives, should Valley Water select any of the other action alternatives.

Key:

LOS = level of service

SR 152 = State Route 152

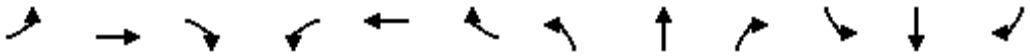
[1] The PeMS data shows the peak hour along SR 152 to be at 4:00 -5:00 AM. However, that data point is about 15 miles to the east. By the time, travelers reach Kaiser-Aetna, it is close to 4:30 AM for the westbound peak. Because we want to reflect the peak hour of greatest impact, using 5:00-6:00 AM also allows the analysis to capture the impact of the change in shifts for the construction workers.

The resulting LOS calculations, based on the HCM analysis methodology and derived using Synchro LOS software, are presented in Table 1-3, which shows that all project alternatives would operate at LOS D or better, except Alternative B which would operate at LOS E in the AM peak hour. Both Santa Clara County and Caltrans recognize that lower LOS may be acceptable if the desired LOS cannot be reasonably achieved.

Table 1-3. Level of Service Summary for the Proposed Project and Other Alternatives for Peak Construction Year

Alternative	SR 152/Kaiser-Aetna Rd. Improvement	Intersection Control	AM Peak Hour		PM Peak Hour	
			Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
Proposed Project	Permanent overpass and tight diamond interchange	TWSC - WB Ramps	9.6	A	9.1	A
		TWSC - EB Ramps	9.4	A	10.3	B
No Project	None	TWSC	72.1	F	181.5	F
Alternative A	Temporary overcrossing	TWSC	9.9	A	10.2	B
Alternative B	Temporary at-grade intersection with signal and roundabout	Signal	56.5	E	24.5	C
Alternative C	Temporary at-grade intersection with signal and SR 152 widening	Signal	18.6	B	14.4	B
Alternative D	Permanent overpass and tight diamond interchange	TWSC - WB Ramps	9.6	A	9.1	A
		TWSC - EB Ramps	9.4	A	10.3	B

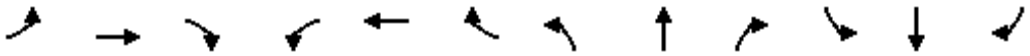
Key:
EB = eastbound
LOS = level of service
sec/veh = seconds per vehicle
SR 152 = State Route 152
TWSC = two way stop control
WB = westbound



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	193	0	1	2589	0	1	1	1	0	0	0
Future Volume (Veh/h)	0	193	0	1	2589	0	1	1	1	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	0	219	0	1	2942	0	1	1	1	0	0	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		Raised			Raised							
Median storage veh)		1			1							
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	2942			219			1692	3163	110	3055	3163	1471
vC1, stage 1 conf vol							219	219		2944	2944	
vC2, stage 2 conf vol							1473	2944		111	219	
vCu, unblocked vol	2942			219			1692	3163	110	3055	3163	1471
tC, single (s)	4.4			4.4			7.8	6.8	7.2	7.8	6.8	7.2
tC, 2 stage (s)							6.8	5.8		6.8	5.8	
tF (s)	2.4			2.4			3.6	4.2	3.4	3.6	4.2	3.4
p0 queue free %	100			100			99	96	100	100	100	100
cM capacity (veh/h)	95			1258			102	24	883	11	24	103

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	WB 4	NB 1	SB 1
Volume Total	0	146	73	1	1471	1471	0	3	0
Volume Left	0	0	0	1	0	0	0	1	0
Volume Right	0	0	0	0	0	0	0	1	0
cSH	1700	1700	1700	1258	1700	1700	1700	57	1700
Volume to Capacity	0.00	0.09	0.04	0.00	0.87	0.87	0.00	0.05	0.00
Queue Length 95th (ft)	0	0	0	0	0	0	0	4	0
Control Delay (s)	0.0	0.0	0.0	7.9	0.0	0.0	0.0	72.1	0.0
Lane LOS				A				F	A
Approach Delay (s)	0.0			0.0				72.1	0.0
Approach LOS								F	A

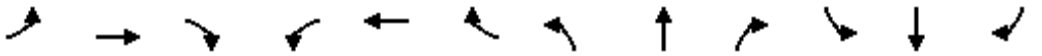
Intersection Summary				
Average Delay	0.1			
Intersection Capacity Utilization	81.6%	ICU Level of Service		D
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	7	2172	1	2	1010	3	1	0	0	7	1	3
Future Volume (Veh/h)	7	2172	1	2	1010	3	1	0	0	7	1	3
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	8	2468	1	2	1148	3	1	0	0	8	1	3
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		Raised			Raised							
Median storage veh)		1			1							
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1151			2469			3066	3640	1234	2402	3637	574
vC1, stage 1 conf vol							2484	2484		1152	1152	
vC2, stage 2 conf vol							582	1155		1250	2485	
vCu, unblocked vol	1151			2469			3066	3640	1234	2402	3637	574
tC, single (s)	4.4			4.4			7.8	6.8	7.2	7.8	6.8	7.2
tC, 2 stage (s)							6.8	5.8		6.8	5.8	
tF (s)	2.4			2.4			3.6	4.2	3.4	3.6	4.2	3.4
p0 queue free %	99			99			95	100	100	91	97	99
cM capacity (veh/h)	534			151			21	37	151	85	36	430

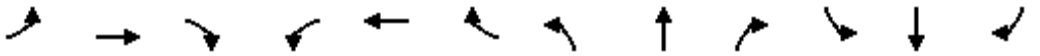
Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	WB 4	NB 1	SB 1
Volume Total	8	1645	824	2	574	574	3	1	12
Volume Left	8	0	0	2	0	0	0	1	8
Volume Right	0	0	1	0	0	0	3	0	3
cSH	534	1700	1700	151	1700	1700	1700	21	93
Volume to Capacity	0.01	0.97	0.48	0.01	0.34	0.34	0.00	0.05	0.13
Queue Length 95th (ft)	1	0	0	1	0	0	0	3	11
Control Delay (s)	11.8	0.0	0.0	29.2	0.0	0.0	0.0	181.5	49.3
Lane LOS	B			D				F	E
Approach Delay (s)	0.0			0.1				181.5	49.3
Approach LOS								F	E

Intersection Summary				
Average Delay	0.3			
Intersection Capacity Utilization	70.1%	ICU Level of Service		C
Analysis Period (min)	15			



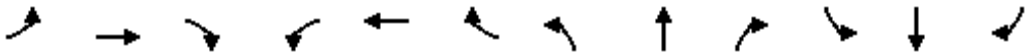
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	120	193	0	1	2589	83	1	1	1	10	0	12
Future Volume (vph)	120	193	0	1	2589	83	1	1	1	10	0	12
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5		4.5	4.5	4.5		4.5			4.5	
Lane Util. Factor	1.00	0.91		1.00	0.91	1.00		1.00			1.00	
Frt	1.00	1.00		1.00	1.00	0.85		0.95			0.92	
Flt Protected	0.95	1.00		0.95	1.00	1.00		0.98			0.98	
Satd. Flow (prot)	1752	4510		1570	4510	1524		1552			1223	
Flt Permitted	0.95	1.00		0.95	1.00	1.00		0.91			0.86	
Satd. Flow (perm)	1752	4510		1570	4510	1524		1434			1071	
Peak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	136	219	0	1	2942	94	1	1	1	11	0	14
RTOR Reduction (vph)	0	0	0	0	0	24	0	1	0	0	23	0
Lane Group Flow (vph)	136	219	0	1	2942	70	0	2	0	0	2	0
Heavy Vehicles (%)	3%	15%	15%	15%	15%	6%	15%	15%	15%	50%	15%	33%
Turn Type	Prot	NA		Prot	NA	Perm	Perm	NA		Perm	NA	
Protected Phases	5	2		1	6			4			8	
Permitted Phases						6	4			8		
Actuated Green, G (s)	12.1	90.8		1.9	80.6	80.6		6.8			6.8	
Effective Green, g (s)	12.1	90.8		1.9	80.6	80.6		6.8			6.8	
Actuated g/C Ratio	0.11	0.80		0.02	0.71	0.71		0.06			0.06	
Clearance Time (s)	4.5	4.5		4.5	4.5	4.5		4.5			4.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0		3.0			3.0	
Lane Grp Cap (vph)	187	3623		26	3216	1087		86			64	
v/s Ratio Prot	c0.08	0.05		0.00	c0.65							
v/s Ratio Perm						0.05		c0.00			0.00	
v/c Ratio	0.73	0.06		0.04	0.91	0.06		0.02			0.02	
Uniform Delay, d1	48.9	2.3		54.7	13.4	4.9		50.0			50.0	
Progression Factor	1.00	1.00		1.00	1.00	1.00		1.00			1.00	
Incremental Delay, d2	13.2	0.0		0.6	4.6	0.0		0.1			0.1	
Delay (s)	62.0	2.3		55.3	18.0	4.9		50.1			50.1	
Level of Service	E	A		E	B	A		D			D	
Approach Delay (s)		25.2			17.6			50.1			50.1	
Approach LOS		C			B			D			D	

Intersection Summary			
HCM 2000 Control Delay	18.6	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	113.0	Sum of lost time (s)	13.5
Intersection Capacity Utilization	79.6%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			



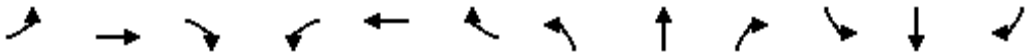
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	11	2172	1	2	1010	8	1	0	0	82	1	111
Future Volume (vph)	11	2172	1	2	1010	8	1	0	0	82	1	111
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5		4.5	4.5	4.5		4.5			4.5	
Lane Util. Factor	1.00	0.91		1.00	0.91	1.00		1.00			1.00	
Frt	1.00	1.00		1.00	1.00	0.85		1.00			0.92	
Flt Protected	0.95	1.00		0.95	1.00	1.00		0.95			0.98	
Satd. Flow (prot)	1327	4510		1570	4510	991		1570			1637	
Flt Permitted	0.95	1.00		0.95	1.00	1.00		0.52			0.86	
Satd. Flow (perm)	1327	4510		1570	4510	991		855			1442	
Peak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	12	2468	1	2	1148	9	1	0	0	93	1	126
RTOR Reduction (vph)	0	0	0	0	0	3	0	0	0	0	40	0
Lane Group Flow (vph)	13	2469	0	2	1148	6	0	1	0	0	180	0
Heavy Vehicles (%)	36%	15%	15%	15%	15%	63%	15%	15%	15%	6%	15%	4%
Turn Type	Prot	NA		Prot	NA	Perm	Perm	NA		Perm	NA	
Protected Phases	5	2		1	6			4			8	
Permitted Phases						6	4			8		
Actuated Green, G (s)	1.8	61.3		1.5	61.0	61.0		17.6			17.6	
Effective Green, g (s)	1.8	61.3		1.5	61.0	61.0		17.6			17.6	
Actuated g/C Ratio	0.02	0.65		0.02	0.65	0.65		0.19			0.19	
Clearance Time (s)	4.5	4.5		4.5	4.5	4.5		4.5			4.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0		3.0			3.0	
Lane Grp Cap (vph)	25	2944		25	2929	643		160			270	
v/s Ratio Prot	c0.01	c0.55		0.00	0.25							
v/s Ratio Perm						0.01		0.00			c0.12	
v/c Ratio	0.52	0.84		0.08	0.39	0.01		0.01			0.67	
Uniform Delay, d1	45.6	12.5		45.5	7.7	5.8		31.0			35.4	
Progression Factor	1.00	1.00		1.00	1.00	1.00		1.00			1.00	
Incremental Delay, d2	18.1	2.2		1.4	0.1	0.0		0.0			6.1	
Delay (s)	63.8	14.8		46.9	7.8	5.8		31.1			41.5	
Level of Service	E	B		D	A	A		C			D	
Approach Delay (s)		15.0			7.9			31.1			41.5	
Approach LOS		B			A			C			D	

Intersection Summary			
HCM 2000 Control Delay	14.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	93.9	Sum of lost time (s)	13.5
Intersection Capacity Utilization	59.7%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	193	120	0	2589	84	0	122	11	0	11	13
Future Volume (vph)	0	193	120	0	2589	84	0	122	11	0	11	13
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5	4.5		4.5	4.5		4.5			4.5	
Lane Util. Factor		0.95	1.00		0.95	1.00		1.00			1.00	
Frt		1.00	0.85		1.00	0.85		0.99			0.93	
Flt Protected		1.00	1.00		1.00	1.00		1.00			1.00	
Satd. Flow (prot)		3139	1568		3139	1524		1755			1251	
Flt Permitted		1.00	1.00		1.00	1.00		1.00			1.00	
Satd. Flow (perm)		3139	1568		3139	1524		1755			1251	
Peak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	0	219	136	0	2942	95	0	139	12	0	12	15
RTOR Reduction (vph)	0	0	19	0	0	14	0	2	0	0	9	0
Lane Group Flow (vph)	0	219	117	0	2942	81	0	150	0	0	19	0
Heavy Vehicles (%)	0%	15%	3%	0%	15%	6%	3%	3%	50%	0%	50%	33%
Turn Type		NA	Perm		NA	Perm		NA			NA	
Protected Phases		2			6			4			8	
Permitted Phases			2			6						
Actuated Green, G (s)		128.5	128.5		128.5	128.5		12.5			12.5	
Effective Green, g (s)		128.5	128.5		128.5	128.5		12.5			12.5	
Actuated g/C Ratio		0.86	0.86		0.86	0.86		0.08			0.08	
Clearance Time (s)		4.5	4.5		4.5	4.5		4.5			4.5	
Vehicle Extension (s)		3.0	3.0		3.0	3.0		3.0			3.0	
Lane Grp Cap (vph)		2689	1343		2689	1305		146			104	
v/s Ratio Prot		0.07			c0.94			c0.09			0.02	
v/s Ratio Perm			0.07			0.05						
v/c Ratio		0.08	0.09		1.09	0.06		1.03			0.18	
Uniform Delay, d1		1.7	1.7		10.8	1.6		68.8			64.0	
Progression Factor		1.00	1.00		1.00	1.00		1.04			1.00	
Incremental Delay, d2		0.0	0.0		49.1	0.0		82.2			0.8	
Delay (s)		1.7	1.7		59.8	1.6		153.7			64.8	
Level of Service		A	A		E	A		F			E	
Approach Delay (s)		1.7			58.0			153.7			64.8	
Approach LOS		A			E			F			E	

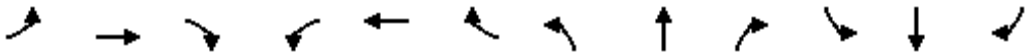
Intersection Summary			
HCM 2000 Control Delay	56.5	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.09		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	89.1%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	2172	12	0	1010	10	0	12	82	0	85	112
Future Volume (vph)	0	2172	12	0	1010	10	0	12	82	0	85	112
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5	4.5		4.5	4.5		4.5			4.5	
Lane Util. Factor		0.95	1.00		0.95	1.00		1.00			1.00	
Frt		1.00	0.85		1.00	0.85		0.88			0.92	
Flt Protected		1.00	1.00		1.00	1.00		1.00			1.00	
Satd. Flow (prot)		3139	1188		3139	991		1526			1673	
Flt Permitted		1.00	1.00		1.00	1.00		1.00			1.00	
Satd. Flow (perm)		3139	1188		3139	991		1526			1673	
Peak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	0	2468	14	0	1148	11	0	14	93	0	97	127
RTOR Reduction (vph)	0	0	3	0	0	2	0	16	0	0	31	0
Lane Group Flow (vph)	0	2468	11	0	1148	9	0	91	0	0	193	0
Heavy Vehicles (%)	0%	15%	36%	0%	15%	63%	0%	36%	6%	0%	6%	4%
Turn Type		NA	Perm		NA	Perm		NA			NA	
Protected Phases		2			6			4			8	
Permitted Phases			2			6						
Actuated Green, G (s)		117.3	117.3		117.3	117.3		18.2			18.2	
Effective Green, g (s)		117.3	117.3		117.3	117.3		18.2			18.2	
Actuated g/C Ratio		0.81	0.81		0.81	0.81		0.13			0.13	
Clearance Time (s)		4.5	4.5		4.5	4.5		4.5			4.5	
Vehicle Extension (s)		3.0	3.0		3.0	3.0		3.0			3.0	
Lane Grp Cap (vph)		2548	964		2548	804		192			210	
v/s Ratio Prot		c0.79			0.37			0.06			c0.12	
v/s Ratio Perm			0.01			0.01						
v/c Ratio		0.97	0.01		0.45	0.01		0.48			0.92	
Uniform Delay, d1		12.0	2.6		4.0	2.6		58.7			62.4	
Progression Factor		1.00	1.00		1.00	1.00		1.90			1.00	
Incremental Delay, d2		11.3	0.0		0.1	0.0		1.1			39.4	
Delay (s)		23.3	2.6		4.2	2.6		112.8			101.8	
Level of Service		C	A		A	A		F			F	
Approach Delay (s)		23.2			4.1			112.8			101.8	
Approach LOS		C			A			F			F	

Intersection Summary			
HCM 2000 Control Delay	24.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.96		
Actuated Cycle Length (s)	144.5	Sum of lost time (s)	9.0
Intersection Capacity Utilization	78.9%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

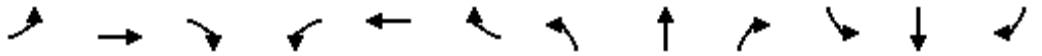
HCM Unsignalized Intersection Capacity Analysis
10: Kaiser Aetna Rd/Kiaser Aetna Rd & SR 152 WB On Ramp/SR 152 WB Off Ramp



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	1	0	83	1	121	0	0	10	12
Future Volume (Veh/h)	0	0	0	1	0	83	1	121	0	0	10	12
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	0	0	0	1	0	94	1	138	0	0	11	14
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	252	158	18	158	165	138	25			138		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	252	158	18	158	165	138	25			138		
tC, single (s)	7.2	6.7	6.4	7.2	6.7	6.4	4.2			4.2		
tC, 2 stage (s)												
tF (s)	3.6	4.1	3.4	3.6	4.1	3.4	2.3			2.3		
p0 queue free %	100	100	100	100	100	89	100			100		
cM capacity (veh/h)	603	711	1024	779	704	877	1509			1369		

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	95	139	25
Volume Left	1	1	0
Volume Right	94	0	14
cSH	876	1509	1700
Volume to Capacity	0.11	0.00	0.01
Queue Length 95th (ft)	9	0	0
Control Delay (s)	9.6	0.1	0.0
Lane LOS	A	A	
Approach Delay (s)	9.6	0.1	0.0
Approach LOS	A		

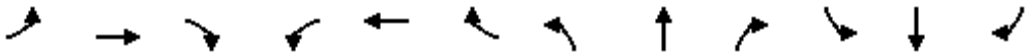
Intersection Summary				
Average Delay	3.6			
Intersection Capacity Utilization	19.0%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	120	0	0	0	0	0	0	2	1	10	1	0
Future Volume (Veh/h)	120	0	0	0	0	0	0	2	1	10	1	0
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	136	0	0	0	0	0	0	2	1	11	1	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	26	26	1	26	26	2	1			3		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	26	26	1	26	26	2	1			3		
tC, single (s)	7.2	6.7	6.4	7.2	6.7	6.4	4.2			4.2		
tC, 2 stage (s)												
tF (s)	3.6	4.1	3.4	3.6	4.1	3.4	2.3			2.3		
p0 queue free %	86	100	100	100	100	100	100			99		
cM capacity (veh/h)	948	836	1047	948	837	1045	1540			1538		

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	136	3	12
Volume Left	136	0	11
Volume Right	0	1	0
cSH	948	1700	1538
Volume to Capacity	0.14	0.00	0.01
Queue Length 95th (ft)	13	0	1
Control Delay (s)	9.4	0.0	6.7
Lane LOS	A		A
Approach Delay (s)	9.4	0.0	6.7
Approach LOS	A		

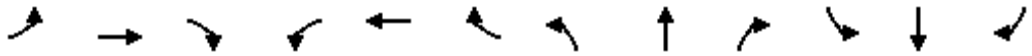
Intersection Summary				
Average Delay	9.0			
Intersection Capacity Utilization	20.6%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	2	0	8	1	11	0	0	83	111
Future Volume (Veh/h)	0	0	0	2	0	8	1	11	0	0	83	111
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	0	0	0	2	0	9	1	13	0	0	94	126
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	181	172	157	172	235	13	220			13		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	181	172	157	172	235	13	220			13		
tC, single (s)	7.2	6.7	6.4	7.2	6.7	6.8	4.2			4.2		
tC, 2 stage (s)												
tF (s)	3.6	4.1	3.4	3.6	4.1	3.9	2.3			2.3		
p0 queue free %	100	100	100	100	100	99	100			100		
cM capacity (veh/h)	745	698	856	763	643	915	1276			1525		

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	11	14	220
Volume Left	2	1	0
Volume Right	9	0	126
cSH	883	1276	1700
Volume to Capacity	0.01	0.00	0.13
Queue Length 95th (ft)	1	0	0
Control Delay (s)	9.1	0.6	0.0
Lane LOS	A	A	
Approach Delay (s)	9.1	0.6	0.0
Approach LOS	A		

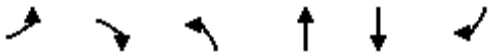
Intersection Summary				
Average Delay	0.4			
Intersection Capacity Utilization	21.2%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	11	0	1	0	0	0	0	1	0	82	3	0
Future Volume (Veh/h)	11	0	1	0	0	0	0	1	0	82	3	0
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	13	0	1	0	0	0	0	1	0	93	3	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	190	190	3	191	190	1	3			1		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	190	190	3	191	190	1	3			1		
tC, single (s)	7.5	6.7	6.4	7.2	6.7	6.4	4.2			4.2		
tC, 2 stage (s)												
tF (s)	3.8	4.1	3.4	3.6	4.1	3.4	2.3			2.3		
p0 queue free %	98	100	100	100	100	100	100			94		
cM capacity (veh/h)	670	642	1044	708	642	1047	1538			1596		

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	14	1	96
Volume Left	13	0	93
Volume Right	1	0	0
cSH	688	1700	1596
Volume to Capacity	0.02	0.00	0.06
Queue Length 95th (ft)	2	0	5
Control Delay (s)	10.3	0.0	7.2
Lane LOS	B		A
Approach Delay (s)	10.3	0.0	7.2
Approach LOS	B		

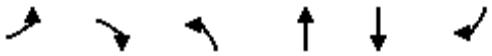
Intersection Summary				
Average Delay	7.5			
Intersection Capacity Utilization	21.4%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	11	1	2	8	111	83
Future Volume (Veh/h)	11	1	2	8	111	83
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	13	1	2	9	126	94
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	186	173	220			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	186	173	220			
tC, single (s)	6.9	6.4	4.2			
tC, 2 stage (s)						
tF (s)	4.0	3.4	2.3			
p0 queue free %	98	100	100			
cM capacity (veh/h)	704	838	1276			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	14	11	220
Volume Left	13	2	0
Volume Right	1	0	94
cSH	712	1276	1700
Volume to Capacity	0.02	0.00	0.13
Queue Length 95th (ft)	2	0	0
Control Delay (s)	10.2	1.4	0.0
Lane LOS	B	A	
Approach Delay (s)	10.2	1.4	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	0.6		
Intersection Capacity Utilization	20.9%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	120	0	1	83	12	10
Future Volume (Veh/h)	120	0	1	83	12	10
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	136	0	1	94	14	11
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	116	20	25			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	116	20	25			
tC, single (s)	6.4	6.4	4.2			
tC, 2 stage (s)						
tF (s)	3.5	3.4	2.3			
p0 queue free %	85	100	100			
cM capacity (veh/h)	878	1022	1509			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	136	95	25
Volume Left	136	1	0
Volume Right	0	0	11
cSH	878	1509	1700
Volume to Capacity	0.15	0.00	0.01
Queue Length 95th (ft)	14	0	0
Control Delay (s)	9.9	0.1	0.0
Lane LOS	A	A	
Approach Delay (s)	9.9	0.1	0.0
Approach LOS	A		

Intersection Summary			
Average Delay	5.3		
Intersection Capacity Utilization	18.5%	ICU Level of Service	A
Analysis Period (min)	15		