SUMMARY OF SIGNIFICANT IMPACTS AND MITIGATION MEASURES

The analysis documented in this report identified significant traffic impacts and associated mitigation measures for four future time frames – two addressing Year 2030 conditions and two relating to Buildout of the proposed Foresthill Divide Community Plan. In addition to considering the Community Plan land uses, both time frames included consideration of the potential development of the proposed Forest Ranch project. The report specifically addressed traffic operations in the weekday AM peak hour and the weekday PM peak hour.

Table 25 summarizes the mitigation measures recommended to offset the significant traffic impacts associated with each of the analysis scenarios under Placer County's current LOS C policy. Table 26 presents similar information, with respect to the modified (LOS D) policy that is under consideration.

Table 25
Mitigation Measure Summary

Study Location	Mitigation Measure	Time Period	Level of Service	
			Without Mitigation	With Mitigation
Year 2030 "Without Forest Ranch"				
Foresthill Road – Foresthill Bridge to Spring Garden Rd. (10.8 miles)	EB[1]: Increase passing lanes from 4.9 to 7.6 miles[3] WB[2]: Increase passing lanes from 1.3 to 6.5 miles	Weekday AM Peak Hour	EB: LOS C WB: LOS E	EB: LOS B WB: LOS C
		Weekday PM Peak Hour	EB: LOS D WB: LOS D	EB: LOS C WB: LOS C
Foresthill Road – Spring Garden Rd. to Todd Valley Rd. (West) (1.7 miles)	WB: Construct 0.8 miles of passing lanes	Weekday AM Peak Hour	EB: LOS B WB: LOS E	EB: LOS B WB: LOS C
		Weekday PM Peak Hour	EB: LOS C WB: LOS C	EB: LOS C WB: LOS B
Foresthill Road – Todd Valley Rd. (West) to Owl Hill Ct. (1.2 miles)	WB: Construct 0.6 miles of passing lanes	Weekday AM Peak Hour	EB: LOS B WB: LOS D	EB: LOS B WB: LOS C
		Weekday PM Peak Hour	EB: LOS B WB: LOS C	EB: LOS B WB: LOS B
Auburn Ravine Rd./ Foresthill Road/Lincoln Way	Modify the westbound approach to provide a dedicated right-turn lane and modify the northbound approach to include dual left-turn lanes	Weekday AM Peak Hour	LOS D	LOS D
		Weekday PM Peak Hour	LOS F	LOS D
Year 2030 "With Forest Ranch"				
Foresthill Road – Foresthill Bridge to Spring Garden Rd. (10.8 miles)	EB: Increase passing lanes from 4.9 to 7.6 miles (Forest Ranch: 29%) WB: Increase passing lanes from 1.3 to 7.6 miles (Forest Ranch: 23% of 5.2 mi. & 100% of 1.1 mi.)	Weekday AM Peak Hour	EB: LOS C WB: LOS E	EB: LOS C WB: LOS C
		Weekday PM Peak Hour	EB: LOS D WB: LOS D	EB: LOS C WB: LOS C
Foresthill Road – Spring Garden Rd. to Todd Valley Rd. (West) (1.7 miles)	WB: Construct 0.8 miles of passing lanes (Forest Ranch: 24%)	Weekday AM Peak Hour	EB: LOS B WB: LOS E	EB: LOS B WB: LOS C
		Weekday PM Peak Hour	EB: LOS C WB: LOS D	EB: LOS C WB: LOS B
Foresthill Road – Todd Valley Rd. (West) to Owl Hill Ct. (1.2 miles)	WB: Construct 0.6 miles of passing lanes (Forest Ranch: 29%)	Weekday AM Peak Hour	EB: LOS C WB: LOS D	EB: LOS C WB: LOS C
		Weekday PM Peak Hour	EB: LOS B WB: LOS D	EB: LOS B WB: LOS B

Table 25 (Continued)
Mitigation Measure Summary

Study Location	Mitigation Measure	Time Period	Level of Service	
			Without Mitigation	Without Mitigation
Year 2030 "With Forest Ranch" (Continued)				
Auburn Ravine Road/I-80 Eastbound Ramps	Modify the westbound approach to convert the shared through/right-turn lane to separate through and right-turn lanes. (Forest Ranch: 100%)	Weekday AM Peak Hour	LOS C	LOS B
		Weekday PM Peak Hour	LOS E	LOS D
Auburn Ravine Rd./ Foresthill Road/Lincoln Way	Modify westbound approach to provide a dedicated right-turn lane; modify northbound approach to include dual left-turn lanes; and convert eastbound right-turn lane into a shared through/right-turn lane. (Forest Ranch: 100% of EB approach improvement, and 27% of WB and NB improvements)	Weekday AM Peak Hour	LOS D	LOS D
		Weekday PM Peak Hour	LOS F	LOS D
Buildout "Without Forest Ranch"				
Foresthill Road – Foresthill Bridge to Yankee Jim's Rd. (16.1 miles)	Upgrade from a two-lane highway to a four-lane facility and widen the Foresthill Bridge to two-lanes in each direction.[5] Also, widen EB Foresthill Rd. to two lanes from Lincoln Way to the bridge.	Weekday AM Peak Hour	EB: LOS D- E[4] WB: LOS E - F	EB: LOS B WB: LOS B
		Weekday PM Peak Hour	EB: LOS D - E WB: LOS D - F	EB: LOS A - B WB: LOS B
Auburn Ravine Road/I-80 Eastbound Ramps	Modify westbound approach to convert shared through/right-turn lane to separate through and right-turn lanes and add an additional northbound-to-eastbound right-turn lane on the off-ramp.	Weekday AM Peak Hour	LOS D	LOS B
		Weekday PM Peak Hour	LOS F	LOS D
Auburn Ravine Rd./ Foresthill Road/Lincoln Way	Modify westbound approach to provide a dedicated right-turn lane; modify northbound approach to include dual left-turn lanes; and convert eastbound right-turn lane into a shared through/right-turn lane.	Weekday AM Peak Hour	LOS F	LOS F[5]
		Weekday PM Peak Hour	LOS F	LOS F[5]

Table 25 (Continued)
Mitigation Measure Summary

Study Location	Mitigation Measure	Time Period	Level of Service	
			Without Mitigation	Without Mitigation
Buildout "With Forest Ranch"				
Foresthill Road – Foresthill Bridge to Yankee Jim's Rd. (16.1 miles)	Upgrade from a two-lane highway to a four-lane facility and widen the Foresthill Bridge to two-lanes in each direction.[5] Also, widen EB Foresthill Road to two lanes from Lincoln Way to the bridge. (Forest Ranch: Varies[6])	Weekday AM Peak Hour	EB: LOS E WB: LOS E - F	EB: LOS B WB: LOS B - C
		Weekday PM Peak Hour	EB: LOS D - E WB: LOS E - F	EB: LOS B WB: LOS B
Auburn Ravine Road/I-80 Eastbound Ramps	Modify westbound approach to convert shared through/right-turn lane to separate through and right-turn lanes and add an additional northbound-to-eastbound right-turn lane on the off-ramp. (Forest Ranch: 5%)	Weekday AM Peak Hour	LOS D	LOS B
		Weekday PM Peak Hour	LOS F	LOS D
Auburn Ravine Rd./ Foresthill Road/Lincoln Way	Modify westbound approach to provide a dedicated right-turn lane; modify northbound approach to include dual left-turn lanes; and convert eastbound right-turn lane into a shared through/right-turn lane. (Forest Ranch: 6%)	Weekday AM Peak Hour	LOS F	LOS F[5]
		Weekday PM Peak Hour	LOS F	LOS F

Notes:
1 Eastbound
2 Westbound
3 All recommended passing lane lengths include tapers.
4 Study location includes several individual roadway segments with levels of service in the range presented.
5 Widening Foresthill Bridge is not financially feasible; therefore, this impact is considered "significant and unavoidable."
6 Forest Ranch responsibility:
- Lincoln Way to Foresthill Bridge – EB: 8%
- Foresthill Bridge widening – EB: 8% / WB: 5%
- Foresthill Bridge to Spring Garden Rd. – EB: 8% / WB: 5%
- Spring Garden Rd. to Todd Valley Rd. (West) – EB: 8% / WB: 6%
- Todd Valley Rd. (West) to Owl Hill Ct. – EB: 9% / WB: 8%
- Owl Hill Ct. to Yankee Jim's Rd. – EB: 17% / WB: 16%

Table 26
Mitigation Measure Summary
Modified Roadway Segment Level of Service Criteria

Study Location	Mitigation Measure	Time Period	Level of Service	
			Without Mitigation	With Mitigation
Year 2030 "Without Forest Ranch"				
Foresthill Road – Foresthill Bridge to Spring Garden Rd. (10.8 miles)	WB[1]: Increase passing lanes from 1.3 to 1.5 miles[2]	Weekday AM Peak Hour	EB[3]: LOS C WB: LOS E	EB: LOS C WB: LOS D
		Weekday PM Peak Hour	EB: LOS D WB: LOS D	EB: LOS D WB: LOS D
Foresthill Road – Spring Garden Rd. to Todd Valley Rd. (West) (1.7 miles)	WB: Construct 0.2 miles of passing lanes	Weekday AM Peak Hour	EB: LOS B WB: LOS E	EB: LOS B WB: LOS D
		Weekday PM Peak Hour	EB: LOS C WB: LOS C	EB: LOS C WB: LOS C
Auburn Ravine Rd./ Foresthill Road/Lincoln Way	Modify the westbound approach to provide a dedicated right-turn lane and modify the northbound approach to include dual left-turn lanes	Weekday AM Peak Hour	LOS D	LOS D
		Weekday PM Peak Hour	LOS F	LOS D
Year 2030 "With Forest Ranch"				
Foresthill Road – Foresthill Bridge to Spring Garden Rd. (10.8 miles)	WB: Increase passing lanes from 1.3 to 1.8 miles (Forest Ranch: 23% of 0.2 mi. & 100% of 0.3 mi.)	Weekday AM Peak Hour	EB: LOS C WB: LOS E	EB: LOS C WB: LOS D
		Weekday PM Peak Hour	EB: LOS D WB: LOS D	EB: LOS D WB: LOS D
Foresthill Road – Spring Garden Rd. to Todd Valley Rd. (West) (1.7 miles)	WB: Construct 0.2 miles of passing lanes (Forest Ranch: 24%)	Weekday AM Peak Hour	EB: LOS B WB: LOS E	EB: LOS B WB: LOS D
		Weekday PM Peak Hour	EB: LOS C WB: LOS D	EB: LOS C WB: LOS C
Auburn Ravine Road/I-80 Eastbound Ramps	Modify the westbound approach to convert the shared through/right-turn lane to separate through and right-turn lanes. (Forest Ranch: 100%)	Weekday AM Peak Hour	LOS C	LOS B
		Weekday PM Peak Hour	LOS E	LOS D

Table 26 (Continued)
Mitigation Measure Summary
Modified Roadway Segment Level of Service Criteria

Study Location	Mitigation Measure	Time Period	Level of Service	
			Without Mitigation	Without Mitigation
Year 2030 "With Forest Ranch" (Continued)				
Auburn Ravine Rd./ Foresthill Road/Lincoln Way	Modify westbound approach to provide a dedicated right-turn lane; modify northbound approach to include dual left-turn lanes; and convert eastbound right-turn lane into a shared through/right-turn lane. (Forest Ranch: 100% of EB approach improvement, and 27% of WB and NB improvements)	Weekday AM Peak Hour	LOS D	LOS D
		Weekday PM Peak Hour	LOS F	LOS D
Buildout "Without Forest Ranch"				
Foresthill Road – Foresthill Bridge to Todd Valley Rd. (13.7 miles)	Upgrade from a two-lane highway to a four-lane facility and widen the Foresthill Bridge to two-lanes in each direction.[5] Also, widen EB Foresthill Rd. to two lanes from Lincoln Way to the bridge.	Weekday AM Peak Hour	EB: LOS E WB: LOS E - F[4]	EB: LOS B WB: LOS B
		Weekday PM Peak Hour	EB: LOS E WB: LOS E - F	EB: LOS B WB: LOS B
Foresthill Road – Todd Valley Rd. to Owl Hill Ct. (1.2 miles)	EB: Widen to two lanes WB: Construct 0.9 miles of passing lanes	Weekday AM Peak Hour	EB: LOS E WB: LOS E	EB: LOS B WB: LOS D
		Weekday PM Peak Hour	EB: LOS D WB: LOS E	EB: LOS A WB: LOS D
Auburn Ravine Road/I-80 Eastbound Ramps	Modify westbound approach to convert shared through/right-turn lane to separate through and right-turn lanes and add an additional northbound-to-eastbound right-turn lane on the off-ramp.	Weekday AM Peak Hour	LOS D	LOS B
		Weekday PM Peak Hour	LOS F	LOS D
Auburn Ravine Rd./ Foresthill Road/Lincoln Way	Modify westbound approach to provide a dedicated right-turn lane; modify northbound approach to include dual left-turn lanes; and convert eastbound right-turn lane into a shared through/right-turn lane.	Weekday AM Peak Hour	LOS F	LOS F[5]
		Weekday PM Peak Hour	LOS F	LOS F[5]

Table 26 (Continued)
Mitigation Measure Summary
Modified Roadway Segment Level of Service Criteria

Study Location	Mitigation Measure	Time Period	Level of Service	
			Without Mitigation	Without Mitigation
Buildout "With Forest Ranch"				
Foresthill Road – Foresthill Bridge to Yankee Jim's Rd. (16.1 miles)	Upgrade from a two-lane highway to a four-lane facility and widen the Foresthill Bridge to two-lanes in each direction.[5] Also, widen EB Foresthill Road to two lanes from Lincoln Way to the bridge. (Forest Ranch: Varies[6])	Weekday AM Peak Hour	EB: LOS E WB: LOS E - F	EB: LOS B WB: LOS B - C
		Weekday PM Peak Hour	EB: LOS D - E WB: LOS E - F	EB: LOS B WB: LOS B
Auburn Ravine Road/I-80 Eastbound Ramps	Modify westbound approach to convert shared through/right-turn lane to separate through and right-turn lanes and add an additional northbound-to-eastbound right-turn lane on the off-ramp. (Forest Ranch: 5%)	Weekday AM Peak Hour	LOS D	LOS B
		Weekday PM Peak Hour	LOS F	LOS D
Auburn Ravine Rd./ Foresthill Road/Lincoln Way	Modify westbound approach to provide a dedicated right-turn lane; modify northbound approach to include dual left-turn lanes; and convert eastbound right-turn lane into a shared through/right-turn lane. (Forest Ranch: 6%)	Weekday AM Peak Hour	LOS F	LOS F[5]
		Weekday PM Peak Hour	LOS F	LOS F

Notes:
1 Westbound
2 All recommended passing lane lengths include tapers.
3 Eastbound
4 Study location includes several individual roadway segments with levels of service in the range presented.
5 Widening Foresthill Bridge is not financially feasible; therefore, this impact is considered "significant and unavoidable."
6 Forest Ranch responsibility:
- Lincoln Way to Foresthill Bridge – EB: 8%
- Foresthill Bridge widening – EB: 8% / WB: 5%
- Foresthill Bridge to Spring Garden Rd. – EB: 8% / WB: 5%
- Spring Garden Rd. to Todd Valley Rd. (West) – EB: 8% / WB: 6%
- Todd Valley Rd. (West) to Owl Hill Ct. – EB: 9% / WB: 8% of 0.9 miles, and 100% of 0.3 miles
- Owl Hill Ct. to Yankee Jim's Rd. – EB and WB: 100%

APPENDIX A

LEVEL OBSERVATIONS FOR ANIMAL COLONY NEIGHBORHOOD MONITORING EVENTS IN TOWN & ER COUNTY

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MEMORANDUM

TO: Tom Brinkman, Placer County Department of Public Works

COPY: Kim Hudson, Quad Knopf

FROM: Neal K. Liddicoat

DATE: August 5, 2005

SUBJECT: Foresthill Divide Community Plan Traffic Analysis
Level of Service Traffic Volume Thresholds

As a follow-up to our previous communications with regard to the appropriate approach to the level of service analysis for the Foresthill Divide Community Plan, I have developed the following set of suggestions. These are presented for your consideration, and I would be happy to modify the approach presented here based on your input.

The approach presented here addresses three roadway types in the study area, as follows:

1. The first roadway type includes the western segments of Foresthill Road, which primarily serve as access routes in and out of the community. These are defined as "Class I" highways in the *Highway Capacity Manual*, as their role is to serve through traffic rather than to provide local access. In our case, the segments between the Foresthill Bridge and Owl Hill Ct. (west of downtown Foresthill) fall into this category.

   These segments will be analyzed using the two-lane highway method documented in the year 2000 edition of the *Highway Capacity Manual*. A directional analysis will be performed, to address concerns about potential operational issue in the westbound/downhill direction with regard to the lack of passing lanes. Most of the factors incorporated into this analysis (e.g., peak hour traffic volume, peak hour factor, heavy vehicle percentage, passing lanes percentage, "no passing" percentage, etc.) will be based on data that we have collected or field observations that have performed. This method defines level of service in terms of a combination of average travel speed and "percent time spent following."

2. The second roadway category is "Secondary/Feeder Roads." These include McKeon-Ponderosa Way, Spring Garden Road, Happy Pines Drive, Todd Valley Road, Mosquito Ridge Road, and Yankee Jim's Road. The analysis of these facilities will reflect both directions combined, using peak hour traffic volumes that we counted. We have developed a recommended set of traffic volume thresholds, based on the method presented in the 1985 *Highway Capacity Manual*. (That was the last version of the HCM to define capacity and level of service strictly in terms of traffic volumes. Since then, other delay-related factors have been used.) The thresholds presented in Table 1 are generally derived from applying a set of adjustment factors to the ideal two-lane capacity value of 2,800 passenger cars per hour (pcph). Those adjustment factors relate to terrain, percent no passing zones, lane and

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Transportation Planning
Construction Management

shoulder width, directional distribution of traffic, percent trucks, etc.) The values presented here are averages of the values found for each of the roadways included in this category.

Table 1
Secondary/Feeder Roads
Level of Service Thresholds

LOS	Max. Hourly Traffic
A	60
B	200
C	375
D	575
E	1,425

3. The third roadway category includes the remaining segments of Foresthill Road (i.e., from west of downtown Foresthill to east of Michigan Bluff Road) as well as Main Street and Race Track Street, near downtown. As we have discussed, these segments of Foresthill Road serve a greater access role than those described above (i.e., they would be categorized as "Class II" highways in the 2000 HCM), although they don't necessarily conform to the other typical characteristics of such a highway (e.g., portions of Foresthill Road in this area have 25 MPH speed limits, and the HCM definition of such roads generally assumes that they will have travel speeds of at least 45 MPH).

   The analysis of these segments will again be based on LOS thresholds developed using the 1985 HCM methodology. The same general adjustment factors described above were applied to the 2,800 pcph ideal capacity to develop the pertinent LOS thresholds. Note that we used the applicable adjustment factors for "level terrain" for Main Street, Race Track Street, and the segments of Foresthill Road between Owl Hill Ct. and Michigan Bluff Road, while the "rolling terrain" factors were applied to Foresthill Road east of Michigan Bluff Road. Again, the thresholds shown in Table 2 represent the averages of the individual values derived for the roads in this category.

Table 2
Local Access Roads
Level of Service Thresholds

LOS	Max. Hourly Traffic
A	100
B	375
C	725
D	1,275
E	2,275

The values shown in Table 2 are substantially higher than those in Table 1 largely because of the higher quality road cross section (e.g., generally, 12-foot lanes plus shoulders), as well as the less rigorous terrain.

I believe that the approach summarized here reflects the varying nature of the roads in the Foresthill Community, without unduly complicating the analysis or the ability of the general public to understand the analysis.

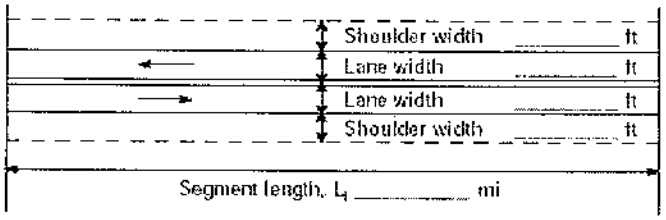
Please feel free to contact me if you have questions or would like to discuss this further. If desired, I would be happy to provide you with the background calculations that led to derivation of the individual traffic volume thresholds presented in Tables 1 and 2.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - Eastbound
Agency or Company	MRO Engineers, Inc.	From/To	Bridge to Spring Garden Road
Date Performed	12/20/06	Jurisdiction	Placer County
Analysis Time Period	AM Peak Hour	Analysis Year	Existing Conditions

Project Description: *Foresthill Divide Community Plan*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☐ Level ☐ Rolling

Grade Length 4.00 mi Up/down 3.0

Peak-hour factor, PHF 0.83

No-passing zone 55%

% Trucks and Buses , P_T 6 %

% Recreational vehicles, P_R 2%

Access points/ *mi* 2

Analysis direction vol., V_d 119veh/h

Opposing direction vol., V_o 523veh/h

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	9.1	1.2
Passenger-car equivalents for RVs, E_R (Exhibit 20-9 or 20-17)	1.5	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.668	0.988
Grade adjustment factor [1], f_G (Exhibit 20-7 or 20-13)	0.75	1.00
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV}*f_G)$	286	638

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field measured speed[3], S_{FM}	mi/h	Base free-flow speed[3], $BFFS_{FM}$	60.0 mi/h
Observed volume[3], V_f	veh/h	Adj. for lane width and shoulder width,[3] f_{LS}(Exh 20-5)	0.0 mi/h
Free-flow speed, FFS_d $FFS=S_{FM}+0.00776(V_f/f_{HV})$	mi/h	Adj. for access points[3], f_A (Exhibit 20-5)	0.5 mi/h
Adjustment for no-passing zones, f_{np} (Exhibit 20-19)	1.4 mi/h	Free-flow speed, FFS_d $(FSS=BFFS-f_{LS}-f_A)$	59.5 mi/h
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	50.9 mi/h

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 20-10 or 20-16)	1.5	1.1
Passenger-car equivalents for RVs, E_R (Exhibit 20-10 or 20-16)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.971	0.994
Grade adjustment factor[1], f_G (Exhibit 20-8 or 20-14)	1.00	1.00
Directional flow rate[2], v_i(pc/h)=$V_i/(PHF*f_{HV}*f_G)$	148	634
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	23.1	
Adj. for no-passing zone, f_{np} (Exhibit. 20-20)	38.4	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	30.3	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	B
Volume to capacity ratio, $v/c=V_p/1{,}700$	0.17
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)=$0.25L_t(V/PHF)$	387
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)=$V*L_t$	1285
Peak 15-min total travel time, TT_{15}(veh-h)=VMT_{15}/ATS	7.6

Notes

1. If the highway is extended segment (level) or rolling terrain, fG=1.0 .
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only.
4. Exhibit 20-21 provides factors a and b.
5. Use alternative Equation 20-14 if some trucks operate at crawl speeds on a specific downgrade.

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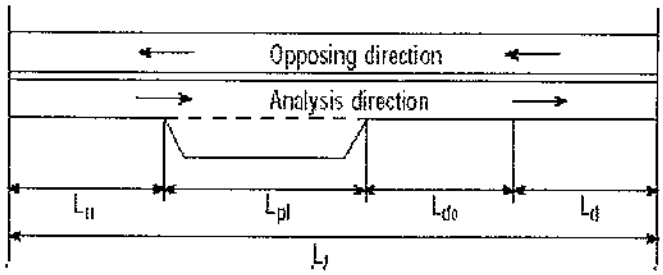
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	*MKL*	Highway of Travel	*Foresthill Road - Eastbound*
Agency or Company	*MRO Engineers, Inc.*	From/To	*Bridge to Spring Garden Road*
Date Performed	*12/20/06*	Jurisdiction	*Placer County*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*Existing Conditions*

Project Description: *Foresthill Divide Community Plan*

Input Data

☑ Class I highway ☐ Class II highway



Total length of analysis segment, L_t (*mi*)	*10.8*
Length of two-lane highway upstream of the passing lane, L_u (*mi*)	*3.0*
Length of passing lane including tapers , L_{pl} (*mi*)	*4.9*
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	*50.9*
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	*30.3*
Level of service[1], LOS_d (from Directional Two-Lane Highway Segment Worksheet)	*B*
Average Travel Speed	
Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (*mi*) (Exhibit 20-23)	*1.70*
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (*mi*) $L_d=L_t-(L_u+L_{pl}+L_{de})$	*1.20*
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 20-24)	*1.08*
Average travel speed including passing lane[2], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl}))$)	*53.0*
Percent Time-Spent-Following	
Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (*mi*)(Exhibit 20-23)	*13.00*
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following. L_d (*mi*)$=L_t-(L_u+L_{pl}+L_{de})$	*-10.10*
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pl} (Exhibit 20-24)	*0.58*
Percent time-spent-following including passing lane[3], $PTSF_{pl}$(%) $PTSF_{pl}= PTSF_d[L_u+L_d+f_{pl}L_{pl}+((1+f_{pl})/2)L_{de}]/L_t$	*21.5*
Level of Service and Other Performance Measures[4]	
Level of service including passing lane LOS_{pl} (Exhibit 20-3 or 20-4)	*B*
Peak 15-min total travel time, TT_{15}(veh-h) $TT_{15}= VMT_{15}/ATS_{pl}$	*7.3*

Notes

1. If LOS_d=F, passing lane analysis cannot be performed.
2. If L_d <0, use alternative Equation 20-22.
3. If L_d<0, use alternative Equation 20-20.
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.

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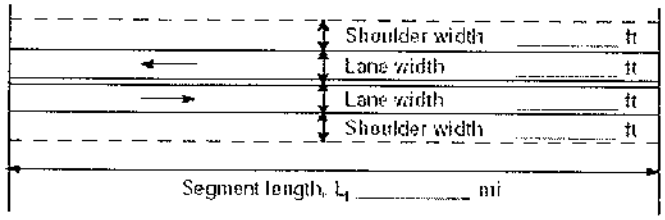
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - Westbound
Agency or Company	MRO Engineers, Inc.	From/To	Bridge to Spring Garden Road
Date Performed	12/20/06	Jurisdiction	Placer County
Analysis Time Period	AM Peak Hour	Analysis Year	Existing Conditions

Project Description: *Foresthill Divide Community Plan*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☐ Level ☐ Rolling

Grade Length 4.00 mi Up/down -3.0

Peak-hour factor, PHF 0.88

No-passing zone 88%

% Trucks and Buses, P_T 2 %

% Recreational vehicles, P_R 2%

Access points/ mi 2

Analysis direction vol., V_d 523veh/h

Opposing direction vol., V_o 119veh/h

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	1.2	9.1
Passenger-car equivalents for RVs, E_R (Exhibit 20-9 or 20-17)	1.0	1.5
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.996	0.853
Grade adjustment factor [1], f_G (Exhibit 20-7 or 20-13)	1.00	0.75
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV}*f_G)$	597	211

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field measured speed[3], S_{FM}	mi/h	Base free-flow speed[3], $BFFS_{FM}$	60.0 mi/h
Observed volume[3], V_f	veh/h	Adj. for lane width and shoulder width,[3] f_{LS}(Exh 20-5)	0.0 mi/h
Free-flow speed, FFS_d $FFS=S_{FM}+0.00776(V_f/f_{HV})$	mi/h	Adj. for access points[3], f_A (Exhibit 20-5)	0.5 mi/h
Adjustment for no-passing zones, f_{np} (Exhibit 20-19)	4.0 mi/h	Free-flow speed, FFS_d $(FSS=BFFS-f_{LS}-f_A)$	59.5 mi/h
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	49.2 mi/h

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 20-10 or 20-16)	1.1	1.5
Passenger-car equivalents for RVs, E_R (Exhibit 20-10 or 20-16)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.998	0.990
Grade adjustment factor[1], f_G (Exhibit 20-8 or 20-14)	1.00	1.00
Directional flow rate[2], v_i(pc/h)=$V_i/(PHF*f_{HV}*f_G)$	596	137
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	50.4	
Adj. for no-passing zone, f_{np} (Exhibit 20-20)	31.9	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	76.4	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	D
Volume to capacity ratio, $v/c=V_p/1{,}700$	0.35
Peak 15-min veh-miles of travel, VMT_{15} (veh- mi)=$0.25L_t(V/PHF)$	1605
Peak-hour vehicle-miles of travel, VMT_{60}(veh- mi)=$V*L_t$	5648
Peak 15-min total travel time, TT_{15}(veh-h)=VMT_{15}/ATS	32.6

Notes

1. If the highway is extended segment (level) or rolling terrain, fG=1.0 .
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only.
4. Exhibit 20-21 provides factors a and b.
5. Use alternative Equation 20-14 if some trucks operate at crawl speeds on a specific downgrade.

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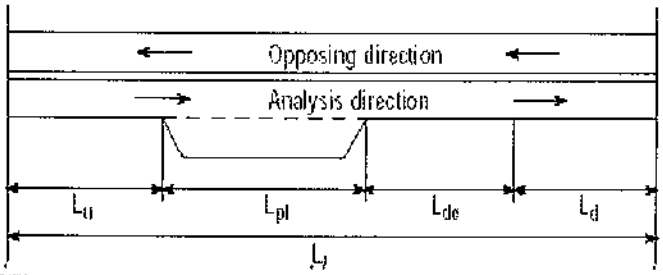
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		*Site Information*	
Analyst	*MKL*	Highway of Travel	*Foresthill Road - Westbound*
Agency or Company	*MRO Engineers, Inc.*	From/To	*Bridge to Spring Garden Road*
Date Performed	*12/20/06*	Jurisdiction	*Placer County*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*Existing Conditions*

Project Description: *Foresthill Divide Community Plan*

Input Data

☑ Class I highway ☐ Class II highway



Total length of analysis segment, L_t (*mi*)	*10.8*
Length of two-lane highway upstream of the passing lane, L_u (*mi*)	*4.8*
Length of passing lane including tapers , L_{pl} (*mi*)	*1.3*
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	*49.2*
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	*76.4*
Level of service[1], LOS_d (from Directional Two-Lane Highway Segment Worksheet)	*D*
Average Travel Speed	
Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (*mi*) (Exhibit 20-23)	*1.70*
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (*mi*) $L_d=L_t-(L_u+L_{pl}+L_{de})$	*3.00*
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 20-24)	*1.10*
Average travel speed including passing lane[2], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl}))$)	*50.2*
Percent Time-Spent-Following	
Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (*mi*)(Exhibit 20-23)	*6.53*
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (*mi*)$=L_t-(L_u+L_{pl}+L_{de})$	*-1.83*
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pt} (Exhibit 20-24)	*0.61*
Percent time-spent-following including passing lane[3], $PTSF_{pl}$(%) $PTSF_{pl}= PTSF_d[L_u+L_d+f_{pl}L_{pl}+((1+f_{pl})/2)L_{de}]/L_t$	*64.5*
Level of Service and Other Performance Measures[4]	
Level of service including passing lane LOS_{pl} (Exhibit 20-3 or 20-4)	*C*
Peak 15-min total travel time, TT_{15}(veh-h) $TT_{15}= VMT_{15}/ATS_{pl}$	*32.0*

Notes

1. If LOS_d=F, passing lane analysis cannot be performed.
2. If L_d <0, use alternative Equation 20-22.
3. If L_d<0, use alternative Equation 20-20.
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.

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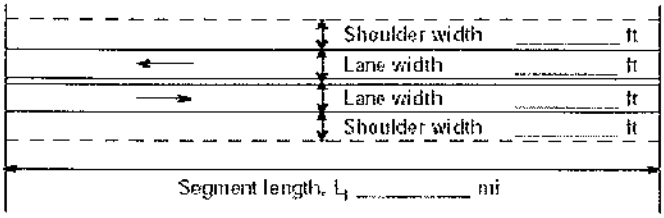
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - Eastbound
Agency or Company	MRO Engineers, Inc.	From/To	Spring Garden to Todd Valley W
Date Performed	12/20/06	Jurisdiction	Placer County
Analysis Time Period	AM Peak Hour	Analysis Year	Existing Conditions

Project Description: Foresthill Divide Community Plan

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☐ Level ☐ Rolling

Grade Length 1.70 mi Up/down 3.4

Peak-hour factor, PHF 0.68

No-passing zone 29%

% Trucks and Buses, P_T 3 %

% Recreational vehicles, P_R 2%

Access points/ mi 4

Analysis direction vol., V_d 156veh/h

Opposing direction vol., V_o 319veh/h

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	6.5	1.2
Passenger-car equivalents for RVs, E_R (Exhibit 20-9 or 20-17)	1.4	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.853	0.994
Grade adjustment factor [1], f_G (Exhibit 20-7 or 20-13)	0.98	1.00
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV}*f_G)$	274	472

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field measured speed[3], S_{FM}	mi/h	Base free-flow speed[3], $BFFS_{FM}$	60.0 mi/h
Observed volume[3], V_f	veh/h	Adj. for lane width and shoulder width,[3] f_{LS}(Exh 20-5)	0.0 mi/h
Free-flow speed, FFS_d $FFS=S_{FM}+0.00776(V_f/f_{HV})$	mi/h	Adj. for access points[3], f_A (Exhibit 20-5)	1.0 mi/h
Adjustment for no-passing zones, f_{np} (Exhibit 20-19)	1.5 mi/h	Free-flow speed, FFS_d $(FSS=BFFS-f_{LS}-f_A)$	59.0 mi/h
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	51.7 mi/h

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 20-10 or 20-16)	1.0	1.1
Passenger-car equivalents for RVs, E_R (Exhibit 20-10 or 20-16)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	1.000	0.997
Grade adjustment factor[1], f_G (Exhibit 20-8 or 20-14)	1.00	1.00
Directional flow rate[2], v_i(pc/h)$=V_i/(PHF*f_{HV}*f_G)$	229	471
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	29.7	
Adj. for no-passing zone, f_{np} (Exhibit 20-20)	35.3	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	41.3	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	B
Volume to capacity ratio, $v/c=V_p/1{,}700$	0.16
Peak 15-min veh-miles of travel, VMT_{15} (veh- mi)$=0.25L_t(V/PHF)$	98
Peak-hour vehicle-miles of travel, VMT_{60}(veh- mi)$=V*L_t$	265
Peak 15-min total travel time, TT_{15}(veh-h)$=VMT_{15}/ATS$	1.9

Notes

1. If the highway is extended segment (level) or rolling terrain, fG=1.0 .
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only.
4. Exhibit 20-21 provides factors a and b.
5. Use alternative Equation 20-14 if some trucks operate at crawl speeds on a specific downgrade.

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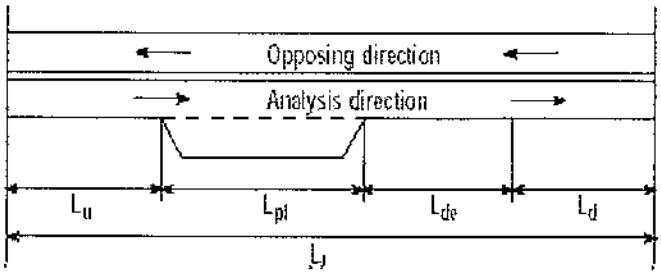
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway of Travel	Foresthill Road - Eastbound
Agency or Company	MRO Engineers, Inc.	From/To	Spring Garden to Todd Valley W
Date Performed	12/20/06	Jurisdiction	Placer County
Analysis Time Period	AM Peak Hour	Analysis Year	Existing Conditions

Project Description: *Foresthill Divide Community Plan*

Input Data

☑ Class I highway ☐ Class II highway



Total length of analysis segment, L_t (*mi*)	1.7
Length of two-lane highway upstream of the passing lane, L_u (*mi*)	0.3
Length of passing lane including tapers , L_{pl} (*mi*)	1.2
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	51.7
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	41.3
Level of service[1], LOS_d (from Directional Two-Lane Highway Segment Worksheet)	B
Average Travel Speed	
Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (*mi*) (Exhibit 20-23)	1.70
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (*mi*) $L_d=L_t-(L_u+L_{pl}+L_{de})$	-1.50
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 20-24)	1.08
Average travel speed including passing lane[2], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl}))$	55.1
Percent Time-Spent-Following	
Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (*mi*)(Exhibit 20-23)	12.29
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (*mi*)$=L_t-(L_u+L_{pl}+L_{de})$	-12.09
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pl} (Exhibit 20-24)	0.58
Percent time-spent-following including passing lane[3], $PTSF_{pl}$(%) $PTSF_{pl}= PTSF_d[L_u+L_d+f_{pl}L_{pl}+((1+f_{pl})/2)L_{de}]/L_t$	27.0
Level of Service and Other Performance Measures[4]	
Level of service including passing lane LOS_{pl} (Exhibit 20-3 or 20-4)	A
Peak 15-min total travel time, TT_{15}(veh-h) $TT_{15}= VMT_{15}/ATS_{pl}$	1.8

Notes

1. If LOS_d=F, passing lane analysis cannot be performed.
2. If L_d <0, use alternative Equation 20-22.
3. If L_d<0, use alternative Equation 20-20.
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.

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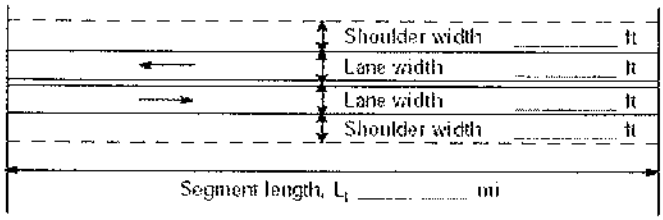
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - Westbound
Agency or Company	MRO Engineers, Inc.	From/To	Spring Garden to Todd Valley W
Date Performed	12/20/06	Jurisdiction	Placer County
Analysis Time Period	AM Peak Hour	Analysis Year	Existing Conditions

Project Description: *Foresthill Divide Community Plan*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☐ Level ☐ Rolling

Grade Length 1.70 mi Up/down -3.4

Peak-hour factor, PHF 0.87

No-passing zone 100%

% Trucks and Buses , P_T 2 %

% Recreational vehicles, P_R 2%

Access points/ mi 5

Analysis direction vol., V_d 319veh/h

Opposing direction vol., V_o 156veh/h

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	1.2	6.5
Passenger-car equivalents for RVs, E_R (Exhibit 20-9 or 20-17)	1.0	1.4
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.996	0.894
Grade adjustment factor [1], f_G (Exhibit 20-7 or 20-13)	1.00	0.75
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV}*f_G)$	368	267

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field measured speed[3], S_{FM}	mi/h	Base free-flow speed[3], $BFFS_{FM}$	60.0 mi/h
Observed volume[3], V_f	veh/h	Adj. for lane width and shoulder width,[3] f_{LS}(Exh 20-5)	0.0 mi/h
Free-flow speed, FFS_d $FFS=S_{FM}+0.00776(V_f/f_{HV})$	mi/h	Adj. for access points[3], f_A (Exhibit 20-5)	1.3 mi/h
Adjustment for no-passing zones, f_{np} (Exhibit 20-19)	3.7 mi/h	Free-flow speed, FFS_d $(FSS=BFFS-f_{LS}-f_A)$	58.8 mi/h
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	50.1 mi/h

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 20-10 or 20-16)	1.1	1.0
Passenger-car equivalents for RVs, E_R (Exhibit 20-10 or 20-16)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.998	1.000
Grade adjustment factor[1], f_G (Exhibit 20-8 or 20-14)	1.00	1.00
Directional flow rate[2], v_i(pc/h)$=V_i/(PHF*f_{HV}*f_G)$	367	179
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	35.5	
Adj. for no-passing zone, f_{np} (Exhibit. 20-20)	49.8	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	68.9	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	D
Volume to capacity ratio, $v/c=V_p/1{,}700$	0.22
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)$=0.25L_t(V/PHF)$	156
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)$=V*L_t$	542
Peak 15-min total travel time, TT_{15}(veh-h)$=VMT_{15}/ATS$	3.1

Notes

1. If the highway is extended segment (level) or rolling terrain, fG=1.0 .
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only.
4. Exhibit 20-21 provides factors a and b.
5. Use alternative Equation 20-14 if some trucks operate at crawl speeds on a specific downgrade.

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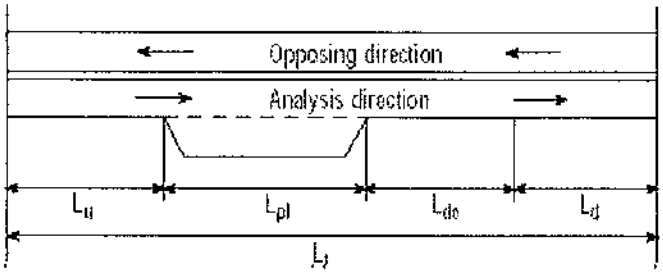
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	*MKL*	Highway of Travel	*Foresthill Road - Westbound*
Agency or Company	*MRO Engineers, Inc.*	From/To	*Spring Garden to Todd Valley W*
Date Performed	*12/20/06*	Jurisdiction	*Placer County*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*Existing Conditions*

Project Description: *Foresthill Divide Community Plan*

Input Data

☑ Class I highway ☐ Class II highway



Total length of analysis segment, L_t (*mi*)	*1.7*
Length of two-lane highway upstream of the passing lane, L_u (*mi*)	*1.7*
Length of passing lane including tapers , L_{pl} (*mi*)	*0.0*
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	*50.1*
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	*68.9*
Level of service[1], LOS_d (from Directional Two-Lane Highway Segment Worksheet)	*D*
Average Travel Speed	
Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (*mi*) (Exhibit 20-23)	*1.70*
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (*mi*) $L_d=L_t-(L_u+L_{pl}+L_{de})$	*-1.70*
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 20-24)	*1.10*
Average travel speed including passing lane[2], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl}))$)	
Percent Time-Spent-Following	
Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (*mi*)(Exhibit 20-23)	*8.91*
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (*mi*)$=L_t-(L_u+L_{pl}+L_{de})$	*-8.91*
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pl} (Exhibit 20-24)	*0.61*
Percent time-spent-following including passing lane[3], $PTSF_{pl}$(%) $PTSF_{pl}= PTSF_d[L_u+L_d+f_{pl}L_{pl}+((1+f_{pl})/2)L_{de}]/L_t$	*68.9*
Level of Service and Other Performance Measures[4]	
Level of service including passing lane LOS_{pl} (Exhibit 20-3 or 20-4)	
Peak 15-min total travel time, TT_{15}(veh-h) $TT_{15}= VMT_{15}/ATS_{pl}$	

Notes

1. If LOS_d=F, passing lane analysis cannot be performed.
2. If L_d <0, use alternative Equation 20-22.
3. If L_d<0, use alternative Equation 20-20.
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.

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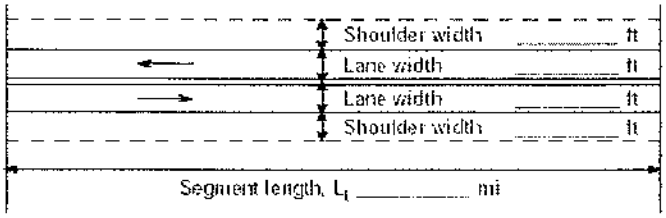
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - Eastbound
Agency or Company	MRO Engineers, Inc.	From/To	Todd Valley W to Owl Hill Ct
Date Performed	12/20/06	Jurisdiction	Placer County
Analysis Time Period	AM Peak Hour	Analysis Year	Existing Conditions

Project Description: *Foresthill Divide Community Plan*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☐ Level ☐ Rolling

Grade Length 1.20 mi Up/down 3.0

Peak-hour factor, PHF 0.54

No-passing zone 17%

% Trucks and Buses, P_T 2 %

% Recreational vehicles, P_R 2%

Access points/ mi 3

Analysis direction vol., V_d 208veh/h

Opposing direction vol., V_o 269veh/h

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	5.0	1.2
Passenger-car equivalents for RVs, E_R (Exhibit 20-9 or 20-17)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.927	0.996
Grade adjustment factor [1], f_G (Exhibit 20-7 or 20-13)	1.00	1.00
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV}*f_G)$	417	500

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field measured speed[3], S_{FM}	mi/h	Base free-flow speed[3], $BFFS_{FM}$	60.0 mi/h
Observed volume[3], V_f	veh/h	Adj. for lane width and shoulder width,[3] f_{LS}(Exh 20-5)	0.0 mi/h
Free-flow speed, FFS_d $FFS=S_{FM}+0.00776(V_f/f_{HV})$	mi/h	Adj. for access points[3], f_A (Exhibit 20-5)	0.8 mi/h
Adjustment for no-passing zones, f_{np} (Exhibit 20-19)	1.2 mi/h	Free-flow speed, FFS_d $(FSS=BFFS-f_{LS}-f_A)$	59.3 mi/h
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	50.9 mi/h

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 20-10 or 20-16)	1.0	1.1
Passenger-car equivalents for RVs, E_R (Exhibit 20-10 or 20-16)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	1.000	0.998
Grade adjustment factor[1], f_G (Exhibit 20-8 or 20-14)	0.93	1.00
Directional flow rate[2], v_i(pc/h)$=V_i/(PHF*f_{HV}*f_G)$	412	499
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	45.5	
Adj. for no-passing zone, f_{np} (Exhibit 20-20)	24.5	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	56.6	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	C
Volume to capacity ratio, $v/c=V_p/1{,}700$	0.25
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)$=0.25L_t(V/PHF)$	116
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)$=V*L_t$	250
Peak 15-min total travel time, TT_{15}(veh-h)$=VMT_{15}/ATS$	2.3

Notes

1. If the highway is extended segment (level) or rolling terrain, fG=1.0 .
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only.
4. Exhibit 20-21 provides factors a and b.
5. Use alternative Equation 20-14 if some trucks operate at crawl speeds on a specific downgrade.

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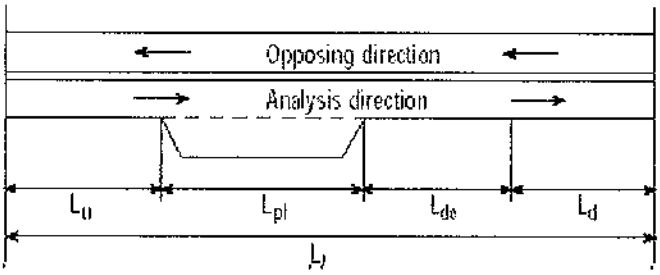
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	*MKL*	Highway of Travel	*Foresthill Road - Eastbound*
Agency or Company	*MRO Engineers, Inc.*	From/To	*Todd Valley W to Owl Hill Ct*
Date Performed	*12/20/06*	Jurisdiction	*Placer County*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*Existing Conditions*

Project Description: *Foresthill Divide Community Plan*

Input Data

☑ Class I highway ☐ Class II highway



Total length of analysis segment, L_t (*mi*)	*1.2*
Length of two-lane highway upstream of the passing lane, L_u (*mi*)	*0.1*
Length of passing lane including tapers , L_{pl} (*mi*)	*1.0*
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	*50.9*
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	*56.6*
Level of service[1], LOS_d (from Directional Two-Lane Highway Segment Worksheet)	*C*
Average Travel Speed	
Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (*mi*) (Exhibit 20-23)	*1.70*
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (*mi*) $L_d=L_t-(L_u+L_{pl}+L_{de})$	*-1.60*
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 20-24)	*1.10*
Average travel speed including passing lane[2], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl}))$	*55.5*
Percent Time-Spent-Following	
Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (*mi*)(Exhibit 20-23)	*8.00*
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (*mi*)$=L_t-(L_u+L_{pl}+L_{de})$	*-7.90*
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pt} (Exhibit 20-24)	*0.61*
Percent time-spent-following including passing lane[3], $PTSF_{pl}$(%) $PTSF_{pl}= PTSF_d[L_u+L_d+f_{pt}L_{pt}+((1+f_{pt})/2)L_{de}]/L_t$	*36.4*
Level of Service and Other Performance Measures[4]	
Level of service including passing lane LOS_{pl} (Exhibit 20-3 or 20-4)	*B*
Peak 15-min total travel time, TT_{15}(veh-h) $TT_{15}= VMT_{15}/ATS_{pl}$	*2.1*

Notes

1. If LOS_d=F, passing lane analysis cannot be performed.
2. If L_d <0, use alternative Equation 20-22.
3. If L_d<0, use alternative Equation 20-20.
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.

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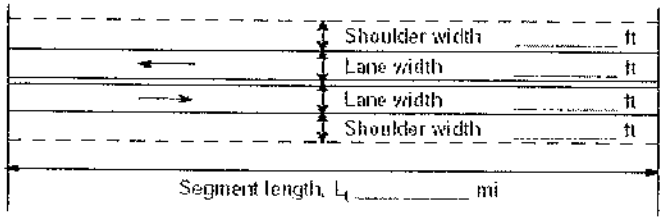
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - Westbound
Agency or Company	MRO Engineers, Inc.	From/To	Todd Valley W to Owl Hill Ct.
Date Performed	12/20/06	Jurisdiction	Placer County
Analysis Time Period	AM Peak Hour	Analysis Year	Existing Conditions

Project Description: Foresthill Divide Community Plan

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☐ Level ☐ Rolling

Grade Length 1.20 mi Up/down -3.0

Peak-hour factor, PHF 0.72

No-passing zone 100%

% Trucks and Buses, P_T 2 %

% Recreational vehicles, P_R 2%

Access points/ mi 4

Analysis direction vol., V_d 269veh/h

Opposing direction vol., V_o 208veh/h

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	1.2	5.0
Passenger-car equivalents for RVs, E_R (Exhibit 20-9 or 20-17)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.996	0.927
Grade adjustment factor [1], f_G (Exhibit 20-7 or 20-13)	1.00	1.00
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV}*f_G)$	375	313

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field measured speed[3], S_{FM}	mi/h	Base free-flow speed[3], $BFFS_{FM}$	60.0 mi/h
Observed volume[3], V_f	veh/h	Adj. for lane width and shoulder width,[3] f_{LS}(Exh 20-5)	0.0 mi/h
Free-flow speed, FFS_d $FFS=S_{FM}+0.00776(V_f/f_{HV})$	mi/h	Adj. for access points[3], f_A (Exhibit 20-5)	1.0 mi/h
Adjustment for no-passing zones, f_{np} (Exhibit 20-19)	3.4 mi/h	Free-flow speed, FFS_d $(FSS=BFFS-f_{LS}-f_A)$	59.0 mi/h
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	50.2 mi/h

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 20-10 or 20-16)	1.1	1.0
Passenger-car equivalents for RVs, E_R (Exhibit 20-10 or 20-16)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.998	1.000
Grade adjustment factor[1], f_G (Exhibit 20-8 or 20-14)	1.00	1.00
Directional flow rate[2], v_i(pc/h)$=V_i/(PHF*f_{HV}*f_G)$	374	289
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	38.8	
Adj. for no-passing zone, f_{np} (Exhibit. 20-20)	51.7	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	67.9	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	D
Volume to capacity ratio, $v/c=V_p/1{,}700$	0.22
Peak 15-min veh-miles of travel, VMT_{15} (veh- mi)$=0.25L_t(V/PHF)$	112
Peak-hour vehicle-miles of travel, VMT_{60}(veh- mi)$=V*L_t$	323
Peak 15-min total travel time, TT_{15}(veh-h)$=VMT_{15}/ATS$	2.2

Notes

1. If the highway is extended segment (level) or rolling terrain, fG=1.0 .
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only.
4. Exhibit 20-21 provides factors a and b.
5. Use alternative Equation 20-14 if some trucks operate at crawl speeds on a specific downgrade.

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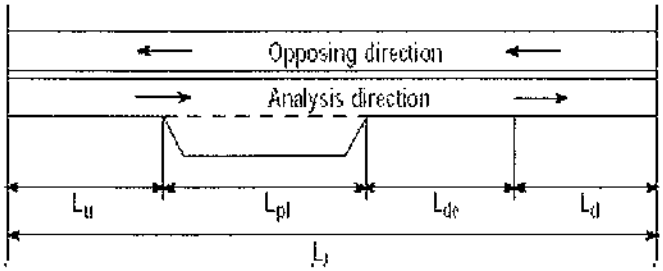
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	*MKL*	Highway of Travel	*Foresthill Road - Westbound*
Agency or Company	*MRO Engineers, Inc.*	From/To	*Todd Valley W to Owl Hill Ct.*
Date Performed	*12/20/06*	Jurisdiction	*Placer County*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*Existing Conditions*

Project Description: *Foresthill Divide Community Plan*

Input Data

☑ Class I highway ☐ Class II highway



Total length of analysis segment, L_t (*mi*)	*1.2*
Length of two-lane highway upstream of the passing lane, L_u (*mi*)	*1.2*
Length of passing lane including tapers , L_{pl} (*mi*)	*0.0*
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	*50.2*
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	*67.9*
Level of service[1], LOS_d (from Directional Two-Lane Highway Segment Worksheet)	*D*
Average Travel Speed	
Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (*mi*) (Exhibit 20-23)	*1.70*
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (*mi*) $L_d=L_t-(L_u+L_{pl}+L_{de})$	*-1.70*
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 20-24)	*1.10*
Average travel speed including passing lane[2], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl})))$	
Percent Time-Spent-Following	
Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (*mi*)(Exhibit 20-23)	*8.74*
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (*mi*)$=L_t-(L_u+L_{pl}+L_{de})$	*-8.74*
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pl} (Exhibit 20-24)	*0.61*
Percent time-spent-following including passing lane[3], $PTSF_{pl}$(%) $PTSF_{pl}= PTSF_d[L_u+L_d+f_{pl}L_{pl}+((1+f_{pl})/2)L_{de}]/L_t$	*67.9*
Level of Service and Other Performance Measures[4]	
Level of service including passing lane LOS_{pl} (Exhibit 20-3 or 20-4)	
Peak 15-min total travel time, TT_{15}(veh-h) $TT_{15}= VMT_{15}/ATS_{pl}$	

Notes

1. If LOS_d=F, passing lane analysis cannot be performed.
2. If L_d <0, use alternative Equation 20-22.
3. If L_d<0, use alternative Equation 20-20.
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.

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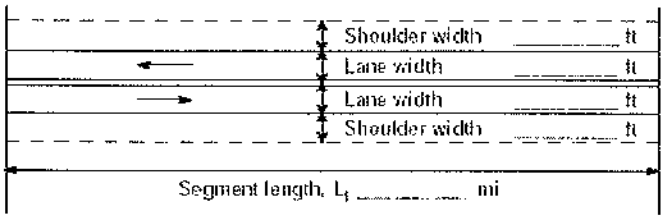
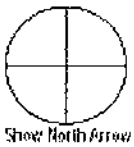
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - Eastbound
Agency or Company	MRO Engineers, Inc.	From/To	Bridge to Spring Garden Road
Date Performed	12/20/06	Jurisdiction	Placer County
Analysis Time Period	PM Peak Hour	Analysis Year	Existing Conditions

Project Description: Foresthill Divide Community Plan

Input Data





☑ Class I highway ☐ Class II highway

Terrain ☐ Level ☐ Rolling

Grade Length 4.00 mi Up/down 3.0

Peak-hour factor, PHF 0.82

No-passing zone 55%

% Trucks and Buses, P_T 1 %

% Recreational vehicles, P_R 2%

Access points/ mi 2

Analysis direction vol., V_d 525veh/h

Opposing direction vol., V_o 147veh/h

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	5.7	1.7
Passenger-car equivalents for RVs, E_R (Exhibit 20-9 or 20-17)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.955	0.993
Grade adjustment factor [1], f_G (Exhibit 20-7 or 20-13)	0.95	1.00
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV}*f_G)$	706	181

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field measured speed[3], S_{FM}	mi/h	Base free-flow speed[3], $BFFS_{FM}$	60.0 mi/h
Observed volume[3], V_f	veh/h	Adj. for lane width and shoulder width,[3] f_{LS}(Exh 20-5)	0.0 mi/h
Free-flow speed, FFS_d $FFS=S_{FM}+0.00776(V_f/f_{HV})$	mi/h	Adj. for access points[3], f_A (Exhibit 20-5)	0.5 mi/h
Adjustment for no-passing zones, f_{np} (Exhibit 20-19)	3.2 mi/h	Free-flow speed, FFS_d $(FSS=BFFS-f_{LS}-f_A)$	59.5 mi/h
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	49 4 mi/h

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 20-10 or 20-16)	1.0	1.1
Passenger-car equivalents for RVs, E_R (Exhibit 20-10 or 20-16)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	1.000	0.999
Grade adjustment factor[1], f_G (Exhibit 20-8 or 20-14)	0.97	1.00
Directional flow rate[2], v_i(pc/h)=$V_i/(PHF*f_{HV}*f_G)$	660	179
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	53.9	
Adj. for no-passing zone, f_{np} (Exhibit 20-20)	27.4	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	75.5	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	D
Volume to capacity ratio, $v/c=V_p/1{,}700$	0.42
Peak 15-min veh-miles of travel, VMT_{15} (veh- mi)=$0.25L_t(V/PHF)$	1729
Peak-hour vehicle-miles of travel, VMT_{60}(veh- mi)=$V*L_t$	5670
Peak 15-min total travel time, TT_{15}(veh-h)=VMT_{15}/ATS	35.0

Notes

1. If the highway is extended segment (level) or rolling terrain, fG=1.0 .
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only.
4. Exhibit 20-21 provides factors a and b.
5. Use alternative Equation 20-14 if some trucks operate at crawl speeds on a specific downgrade.

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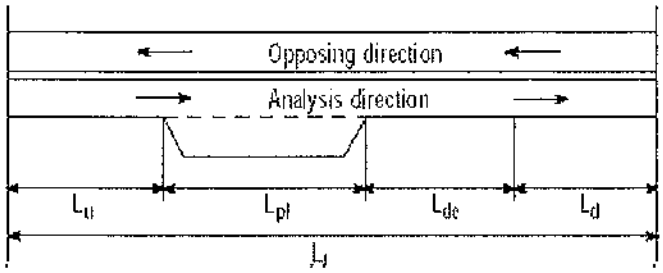
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

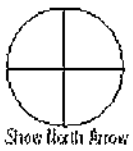
General Information		***Site Information***	
Analyst	*MKL*	Highway of Travel	*Foresthill Road - Eastbound*
Agency or Company	*MRO Engineers, Inc.*	From/To	*Bridge to Spring Garden Road*
Date Performed	*12/20/06*	Jurisdiction	*Placer County*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*Existing Conditions*

Project Description: *Foresthill Divide Community Plan*

Input Data

☑ Class I highway ☐ Class II highway





Total length of analysis segment, L_t (*mi*)	*10.8*
Length of two-lane highway upstream of the passing lane, L_u (*mi*)	*3.0*
Length of passing lane including tapers , L_{pl} (*mi*)	*4.9*
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	*49.4*
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	*75.5*
Level of service[1], LOS_d (from Directional Two-Lane Highway Segment Worksheet)	*D*
Average Travel Speed	
Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (*mi*) (Exhibit 20-23)	*1.70*
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (*mi*) $L_d=L_t-(L_u+L_{pl}+L_{de})$	*1.20*
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 20-24)	*1.11*
Average travel speed including passing lane[2], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl}))$)	*52.1*
Percent Time-Spent-Following	
Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (*mi*)(Exhibit 20-23)	*6.02*
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (*mi*)$=L_t-(L_u+L_{pl}+L_{de})$	*-3.12*
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pl} (Exhibit 20-24)	*0.62*
Percent time-spent-following including passing lane[3], $PTSF_{pl}$(%) $PTSF_{pl}= PTSF_d[L_u+L_d+f_{pl}L_{pl}+((1+f_{pl})/2)L_{de}]/L_t$	*56.6*
Level of Service and Other Performance Measures[4]	
Level of service including passing lane LOS_{pl} (Exhibit 20-3 or 20-4)	*C*
Peak 15-min total travel time, TT_{15}(veh-h) $TT_{15}= VMT_{15}/ATS_{pl}$	*33.2*

Notes

1. If LOS_d=F, passing lane analysis cannot be performed.
2. If L_d <0, use alternative Equation 20-22.
3. If L_d<0, use alternative Equation 20-20.
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.

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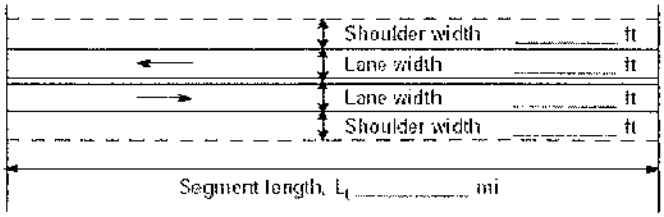
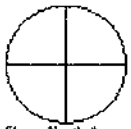
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - Westbound
Agency or Company	MRO Engineers, Inc.	From/To	Bridge to Spring Garden Road
Date Performed	12/20/06	Jurisdiction	Placer County
Analysis Time Period	PM Peak Hour	Analysis Year	Existing Conditions

Project Description: Foresthill Divide Community Plan

Input Data





☑ Class I highway ☐ Class II highway

Terrain ☐ Level ☐ Rolling

Grade Length 4.00 mi Up/down -3.0

Peak-hour factor, PHF 0.69

No-passing zone 88%

% Trucks and Buses, P_T 4 %

% Recreational vehicles, P_R 2%

Access points/ mi 2

Analysis direction vol., V_d 147veh/h

Opposing direction vol., V_o 525veh/h

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	1.7	5.7
Passenger-car equivalents for RVs, E_R (Exhibit 20-9 or 20-17)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.973	0.842
Grade adjustment factor [1], f_G (Exhibit 20-7 or 20-13)	1.00	0.95
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV}*f_G)$	219	951

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field measured speed[3], S_{FM}	mi/h	Base free-flow speed[3], $BFFS_{FM}$	60.0 mi/h
Observed volume[3], V_f	veh/h	Adj. for lane width and shoulder width,[3] f_{LS}(Exh 20-5)	0.0 mi/h
Free-flow speed, FFS_d $FFS=S_{FM}+0.00776(V_f/f_{HV})$	mi/h	Adj. for access points[3], f_A (Exhibit 20-5)	0.5 mi/h
Adjustment for no-passing zones, f_{np} (Exhibit 20-19)	1.2 mi/h	Free-flow speed, FFS_d $(FSS=BFFS-f_{LS}-f_A)$	59.5 mi/h
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	49.2 mi/h

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 20-10 or 20-16)	1.1	1.0
Passenger-car equivalents for RVs, E_R (Exhibit 20-10 or 20-16)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.996	1.000
Grade adjustment factor[1], f_G (Exhibit 20-8 or 20-14)	1.00	0.97
Directional flow rate[2], v_i(pc/h)$=V_i/(PHF*f_{HV}*f_G)$	214	784
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	32.4	
Adj. for no-passing zone, f_{np} (Exhibit. 20-20)	35.9	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	40.1	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	C
Volume to capacity ratio, $v/c=V_p/1{,}700$	0.13
Peak 15-min veh-miles of travel, VMT_{15} (veh- mi)$=0.25L_t(V/PHF)$	575
Peak-hour vehicle-miles of travel, VMT_{60}(veh- mi)$=V*L_t$	1588
Peak 15-min total travel time, TT_{15}(veh-h)$=VMT_{15}/ATS$	11.7

Notes

1. If the highway is extended segment (level) or rolling terrain, fG=1.0 .
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F
3. For the analysis direction only.
4. Exhibit 20-21 provides factors a and b.
5. Use alternative Equation 20-14 if some trucks operate at crawl speeds on a specific downgrade.

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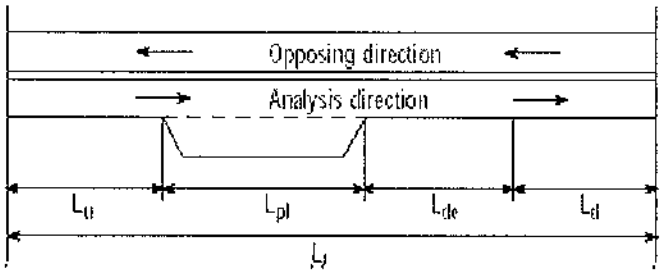
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		*Site Information*	
Analyst	*MKL*	Highway of Travel	*Foresthill Road - Westbound*
Agency or Company	*MRO Engineers, Inc.*	From/To	*Bridge to Spring Garden Road*
Date Performed	*12/20/06*	Jurisdiction	*Placer County*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*Existing Conditions*

Project Description: *Foresthill Divide Community Plan*

Input Data

☑ Class I highway ☐ Class II highway



Total length of analysis segment, L_t (*mi*)	*10.8*
Length of two-lane highway upstream of the passing lane, L_u (*mi*)	*4.8*
Length of passing lane including tapers , L_{pl} (*mi*)	*1.3*
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	*49.2*
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	*40.1*
Level of service[1], LOS_d (from Directional Two-Lane Highway Segment Worksheet)	*C*
Average Travel Speed	
Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (*mi*) (Exhibit 20-23)	*1.70*
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (*mi*) $L_d=L_t-(L_u+L_{pl}+L_{de})$	*3.00*
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 20-24)	*1.08*
Average travel speed including passing lane[2], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl}))$)	*50.0*
Percent Time-Spent-Following	
Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (*mi*)(Exhibit 20-23)	*12.66*
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (*mi*)$=L_t-(L_u+L_{pl}+L_{de})$	*-7.96*
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pt} (Exhibit 20-24)	*0.58*
Percent time-spent-following including passing lane[3], $PTSF_{pl}$(%) $PTSF_{pl}= PTSF_d[L_u+L_d+f_{pt}L_{pl}+((1+f_{pt})/2)L_{de}]/L_t$	*32.1*
Level of Service and Other Performance Measures[4]	
Level of service including passing lane LOS_{pl} (Exhibit 20-3 or 20-4)	*C*
Peak 15-min total travel time, TT_{15}(veh-h) $TT_{15}= VMT_{15}/ATS_{pl}$	*11.5*

Notes

1. If LOS_d=F, passing lane analysis cannot be performed.
2. If L_d <0, use alternative Equation 20-22.
3. If L_d<0, use alternative Equation 20-20.
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.

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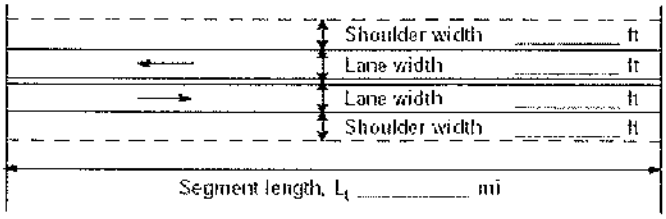
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - Eastbound
Agency or Company	MRO Engineers, Inc.	From/To	Spring Garden to Todd Valley W
Date Performed	12/20/06	Jurisdiction	Placer County
Analysis Time Period	PM Peak Hour	Analysis Year	Existing Conditions

Project Description: *Foresthill Divide Community Plan*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☐ Level ☐ Rolling

Grade Length 1.70 mi Up/down 3.4

Peak-hour factor, PHF 0.87

No-passing zone 29%

% Trucks and Buses, P_T 2 %

% Recreational vehicles, P_R 2%

Access points/ mi 4

Analysis direction vol., V_d 274veh/h

Opposing direction vol., V_o 187veh/h

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	5.7	1.7
Passenger-car equivalents for RVs, E_R (Exhibit 20-9 or 20-17)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.915	0.986
Grade adjustment factor [1], f_G (Exhibit 20-7 or 20-13)	0.98	1.00
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV}*f_G)$	351	218

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field measured speed[3], S_{FM}	mi/h	Base free-flow speed[3], $BFFS_{FM}$	60.0 mi/h
Observed volume[3], V_f	veh/h	Adj. for lane width and shoulder width,[3] f_{LS}(Exh 20-5)	0.0 mi/h
Free-flow speed, FFS_d $FFS=S_{FM}+0.00776(V_f/f_{HV})$	mi/h	Adj. for access points[3], f_A (Exhibit 20-5)	1.0 mi/h
Adjustment for no-passing zones, f_{np} (Exhibit 20-19)	2.2 mi/h	Free-flow speed, FFS_d $(FSS=BFFS-f_{LS}-f_A)$	59.0 mi/h
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	52.4 mi/h

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 20-10 or 20-16)	1.0	1.1
Passenger-car equivalents for RVs, E_R (Exhibit 20-10 or 20-16)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	1.000	0.998
Grade adjustment factor[1], f_G (Exhibit 20-8 or 20-14)	0.94	1.00
Directional flow rate[2], v_i(pc/h)$=V_i/(PHF*f_{HV}*f_G)$	334	215
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	33.5	
Adj. for no-passing zone, f_{np} (Exhibit 20-20)	40.1	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	57.9	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	C
Volume to capacity ratio, $v/c=V_p/1{,}700$	0.21
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)$=0.25L_t(V/PHF)$	134
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)$=V*L_t$	466
Peak 15-min total travel time, TT_{15}(veh-h)$=VMT_{15}/ATS$	2.6

Notes

1. If the highway is extended segment (level) or rolling terrain, fG=1.0 .
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only.
4. Exhibit 20-21 provides factors a and b.
5. Use alternative Equation 20-14 if some trucks operate at crawl speeds on a specific downgrade.

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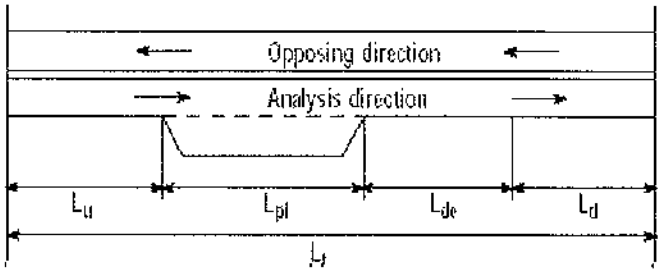
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway of Travel	Foresthill Road - Eastbound
Agency or Company	MRO Engineers, Inc.	From/To	Spring Garden to Todd Valley W
Date Performed	12/20/06	Jurisdiction	Placer County
Analysis Time Period	PM Peak Hour	Analysis Year	Existing Conditions

Project Description: *Foresthill Divide Community Plan*

Input Data

☑ Class I highway ☐ Class II highway



Total length of analysis segment, L_t (*mi*)	1.7
Length of two-lane highway upstream of the passing lane, L_u (*mi*)	0.3
Length of passing lane including tapers , L_{pl} (*mi*)	1.2
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	52.4
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	57.9
Level of service[1], LOS_d (from Directional Two-Lane Highway Segment Worksheet)	C
Average Travel Speed	
Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (*mi*) (Exhibit 20-23)	1.70
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (*mi*) $L_d=L_t-(L_u+L_{pl}+L_{de})$	-1.50
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 20-24)	1.10
Average travel speed including passing lane[2], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl})))$	56.6
Percent Time-Spent-Following	
Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (*mi*)(Exhibit 20-23)	9.72
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following. L_d (*mi*)$=L_t-(L_u+L_{pl}+L_{de})$	-9.52
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pt} (Exhibit 20-24)	0.61
Percent time-spent-following including passing lane[3], $PTSF_{pt}$(%) $PTSF_{pt}= PTSF_d[L_u+L_d+f_{pt}L_{pt}+((1+f_{pt})/2)L_{de}]/L_t$	39.3
Level of Service and Other Performance Measures[4]	
Level of service including passing lane LOS_{pt} (Exhibit 20-3 or 20-4)	B
Peak 15-min total travel time, TT_{15}(veh-h) $TT_{15}= VMT_{15}/ATS_{pt}$	2.4

Notes

1. If LOS_d=F, passing lane analysis cannot be performed.
2. If L_d <0, use alternative Equation 20-22.
3. If L_d<0, use alternative Equation 20-20.
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.

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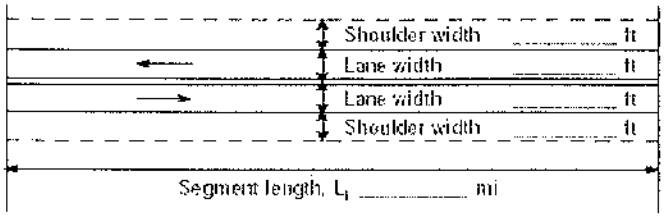
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - Westbound
Agency or Company	MRO Engineers, Inc.	From/To	Spring Garden to Todd Valley W
Date Performed	12/20/06	Jurisdiction	Placer County
Analysis Time Period	PM Peak Hour	Analysis Year	Existing Conditions

Project Description: *Foresthill Divide Community Plan*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☐ Level ☐ Rolling

Grade Length 1.70 mi Up/down -3.4

Peak-hour factor, PHF 0.82

No-passing zone 100%

% Trucks and Buses, P_T 3 %

% Recreational vehicles, P_R 2%

Access points/ mi 5

Analysis direction vol., V_d 187veh/h

Opposing direction vol., V_o 274veh/h

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	1.7	5.7
Passenger-car equivalents for RVs, E_R (Exhibit 20-9 or 20-17)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.979	0.877
Grade adjustment factor [1], f_G (Exhibit 20-7 or 20-13)	1.00	0.98
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV}*f_G)$	233	388

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field measured speed[3], S_{FM}	mi/h	Base free-flow speed[3], $BFFS_{FM}$	60.0 mi/h
Observed volume[3], V_f	veh/h	Adj. for lane width and shoulder width,[3] f_{LS}(Exh 20-5)	0.0 mi/h
Free-flow speed, FFS_d $FFS=S_{FM}+0.00776(V_f/f_{HV})$	mi/h	Adj. for access points[3], f_A (Exhibit 20-5)	1.3 mi/h
Adjustment for no-passing zones, f_{np} (Exhibit 20-19)	3.0 mi/h	Free-flow speed, FFS_d $(FSS=BFFS-f_{LS}-f_A)$	58.8 mi/h
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	51.0 mi/h

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 20-10 or 20-16)	1.1	1.0
Passenger-car equivalents for RVs, E_R (Exhibit 20-10 or 20-16)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.997	1.000
Grade adjustment factor[1], f_G (Exhibit 20-8 or 20-14)	1.00	0.94
Directional flow rate[2], v_i(pc/h)$=V_i/(PHF*f_{HV}*f_G)$	229	354
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	27.6	
Adj. for no-passing zone, f_{np} (Exhibit. 20-20)	54.7	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	49.1	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	B
Volume to capacity ratio, $v/c=V_p/1{,}700$	0.14
Peak 15-min veh-miles of travel, VMT_{15} (veh- mi)$=0.25L_t(V/PHF)$	97
Peak-hour vehicle-miles of travel, VMT_{60}(veh- mi)$=V*L_t$	318
Peak 15-min total travel time, TT_{15}(veh-h)$=VMT_{15}/ATS$	1.9

Notes

1. If the highway is extended segment (level) or rolling terrain, fG=1.0 .
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only.
4. Exhibit 20-21 provides factors a and b.
5. Use alternative Equation 20-14 if some trucks operate at crawl speeds on a specific downgrade.

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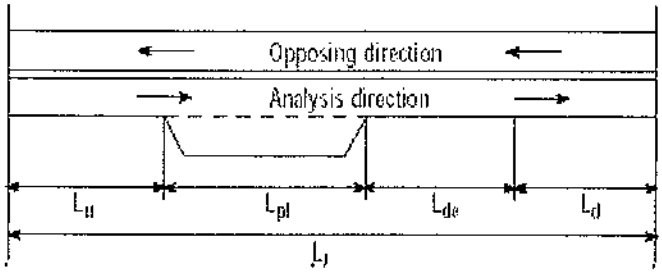
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway of Travel	Foresthill Road - Westbound
Agency or Company	MRO Engineers, Inc.	From/To	Spring Garden to Todd Valley W
Date Performed	12/20/06	Jurisdiction	Placer County
Analysis Time Period	PM Peak Hour	Analysis Year	Existing Conditions

Project Description: *Foresthill Divide Community Plan*

Input Data

☑ Class I highway ☐ Class II highway



Total length of analysis segment, L_t (*mi*)	*1.7*
Length of two-lane highway upstream of the passing lane, L_u (*mi*)	*1.7*
Length of passing lane including tapers , L_{pl} (*mi*)	*0.0*
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	*51.0*
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	*49.1*
Level of service[1], LOS_d (from Directional Two-Lane Highway Segment Worksheet)	*B*
Average Travel Speed	
Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (*mi*) (Exhibit 20-23)	*1.70*
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (*mi*) $L_d=L_t-(L_u+L_{pl}+L_{de})$	*-1.70*
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 20-24)	*1.08*
Average travel speed including passing lane[2], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl}))$)	
Percent Time-Spent-Following	
Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (*mi*)(Exhibit 20-23)	*12.29*
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (*mi*)$=L_t-(L_u+L_{pl}+L_{de})$	*-12.29*
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pl} (Exhibit 20-24)	*0.58*
Percent time-spent-following including passing lane[3], $PTSF_{pl}$(%) $PTSF_{pl}= PTSF_d[L_u+L_d+f_{pl}L_{pl}+((1+f_{pl})/2)L_{de}]/L_t$	*49.1*
Level of Service and Other Performance Measures[4]	
Level of service including passing lane LOS_{pl} (Exhibit 20-3 or 20-4)	
Peak 15-min total travel time, TT_{15}(veh-h) $TT_{15}= VMT_{15}/ATS_{pl}$	

Notes

1. If LOS_d=F, passing lane analysis cannot be performed.
2. If L_d <0, use alternative Equation 20-22.
3. If L_d<0, use alternative Equation 20-20.
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.

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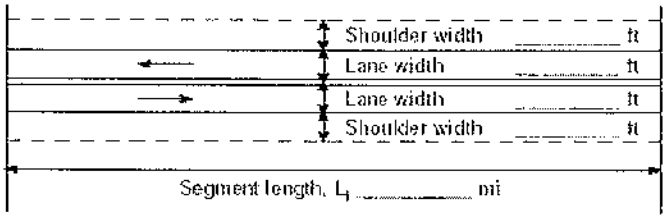
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - Eastbound
Agency or Company	MRO Engineers, Inc.	From/To	Todd Valley W to Owl Hill Ct.
Date Performed	12/20/06	Jurisdiction	Placer County
Analysis Time Period	PM Peak Hour	Analysis Year	Existing Conditions

Project Description: *Foresthill Divide Community Plan*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☐ Level ☐ Rolling

Grade Length 1.20 mi Up/down 3.0

Peak-hour factor, PHF 0.77

No-passing zone 17%

% Trucks and Buses, P_T 2 %

% Recreational vehicles, P_R 2%

Access points/ mi 3

Analysis direction vol., V_d 229veh/h

Opposing direction vol., V_o 197veh/h

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	5.0	1.7
Passenger-car equivalents for RVs, E_R (Exhibit 20-9 or 20-17)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.927	0.986
Grade adjustment factor [1], f_G (Exhibit 20-7 or 20-13)	1.00	1.00
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV}*f_G)$	322	259

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field measured speed[3], S_{FM}	mi/h	Base free-flow speed[3], $BFFS_{FM}$	60.0 mi/h
Observed volume[3], V_f	veh/h	Adj. for lane width and shoulder width,[3] f_{LS}(Exh 20-5)	0.0 mi/h
Free-flow speed, FFS_d $FFS=S_{FM}+0.00776(V_f/f_{HV})$	mi/h	Adj. for access points[3], f_A (Exhibit 20-5)	0.8 mi/h
Adjustment for no-passing zones, f_{np} (Exhibit 20-19)	1.7 mi/h	Free-flow speed, FFS_d $(FSS=BFFS-f_{LS}-f_A)$	59.3 mi/h
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	53.0 mi/h

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 20-10 or 20-16)	1.0	1.1
Passenger-car equivalents for RVs, E_R (Exhibit 20-10 or 20-16)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	1.000	0.998
Grade adjustment factor[1], f_G (Exhibit 20-8 or 20-14)	1.00	1.00
Directional flow rate[2], v_i(pc/h)=$V_i/(PHF*f_{HV}*f_G)$	297	256
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	31.7	
Adj. for no-passing zone, f_{np} (Exhibit. 20-20)	34.8	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	50.4	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	C
Volume to capacity ratio, $v/c=V_p/1{,}700$	0.19
Peak 15-min veh-miles of travel, VMT_{15} (veh- mi)=$0.25L_t(V/PHF)$	89
Peak-hour vehicle-miles of travel, VMT_{60}(veh- mi)=$V*L_t$	275
Peak 15-min total travel time, TT_{15}(veh-h)=VMT_{15}/ATS	1.7

Notes

1. If the highway is extended segment (level) or rolling terrain, fG=1.0 .
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only.
4. Exhibit 20-21 provides factors a and b.
5. Use alternative Equation 20-14 if some trucks operate at crawl speeds on a specific downgrade.

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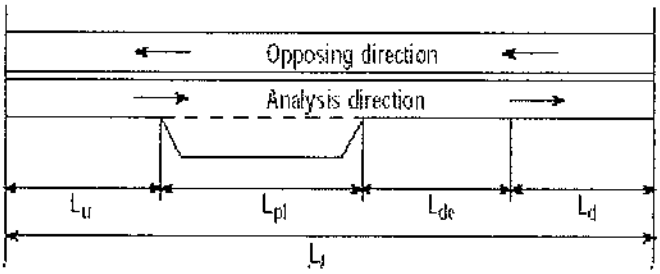
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	*MKL*	Highway of Travel	*Foresthill Road - Eastbound*
Agency or Company	*MRO Engineers, Inc.*	From/To	*Todd Valley W to Owl Hill Ct.*
Date Performed	*12/20/06*	Jurisdiction	*Placer County*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*Existing Conditions*

Project Description: *Foresthill Divide Community Plan*

Input Data

☑ Class I highway ☐ Class II highway



Total length of analysis segment, L_t (*mi*)	*1.2*
Length of two-lane highway upstream of the passing lane, L_u (*mi*)	*0.1*
Length of passing lane including tapers , L_{pl} (*mi*)	*1.0*
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	*53.0*
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	*50.4*
Level of service[1], LOS_d (from Directional Two-Lane Highway Segment Worksheet)	*C*
Average Travel Speed	
Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (*mi*) (Exhibit 20-23)	*1.70*
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (*mi*) $L_d=L_t-(L_u+L_{pl}+L_{de})$	*-1.60*
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 20-24)	*1.10*
Average travel speed including passing lane[2], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl})))$	*57.8*
Percent Time-Spent-Following	
Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (*mi*)(Exhibit 20-23)	*10.62*
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (*mi*)$=L_t-(L_u+L_{pl}+L_{de})$	*-10.52*
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pl} (Exhibit 20-24)	*0.58*
Percent time-spent-following including passing lane[3], $PTSF_{pl}$(%) $PTSF_{pl}= PTSF_d[L_u+L_d+f_{pl}L_{pl}+((1+f_{pl})/2)L_{de}]/L_t$	*31.0*
Level of Service and Other Performance Measures[4]	
Level of service including passing lane LOS_{pl} (Exhibit 20-3 or 20-4)	*A*
Peak 15-min total travel time, TT_{15}(veh-h) $TT_{15}= VMT_{15}/ATS_{pl}$	*1.5*

Notes

1. If LOS_d=F, passing lane analysis cannot be performed.
2. If L_d <0, use alternative Equation 20-22.
3. If L_d<0, use alternative Equation 20-20.
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.

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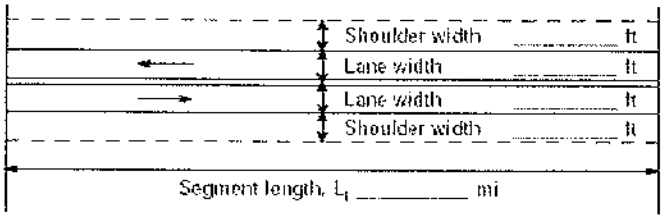
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - Westbound
Agency or Company	MRO Engineers, Inc.	From/To	Todd Valley W to Owl Hill Ct.
Date Performed	12/20/06	Jurisdiction	Placer County
Analysis Time Period	PM Peak Hour	Analysis Year	Existing Conditions

Project Description. *Foresthill Divide Community Plan*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☑ Level ☐ Rolling

Grade Length 1.20 mi Up/down -3.0

Peak-hour factor, PHF 0.81

No-passing zone 100%

% Trucks and Buses , P_T 4 %

% Recreational vehicles, P_R 2%

Access points/ mi 4

Analysis direction vol., V_d 197veh/h

Opposing direction vol., V_o 229veh/h

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	1.7	5.0
Passenger-car equivalents for RVs, E_R (Exhibit 20-9 or 20-17)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.973	0.863
Grade adjustment factor [1], f_G (Exhibit 20-7 or 20-13)	1.00	1.00
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV}*f_G)$	250	329

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field measured speed[3], S_{FM}	mi/h	Base free-flow speed[3], $BFFS_{FM}$	60.0 mi/h
Observed volume[3], V_f	veh/h	Adj. for lane width and shoulder width,[3] f_{LS}(Exh 20-5)	0.0 mi/h
Free-flow speed, FFS_d $FFS=S_{FM}+0.00776(V_f/f_{HV})$	mi/h	Adj. for access points[3], f_A (Exhibit 20-5)	1.0 mi/h
Adjustment for no-passing zones, f_{np} (Exhibit 20-19)	3.3 mi/h	Free-flow speed, FFS_d $(FSS=BFFS-f_{LS}-f_A)$	59.0 mi/h
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	51.2 mi/h

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 20-10 or 20-16)	1.1	1.0
Passenger-car equivalents for RVs, E_R (Exhibit 20-10 or 20-16)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.996	1.000
Grade adjustment factor[1], f_G (Exhibit 20-8 or 20-14)	1.00	1.00
Directional flow rate[2], v_i(pc/h)$=V_i/(PHF*f_{HV}*f_G)$	244	283
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	27.8	
Adj. for no-passing zone, f_{np} (Exhibit. 20-20)	55.2	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	53.3	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	C
Volume to capacity ratio, $v/c=V_p/1{,}700$	0.15
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)$=0.25L_t(V/PHF)$	73
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)$=V*L_t$	236
Peak 15-min total travel time, TT_{15}(veh-h)$=VMT_{15}/ATS$	1.4

Notes

1. If the highway is extended segment (level) or rolling terrain, fG=1.0 .
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only.
4. Exhibit 20-21 provides factors a and b.
5. Use alternative Equation 20-14 if some trucks operate at crawl speeds on a specific downgrade.

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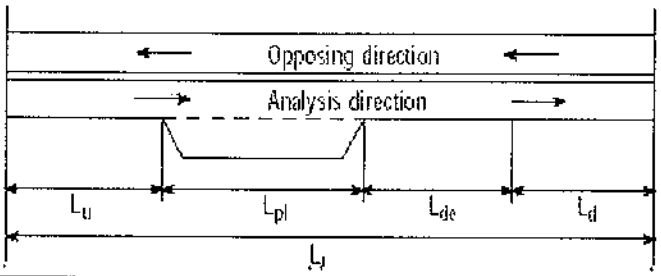
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway of Travel	Foresthill Road - Westbound
Agency or Company	MRO Engineers, Inc	From/To	Todd Valley W to Owl Hill Ct.
Date Performed	12/20/06	Jurisdiction	Placer County
Analysis Time Period	PM Peak Hour	Analysis Year	Existing Conditions

Project Description: *Foresthill Divide Community Plan*

Input Data

☑ Class I highway ☐ Class II highway



Total length of analysis segment, L_t (*mi*)	1.2
Length of two-lane highway upstream of the passing lane, L_u (*mi*)	1.2
Length of passing lane including tapers , L_{pl} (*mi*)	0.0
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	51.2
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	53.3
Level of service[1], LOS_d (from Directional Two-Lane Highway Segment Worksheet)	C
Average Travel Speed	
Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (*mi*) (Exhibit 20-23)	1.70
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (*mi*) $L_d=L_t-(L_u+L_{pl}+L_{de})$	-1.70
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 20-24)	1.08
Average travel speed including passing lane[2], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl})))$	
Percent Time-Spent-Following	
Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (*mi*)(Exhibit 20-23)	11.92
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following. L_d (*mi*)$=L_t-(L_u+L_{pl}+L_{de})$	-11.92
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pl} (Exhibit 20-24)	0.58
Percent time-spent-following including passing lane[3], $PTSF_{pl}$(%) $PTSF_{pl}= PTSF_d[L_u+L_d+f_{pl}L_{pl}+((1+f_{pl})/2)L_{de}]/L_t$	53.3
Level of Service and Other Performance Measures[4]	
Level of service including passing lane LOS_{pl} (Exhibit 20-3 or 20-4)	
Peak 15-min total travel time, TT_{15}(veh-h) $TT_{15}= VMT_{15}/ATS_{pl}$	

Notes

1. If LOS_d=F, passing lane analysis cannot be performed.
2. If L_d <0, use alternative Equation 20-22.
3. If L_d<0, use alternative Equation 20-20.
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.

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Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0					4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00					1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	0.97	1.00	0.98					1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00					1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.92					1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00					0.95	1.00	1.00
Satd. Flow (prot)	1770	1863	1537	1770	1689					1770	1863	1537
Flt Permitted	0.95	1.00	1.00	0.95	1.00					0.95	1.00	1.00
Satd. Flow (perm)	1770	1863	1537	1770	1689					1770	1863	1537
Volume (vph)	59	93	49	249	190	213	0	0	0	120	183	64
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	64	101	53	271	207	232	0	0	0	130	199	70
RTOR Reduction (vph)	0	0	37	0	52	0	0	0	0	0	0	58
Lane Group Flow (vph)	64	101	16	271	387	0	0	0	0	130	199	12
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Turn Type	Prot		Perm	Prot						Split		Perm
Protected Phases	7	4		3	8					6	6	
Permitted Phases			4									6
Actuated Green, G (s)	5.0	18.6	18.6	21.2	34.8					11.2	11.2	11.2
Effective Green, g (s)	4.0	17.6	17.6	20.2	33.8					10.2	10.2	10.2
Actuated g/C Ratio	0.07	0.29	0.29	0.34	0.56					0.17	0.17	0.17
Clearance Time (s)	3.0	3.0	3.0	3.0	3.0					3.0	3.0	3.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0					3.0	3.0	3.0
Lane Grp Cap (vph)	118	546	451	596	951					301	317	261
v/s Ratio Prot	c0.04	0.05		0.15	c0.26					0.07	c0.11	
v/s Ratio Perm			0.03									0.05
v/c Ratio	0.54	0.18	0.03	0.45	0.41					0.43	0.63	0.05
Uniform Delay, d1	27.1	15.8	15.1	15.6	7.4					22.3	23.1	20.8
Progression Factor	1.00	1.00	1.00	0.72	0.66					1.00	1.00	1.00
Incremental Delay, d2	5.0	0.7	0.1	0.5	1.3					1.0	3.9	0.1
Delay (s)	32.1	16.6	15.3	11.8	6.2					23.3	27.0	20.9
Level of Service	C	B	B	B	A					C	C	C
Approach Delay (s)		20.8			8.3			0.0			24.7	
Approach LOS		C			A			A			C	

Intersection Summary

HCM Average Control Delay	15.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.50		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	47.3%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑	↑↑		↰	↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	4.0
Lane Util. Factor		1.00	0.95		1.00	1.00
Frpb, ped/bikes		1.00	1.00		1.00	0.97
Flpb, ped/bikes		1.00	1.00		1.00	1.00
Frt		1.00	1.00		1.00	0.85
Flt Protected		1.00	1.00		0.95	1.00
Satd. Flow (prot)		1863	3539		1770	1537
Flt Permitted		1.00	1.00		0.95	1.00
Satd. Flow (perm)		1863	3539		1770	1537
Volume (vph)	0	213	578	0	104	74
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	232	628	0	113	80
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	232	628	0	113	80
Confl. Peds. (#/hr)	5			5	5	5
Turn Type						Perm
Protected Phases		4	8		6	
Permitted Phases						6
Actuated Green, G (s)		44.3	44.3		8.7	8.7
Effective Green, g (s)		43.3	43.3		8.7	8.7
Actuated g/C Ratio		0.72	0.72		0.14	0.14
Clearance Time (s)		3.0	3.0		4.0	4.0
Vehicle Extension (s)		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)		1344	2554		257	223
v/s Ratio Prot		0.12	c0.18		c0.06	
v/s Ratio Perm						0.05
v/c Ratio		0.17	0.25		0.44	0.36
Uniform Delay, d1		2.7	2.8		23.4	23.1
Progression Factor		1.73	0.67		1.00	1.00
Incremental Delay, d2		0.3	0.2		1.2	1.0
Delay (s)		4.9	2.1		24.6	24.1
Level of Service		A	A		C	C
Approach Delay (s)		4.9	2.1		24.4	
Approach LOS		A	A		C	

Intersection Summary			
HCM Average Control Delay	6.8	HCM Level of Service	A
HCM Volume to Capacity ratio	0.28		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	45.2%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0	4.0		4.0	4.0			
Lane Util. Factor	1.00	1.00			1.00	1.00		1.00	1.00			
Frpb, ped/bikes	1.00	1.00			1.00	0.97		1.00	0.97			
Flpb, ped/bikes	1.00	1.00			1.00	1.00		0.99	1.00			
Frt	1.00	1.00			1.00	0.85		1.00	0.85			
Flt Protected	0.95	1.00			1.00	1.00		0.95	1.00			
Satd. Flow (prot)	1770	1863			1863	1537		1766	1537			
Flt Permitted	0.95	1.00			1.00	1.00		0.95	1.00			
Satd. Flow (perm)	1770	1863			1863	1537		1766	1537			
Volume (vph)	47	270	0	0	465	245	113	2	166	0	0	0
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	51	293	0	0	505	266	123	2	180	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	92	0	0	0	0	0	0
Lane Group Flow (vph)	51	293	0	0	505	174	0	125	180	0	0	0
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Turn Type	Prot					Perm	Perm		Perm			
Protected Phases	7	4			8			2				
Permitted Phases						8	2		2			
Actuated Green, G (s)	3.1	42.3			36.2	36.2		11.7	11.7			
Effective Green, g (s)	2.1	41.3			35.2	35.2		10.7	10.7			
Actuated g/C Ratio	0.04	0.69			0.59	0.59		0.18	0.18			
Clearance Time (s)	3.0	3.0			3.0	3.0		3.0	3.0			
Vehicle Extension (s)	3.0	3.0			3.0	3.0		3.0	3.0			
Lane Grp Cap (vph)	62	1282			1093	902		315	274			
v/s Ratio Prot	c0.03	0.16			c0.27							
v/s Ratio Perm						0.17		0.07	0.12			
v/c Ratio	0.82	0.23			0.46	0.19		0.40	0.66			
Uniform Delay, d1	28.8	3.5			7.0	5.8		21.8	22.9			
Progression Factor	1.01	0.03			1.00	1.41		1.00	1.00			
Incremental Delay, d2	56.0	0.4			1.0	0.3		0.8	5.6			
Delay (s)	84.9	0.5			8.0	8.5		22.6	28.5			
Level of Service	F	A			A	A		C	C			
Approach Delay (s)		13.0			8.2			26.1			0.0	
Approach LOS		B			A			C			A	

Intersection Summary			
HCM Average Control Delay	13.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	45.2%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	1.00	1.00	0.95		1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00		1.00	1.00		1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.97		1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	1863	1556	1770	3418		1770	3436		1770	3539	1537
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	1863	1556	1770	3418		1770	3436		1770	3539	1537
Volume (vph)	145	85	206	81	301	77	295	166	32	36	82	114
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	158	92	224	88	327	84	321	180	35	39	89	124
RTOR Reduction (vph)	0	0	177	0	38	0	0	23	0	0	0	0
Lane Group Flow (vph)	158	92	47	88	373	0	321	192	0	39	89	124
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Turn Type	Split		Perm	Split			Prot			Prot		Perm
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases			4									6
Actuated Green, G (s)	12.5	12.5	12.5	9.7	9.7		16.4	22.4		2.4	8.4	8.4
Effective Green, g (s)	12.5	12.5	12.5	8.7	8.7		15.4	21.4		1.4	7.4	7.4
Actuated g/C Ratio	0.21	0.21	0.21	0.14	0.14		0.26	0.36		0.02	0.12	0.12
Clearance Time (s)	4.0	4.0	4.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	715	388	324	257	496		454	1226		41	436	190
v/s Ratio Prot	0.05	0.05		0.05	c0.12		c0.18	0.06		0.02	0.03	
v/s Ratio Perm			0.14									0.08
v/c Ratio	0.22	0.24	0.14	0.34	0.75		0.71	0.16		0.95	0.20	0.65
Uniform Delay, d1	19.7	19.8	19.4	23.1	24.6		20.3	13.2		29.3	23.7	25.1
Progression Factor	0.79	0.79	1.11	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	0.7	1.4	0.9	0.8	6.3		5.0	0.1		121.0	0.2	7.8
Delay (s)	16.2	17.0	22.4	23.9	30.9		25.2	13.2		150.2	23.9	32.9
Level of Service	B	B	C	C	C		C	B		F	C	C
Approach Delay (s)		19.3			29.7			20.4			47.9	
Approach LOS		B			C			C			D	

Intersection Summary			
HCM Average Control Delay	26.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	52.4%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0					4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00					1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	0.97	1.00	0.98					1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00					1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.91					1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00					0.95	1.00	1.00
Satd. Flow (prot)	1770	1863	1535	1770	1668					1770	1863	1535
Flt Permitted	0.95	1.00	1.00	0.95	1.00					0.95	1.00	1.00
Satd. Flow (perm)	1770	1863	1535	1770	1668					1770	1863	1535
Volume (vph)	82	189	68	201	208	294	0	0	0	173	146	78
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	89	205	74	218	226	320	0	0	0	188	159	85
RTOR Reduction (vph)	0	0	39	0	54	0	0	0	0	0	0	71
Lane Group Flow (vph)	89	205	35	218	492	0	0	0	0	188	159	14
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Turn Type	Prot		Perm	Prot						Split		Perm
Protected Phases	7	4		3	8					6	6	
Permitted Phases			4									6
Actuated Green, G (s)	7.2	34.5	34.5	14.0	41.3					12.5	12.5	12.5
Effective Green, g (s)	6.2	33.5	33.5	13.0	40.3					11.5	11.5	11.5
Actuated g/C Ratio	0.09	0.48	0.48	0.19	0.58					0.16	0.16	0.16
Clearance Time (s)	3.0	3.0	3.0	3.0	3.0					3.0	3.0	3.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0					3.0	3.0	3.0
Lane Grp Cap (vph)	157	892	735	329	960					291	306	252
v/s Ratio Prot	c0.05	0.11		c0.12	c0.33					c0.11	0.09	
v/s Ratio Perm			0.05									0.06
v/c Ratio	0.57	0.23	0.05	0.66	0.51					0.65	0.52	0.06
Uniform Delay, d1	30.6	10.7	9.7	26.5	8.9					27.3	26.7	24.7
Progression Factor	1.00	1.00	1.00	0.82	0.88					1.00	1.00	1.00
Incremental Delay, d2	4.6	0.6	0.1	4.9	1.9					4.9	1.5	0.1
Delay (s)	35.2	11.3	9.9	26.5	9.8					32.2	28.2	24.8
Level of Service	D	B	A	C	A					C	C	C
Approach Delay (s)		16.8			14.5			0.0			29.3	
Approach LOS		B			B			A			C	

Intersection Summary			
HCM Average Control Delay	19.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	53.4%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑	↑↑		↖	↗
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	4.0
Lane Util. Factor		1.00	0.95		1.00	1.00
Frpb, ped/bikes		1.00	1.00		1.00	0.97
Flpb, ped/bikes		1.00	1.00		1.00	1.00
Frt		1.00	1.00		1.00	0.85
Flt Protected		1.00	1.00		0.95	1.00
Satd. Flow (prot)		1863	3539		1770	1535
Flt Permitted		1.00	1.00		0.95	1.00
Satd. Flow (perm)		1863	3539		1770	1535
Volume (vph)	0	362	627	0	145	76
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	393	682	0	158	83
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	393	682	0	158	83
Confl. Peds. (#/hr)	5			5	5	5
Turn Type						Perm
Protected Phases		4	8		6	
Permitted Phases						6
Actuated Green, G (s)		52.1	52.1		10.9	10.9
Effective Green, g (s)		51.1	51.1		10.9	10.9
Actuated g/C Ratio		0.73	0.73		0.16	0.16
Clearance Time (s)		3.0	3.0		4.0	4.0
Vehicle Extension (s)		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)		1360	2583		276	239
v/s Ratio Prot		c0.21	0.19		c0.09	
v/s Ratio Perm						0.05
v/c Ratio		0.29	0.26		0.57	0.35
Uniform Delay, d1		3.2	3.2		27.4	26.4
Progression Factor		0.91	1.98		1.00	1.00
Incremental Delay, d2		0.5	0.2		2.9	0.9
Delay (s)		3.5	6.5		30.2	27.3
Level of Service		A	A		C	C
Approach Delay (s)		3.5	6.5		29.2	
Approach LOS		A	A		C	

Intersection Summary			
HCM Average Control Delay	9.7	HCM Level of Service	A
HCM Volume to Capacity ratio	0.34		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	58.4%	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												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0	4.0		4.0	4.0			
Lane Util. Factor	1.00	1.00			1.00	1.00		1.00	1.00			
Frpb, ped/bikes	1.00	1.00			1.00	0.97		1.00	0.97			
Flpb, ped/bikes	1.00	1.00			1.00	1.00		0.99	1.00			
Frt	1.00	1.00			1.00	0.85		1.00	0.85			
Flt Protected	0.95	1.00			1.00	1.00		0.95	1.00			
Satd. Flow (prot)	1770	1863			1863	1535		1764	1535			
Flt Permitted	0.95	1.00			1.00	1.00		0.95	1.00			
Satd. Flow (perm)	1770	1863			1863	1535		1764	1535			
Volume (vph)	83	424	0	0	412	335	215	4	467	0	0	0
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	90	461	0	0	448	364	234	4	508	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	143	0	0	61	0	0	0
Lane Group Flow (vph)	90	461	0	0	448	221	0	238	447	0	0	0
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Turn Type	Prot					Perm	Perm		Perm			
Protected Phases	7	4			8			2				
Permitted Phases						8	2		2			
Actuated Green, G (s)	5.6	40.1			31.5	31.5		23.9	23.9			
Effective Green, g (s)	4.6	39.1			30.5	30.5		22.9	22.9			
Actuated g/C Ratio	0.07	0.56			0.44	0.44		0.33	0.33			
Clearance Time (s)	3.0	3.0			3.0	3.0		3.0	3.0			
Vehicle Extension (s)	3.0	3.0			3.0	3.0		3.0	3.0			
Lane Grp Cap (vph)	116	1041			812	669		577	502			
v/s Ratio Prot	c0.05	0.25			c0.24							
v/s Ratio Perm						0.24		0.13	0.33			
v/c Ratio	0.78	0.44			0.55	0.33		0.41	0.89			
Uniform Delay, d1	32.2	9.1			14.7	13.0		18.3	22.4			
Progression Factor	1.06	1.17			0.51	0.72		1.00	1.00			
Incremental Delay, d2	26.5	1.3			1.7	0.8		0.5	17.8			
Delay (s)	60.6	11.9			9.1	10.3		18.8	40.1			
Level of Service	E	B			A	B		B	D			
Approach Delay (s)		19.8			9.6			33.3			0.0	
Approach LOS		B			A			C			A	

Intersection Summary			
HCM Average Control Delay	20.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	58.4%	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												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	1.00	1.00	0.95		1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00		1.00	0.99		1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.96		1.00	0.96		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	1863	1554	1770	3388		1770	3357		1770	3539	1535
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	1863	1554	1770	3388		1770	3357		1770	3539	1535
Volume (vph)	376	249	266	37	164	56	350	332	133	144	188	233
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	409	271	289	40	178	61	380	361	145	157	204	253
RTOR Reduction (vph)	0	0	222	0	48	0	0	61	0	0	0	0
Lane Group Flow (vph)	409	271	67	40	191	0	380	445	0	157	204	253
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Turn Type	Split		Perm	Split			Prot			Prot		Perm
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases			4									6
Actuated Green, G (s)	16.2	16.2	16.2	6.0	6.0		18.9	25.5		9.3	15.9	15.9
Effective Green, g (s)	16.2	16.2	16.2	5.0	5.0		17.9	24.5		8.3	14.9	14.9
Actuated g/C Ratio	0.23	0.23	0.23	0.07	0.07		0.26	0.35		0.12	0.21	0.21
Clearance Time (s)	4.0	4.0	4.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	794	431	360	126	242		453	1175		210	753	327
v/s Ratio Prot	0.12	0.15		0.02	c0.07		c0.21	0.15		0.09	0.06	
v/s Ratio Perm			0.19									0.16
v/c Ratio	0.52	0.63	0.19	0.32	0.79		0.84	0.38		0.75	0.27	0.77
Uniform Delay, d1	23.5	24.2	21.6	30.9	32.0		24.7	17.0		29.8	23.0	26.0
Progression Factor	1.02	1.02	1.69	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	1.9	5.4	0.9	1.5	15.5		12.8	0.2		13.5	0.2	10.9
Delay (s)	25.8	30.0	37.4	32.3	47.5		37.5	17.3		43.4	23.2	36.8
Level of Service	C	C	D	C	D		D	B		D	C	D
Approach Delay (s)		30.5			45.3			25.9			34.0	
Approach LOS		C			D			C			C	

Intersection Summary			
HCM Average Control Delay	31.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	57.4%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

MRO ENGINEERS

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Memorandum

TO: Richard Moorehead, Placer County Department of Public Works
Loren Clark, Placer County Planning Department
Michael Wells, Placer County Planning Department

COPY: Ron Mauck, Quad Knopf
Kim Hudson, Quad Knopf

FROM: Melissa K. Lincoln
Neal K. Liddicoat

DATE: September 7, 2006

SUBJECT: Foresthill Divide Community Plan Traffic Analysis Trip Generation Rates

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As we resume work on the Foresthill Divide Community Plan traffic analysis, we are evaluating the trip generation rates used in previous analyses in the Foresthill Community, to determine their appropriateness for the current effort. Based on this process, we have developed a set of recommended trip generation rates, which are presented in this memorandum for your review and approval.

One key issue in this regard is the degree to which the trip generation rates used in the current analysis should be consistent with the trip generation rates developed by kdANDERSON Transportation Engineers for the *Foresthill Community Plan DEIR Transportation and Circulation Element* (April 8, 2003) and the *Forest Ranch DEIR Transportation and Circulation Element* (September 30, 2003). Although some aspects of the trip rates derived for the previous analyses remain valid, review of these two documents indicated the need to revise the trip generation rates to reflect more recent information. Specifically, the trip rates presented in this memo are based on the most current edition of the Institute of Transportation Engineers (ITE) *Trip Generation* manual (Seventh Edition, 2003), as well as on traffic volume data collected in Foresthill as part of the current analysis.

Additionally, the kdANDERSON trip generation rates reflected only daily conditions and, for the non-residential land uses, were typically stated in terms of "trips per acre." The current traffic analysis will address AM and PM peak-hour conditions at selected study intersections in addition to daily conditions on key roadway segments; thus, peak hour trip rates are also needed. Moreover, at our request, the Foresthill land use projections for the non-residential uses provide building square footage, rather than acreage. Therefore, it is necessary to have trip rates in terms of "trips per 1,000 square feet." Finally, many of the kdAnderson rates were derived assuming quite different floor area ratios (FAR) than the values assumed in developing the land use projections to be incorporated into the current analysis. For example, the previous Foresthill Divide Community Plan traffic analysis used a trip rate based on the assumption that retail development would occur at a FAR of 0.10, whereas the current FAR assumption is 0.23. Similarly, the previous traffic analysis assumed that office/business professional land uses would develop at a FAR of 0.05, while the current assumption is 0.25. Consequently, for the reasons stated above, the previous trip generation rates would no longer apply.

Rural Conditions Adjustment Factor

In the previous Foresthill Community Plan traffic study, an 80 percent adjustment factor was applied to all of the daily trip generation rates to account for the rural conditions of the Foresthill Community. This adjustment was based on the approach incorporated into the Placer County travel demand forecasting model. (According to the Forest Ranch traffic report, only the residential land uses were subject to this adjustment in that analysis.) Our approach to application of this adjustment factor is presented for each land use in the following paragraphs.

MRO ENGINEERS

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Memorandum

Recommended Trip Generation Rates

The attached table presents the trip generation rates recommended for use in the current Foresthill Divide Community Plan Traffic Analysis. Each land use category is briefly discussed below.

- ***Single-family Residential*** – The single-family residential trip generation rates for daily and peak-hour conditions were derived directly from existing traffic counts for the Todd Valley area and, therefore, no adjustment was needed to account for rural conditions. The daily trip rate is about nine percent lower than the rate used in the previous analysis.
- ***Multi-family Residential*** – These rates are based on adjusting the single-family residential rate presented above to reflect the travel demand relationship between the two types of residential land uses, according to the Placer County traffic model. The model's trip rates indicate that multi-family uses generate about 72 percent as many trips as single-family uses. Thus, the single-family residential rates were multiplied by 0.72 to derive the multi-family rates. Again, no further adjustment was necessary, as the rates are based on data collected in Foresthill. As with the single-family residential, this daily trip rate is about nine percent lower than the previously-used rate.
- ***Senior Adult Housing*** – The 80 percent "rural conditions" adjustment was applied to the rates presented in the current ITE *Trip Generation* manual to derive these rates. The recommended daily rate is slightly higher than the previous rate, which was taken from the Bickford Ranch analysis (i.e., 2.97 trips/DU recommended vs. 2.94 trips/DU previously used).
- ***Retail*** – The recommended rate reflects application of the 80 percent rural conditions factor to the average "specialty retail" rate in the ITE *Trip Generation* manual. This is generally consistent with the derivation of the previously-used rate although, as noted above, the previous analysis assumed a much lower retail FAR. The current assumption (FAR = 0.23) suggests a level of development intensity that is not substantially different from the suburban retail development patterns reflected in the ITE data; therefore, no further adjustment is believed to be necessary, beyond that described above. The previous Foresthill Divide Community Plan analysis also included a 20 percent pass-by trip adjustment in connection with the retail land uses. While this strikes us as a reasonable assumption, we would like confirmation that this factor is acceptable to County staff.
- ***Office*** – The recommended office/business professional trip rates are similar to the retail rates, in that they represent adjustment of the ITE "general office" rates to reflect rural conditions. Again, the previous analysis assumed a much lower FAR than is currently being considered (which approximates the typical suburban development FAR reflected in the ITE data), so no further adjustment is needed. (The previous Forest Ranch analysis indicated that medical/dental offices were proposed as part of that project. If so, different trip rates are needed, as such uses generate substantially more traffic than general office.)
- ***Industrial*** – The ITE "industrial park" rates were modified using the County's 80 percent "rural conditions" adjustment.
- ***High School and Elementary School*** – The recommended high school and elementary school trip generation rates represent the average rates presented in the ITE *Trip Generation* manual; no "rural conditions" factoring was applied.

Please review these recommended trip generation rates, and let us know in the next week if you have any questions or need further clarifications.

Thank you for your input.

Table 1
Recommended Trip Generation Rates
Foresthill Divide Community Plan Traffic Analysis

Land Use	Trip Generation Unit	Daily Trip Rate	AM Peak Hour Trip Rate			PM Peak Hour Trip Rate		
			In	Out	Total	In	Out	Total
Single-Family Residential	Trips/DU[1]	5.07	0.10	0.36	0.46	0.33	0.16	0.49
Multi-Family Residential	Trips/DU	3.66	0.05	0.22	0.27	0.22	0.11	0.33
Senior Adult Housing (Retirement Community)	Trips/DU	2.97	0.06	0.10	0.16	0.13	0.08	0.21
Retail	Trips/1,000 SF[2]	35.5	0.37	0.23	0.60	0.95	1.22	2.17
Office/Business Professional	Trips/1,000 SF	8.81	1.09	0.15	1.24	0.20	0.99	1.19
Industrial	Trips/1,000 SF	5.57	0.55	0.12	0.67	0.14	0.55	0.69
High School	Trips/ Student	1.71	0.28	0.13	0.41	0.07	0.07	0.14
Elementary School	Trips/ Student	1.29	0.23	0.19	0.42	0.07	0.07	0.14

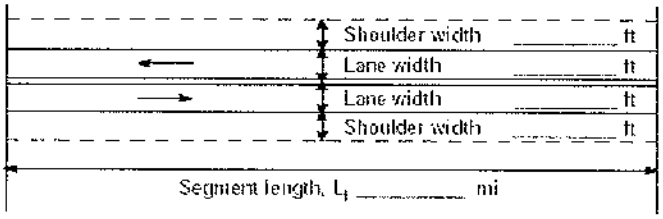
Notes:
[1] Dwelling unit
[2] Square feet

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - Eastbound
Agency or Company	MRO Engineers, Inc.	From/To	Bridge to Spring Garden Road
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	AM Peak Hour	Analysis Year	Year 2030 Without Forest Ranch

Project Description: *Foresthill Divide Community Plan*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☐ Level ☐ Rolling

Grade Length 4.00 mi Up/down 3.0

Peak-hour factor, PHF 0.88

No-passing zone 55%

% Trucks and Buses, P_T 6 %

% Recreational vehicles, P_R 2%

Access points/ mi 2

Analysis direction vol., V_d 253veh/h

Opposing direction vol., V_o 888veh/h

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	7.5	1.1
Passenger-car equivalents for RVs, E_R (Exhibit 20-9 or 20-17)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.719	0.994
Grade adjustment factor [1], f_G (Exhibit 20-7 or 20-13)	0.94	1.00
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV}*f_G)$	425	1015

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field measured speed[3], S_{FM}	mi/h	Base free-flow speed[3], $BFFS_{FM}$	60.0 mi/h
Observed volume[3], V_f	veh/h	Adj. for lane width and shoulder width,[3] f_{LS}(Exh 20-5)	0.0 mi/h
Free-flow speed, FFS_d $FFS=S_{FM}+0.00776(V_f/f_{HV})$	mi/h	Adj. for access points[3], f_A (Exhibit 20-5)	0.5 mi/h
Adjustment for no-passing zones, f_{np} (Exhibit 20-19)	0.8 mi/h	Free-flow speed, FFS_d $(FSS=BFFS-f_{LS}-f_A)$	59.5 mi/h
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	47.5 mi/h

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 20-10 or 20-16)	1.5	1.0
Passenger-car equivalents for RVs, E_R (Exhibit 20-10 or 20-16)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.971	1.000
Grade adjustment factor[1], f_G (Exhibit 20-8 or 20-14)	1.00	1.00
Directional flow rate[2], v_i(pc/h)$=V_i/(PHF*f_{HV}*f_G)$	296	1009
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	42.3	
Adj. for no-passing zone, f_{np} (Exhibit. 20-20)	26.6	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	48.3	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	C
Volume to capacity ratio, $v/c=V_p/1{,}700$	0.25
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)$=0.25L_t(V/PHF)$	776
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)$=V*L_t$	2732
Peak 15-min total travel time, TT_{15}(veh-h)$=VMT_{15}/ATS$	16.3

Notes

1. If the highway is extended segment (level) or rolling terrain, fG=1.0 .
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only.
4. Exhibit 20-21 provides factors a and b.
5. Use alternative Equation 20-14 if some trucks operate at crawl speeds on a specific downgrade.

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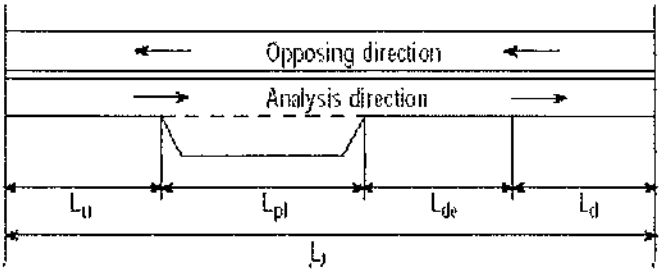
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	*MKL*	Highway of Travel	*Foresthill Road - Eastbound*
Agency or Company	*MRO Engineers, Inc.*	From/To	*Bridge to Spring Garden Road*
Date Performed	*2/27/07*	Jurisdiction	*Placer County*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*Year 2030 Without Forest Ranch*

Project Description: *Foresthill Divide Community Plan*

Input Data

☑ Class I highway ☐ Class II highway



Total length of analysis segment, L_t (*mi*)	*10.8*
Length of two-lane highway upstream of the passing lane, L_u (*mi*)	*3.0*
Length of passing lane including tapers , L_{pl} (*mi*)	*4.9*
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	*47.5*
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	*48.3*
Level of service[1], LOS_d (from Directional Two-Lane Highway Segment Worksheet)	*C*
Average Travel Speed	
Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (*mi*) (Exhibit 20-23)	*1.70*
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (*mi*) $L_d=L_t-(L_u+L_{pl}+L_{de})$	*1.20*
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 20-24)	*1.10*
Average travel speed including passing lane[2], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl}))$	*49.9*
Percent Time-Spent-Following	
Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (*mi*)(Exhibit 20-23)	*10.65*
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (*mi*)$=L_t-(L_u+L_{pl}+L_{de})$	*-7.75*
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pl} (Exhibit 20-24)	*0.58*
Percent time-spent-following including passing lane[3], $PTSF_{pl}$(%) $PTSF_{pl}= PTSF_d[L_u+L_d+f_{pl}L_{pl}+((1+f_{pl})/2)L_{de}]/L_t$	*34.4*
Level of Service and Other Performance Measures[4]	
Level of service including passing lane LOS_{pl} (Exhibit 20-3 or 20-4)	*C*
Peak 15-min total travel time, TT_{15}(veh-h) $TT_{15}= VMT_{15}/ATS_{pl}$	*15.5*

Notes

1. If LOS_d=F, passing lane analysis cannot be performed.
2. If L_d <0, use alternative Equation 20-22.
3. If L_d<0, use alternative Equation 20-20.
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.

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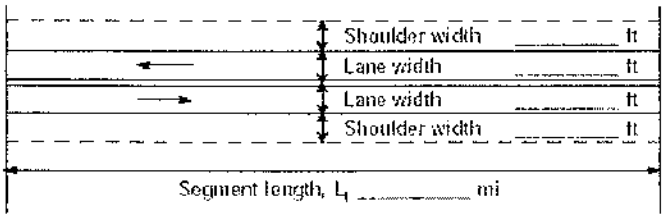
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - Westbound
Agency or Company	MRO Engineers, Inc.	From/To	Bridge to Spring Garden Road
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	AM Peak Hour	Analysis Year	Year 2030 Without Forest Ranch

Project Description: *Foresthill Divide Community Plan*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☐ Level ☐ Rolling

Grade Length 4.00 mi Up/down -3.0

Peak-hour factor, PHF 0.88

No-passing zone 88%

% Trucks and Buses, P_T 2 %

% Recreational vehicles, P_R 2%

Access points/ mi 2

Analysis direction vol., V_d 888veh/h

Opposing direction vol., V_o 253veh/h

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	1.1	7.5
Passenger-car equivalents for RVs, E_R (Exhibit 20-9 or 20-17)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.998	0.885
Grade adjustment factor [1], f_G (Exhibit 20-7 or 20-13)	1.00	0.94
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV}*f_G)$	1011	346

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field measured speed[3], S_{FM}	mi/h	Base free-flow speed[3], $BFFS_{FM}$	60.0 mi/h
Observed volume[3], V_f	veh/h	Adj. for lane width and shoulder width,[3] f_{LS}(Exh 20-5)	0.0 mi/h
Free-flow speed, FFS_d $FFS=S_{FM}+0.00776(V/f_{HV})$	mi/h	Adj. for access points[3], f_A (Exhibit 20-5)	0.5 mi/h
Adjustment for no-passing zones, f_{np} (Exhibit 20-19)	3.1 mi/h	Free-flow speed, FFS_d $(FSS=BFFS-f_{LS}-f_A)$	59 5 mi/h
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	45.8 mi/h

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 20-10 or 20-16)	1.0	1.5
Passenger-car equivalents for RVs, E_R (Exhibit 20-10 or 20-16)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	1.000	0.990
Grade adjustment factor[1], f_G (Exhibit 20-8 or 20-14)	1.00	1.00
Directional flow rate[2], v_i(pc/h)$=V_i/(PHF*f_{HV}*f_G)$	1009	290
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	71.7	
Adj. for no-passing zone, f_{np} (Exhibit 20-20)	24.1	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	90.4	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	E
Volume to capacity ratio, $v/c=V_p/1{,}700$	0.59
Peak 15-min veh-miles of travel, VMT_{15} (veh- mi)$=0.25L_t(V/PHF)$	2725
Peak-hour vehicle-miles of travel, VMT_{60}(veh- mi)$=V*L_t$	9590
Peak 15-min total travel time, TT_{15}(veh-h)$=VMT_{15}/ATS$	59.4

Notes

1. If the highway is extended segment (level) or rolling terrain, fG=1.0 .
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only.
4. Exhibit 20-21 provides factors a and b.
5. Use alternative Equation 20-14 if some trucks operate at crawl speeds on a specific downgrade.

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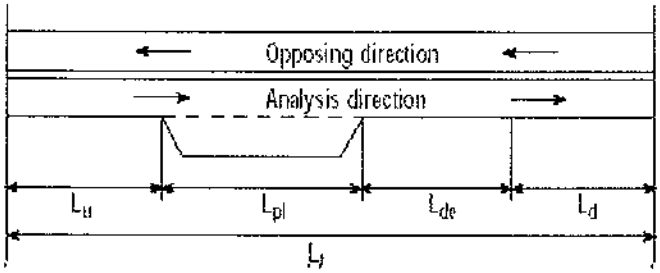
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

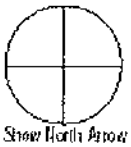
General Information		Site Information	
Analyst	MKL	Highway of Travel	Foresthill Road - Westbound
Agency or Company	MRO Engineers, Inc.	From/To	Bridge to Spring Garden Road
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	AM Peak Hour	Analysis Year	Year 2030 Without Forest Ranch

Project Description: *Foresthill Divide Community Plan*

Input Data

☑ Class I highway ☐ Class II highway





Total length of analysis segment, L_t (*mi*)	10.8
Length of two-lane highway upstream of the passing lane, L_u (*mi*)	4.8
Length of passing lane including tapers , L_{pl} (*mi*)	1.3
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	45.8
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	90.4
Level of service[1], LOS_d (from Directional Two-Lane Highway Segment Worksheet)	E
Average Travel Speed	
Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (*mi*) (Exhibit 20-23)	1.70
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (*mi*) $L_d=L_t-(L_u+L_{pl}+L_{de})$	3.00
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 20-24)	1.11
Average travel speed including passing lane[2], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl}))$)	46.8
Percent Time-Spent-Following	
Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (*mi*)(Exhibit 20-23)	3.60
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (*mi*)$=L_t-(L_u+L_{pl}+L_{de})$	1.10
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pl} (Exhibit 20-24)	0.62
Percent time-spent-following including passing lane[3], $PTSF_{pl}$(%) $PTSF_{pl}= PTSF_d[L_u+L_d+f_{pl}L_{pl}+((1+f_{pl})/2)L_{de}]/L_t$	80.5
Level of Service and Other Performance Measures[4]	
Level of service including passing lane LOS_{pl} (Exhibit 20-3 or 20-4)	E
Peak 15-min total travel time, TT_{15}(veh-h) $TT_{15}= VMT_{15}/ATS_{pl}$	58.2

Notes

1. If LOS_d=F, passing lane analysis cannot be performed.
2. If L_d <0, use alternative Equation 20-22.
3. If L_d<0, use alternative Equation 20-20.
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.

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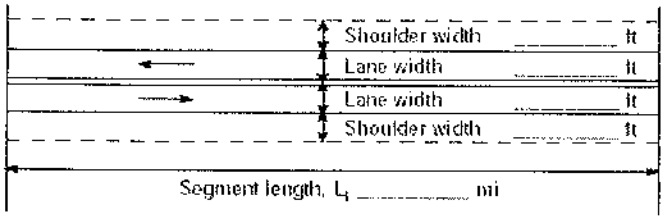
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - Eastbound
Agency or Company	MRO Engineers, Inc.	From/To	Spring Garden to Todd Valley W
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	AM Peak Hour	Analysis Year	Year 2030 Without Forest Ranch

Project Description: *Foresthill Divide Community Plan*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☐ Level ☐ Rolling

Grade Length 1.70 mi Up/down 3.4

Peak-hour factor, PHF 0.75

No-passing zone 29%

% Trucks and Buses , P_T 3 %

% Recreational vehicles, P_R 2%

Access points/ mi 4

Analysis direction vol., V_d 328veh/h

Opposing direction vol., V_o 605veh/h

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	5.7	1.1
Passenger-car equivalents for RVs, E_R (Exhibit 20-9 or 20-17)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.877	0.997
Grade adjustment factor [1], f_G (Exhibit 20-7 or 20-13)	0.98	1.00
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV}*f_G)$	508	809

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field measured speed[3], S_{FM}	mi/h	Base free-flow speed[3], $BFFS_{FM}$	60.0 mi/h
Observed volume[3], V_f	veh/h	Adj. for lane width and shoulder width,[3] f_{LS}(Exh 20-5)	0.0 mi/h
Free-flow speed, FFS_d $FFS=S_{FM}+0.00776(V_f/f_{HV})$	mi/h	Adj. for access points[3], f_A (Exhibit 20-5)	1.0 mi/h
Adjustment for no-passing zones, f_{np} (Exhibit 20-19)	0.7 mi/h	Free-flow speed, FFS_d $(FSS=BFFS-f_{LS}-f_A)$	59.0 mi/h
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	48.1 mi/h

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 20-10 or 20-16)	1.0	1.0
Passenger-car equivalents for RVs, E_R (Exhibit 20-10 or 20-16)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	1.000	1.000
Grade adjustment factor[1], f_G (Exhibit 20-8 or 20-14)	0.94	1.00
Directional flow rate[2], v_i(pc/h)$=V_i/(PHF*f_{HV}*f_G)$	463	807
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	52.7	
Adj. for no-passing zone, f_{np} (Exhibit. 20-20)	22.5	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	60.9	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	C
Volume to capacity ratio, $v/c=V_p/1{,}700$	0.30
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)$=0.25L_t(V/PHF)$	186
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)$=V*L_t$	558
Peak 15-min total travel time, TT_{15}(veh-h)$=VMT_{15}/ATS$	3.9

Notes

1. If the highway is extended segment (level) or rolling terrain, fG=1.0 .
2. If v_i(v_d or v_o) >=1,700 pc/h, terminale analysis--the LOS is F.
3. For the analysis direction only.
4. Exhibit 20-21 provides factors a and b.
5. Use alternative Equation 20-14 if some trucks operate at crawl speeds on a specific downgrade.

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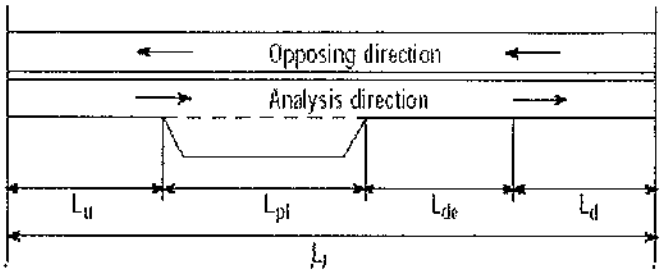
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	*MKL*	Highway of Travel	*Foresthill Road - Eastbound*
Agency or Company	*MRO Engineers, Inc.*	From/To	*Spring Garden to Todd Valley W*
Date Performed	*2/27/07*	Jurisdiction	*Placer County*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*Year 2030 Without Forest Ranch*

Project Description: *Foresthill Divide Community Plan*

Input Data

☑ Class I highway ☐ Class II highway



Total length of analysis segment, L_t (*mi*)	*1.7*
Length of two-lane highway upstream of the passing lane, L_u (*mi*)	*0.3*
Length of passing lane including tapers , L_{pl} (*mi*)	*1.2*
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	*48.1*
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	*60.9*
Level of service[1], LOS_d (from Directional Two-Lane Highway Segment Worksheet)	*C*
Average Travel Speed	
Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (*mi*) (Exhibit 20-23)	*1.70*
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (*mi*) $L_d=L_t-(L_u+L_{pl}+L_{de})$	*-1.50*
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 20-24)	*1.10*
Average travel speed including passing lane[2], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl})))$	*51.9*
Percent Time-Spent-Following	
Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (*mi*)(Exhibit 20-23)	*7.60*
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (*mi*)$=L_t-(L_u+L_{pl}+L_{de})$	*-7.40*
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pl} (Exhibit 20-24)	*0.61*
Percent time-spent-following including passing lane[3], $PTSF_{pl}$(%) $PTSF_{pl}= PTSF_d[L_u+L_d+f_{pl}L_{pl}+((1+f_{pl})/2)L_{de}]/L_t$	*41.4*
Level of Service and Other Performance Measures[4]	
Level of service including passing lane LOS_{pl} (Exhibit 20-3 or 20-4)	*B*
Peak 15-min total travel time, TT_{15}(veh-h) $TT_{15}= VMT_{15}/ATS_{pl}$	*3.6*

Notes

1. If LOS_d=F, passing lane analysis cannot be performed.
2. If L_d <0, use alternative Equation 20-22.
3. If L_d<0, use alternative Equation 20-20.
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.

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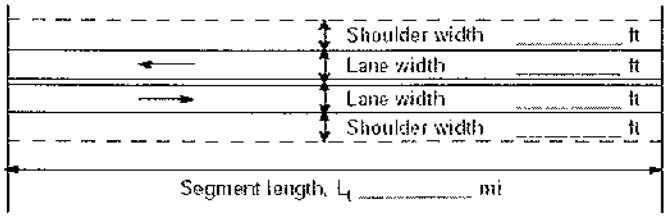
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - Westbound
Agency or Company	MRO Engineers, Inc.	From/To	Spring Garden to Todd Valley W
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	AM Peak Hour	Analysis Year	Year 2030 Without Forest Ranch

Project Description: *Foresthill Divide Community Plan*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☐ Level ☑ Rolling

Grade Length 1.70 mi Up/down -3.4

Peak-hour factor, PHF 0.88

No-passing zone 100%

% Trucks and Buses, P_T 2 %

% Recreational vehicles, P_R 2%

Access points/ mi 5

Analysis direction vol., V_d 605veh/h

Opposing direction vol., V_o 328veh/h

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	1.1	5.7
Passenger-car equivalents for RVs, E_R (Exhibit 20-9 or 20-17)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.998	0.915
Grade adjustment factor [1], f_G (Exhibit 20-7 or 20-13)	1.00	0.98
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV}*f_G)$	689	415

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field measured speed[3], S_{FM}	mi/h	Base free-flow speed[3], $BFFS_{FM}$	60.0 mi/h
Observed volume[3], V_f	veh/h	Adj. for lane width and shoulder width,[3] f_{LS}(Exh 20-5)	0.0 mi/h
Free-flow speed, FFS_d $FFS=S_{FM}+0.00776(V_f/f_{HV})$	mi/h	Adj. for access points[3], f_A (Exhibit 20-5)	1.3 mi/h
Adjustment for no-passing zones, f_{np} (Exhibit 20-19)	2.8 mi/h	Free-flow speed, FFS_d $(FSS=BFFS-f_{LS}-f_A)$	58.8 mi/h
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	47.4 mi/h

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 20-10 or 20-16)	1.0	1.0
Passenger-car equivalents for RVs, E_R (Exhibit 20-10 or 20-16)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	1.000	1.000
Grade adjustment factor[1], f_G (Exhibit 20-8 or 20-14)	1.00	0.94
Directional flow rate[2], v_i(pc/h)$=V_i/(PHF*f_{HV}*f_G)$	688	395
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	59.9	
Adj. for no-passing zone, f_{np} (Exhibit, 20-20)	33.1	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	80.9	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	E
Volume to capacity ratio, $v/c=V_p/1{,}700$	0.41
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)$=0.25L_t(V/PHF)$	292
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)$=V*L_t$	1029
Peak 15-min total travel time, TT_{15}(veh-h)$=VMT_{15}/ATS$	6.2

Notes

1. If the highway is extended segment (level) or rolling terrain, fG=1.0 .
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only.
4. Exhibit 20-21 provides factors a and b.
5. Use alternative Equation 20-14 if some trucks operate at crawl speeds on a specific downgrade.

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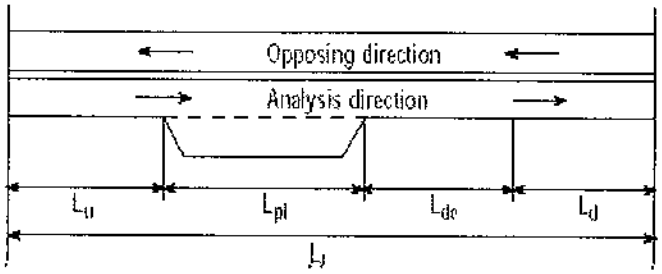
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway of Travel	Foresthill Road - Westbound
Agency or Company	MRO Engineers, Inc.	From/To	Spring Garden to Todd Valley W
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	AM Peak Hour	Analysis Year	Year 2030 Without Forest Ranch

Project Description: *Foresthill Divide Community Plan*

Input Data

☑ Class I highway ☐ Class II highway



Total length of analysis segment, L_t (*mi*)	1.7
Length of two-lane highway upstream of the passing lane, L_u (*mi*)	1.7
Length of passing lane including tapers , L_{pl} (*mi*)	0.0
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	47.4
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	80.9
Level of service[1], LOS_d (from Directional Two-Lane Highway Segment Worksheet)	E
Average Travel Speed	
Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (*mi*) (Exhibit 20-23)	1.70
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (*mi*) $L_d=L_t-(L_u+L_{pl}+L_{de})$	-1.70
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 20-24)	1.11
Average travel speed including passing lane[2], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl})))$	
Percent Time-Spent-Following	
Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (*mi*)(Exhibit 20-23)	5.80
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (*mi*)$=L_t-(L_u+L_{pl}+L_{de})$	-5.80
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pt} (Exhibit 20-24)	0.62
Percent time-spent-following including passing lane[3], $PTSF_{pl}$(%) $PTSF_{pl}= PTSF_d[L_u+L_d+f_{pt}L_{pl}+\{(1+f_{pt})/2\}L_{de}]/L_t$	80.9
Level of Service and Other Performance Measures[4]	
Level of service including passing lane LOS_{pl} (Exhibit 20-3 or 20-4)	
Peak 15-min total travel time, TT_{15}(veh-h) $TT_{15}= VMT_{15}/ATS_{pl}$	

Notes

1. If LOS_d=F, passing lane analysis cannot be performed.
2. If L_d <0, use alternative Equation 20-22.
3. If L_d<0, use alternative Equation 20-20.
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.

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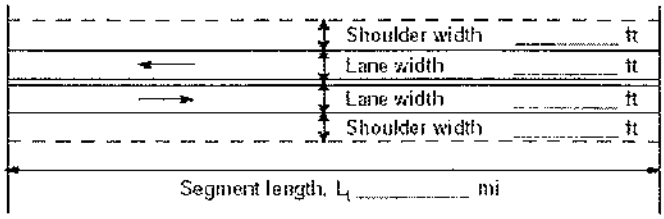
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - Eastbound
Agency or Company	MRO Engineers, Inc.	From/To	Todd Valley W to Owl Hill Ct
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	AM Peak Hour	Analysis Year	Year 2030 Without Forest Ranch

Project Description: Foresthill Divide Community Plan

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☐ Level ☐ Rolling

Grade Length 1.20 mi Up/down 3.0

Peak-hour factor, PHF 0.59

No-passing zone 17%

% Trucks and Buses, P_T 2 %

% Recreational vehicles, P_R 2%

Access points/ mi 3

Analysis direction vol., V_d 353veh/h

Opposing direction vol., V_o 481veh/h

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	5.0	1.1
Passenger-car equivalents for RVs, E_R (Exhibit 20-9 or 20-17)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.926	0.998
Grade adjustment factor [1], f_G (Exhibit 20-7 or 20-13)	1.00	1.00
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV}*f_G)$	646	817

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field measured speed[3], S_{FM}	mi/h	Base free-flow speed[3], $BFFS_{FM}$	60.0 mi/h
Observed volume[3], V_f	veh/h	Adj. for lane width and shoulder width,[3] f_{LS}(Exh 20-5)	0.0 mi/h
Free-flow speed, FFS_d $FFS=S_{FM}+0.00776(V_f/f_{HV})$	mi/h	Adj. for access points[3], f_A (Exhibit 20-5)	0.8 mi/h
Adjustment for no-passing zones, f_{np} (Exhibit 20-19)	0.6 mi/h	Free-flow speed, FFS_d $(FSS=BFFS-f_{LS}-f_A)$	59.3 mi/h
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	47.3 mi/h

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 20-10 or 20-16)	1.0	1.0
Passenger-car equivalents for RVs, E_R (Exhibit 20-10 or 20-16)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	1.000	1.000
Grade adjustment factor[1], f_G (Exhibit 20-8 or 20-14)	0.93	1.00
Directional flow rate[2], v_i(pc/h)$=V_i/(PHF*f_{HV}*f_G)$	641	815
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	62.7	
Adj. for no-passing zone, f_{np} (Exhibit 20-20)	17.4	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	70.3	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	D
Volume to capacity ratio, $v/c=V_p/1{,}700$	0.38
Peak 15-min veh-miles of travel, VMT_{15} (veh- mi)$=0.25L_t(V/PHF)$	179
Peak-hour vehicle-miles of travel, VMT_{60}(veh- mi)$=V*L_t$	424
Peak 15-min total travel time, TT_{15}(veh-h)$=VMT_{15}/ATS$	3.8

Notes

1. If the highway is extended segment (level) or rolling terrain, fG=1.0 .
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only.
4. Exhibit 20-21 provides factors a and b.
5. Use alternative Equation 20-14 if some trucks operate at crawl speeds on a specific downgrade.

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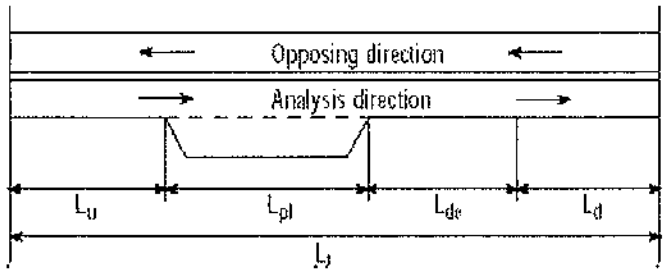
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	*MKL*	Highway of Travel	*Foresthill Road - Eastbound*
Agency or Company	*MRO Engineers, Inc*	From/To	*Todd Valley W to Owl Hill Ct*
Date Performed	*2/27/07*	Jurisdiction	*Placer County*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*Year 2030 Without Forest Ranch*

Project Description: *Foresthill Divide Community Plan*

Input Data

☑ Class I highway ☐ Class II highway



Total length of analysis segment, L_t (*mi*)	*1.2*
Length of two-lane highway upstream of the passing lane, L_u (*mi*)	*0.1*
Length of passing lane including tapers , L_{pl} (*mi*)	*1.0*
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	*47.3*
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	*70.3*
Level of service[1], LOS_d (from Directional Two-Lane Highway Segment Worksheet)	*D*
Average Travel Speed	
Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (*mi*) (Exhibit 20-23)	*1.70*
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (*mi*) $L_d=L_t-(L_u+L_{pl}+L_{de})$	*-1.60*
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 20-24)	*1.11*
Average travel speed including passing lane[2], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+\{2L_{de}/(1+f_{pl})\})$	*52.0*
Percent Time-Spent-Following	
Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (*mi*)(Exhibit 20-23)	*6.17*
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (*mi*)$=L_t-(L_u+L_{pl}+L_{de})$	*-6.07*
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pl} (Exhibit 20-24)	*0.62*
Percent time-spent-following including passing lane[3], $PTSF_{pl}$(%) $PTSF_{pl}= PTSF_d[L_u+L_d+f_{pl}L_{pl}+((1+f_{pl})/2)L_{de}]/L_t$	*45.8*
Level of Service and Other Performance Measures[4]	
Level of service including passing lane LOS_{pl} (Exhibit 20-3 or 20-4)	*B*
Peak 15-min total travel time, TT_{15}(veh-h) $TT_{15}= VMT_{15}/ATS_{pl}$	*3.4*

Notes

1. If LOS_d=F, passing lane analysis cannot be performed.
2. If L_d <0, use alternative Equation 20-22.
3. If L_d<0, use alternative Equation 20-20.
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.

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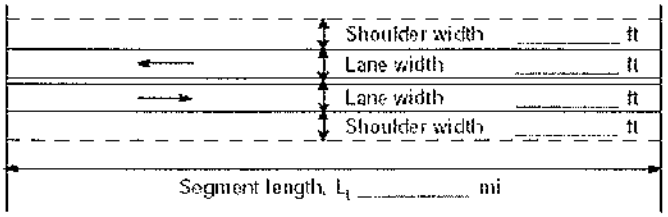
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - Westbound
Agency or Company	MRO Engineers, Inc.	From/To	Todd Valley W to Owl Hill Ct.
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	AM Peak Hour	Analysis Year	Year 2030 Without Forest Ranch

Project Description: *Foresthill Divide Community Plan*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☐ Level ☐ Rolling

Grade Length 1.20 mi Up/down -3.0

Peak-hour factor, PHF 0.79

No-passing zone 100%

% Trucks and Buses , P_T 2 %

% Recreational vehicles, P_R 2%

Access points/ mi 4

Analysis direction vol., V_d 481veh/h

Opposing direction vol., V_o 353veh/h

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	1.1	5.0
Passenger-car equivalents for RVs, E_R (Exhibit 20-9 or 20-17)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.998	0.927
Grade adjustment factor [1], f_G (Exhibit 20-7 or 20-13)	1.00	1.00
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV}*f_G)$	610	484

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field measured speed[3], S_{FM}	mi/h	Base free-flow speed[3], $BFFS_{FM}$	60.0 mi/h
Observed volume[3], V_f	veh/h	Adj. for lane width and shoulder width,[3] f_{LS}(Exh 20-5)	0.0 mi/h
Free-flow speed, FFS_d $FFS=S_{FM}+0.00776(V_f/f_{HV})$	mi/h	Adj. for access points[3], f_A (Exhibit 20-5)	1.0 mi/h
Adjustment for no-passing zones, f_{np} (Exhibit 20-19)	2.5 mi/h	Free-flow speed, FFS_d $(FSS=BFFS-f_{LS}-f_A)$	59.0 mi/h
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	48.0 mi/h

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 20-10 or 20-16)	1.0	1.0
Passenger-car equivalents for RVs, E_R (Exhibit 20-10 or 20-16)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	1.000	1.000
Grade adjustment factor[1], f_G (Exhibit 20-8 or 20-14)	1.00	0.93
Directional flow rate[2], v_i(pc/h)$=V_i/(PHF*f_{HV}*f_G)$	609	478
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	57.5	
Adj. for no-passing zone, f_{np} (Exhibit. 20-20)	36.0	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	77.7	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	D
Volume to capacity ratio, $v/c=V_p/1{,}700$	0.36
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)$=0.25L_t(V/PHF)$	183
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)$=V*L_t$	577
Peak 15-min total travel time, TT_{15}(veh-h)$=VMT_{15}/ATS$	3.8

Notes

1. If the highway is extended segment (level) or rolling terrain, fG=1.0 .
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only.
4. Exhibit 20-21 provides factors a and b.
5. Use alternative Equation 20-14 if some trucks operate at crawl speeds on a specific downgrade.

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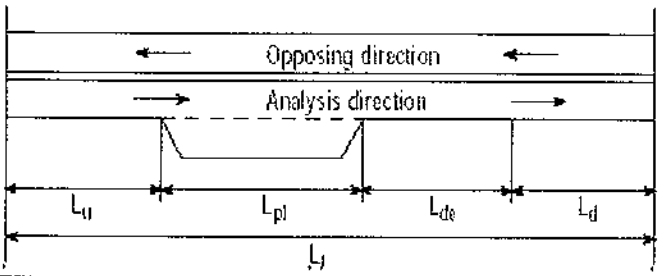
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway of Travel	Foresthill Road - Westbound
Agency or Company	MRO Engineers, Inc.	From/To	Todd Valley W to Owl Hill Ct.
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	AM Peak Hour	Analysis Year	Year 2030 Without Forest Ranch

Project Description: Foresthill Divide Community Plan

Input Data

☑ Class I highway ☐ Class II highway



Total length of analysis segment, L_t (*mi*)	1.2
Length of two-lane highway upstream of the passing lane, L_u (*mi*)	1.2
Length of passing lane including tapers , L_{pl} (*mi*)	0.0
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	48.0
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	77.7
Level of service[1], LOS_d (from Directional Two-Lane Highway Segment Worksheet)	D
Average Travel Speed	
Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (*mi*) (Exhibit 20-23)	1.70
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (*mi*) $L_d=L_t-(L_u+L_{pl}+L_{de})$	-1.70
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 20-24)	1.11
Average travel speed including passing lane[2], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl}))$)	
Percent Time-Spent-Following	
Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (*mi*)(Exhibit 20-23)	6.43
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (*mi*)$=L_t-(L_u+L_{pl}+L_{de})$	-6.43
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pt} (Exhibit 20-24)	0.62
Percent time-spent-following including passing lane[3], $PTSF_{pl}$(%) $PTSF_{pl}= PTSF_d[L_u+L_d+f_{pt}L_{pl}+((1+f_{pt})/2)L_{de}]/L_t$	77.7
Level of Service and Other Performance Measures[4]	
Level of service including passing lane LOS_{pl} (Exhibit 20-3 or 20-4)	
Peak 15-min total travel time, TT_{15}(veh-h) $TT_{15}= VMT_{15}/ATS_{pl}$	

Notes

1. If LOS_d=F, passing lane analysis cannot be performed.
2. If L_d <0, use alternative Equation 20-22.
3. If L_d<0, use alternative Equation 20-20.
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.

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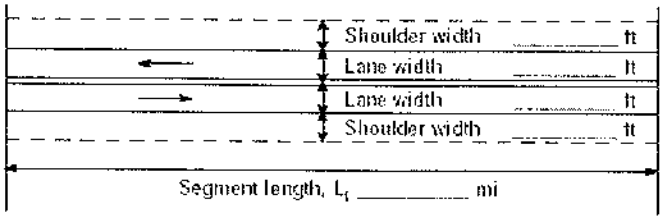
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - Eastbound
Agency or Company	MRO Engineers, Inc.	From/To	Bridge to Spring Garden Road
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	PM Peak Hour	Analysis Year	Year 2030 Without Forest Ranch

Project Description: *Foresthill Divide Community Plan*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☐ Level ☐ Rolling

Grade Length 4.00 mi Up/down 3.0

Peak-hour factor, PHF 0.88

No-passing zone 55%

% Trucks and Buses , P_T 1 %

% Recreational vehicles, P_R 2%

Access points/ mi 2

Analysis direction vol., V_d 899veh/h

Opposing direction vol., V_o 341veh/h

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	5.7	1.2
Passenger-car equivalents for RVs, E_R (Exhibit 20-9 or 20-17)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.955	0.998
Grade adjustment factor [1], f_G (Exhibit 20-7 or 20-13)	0.95	1.00
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV}*f_G)$	1126	388

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field measured speed[3], S_{FM}	mi/h	Base free-flow speed[3], $BFFS_{FM}$	60.0 mi/h
Observed volume[3], V_f	veh/h	Adj. for lane width and shoulder width,[3] f_{LS}(Exh 20-5)	0.0 mi/h
Free-flow speed, FFS_d $FFS=S_{FM}+0.00776(V_f/f_{HV})$	mi/h	Adj. for access points[3], f_A (Exhibit 20-5)	0.5 mi/h
Adjustment for no-passing zones, f_{np} (Exhibit 20-19)	2.4 mi/h	Free-flow speed, FFS_d $(FSS=BFFS-f_{LS}-f_A)$	59.5 mi/h
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	45.3 mi/h

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 20-10 or 20-16)	1.0	1.1
Passenger-car equivalents for RVs, E_R (Exhibit 20-10 or 20-16)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	1.000	0.999
Grade adjustment factor[1], f_G (Exhibit 20-8 or 20-14)	0.97	1.00
Directional flow rate[2], v_i(pc/h)$=V_i/(PHF*f_{HV}*f_G)$	1053	388
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	74.2	
Adj. for no-passing zone, f_{np} (Exhibit 20-20)	18.3	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	87.5	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	E
Volume to capacity ratio, $v/c=V_p/1,700$	0.66
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)$=0.25L_t(V/PHF)$	2758
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)$=V*L_t$	9709
Peak 15-min total travel time, TT_{15}(veh-h)$=VMT_{15}/ATS$	60.9

Notes

1. If the highway is extended segment (level) or rolling terrain, fG=1.0 .
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only.
4. Exhibit 20-21 provides factors a and b.
5. Use alternative Equation 20-14 if some trucks operate at crawl speeds on a specific downgrade.

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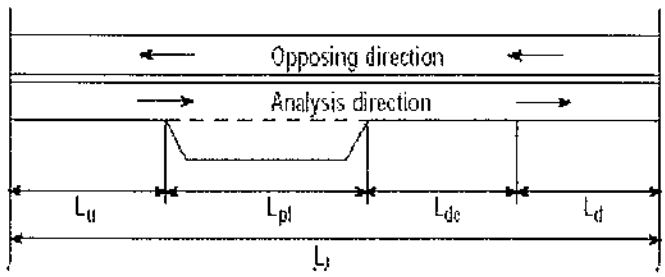
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway of Travel	Foresthill Road - Eastbound
Agency or Company	MRO Engineers, Inc.	From/To	Bridge to Spring Garden Road
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	PM Peak Hour	Analysis Year	Year 2030 Without Forest Ranch

Project Description: *Foresthill Divide Community Plan*

Input Data

☑ Class I highway ☐ Class II highway



Total length of analysis segment, L_t (*mi*)	10.8
Length of two-lane highway upstream of the passing lane, L_u (*mi*)	3.0
Length of passing lane including tapers , L_{pl} (*mi*)	4.9
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	45.3
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	87.5
Level of service[1], LOS_d (from Directional Two-Lane Highway Segment Worksheet)	E
Average Travel Speed	
Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (*mi*) (Exhibit 20-23)	1.70
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (*mi*) $L_d=L_t-(L_u+L_{pl}+L_{de})$	1.20
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 20-24)	1.11
Average travel speed including passing lane[2], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl})))$	47.9
Percent Time-Spent-Following	
Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (*mi*)(Exhibit 20-23)	3.60
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (*mi*)$=L_t-(L_u+L_{pl}+L_{de})$	-0.70
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pl} (Exhibit 20-24)	0.62
Percent time-spent-following including passing lane[3], $PTSF_{pl}$(%) $PTSF_{pl}= PTSF_d[L_u+L_d+f_{pl}L_{pl}+((1+f_{pl})/2)L_{de}]/L_t$	67.1
Level of Service and Other Performance Measures[4]	
Level of service including passing lane LOS_{pl} (Exhibit 20-3 or 20-4)	D
Peak 15-min total travel time, TT_{15}(veh-h) $TT_{15}= VMT_{15}/ATS_{pl}$	57.6

Notes

1. If LOS_d=F, passing lane analysis cannot be performed.
2. If L_d <0, use alternative Equation 20-22.
3. If L_d<0, use alternative Equation 20-20.
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.

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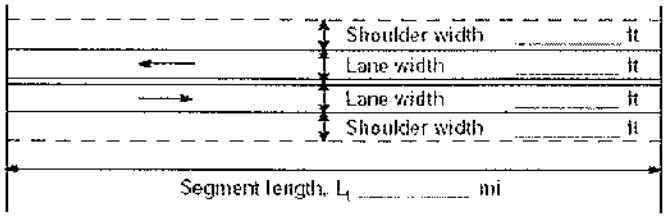
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - Westbound
Agency or Company	MRO Engineers, Inc.	From/To	Bridge to Spring Garden Road
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	PM Peak Hour	Analysis Year	Year 2030 Without Forest Ranch

Project Description: *Foresthill Divide Community Plan*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☐ Level ☐ Rolling

Grade Length 4.00 mi Up/down -3.0

Peak-hour factor, PHF 0.76

No-passing zone 88%

% Trucks and Buses , P_T 4 %

% Recreational vehicles, P_R 2%

Access points/ *mi* 2

Analysis direction vol., V_d 341veh/h

Opposing direction vol., V_o 899veh/h

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	1.2	5.7
Passenger-car equivalents for RVs, E_R (Exhibit 20-9 or 20-17)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.992	0.842
Grade adjustment factor [1], f_G (Exhibit 20-7 or 20-13)	1.00	0.95
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV}*f_G)$	452	1479

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field measured speed[3], S_{FM}	mi/h	Base free-flow speed[3], $BFFS_{FM}$	60.0 mi/h
Observed volume[3], V_f	veh/h	Adj. for lane width and shoulder width,[3] f_{LS}(Exh 20-5)	0.0 mi/h
Free-flow speed, FFS_d $FFS=S_{FM}+0.00776(V_f/f_{HV})$	mi/h	Adj. for access points[3], f_A (Exhibit 20-5)	0.5 mi/h
Adjustment for no-passing zones, f_{np} (Exhibit 20-19)	0.8 mi/h	Free-flow speed, FFS_d $(FSS=BFFS-f_{LS}-f_A)$	59.5 mi/h
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	43.7 mi/h

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 20-10 or 20-16)	1.1	1.0
Passenger-car equivalents for RVs, E_R (Exhibit 20-10 or 20-16)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.996	1.000
Grade adjustment factor[1], f_G (Exhibit 20-8 or 20-14)	1.00	0.97
Directional flow rate[2], v_i(pc/h)$=V_i/(PHF*f_{HV}*f_G)$	450	1219
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	56.7	
Adj. for no-passing zone, f_{np} (Exhibit. 20-20)	22.4	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	62.8	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	D
Volume to capacity ratio, $v/c=V_p/1{,}700$	0.27
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)$=0.25L_t(V/PHF)$	1211
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)$=V*L_t$	3683
Peak 15-min total travel time, TT_{15}(veh-h)$=VMT_{15}/ATS$	27.7

Notes

1. If the highway is extended segment (level) or rolling terrain, fG=1.0 .
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only.
4. Exhibit 20-21 provides factors a and b.
5. Use alternative Equation 20-14 if some trucks operate at crawl speeds on a specific downgrade.

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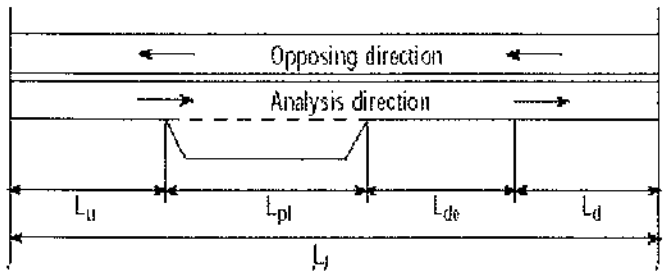
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway of Travel	Foresthill Road - Westbound
Agency or Company	MRO Engineers, Inc.	From/To	Bridge to Spring Garden Road
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	PM Peak Hour	Analysis Year	Year 2030 Without Forest Ranch

Project Description: *Foresthill Divide Community Plan*

Input Data

☑ Class I highway ☐ Class II highway



Total length of analysis segment, L_t (*mi*)	10.8
Length of two-lane highway upstream of the passing lane, L_u (*mi*)	4.8
Length of passing lane including tapers , L_{pl} (*mi*)	1.3
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	43.7
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	62.8
Level of service[1], LOS_d (from Directional Two-Lane Highway Segment Worksheet)	D
Average Travel Speed	
Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (*mi*) (Exhibit 20-23)	1.70
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (*mi*) $L_d=L_t-(L_u+L_{pl}+L_{de})$	3.00
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 20-24)	1.10
Average travel speed including passing lane[2], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl})))$	44.6
Percent Time-Spent-Following	
Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (*mi*)(Exhibit 20-23)	7.70
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (*mi*)$=L_t-(L_u+L_{pl}+L_{de})$	-3.00
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pl} (Exhibit 20-24)	0.61
Percent time-spent-following including passing lane[3], $PTSF_{pl}$(%) $PTSF_{pl}=PTSF_d[L_u+L_d+f_{pl}L_{pl}+((1+f_{pl})/2)L_{de}]/L_t$	52.4
Level of Service and Other Performance Measures[4]	
Level of service including passing lane LOS_{pl} (Exhibit 20-3 or 20-4)	D
Peak 15-min total travel time, TT_{15}(veh-h) $TT_{15}=VMT_{15}/ATS_{pl}$	27.2

Notes

1. If LOS_d=F, passing lane analysis cannot be performed.
2. If L_d <0, use alternative Equation 20-22.
3. If L_d<0, use alternative Equation 20-20.
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.

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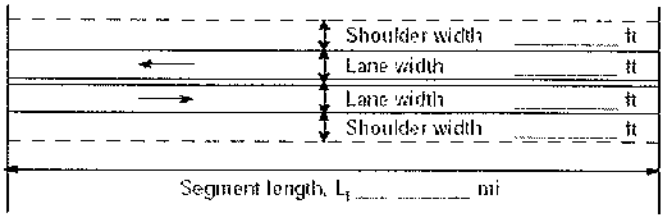
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - Eastbound
Agency or Company	MRO Engineers, Inc.	From/To	Spring Garden to Todd Valley W
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	PM Peak Hour	Analysis Year	Year 2030 Without Forest Ranch

Project Description: *Foresthill Divide Community Plan*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☐ Level ☐ Rolling

Grade Length 1.70 mi Up/down 3.4

Peak-hour factor, PHF 0.88

No-passing zone 29%

% Trucks and Buses, P_T 2 %

% Recreational vehicles, P_R 2%

Access points/ *mi* 4

Analysis direction vol., V_d 573veh/h

Opposing direction vol., V_o 383veh/h

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	4.3	1.2
Passenger-car equivalents for RVs, E_R (Exhibit 20-9 or 20-17)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.937	0.996
Grade adjustment factor [1], f_G (Exhibit 20-7 or 20-13)	1.00	1.00
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV}*f_G)$	695	437

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field measured speed[3], S_{FM}	mi/h	Base free-flow speed[3], $BFFS_{FM}$	60.0 mi/h
Observed volume[3], V_f	veh/h	Adj. for lane width and shoulder width,[3] f_{LS}(Exh 20-5)	0.0 mi/h
Free-flow speed, FFS_d $FFS=S_{FM}+0.00776(V_f/f_{HV})$	mi/h	Adj. for access points[3], f_A (Exhibit 20-5)	1.0 mi/h
Adjustment for no-passing zones, f_{np} (Exhibit 20-19)	1.6 mi/h	Free-flow speed, FFS_d $(FSS=BFFS-f_{LS}-f_A)$	59.0 mi/h
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	48.7 mi/h

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 20-10 or 20-16)	1.0	1.1
Passenger-car equivalents for RVs, E_R (Exhibit 20-10 or 20-16)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	1.000	0.998
Grade adjustment factor[1], f_G (Exhibit 20-8 or 20-14)	0.94	1.00
Directional flow rate[2], v_i(pc/h)$=V_i/(PHF*f_{HV}*f_G)$	690	436
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	60.9	
Adj. for no-passing zone, f_{np} (Exhibit 20-20)	24.5	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	76.0	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	D
Volume to capacity ratio, $v/c=V_p/1{,}700$	0.41
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)$=0.25L_t(V/PHF)$	277
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)$=V*L_t$	974
Peak 15-min total travel time, TT_{15}(veh-h)$=VMT_{15}/ATS$	5.7

Notes

1. If the highway is extended segment (level) or rolling terrain, fG=1.0 .
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only.
4. Exhibit 20-21 provides factors a and b.
5. Use alternative Equation 20-14 if some trucks operate at crawl speeds on a specific downgrade.

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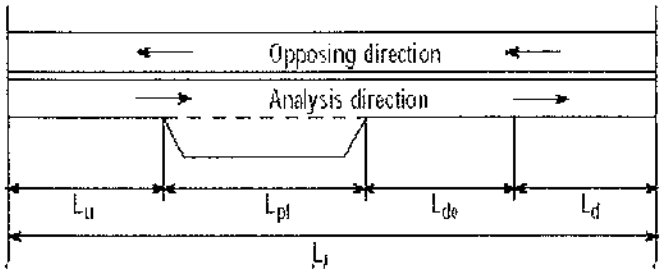
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	*MKL*	Highway of Travel	*Foresthill Road - Eastbound*
Agency or Company	*MRO Engineers, Inc.*	From/To	*Spring Garden to Todd Valley W*
Date Performed	*2/27/07*	Jurisdiction	*Placer County*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*Year 2030 Without Forest Ranch*

Project Description: *Foresthill Divide Community Plan*

Input Data

☑ Class I highway ☐ Class II highway



Total length of analysis segment, L_t (*mi*)	*1.7*
Length of two-lane highway upstream of the passing lane, L_u (*mi*)	*0.3*
Length of passing lane including tapers , L_{pl} (*mi*)	*1.2*
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	*48.7*
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	*76.0*
Level of service[1], LOS_d (from Directional Two-Lane Highway Segment Worksheet)	*D*
Average Travel Speed	
Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (*mi*) (Exhibit 20-23)	*1.70*
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (*mi*) $L_d=L_t-(L_u+L_{pl}+L_{de})$	*-1.50*
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 20-24)	*1.11*
Average travel speed including passing lane[2], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl})))$	*52.9*
Percent Time-Spent-Following	
Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (*mi*)(Exhibit 20-23)	*5.78*
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (*mi*)$=L_t-(L_u+L_{pl}+L_{de})$	*-5.58*
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pl} (Exhibit 20-24)	*0.62*
Percent time-spent-following including passing lane[3], $PTSF_{pl}$(%) $PTSF_{pl}= PTSF_d[L_u+L_d+f_{pl}L_{pl}+((1+f_{pl})/2)L_{de}]/L_t$	*52.3*
Level of Service and Other Performance Measures[4]	
Level of service including passing lane LOS_{pl} (Exhibit 20-3 or 20-4)	C
Peak 15-min total travel time, TT_{15}(veh-h) $TT_{15}= VMT_{15}/ATS_{pl}$	*5.2*

Notes

1. If LOS_d=F, passing lane analysis cannot be performed.
2. If L_d <0, use alternative Equation 20-22.
3. If L_d<0, use alternative Equation 20-20.
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.

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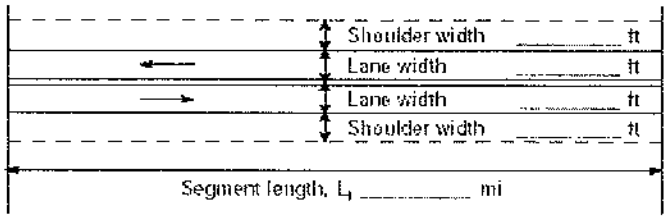
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - Westbound
Agency or Company	MRO Engineers, Inc.	From/To	Spring Garden to Todd Valley W
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	PM Peak Hour	Analysis Year	Year 2030 Without Forest Ranch

Project Description: *Foresthill Divide Community Plan*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☐ Level ☐ Rolling

Grade Length 1.70 mi Up/down -3.4

Peak-hour factor, PHF 0.88

No-passing zone 100%

% Trucks and Buses , P_T 3 %

% Recreational vehicles, P_R 2%

Access points/ mi 5

Analysis direction vol., V_d 383veh/h

Opposing direction vol., V_o 573veh/h

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	1.2	4.3
Passenger-car equivalents for RVs, E_R (Exhibit 20-9 or 20-17)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.994	0.909
Grade adjustment factor [1], f_G (Exhibit 20-7 or 20-13)	1.00	1.00
Directional flow rate[2], v_i(pc/h) $v_i=V_f/(PHF*f_{HV}*f_G)$	438	716

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field measured speed[3], S_{FM}	mi/h	Base free-flow speed[3], $BFFS_{FM}$	60.0 mi/h
Observed volume[3], V_f	veh/h	Adj. for lane width and shoulder width,[3] f_{LS}(Exh 20-5)	0.0 mi/h
Free-flow speed, FFS_d $FFS=S_{FM}+0.00776(V_f/f_{HV})$	mi/h	Adj. for access points[3], f_A (Exhibit 20-5)	1.3 mi/h
Adjustment for no-passing zones, f_{np} (Exhibit 20-19)	1.6 mi/h	Free-flow speed, FFS_d $(FSS=BFFS-f_{LS}-f_A)$	58.8 mi/h
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	48.2 mi/h

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 20-10 or 20-16)	1.1	1.0
Passenger-car equivalents for RVs, E_R (Exhibit 20-10 or 20-16)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.997	1.000
Grade adjustment factor[1], f_G (Exhibit 20-8 or 20-14)	1.00	0.94
Directional flow rate[2], v_i(pc/h)$=V_f/(PHF*f_{HV}*f_G)$	437	690
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	49.7	
Adj. for no-passing zone, f_{np} (Exhibit. 20-20)	33.7	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	62.8	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	C
Volume to capacity ratio, $v/c=V_p/1{,}700$	0.26
Peak 15-min veh-miles of travel, VMT_{15} (veh- mi)$=0.25L_t(V/PHF)$	185
Peak-hour vehicle-miles of travel, VMT_{60}(veh- mi)$=V*L_t$	651
Peak 15-min total travel time, TT_{15}(veh-h)$=VMT_{15}/ATS$	3.8

Notes

1. If the highway is extended segment (level) or rolling terrain, fG=1.0 .
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only.
4. Exhibit 20-21 provides factors a and b.
5. Use alternative Equation 20-14 if some trucks operate at crawl speeds on a specific downgrade.

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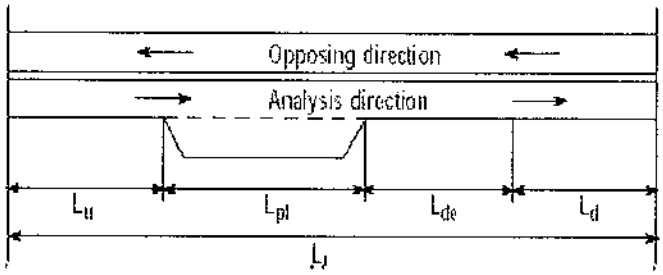
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway of Travel	Foresthill Road - Westbound
Agency or Company	MRO Engineers, Inc.	From/To	Spring Garden to Todd Valley W
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	PM Peak Hour	Analysis Year	Year 2030 Without Forest Ranch

Project Description: *Foresthill Divide Community Plan*

Input Data

☑ Class I highway ☐ Class II highway



Total length of analysis segment, L_t (*mi*)	1.7
Length of two-lane highway upstream of the passing lane, L_u (*mi*)	1.7
Length of passing lane including tapers , L_{pl} (*mi*)	0.0
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	48.2
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	62.8
Level of service[1], LOS_d (from Directional Two-Lane Highway Segment Worksheet)	C
Average Travel Speed	
Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (*mi*) (Exhibit 20-23)	1.70
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (*mi*) $L_d=L_t-(L_u+L_{pl}+L_{de})$	-1.70
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 20-24)	1.10
Average travel speed including passing lane[2], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl})))$	
Percent Time-Spent-Following	
Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (*mi*)(Exhibit 20-23)	7.80
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (*mi*)$=L_t-(L_u+L_{pl}+L_{de})$	-7.80
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pl} (Exhibit 20-24)	0.61
Percent time-spent-following including passing lane[3], $PTSF_{pl}$(%) $PTSF_{pl}= PTSF_d[L_u+L_d+f_{pl}L_{pl}+((1+f_{pl})/2)L_{de}]/L_t$	62.8
Level of Service and Other Performance Measures[4]	
Level of service including passing lane LOS_{pl} (Exhibit 20-3 or 20-4)	
Peak 15-min total travel time, TT_{15}(veh-h) $TT_{15}= VMT_{15}/ATS_{pl}$	

Notes

1. If LOS_d=F, passing lane analysis cannot be performed.
2. If L_d <0, use alternative Equation 20-22.
3. If L_d<0, use alternative Equation 20-20.
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.

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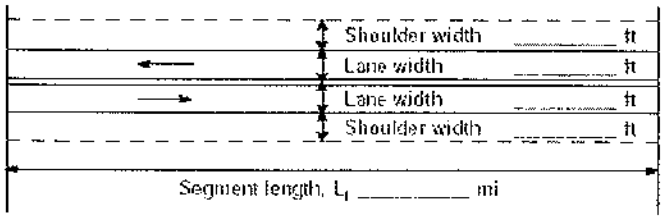
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - Eastbound
Agency or Company	MRO Engineers, Inc.	From/To	Todd Valley W to Owl Hill Ct.
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	PM Peak Hour	Analysis Year	Year 2030 Without Forest Ranch

Project Description. *Foresthill Divide Community Plan*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☐ Level ☐ Rolling

Grade Length 1.20 mi Up/down 3.0

Peak-hour factor, PHF 0.85

No-passing zone 17%

% Trucks and Buses , P_T 2 %

% Recreational vehicles, P_R 2%

Access points/ mi 3

Analysis direction vol., V_d 430veh/h

Opposing direction vol., V_o 350veh/h

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	5.0	1.2
Passenger-car equivalents for RVs, E_R (Exhibit 20-9 or 20-17)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.927	0.996
Grade adjustment factor [1], f_G (Exhibit 20-7 or 20-13)	1.00	1.00
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV}*f_G)$	548	413

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field measured speed[3], S_{FM}	mi/h	Base free-flow speed[3], $BFFS_{FM}$	60.0 mi/h
Observed volume[3], V_f	veh/h	Adj. for lane width and shoulder width,[3] f_{LS}(Exh 20-5)	0.0 mi/h
Free-flow speed, FFS_d $FFS=S_{FM}+0.00776(V_f/f_{HV})$	mi/h	Adj. for access points[3], f_A (Exhibit 20-5)	0.8 mi/h
Adjustment for no-passing zones, f_{np} (Exhibit 20-19)	1.4 mi/h	Free-flow speed, FFS_d $(FSS=BFFS-f_{LS}-f_A)$	59.3 mi/h
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	50.4 mi/h

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 20-10 or 20-16)	1.0	1.1
Passenger-car equivalents for RVs, E_R (Exhibit 20-10 or 20-16)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	1.000	0.998
Grade adjustment factor[1], f_G (Exhibit 20-8 or 20-14)	0.93	1.00
Directional flow rate[2], v_i(pc/h)$=V_i/(PHF*f_{HV}*f_G)$	542	413
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	52.4	
Adj. for no-passing zone, f_{np} (Exhibit. 20-20)	25.5	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	66.9	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	D
Volume to capacity ratio, $v/c=V_p/1{,}700$	0.32
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)$=0.25L_t(V/PHF)$	152
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)$=V*L_t$	516
Peak 15-min total travel time, TT_{15}(veh-h)$=VMT_{15}/ATS$	3.0

Notes

1. If the highway is extended segment (level) or rolling terrain, fG=1.0 .
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only.
4. Exhibit 20-21 provides factors a and b.
5. Use alternative Equation 20-14 if some trucks operate at crawl speeds on a specific downgrade.

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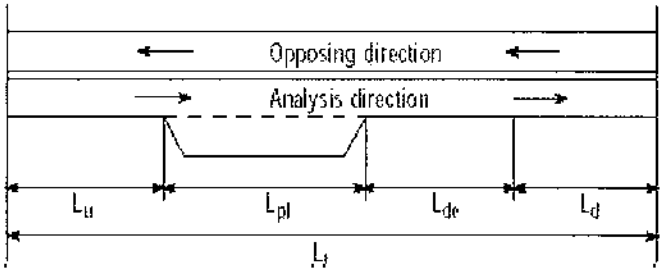
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway of Travel	Foresthill Road - Eastbound
Agency or Company	MRO Engineers, Inc.	From/To	Todd Valley W to Owl Hill Ct.
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	PM Peak Hour	Analysis Year	Year 2030 Without Forest Ranch

Project Description: *Foresthill Divide Community Plan*

Input Data

☑ Class I highway ☐ Class II highway



Total length of analysis segment, L_t (*mi*)	1.2
Length of two-lane highway upstream of the passing lane, L_u (*mi*)	0.1
Length of passing lane including tapers , L_{pl} (*mi*)	1.0
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	50.4
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	66.9
Level of service[1], LOS_d (from Directional Two-Lane Highway Segment Worksheet)	D
Average Travel Speed	
Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (*mi*) (Exhibit 20-23)	1.70
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (*mi*) $L_d=L_t-(L_u+L_{pl}+L_{de})$	-1.60
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 20-24)	1.10
Average travel speed including passing lane[2], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl}))$)	55.0
Percent Time-Spent-Following	
Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (*mi*)(Exhibit 20-23)	6.96
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (*mi*)$=L_t-(L_u+L_{pl}+L_{de})$	-6.86
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pl} (Exhibit 20-24)	0.61
Percent time-spent-following including passing lane[3], $PTSF_{pl}$(%) $PTSF_{pl}= PTSF_d[L_u+L_d+f_{pl}L_{pl}+((1+f_{pl})/2)L_{de}]/L_t$	43.0
Level of Service and Other Performance Measures[4]	
Level of service including passing lane LOS_{pl} (Exhibit 20-3 or 20-4)	B
Peak 15-min total travel time, TT_{15}(veh-h) $TT_{15}= VMT_{15}/ATS_{pl}$	2.8

Notes

1. If LOS_d=F, passing lane analysis cannot be performed.
2. If L_d <0, use alternative Equation 20-22.
3. If L_d<0, use alternative Equation 20-20.
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.

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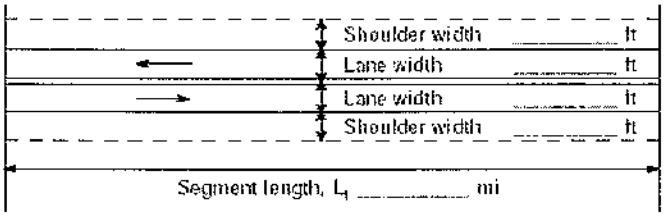
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*MKL*	Highway / Direction of Travel	*Foresthill Road - Westbound*
Agency or Company	*MRO Engineers, Inc.*	From/To	*Todd Valley W to Owl Hill Ct.*
Date Performed	*2/27/07*	Jurisdiction	*Placer County*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*Year 2030 Without Forest Ranch*

Project Description: *Foresthill Divide Community Plan*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☐ Level ☐ Rolling

Grade Length *1.20* mi Up/down *-3.0*

Peak-hour factor, PHF *0.88*

No-passing zone *100%*

% Trucks and Buses , P_T *4 %*

% Recreational vehicles, P_R *2%*

Access points/ *mi* *4*

Analysis direction vol., V_d *350*veh/h

Opposing direction vol., V_o *430*veh/h

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	*1.2*	*5.0*
Passenger-car equivalents for RVs, E_R (Exhibit 20-9 or 20-17)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.992*	*0.863*
Grade adjustment factor [1], f_G (Exhibit 20-7 or 20-13)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV}*f_G)$	*401*	*568*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field measured speed[3], S_{FM}	*mi/h*	Base free-flow speed[3], $BFFS_{FM}$	*60.0 mi/h*
Observed volume[3], V_f	veh/h	Adj. for lane width and shoulder width,[3] f_{LS}(Exh 20-5)	*0.0 mi/h*
Free-flow speed, FFS_d $FFS=S_{FM}+0.00776(V_f/f_{HV})$	*mi/h*	Adj. for access points[3], f_A (Exhibit 20-5)	*1.0 mi/h*
Adjustment for no-passing zones, f_{np} (Exhibit 20-19)	*2.1 mi/h*	Free-flow speed, FFS_d $(FSS=BFFS-f_{LS}-f_A)$	*59.0 mi/h*
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	*49.4 mi/h*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 20-10 or 20-16)	*1.1*	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 20-10 or 20-16)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.996*	*1.000*
Grade adjustment factor[1], f_G (Exhibit 20-8 or 20-14)	*1.00*	*0.93*
Directional flow rate[2], v_i(pc/h)$=V_i/(PHF*f_{HV}*f_G)$	*399*	*523*
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	*44.9*	
Adj. for no-passing zone, f_{np} (Exhibit. 20-20)	*38.5*	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	*61.5*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	*C*
Volume to capacity ratio, $v/c=V_p/1{,}700$	*0.24*
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)$=0.25L_t(V/PHF)$	*119*
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)$=V*L_t$	*420*
Peak 15-min total travel time, TT_{15}(veh-h)$=VMT_{15}/ATS$	*2.4*

Notes

1. If the highway is extended segment (level) or rolling terrain, fG=1.0 .
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only.
4. Exhibit 20-21 provides factors a and b.
5. Use alternative Equation 20-14 if some trucks operate at crawl speeds on a specific downgrade.

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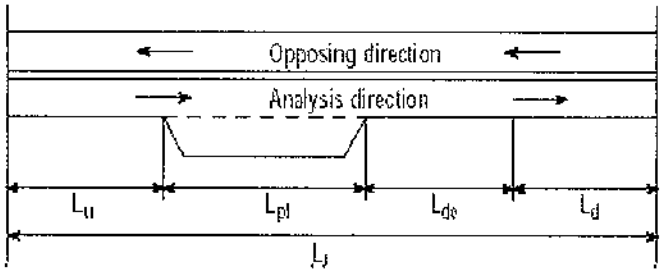
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway of Travel	Foresthill Road - Westbound
Agency or Company	MRO Engineers, Inc.	From/To	Todd Valley W to Owl Hill Ct.
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	PM Peak Hour	Analysis Year	Year 2030 Without Forest Ranch

Project Description: *Foresthill Divide Community Plan*

Input Data

☑ Class I highway ☐ Class II highway



Total length of analysis segment, L_t (*mi*)	*1.2*
Length of two-lane highway upstream of the passing lane, L_u (*mi*)	*1.2*
Length of passing lane including tapers , L_{pl} (*mi*)	*0.0*
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	*49.4*
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	*61.5*
Level of service[1], LOS_d (from Directional Two-Lane Highway Segment Worksheet)	*C*
Average Travel Speed	
Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (*mi*) (Exhibit 20-23)	*1.70*
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (*mi*) $L_d=L_t-(L_u+L_{pl}+L_{de})$	*-1.70*
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 20-24)	*1.10*
Average travel speed including passing lane[2], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl}))$)	
Percent Time-Spent-Following	
Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (*mi*)(Exhibit 20-23)	*8.12*
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (*mi*)$=L_t-(L_u+L_{pl}+L_{de})$	*-8.12*
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pl} (Exhibit 20-24)	*0.61*
Percent time-spent-following including passing lane[3], $PTSF_{pl}$(%) $PTSF_{pl}= PTSF_d[L_u+L_d+f_{pl}L_{pl}+((1+f_{pl})/2)L_{de}]/L_t$	*61.5*
Level of Service and Other Performance Measures[4]	
Level of service including passing lane LOS_{pl} (Exhibit 20-3 or 20-4)	
Peak 15-min total travel time, TT_{15}(veh-h) $TT_{15}= VMT_{15}/ATS_{pl}$	

Notes

1. If LOS_d=F, passing lane analysis cannot be performed.
2. If L_d <0, use alternative Equation 20-22.
3. If L_d<0, use alternative Equation 20-20.
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.

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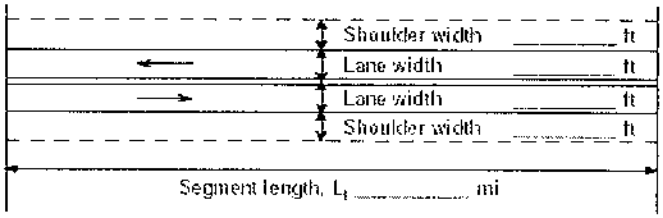
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*MKL*	Highway / Direction of Travel	*Foresthill Road - EB - Mitig.*
Agency or Company	*MRO Engineers, Inc.*	From/To	*Bridge to Spring Garden Road*
Date Performed	*2/27/07*	Jurisdiction	*Placer County*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*Year 2030 Without Forest Ranch*

Project Description. *Foresthill Divide Community Plan*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☐ Level ☐ Rolling

Grade Length *4.00* mi Up/down *3.0*

Peak-hour factor, PHF *0.88*

No-passing zone *30%*

% Trucks and Buses , P_T *6 %*

% Recreational vehicles, P_R *2%*

Access points/ *mi* *2*

Analysis direction vol., V_d *253*veh/h

Opposing direction vol., V_o *888*veh/h

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	*7.5*	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-9 or 20-17)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.719*	*0.994*
Grade adjustment factor [1], f_G (Exhibit 20-7 or 20-13)	*0.94*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV}*f_G)$	*425*	*1015*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field measured speed[3], S_{FM}	*mi/h*	Base free-flow speed[3], $BFFS_{FM}$	*60.0 mi/h*
Observed volume[3], V_f	veh/h	Adj. for lane width and shoulder width,[3] f_{LS}(Exh 20-5)	*0.0 mi/h*
Free-flow speed, FFS_d $FFS=S_{FM}+0.00776(V_f/f_{HV})$	*mi/h*	Adj. for access points[3], f_A (Exhibit 20-5)	*0.5 mi/h*
Adjustment for no-passing zones, f_{np} (Exhibit 20-19)	*0.6 mi/h*	Free-flow speed, FFS_d $(FSS=BFFS-f_{LS}-f_A)$	*59.5 mi/h*
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	*47.7 mi/h*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 20-10 or 20-16)	*1.5*	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 20-10 or 20-16)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.971*	*1.000*
Grade adjustment factor[1], f_G (Exhibit 20-8 or 20-14)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h)$=V_i/(PHF*f_{HV}*f_G)$	*296*	*1009*
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	*42.3*	
Adj. for no-passing zone, f_{np} (Exhibit. 20-20)	*22.1*	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	*47.3*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	*C*
Volume to capacity ratio, $v/c=V_p/1{,}700$	*0.25*
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)$=0.25L_t(V/PHF)$	*776*
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)$=V*L_t$	*2732*
Peak 15-min total travel time, TT_{15}(veh-h)$=VMT_{15}/ATS$	*16.3*

Notes

1. If the highway is extended segment (level) or rolling terrain, fG=1.0 .
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only.
4. Exhibit 20-21 provides factors a and b.
5. Use alternative Equation 20-14 if some trucks operate at crawl speeds on a specific downgrade.

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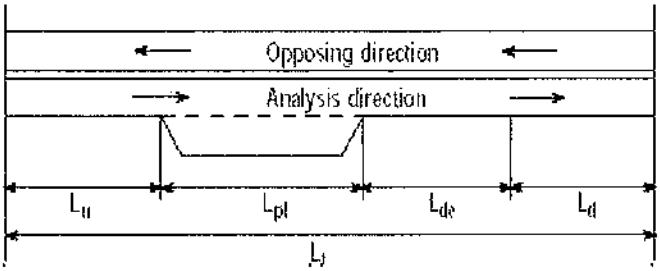
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	*MKL*	Highway of Travel	*Foresthill Road - EB - Mitig.*
Agency or Company	*MRO Engineers, Inc.*	From/To	*Bridge to Spring Garden Road*
Date Performed	*2/27/07*	Jurisdiction	*Placer County*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*Year 2030 Without Forest Ranch*

Project Description: *Foresthill Divide Community Plan*

Input Data

☑ Class I highway ☐ Class II highway



Total length of analysis segment, L_t (*mi*)	*10.8*
Length of two-lane highway upstream of the passing lane, L_u (*mi*)	*1.5*
Length of passing lane including tapers , L_{pl} (*mi*)	*7.6*
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	*47.7*
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	*47.3*
Level of service[1], LOS_d (from Directional Two-Lane Highway Segment Worksheet)	*C*
Average Travel Speed	
Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (*mi*) (Exhibit 20-23)	*1.70*
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (*mi*) $L_d=L_t-(L_u+L_{pl}+L_{de})$	*0.00*
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 20-24)	*1.10*
Average travel speed including passing lane[2], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl})))$	*51.4*
Percent Time-Spent-Following	
Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (*mi*)(Exhibit 20-23)	*10.65*
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (*mi*)$=L_t-(L_u+L_{pl}+L_{de})$	*-8.95*
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pt} (Exhibit 20-24)	*0.58*
Percent time-spent-following including passing lane[3], $PTSF_{pt}$(%) $PTSF_{pt}= PTSF_d[L_u+L_d+f_{pt}L_{pt}+((1+f_{pt})/2)L_{de}]/L_t$	*30.5*
Level of Service and Other Performance Measures[4]	
Level of service including passing lane LOS_{pl} (Exhibit 20-3 or 20-4)	*B*
Peak 15-min total travel time, TT_{15}(veh-h) $TT_{15}= VMT_{15}/ATS_{pl}$	*15.1*

Notes

1. If LOS_d=F, passing lane analysis cannot be performed.
2. If L_d <0, use alternative Equation 20-22.
3. If L_d<0, use alternative Equation 20-20.
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.

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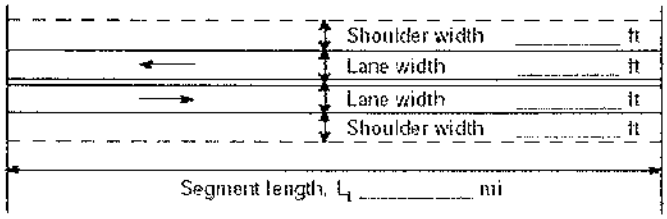
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - WB - Milig.
Agency or Company	MRO Engineers, Inc.	From/To	Bridge to Spring Garden Road
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	AM Peak Hour	Analysis Year	Year 2030 Without Forest Ranch

Project Description: *Foresthill Divide Community Plan*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☐ Level ☐ Rolling

Grade Length 4.00 mi Up/down -3.0

Peak-hour factor, PHF 0.88

No-passing zone 40%

% Trucks and Buses , P_T 2 %

% Recreational vehicles, P_R 2%

Access points/ mi 2

Analysis direction vol., V_d 888veh/h

Opposing direction vol., V_o 253veh/h

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	1.1	7.5
Passenger-car equivalents for RVs, E_R (Exhibit 20-9 or 20-17)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.998	0.885
Grade adjustment factor [1], f_G (Exhibit 20-7 or 20-13)	1.00	0.94
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV}*f_G)$	1011	346

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field measured speed[3], S_{FM}	mi/h	Base free-flow speed[3], $BFFS_{FM}$	60.0 mi/h
Observed volume[3], V_f	veh/h	Adj. for lane width and shoulder width,[3] f_{LS}(Exh 20-5)	0.0 mi/h
Free-flow speed, FFS_d $FFS=S_{FM}+0.00776(V_f/f_{HV})$	mi/h	Adj. for access points[3], f_A (Exhibit 20-5)	0.5 mi/h
Adjustment for no-passing zones, f_{np} (Exhibit 20-19)	2.2 mi/h	Free-flow speed, FFS_d $(FSS=BFFS-f_{LS}-f_A)$	59.5 mi/h
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	46.7 mi/h

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 20-10 or 20-16)	1.0	1.5
Passenger-car equivalents for RVs, E_R (Exhibit 20-10 or 20-16)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	1.000	0.990
Grade adjustment factor[1], f_G (Exhibit 20-8 or 20-14)	1.00	1.00
Directional flow rate[2], v_i(pc/h)$=V_i/(PHF*f_{HV}*f_G)$	1009	290
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	71.7	
Adj. for no-passing zone, f_{np} (Exhibit. 20-20)	16.4	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	84.4	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	E
Volume to capacity ratio, $v/c=V_p/1{,}700$	0.59
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)$=0.25L_t(V/PHF)$	2725
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)$=V*L_t$	9590
Peak 15-min total travel time, TT_{15}(veh-h)$=VMT_{15}/ATS$	58.3

Notes

1. If the highway is extended segment (level) or rolling terrain, fG=1.0 .
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only.
4. Exhibit 20-21 provides factors a and b.
5. Use alternative Equation 20-14 if some trucks operate at crawl speeds on a specific downgrade.

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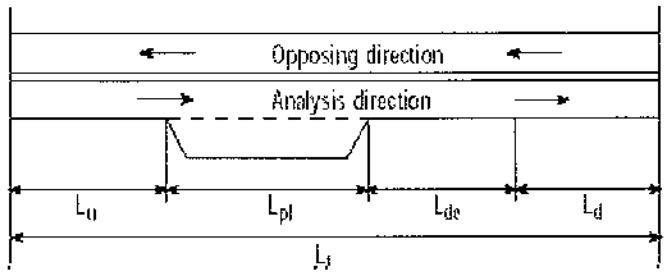
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		*Site Information*	
Analyst	*MKL*	Highway of Travel	*Foresthill Road - WB - Mitig.*
Agency or Company	*MRO Engineers, Inc.*	From/To	*Bridge to Spring Garden Road*
Date Performed	*2/27/07*	Jurisdiction	*Placer County*
Analysis Time Period	*AM Peak Hour*	Analysis Year	*Year 2030 Without Forest Ranch*

Project Description. *Foresthill Divide Community Plan*

Input Data

☑ Class I highway ☐ Class II highway



Total length of analysis segment, L_t (*mi*)	*10.8*
Length of two-lane highway upstream of the passing lane, L_u (*mi*)	*2.2*
Length of passing lane including tapers , L_{pl} (*mi*)	*6.5*
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	*46.7*
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	*84.4*
Level of service[1], LOS_d (from Directional Two-Lane Highway Segment Worksheet)	*E*
Average Travel Speed	
Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (*mi*) (Exhibit 20-23)	*1.70*
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (*mi*) $L_d=L_t-(L_u+L_{pl}+L_{de})$	*0.40*
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 20-24)	*1.11*
Average travel speed including passing lane[2], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl}))$)	*50.2*
Percent Time-Spent-Following	
Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (*mi*)(Exhibit 20-23)	*3.60*
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (*mi*)$=L_t-(L_u+L_{pl}+L_{de})$	*-1.50*
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pl} (Exhibit 20-24)	*0.62*
Percent time-spent-following including passing lane[3], $PTSF_{pl}$(%) $PTSF_{pl}= PTSF_d[L_u+L_d+f_{pl}L_{pl}+((1+f_{pl})/2)L_{de}]/L_t$	*60.7*
Level of Service and Other Performance Measures[4]	
Level of service including passing lane LOS_{pl} (Exhibit 20-3 or 20-4)	*C*
Peak 15-min total travel time, TT_{15}(veh-h) $TT_{15}= VMT_{15}/ATS_{pl}$	*54.3*

Notes

1. If LOS_d=F, passing lane analysis cannot be performed.
2. If L_d <0, use alternative Equation 20-22.
3. If L_d<0, use alternative Equation 20-20.
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.

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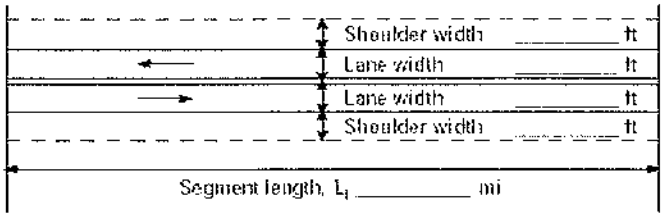
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - WB - Mitig.
Agency or Company	MRO Engineers, Inc.	From/To	Spring Garden to Todd Valley W
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	AM Peak Hour	Analysis Year	Year 2030 Without Forest Ranch

Project Description: Foresthill Divide Community Plan

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☐ Level ☐ Rolling

Grade Length 1.70 mi Up/down -3.4

Peak-hour factor, PHF 0.88

No-passing zone 50%

% Trucks and Buses , P_T 2 %

% Recreational vehicles, P_R 2%

Access points/ mi 5

Analysis direction vol., V_d 605veh/h

Opposing direction vol., V_o 328veh/h

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	1.1	5.7
Passenger-car equivalents for RVs, E_R (Exhibit 20-9 or 20-17)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.998	0.915
Grade adjustment factor [1], f_G (Exhibit 20-7 or 20-13)	1.00	0.98
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV}*f_G)$	689	415

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field measured speed[3], S_{FM}	mi/h	Base free-flow speed[3], $BFFS_{FM}$	60.0 mi/h
Observed volume[3], V_f	veh/h	Adj. for lane width and shoulder width,[3] f_{LS}(Exh 20-5)	0.0 mi/h
Free-flow speed, FFS_d $FFS=S_{FM}+0.00776(V_f/f_{HV})$	mi/h	Adj. for access points[3], f_A (Exhibit 20-5)	1.3 mi/h
Adjustment for no-passing zones, f_{np} (Exhibit 20-19)	2.2 mi/h	Free-flow speed, FFS_d $(FSS=BFFS-f_{LS}-f_A)$	58.8 mi/h
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	48.0 mi/h

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 20-10 or 20-16)	1.0	1.0
Passenger-car equivalents for RVs, E_R (Exhibit 20-10 or 20-16)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	1.000	1.000
Grade adjustment factor[1], f_G (Exhibit 20-8 or 20-14)	1.00	0.94
Directional flow rate[2], v_i(pc/h)$=V_i/(PHF*f_{HV}*f_G)$	688	395
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	59.9	
Adj. for no-passing zone, f_{np} (Exhibit. 20-20)	28.8	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	78.2	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	D
Volume to capacity ratio, $v/c=V_p/1{,}700$	0.41
Peak 15-min veh-miles of travel, VMT_{15} (veh- mi)$=0.25L_t(V/PHF)$	292
Peak-hour vehicle-miles of travel, VMT_{60}(veh- mi)$=V*L_t$	1029
Peak 15-min total travel time, TT_{15}(veh-h)$=VMT_{15}/ATS$	6.1

Notes

1. If the highway is extended segment (level) or rolling terrain, fG=1.0 .
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only.
4. Exhibit 20-21 provides factors a and b.
5. Use alternative Equation 20-14 if some trucks operate at crawl speeds on a specific downgrade.

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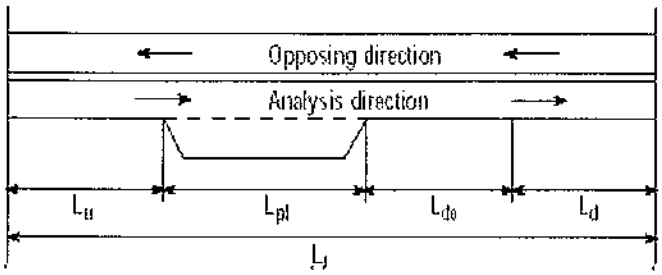
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

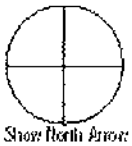
General Information		Site Information	
Analyst	MKL	Highway of Travel	Foresthill Road - WB - Mitig.
Agency or Company	MRO Engineers, Inc.	From/To	Spring Garden to Todd Valley W
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	AM Peak Hour	Analysis Year	Year 2030 Without Forest Ranch

Project Description: *Foresthill Divide Community Plan*

Input Data

☑ Class I highway ☐ Class II highway





Total length of analysis segment, L_t (*mi*)	1.7
Length of two-lane highway upstream of the passing lane, L_u (*mi*)	0.5
Length of passing lane including tapers , L_{pl} (*mi*)	0.8
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	48.0
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	78.2
Level of service[1], LOS_d (from Directional Two-Lane Highway Segment Worksheet)	D
Average Travel Speed	
Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (*mi*) (Exhibit 20-23)	1.70
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (*mi*) $L_d=L_t-(L_u+L_{pl}+L_{de})$	-1.30
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 20-24)	1.11
Average travel speed including passing lane[2], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl}))$)	51.5
Percent Time-Spent-Following	
Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (*mi*)(Exhibit 20-23)	5.80
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (*mi*)$=L_t-(L_u+L_{pl}+L_{de})$	-5.40
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pt} (Exhibit 20-24)	0.62
Percent time-spent-following including passing lane[3], $PTSF_{pl}$(%) $PTSF_{pl}= PTSF_d[L_u+L_d+f_{pt}L_{pl}+((1+f_{pt})/2)L_{de}]/L_t$	57.5
Level of Service and Other Performance Measures[4]	
Level of service including passing lane LOS_{pl} (Exhibit 20-3 or 20-4)	C
Peak 15-min total travel time, TT_{15}(veh-h) $TT_{15}= VMT_{15}/ATS_{pl}$	5.7

Notes

1. If LOS_d=F, passing lane analysis cannot be performed.
2. If L_d <0, use alternative Equation 20-22.
3. If L_d<0, use alternative Equation 20-20.
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.

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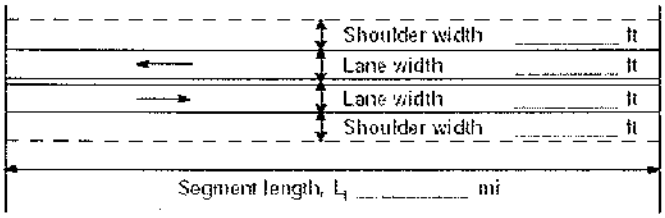
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - WB - Mitig.
Agency or Company	MRO Engineers, Inc.	From/To	Todd Valley W to Owl Hill Ct.
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	AM Peak Hour	Analysis Year	Year 2030 Without Forest Ranch

Project Description: Foresthill Divide Community Plan

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☐ Level ☐ Rolling

Grade Length 1.20 mi Up/down -3.0

Peak-hour factor, PHF 0.79

No-passing zone 50%

% Trucks and Buses, P_T 2 %

% Recreational vehicles, P_R 2%

Access points/ mi 4

Analysis direction vol., V_d 481veh/h

Opposing direction vol., V_o 353veh/h

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	1.1	5.0
Passenger-car equivalents for RVs, E_R (Exhibit 20-9 or 20-17)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.998	0.927
Grade adjustment factor [1], f_G (Exhibit 20-7 or 20-13)	1.00	1.00
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV}*f_G)$	610	484

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field measured speed[3], S_{FM}	mi/h	Base free-flow speed[3], $BFFS_{FM}$	60.0 mi/h
Observed volume[3], V_f	veh/h	Adj for lane width and shoulder width,[3] f_{LS}(Exh 20-5)	0.0 mi/h
Free-flow speed, FFS_d $FFS=S_{FM}+0.00776(V_f/f_{HV})$	mi/h	Adj. for access points[3], f_A (Exhibit 20-5)	1.0 mi/h
Adjustment for no-passing zones, f_{np} (Exhibit 20-19)	1.9 mi/h	Free-flow speed, FFS_d $(FSS=BFFS-f_{LS}-f_A)$	59.0 mi/h
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	48.6 mi/h

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 20-10 or 20-16)	1.0	1.0
Passenger-car equivalents for RVs, E_R (Exhibit 20-10 or 20-16)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	1.000	1.000
Grade adjustment factor[1], f_G (Exhibit 20-8 or 20-14)	1.00	0.93
Directional flow rate[2], v_i(pc/h)$=V_i/(PHF*f_{HV}*f_G)$	609	478
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	57.5	
Adj. for no-passing zone, f_{np} (Exhibit. 20-20)	31.7	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	75.3	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	D
Volume to capacity ratio, $v/c=V_p/1{,}700$	0.36
Peak 15-min veh-miles of travel, VMT_{15} (veh- mi)$=0.25L_t(V/PHF)$	183
Peak-hour vehicle-miles of travel, VMT_{60}(veh- mi)$=V*L_t$	577
Peak 15-min total travel time, TT_{15}(veh-h)$=VMT_{15}/ATS$	3.8

Notes

1. If the highway is extended segment (level) or rolling terrain, fG=1.0 .
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only.
4. Exhibit 20-21 provides factors a and b.
5. Use alternative Equation 20-14 if some trucks operate at crawl speeds on a specific downgrade.

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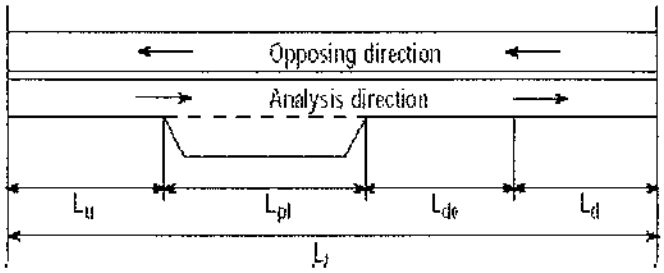
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

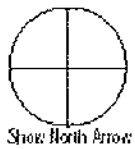
General Information		Site Information	
Analyst	MKL	Highway of Travel	Foresthill Road - WB - Mitig.
Agency or Company	MRO Engineers, Inc.	From/To	Todd Valley W to Owl Hill Ct.
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	AM Peak Hour	Analysis Year	Year 2030 Without Forest Ranch

Project Description: *Foresthill Divide Community Plan*

Input Data

☑ Class I highway ☐ Class II highway





Total length of analysis segment, L_t (*mi*)	1.2
Length of two-lane highway upstream of the passing lane, L_u (*mi*)	0.3
Length of passing lane including tapers , L_{pl} (*mi*)	0.6
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	48.6
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	75.3
Level of service[1], LOS_d (from Directional Two-Lane Highway Segment Worksheet)	D
Average Travel Speed	
Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (*mi*) (Exhibit 20-23)	1.70
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (*mi*) $L_d=L_t-(L_u+L_{pl}+L_{de})$	-1.40
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 20-24)	1.11
Average travel speed including passing lane[2], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl})))$	52.4
Percent Time-Spent-Following	
Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (*mi*)(Exhibit 20-23)	6.43
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (*mi*)$=L_t-(L_u+L_{pl}+L_{de})$	-6.13
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pl} (Exhibit 20-24)	0.62
Percent time-spent-following including passing lane[3], $PTSF_{pl}$(%) $PTSF_{pl}= PTSF_d[L_u+L_d+f_{pl}L_{pl}+((1+f_{pl})/2)L_{de}]/L_t$	54.0
Level of Service and Other Performance Measures[4]	
Level of service including passing lane LOS_{pl} (Exhibit 20-3 or 20-4)	C
Peak 15-min total travel time, TT_{15}(veh-h) $TT_{15}= VMT_{15}/ATS_{pl}$	3.5

Notes

1. If LOS_d=F, passing lane analysis cannot be performed.
2. If L_d <0, use alternative Equation 20-22.
3. If L_d<0, use alternative Equation 20-20.
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.

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DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - EB - Milig.
Agency or Company	MRO Engineers, Inc.	From/To	Bridge to Spring Garden Road
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	PM Peak Hour	Analysis Year	Year 2030 Without Forest Ranch

Project Description: Foresthill Divide Community Plan

Input Data

Shoulder width _____ ft
Lane width _____ ft
Lane width _____ ft
Shoulder width _____ ft
Segment length, L_t _____ mi

Show North Arrow

☑ Class I highway ☐ Class II highway

Terrain ☐ Level ☐ Rolling
Grade Length 4.00 mi Up/down 3.0
Peak-hour factor, PHF 0.88
No-passing zone 30%
% Trucks and Buses, P_T 1 %
% Recreational vehicles, P_R 2%
Access points/ mi 2

Analysis direction vol., V_d 899veh/h
Opposing direction vol., V_o 341veh/h

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	5.7	1.2
Passenger-car equivalents for RVs, E_R (Exhibit 20-9 or 20-17)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.955	0.998
Grade adjustment factor [1], f_G (Exhibit 20-7 or 20-13)	0.95	1.00
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV}*f_G)$	1126	388

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field measured speed[3], S_{FM}	mi/h	Base free-flow speed[3], $BFFS_{FM}$	60.0 mi/h
Observed volume[3], V_f	veh/h	Adj. for lane width and shoulder width,[3] f_{LS}(Exh 20-5)	0.0 mi/h
Free-flow speed, FFS_d $FFS=S_{FM}+0.00776(V_f/f_{HV})$	mi/h	Adj. for access points[3], f_A (Exhibit 20-5)	0.5 mi/h
Adjustment for no-passing zones, f_{np} (Exhibit 20-19)	1.7 mi/h	Free-flow speed, FFS_d $(FSS=BFFS-f_{LS}-f_A)$	59.5 mi/h
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	46.0 mi/h

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 20-10 or 20-16)	1.0	1.1
Passenger-car equivalents for RVs, E_R (Exhibit 20-10 or 20-16)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	1.000	0.999
Grade adjustment factor[1], f_G (Exhibit 20-8 or 20-14)	0.97	1.00
Directional flow rate[2], v_i(pc/h)$=V_i/(PHF*f_{HV}*f_G)$	1053	388
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	74.2	
Adj. for no-passing zone, f_{np} (Exhibit 20-20)	14.6	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	84.8	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	E
Volume to capacity ratio, $v/c=V_p/1{,}700$	0.66
Peak 15-min veh-miles of travel, VMT_{15} (veh- mi)$=0.25L_t(V/PHF)$	2758
Peak-hour vehicle-miles of travel, VMT_{60}(veh- mi)$=V*L_t$	9709
Peak 15-min total travel time, TT_{15}(veh-h)$=VMT_{15}/ATS$	59.9

Notes

1. If the highway is extended segment (level) or rolling terrain, fG=1.0 .
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only.
4. Exhibit 20-21 provides factors a and b.
5. Use alternative Equation 20-14 if some trucks operate at crawl speeds on a specific downgrade.

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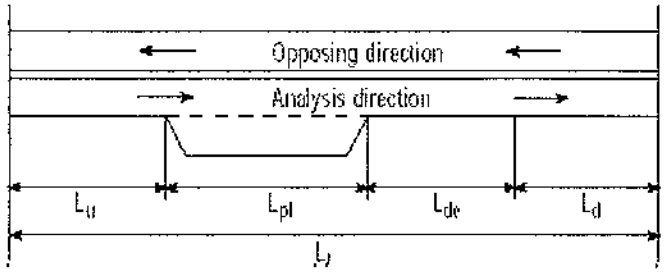
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway of Travel	Foresthill Road - EB - Mitig.
Agency or Company	MRO Engineers, Inc	From/To	Bridge to Spring Garden Road
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	PM Peak Hour	Analysis Year	Year 2030 Without Forest Ranch

Project Description: *Foresthill Divide Community Plan*

Input Data

☑ Class I highway ☐ Class II highway



Total length of analysis segment, L_t (*mi*)	10.8
Length of two-lane highway upstream of the passing lane, L_u (*mi*)	1.5
Length of passing lane including tapers , L_{pl} (*mi*)	7.6
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	46.0
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	84.8
Level of service[1], LOS_d (from Directional Two-Lane Highway Segment Worksheet)	E
Average Travel Speed	
Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (*mi*) (Exhibit 20-23)	1.70
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (*mi*) $L_d=L_t-(L_u+L_{pl}+L_{de})$	0.00
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 20-24)	1.11
Average travel speed including passing lane[2], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl})))$	49.9
Percent Time-Spent-Following	
Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (*mi*)(Exhibit 20-23)	3.60
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (*mi*)$=L_t-(L_u+L_{pl}+L_{de})$	-1.90
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pl} (Exhibit 20-24)	0.62
Percent time-spent-following including passing lane[3], $PTSF_{pl}$(%) $PTSF_{pl}= PTSF_d[L_u+L_d+f_{pl}L_{pl}+((1+f_{pl})/2)L_{de}]/L_t$	58.3
Level of Service and Other Performance Measures[4]	
Level of service including passing lane LOS_{pl} (Exhibit 20-3 or 20-4)	C
Peak 15-min total travel time, TT_{15}(veh-h) $TT_{15}= VMT_{15}/ATS_{pl}$	55.3

Notes

1. If LOS_d=F, passing lane analysis cannot be performed.
2. If L_d <0, use alternative Equation 20-22.
3. If L_d<0, use alternative Equation 20-20.
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.

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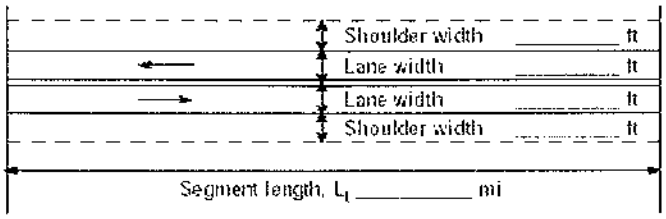
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - WB - Mitig.
Agency or Company	MRO Engineers, Inc.	From/To	Bridge to Spring Garden Road
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	PM Peak Hour	Analysis Year	Year 2030 Without Forest Ranch

Project Description: Foresthill Divide Community Plan

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☐ Level ☐ Rolling

Grade Length 4.00 mi Up/down -3.0

Peak-hour factor, PHF 0.76

No-passing zone 40%

% Trucks and Buses , P_T 4 %

% Recreational vehicles, P_R 2%

Access points/ mi 2

Analysis direction vol , V_d 341veh/h

Opposing direction vol., V_o 899veh/h

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	1.2	5.7
Passenger-car equivalents for RVs, E_R (Exhibit 20-9 or 20-17)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.992	0.842
Grade adjustment factor [1], f_G (Exhibit 20-7 or 20-13)	1.00	0.95
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV}*f_G)$	452	1479

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field measured speed[3], S_{FM}	mi/h	Base free-flow speed[3], $BFFS_{FM}$	60.0 mi/h
Observed volume[3], V_f	veh/h	Adj. for lane width and shoulder width,[3] f_{LS}(Exh 20-5)	0.0 mi/h
Free-flow speed, FFS_d $FFS=S_{FM}+0.00776(V_f/f_{HV})$	mi/h	Adj. for access points[3], f_A (Exhibit 20-5)	0.5 mi/h
Adjustment for no-passing zones, f_{np} (Exhibit 20-19)	0.6 mi/h	Free-flow speed, FFS_d $(FSS=BFFS-f_{LS}-f_A)$	59.5 mi/h
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	43.9 mi/h

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 20-10 or 20-16)	1.1	1.0
Passenger-car equivalents for RVs, E_R (Exhibit 20-10 or 20-16)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.996	1.000
Grade adjustment factor[1], f_G (Exhibit 20-8 or 20-14)	1.00	0.97
Directional flow rate[2], v_i(pc/h)$=V_i/(PHF*f_{HV}*f_G)$	450	1219
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	56.7	
Adj. for no-passing zone, f_{np} (Exhibit. 20-20)	19.2	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	61.9	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	D
Volume to capacity ratio, $v/c=V_p/1{,}700$	0.27
Peak 15-min veh-miles of travel, VMT_{15} (veh- mi)$=0.25L_t(V/PHF)$	1211
Peak-hour vehicle-miles of travel, VMT_{60}(veh- mi)$=V*L_t$	3683
Peak 15-min total travel time, TT_{15}(veh-h)$=VMT_{15}/ATS$	27.6

Notes

1. If the highway is extended segment (level) or rolling terrain, fG=1.0 .
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only.
4. Exhibit 20-21 provides factors a and b.
5. Use alternative Equation 20-14 if some trucks operate at crawl speeds on a specific downgrade.

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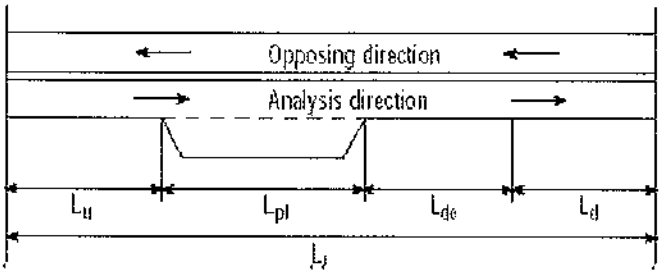
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

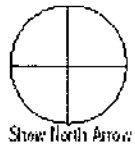
General Information		Site Information	
Analyst	*MKL*	Highway of Travel	*Foresthill Road - WB - Mitig.*
Agency or Company	*MRO Engineers, Inc.*	From/To	*Bridge to Spring Garden Road*
Date Performed	*2/27/07*	Jurisdiction	*Placer County*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*Year 2030 Without Forest Ranch*

Project Description: *Foresthill Divide Community Plan*

Input Data

☑ Class I highway ☐ Class II highway





Total length of analysis segment, L_t (*mi*)	*10.8*
Length of two-lane highway upstream of the passing lane, L_u (*mi*)	*2.2*
Length of passing lane including tapers , L_{pl} (*mi*)	*6.5*
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	*43.9*
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	*61.9*
Level of service[1], LOS_d (from Directional Two-Lane Highway Segment Worksheet)	*D*
Average Travel Speed	
Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (*mi*) (Exhibit 20-23)	*1.70*
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (*mi*) $L_d=L_t-(L_u+L_{pl}+L_{de})$	*0.40*
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 20-24)	*1.10*
Average travel speed including passing lane[2], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl}))$)	*46.8*
Percent Time-Spent-Following	
Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (*mi*)(Exhibit 20-23)	*7.70*
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (*mi*)$=L_t-(L_u+L_{pl}+L_{de})$	*-5.60*
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pl} (Exhibit 20-24)	*0.61*
Percent time-spent-following including passing lane[3], $PTSF_{pl}$(%) $PTSF_{pl}= PTSF_d[L_u+L_d+f_{pl}L_{pl}+((1+f_{pl})/2)L_{de}]/L_t$	*43.3*
Level of Service and Other Performance Measures[4]	
Level of service including passing lane LOS_{pl} (Exhibit 20-3 or 20-4)	*C*
Peak 15-min total travel time, TT_{15}(veh-h) $TT_{15}= VMT_{15}/ATS_{pl}$	*25.9*

Notes

1. If LOS_d=F, passing lane analysis cannot be performed.
2. If L_d <0, use alternative Equation 20-22.
3. If L_d<0, use alternative Equation 20-20.
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.

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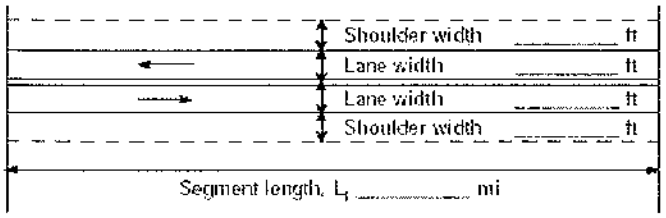
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - WB - Mitig.
Agency or Company	MRO Engineers, Inc.	From/To	Spring Garden to Todd Valley W
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	PM Peak Hour	Analysis Year	Year 2030 Without Forest Ranch

Project Description: *Foresthill Divide Community Plan*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☐ Level ☐ Rolling

Grade Length 1.70 mi Up/down -3.4

Peak-hour factor, PHF 0.88

No-passing zone 50%

% Trucks and Buses, P_T 3 %

% Recreational vehicles, P_R 2%

Access points/ mi 5

Analysis direction vol., V_d 383veh/h

Opposing direction vol., V_o 573veh/h

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	1.2	4.3
Passenger-car equivalents for RVs, E_R (Exhibit 20-9 or 20-17)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.994	0.909
Grade adjustment factor [1], f_G (Exhibit 20-7 or 20-13)	1.00	1.00
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV}*f_G)$	438	716

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field measured speed[3], S_{FM}	mi/h	Base free-flow speed[3], $BFFS_{FM}$	60.0 mi/h
Observed volume[3], V_f	veh/h	Adj. for lane width and shoulder width,[3] f_{LS}(Exh 20-5)	0.0 mi/h
Free-flow speed, FFS_d $FFS=S_{FM}+0.00776(V_f/f_{HV})$	mi/h	Adj. for access points[3], f_A (Exhibit 20-5)	1.3 mi/h
Adjustment for no-passing zones, f_{np} (Exhibit 20-19)	1.2 mi/h	Free-flow speed, FFS_d $(FSS=BFFS-f_{LS}-f_A)$	58.8 mi/h
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	48.6 mi/h

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 20-10 or 20-16)	1.1	1.0
Passenger-car equivalents for RVs, E_R (Exhibit 20-10 or 20-16)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.997	1.000
Grade adjustment factor[1], f_G (Exhibit 20-8 or 20-14)	1.00	0.94
Directional flow rate[2], v_i(pc/h)$=V_i/(PHF*f_{HV}*f_G)$	437	690
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	49.7	
Adj. for no-passing zone, f_{np} (Exhibit. 20-20)	29.3	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	61.1	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	C
Volume to capacity ratio, $v/c=V_p/1{,}700$	0.26
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)$=0.25L_t(V/PHF)$	185
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)$=V*L_t$	651
Peak 15-min total travel time, TT_{15}(veh-h)$=VMT_{15}/ATS$	3.8

Notes

1. If the highway is extended segment (level) or rolling terrain, fG=1.0 .
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only.
4. Exhibit 20-21 provides factors a and b.
5. Use alternative Equation 20-14 if some trucks operate at crawl speeds on a specific downgrade.

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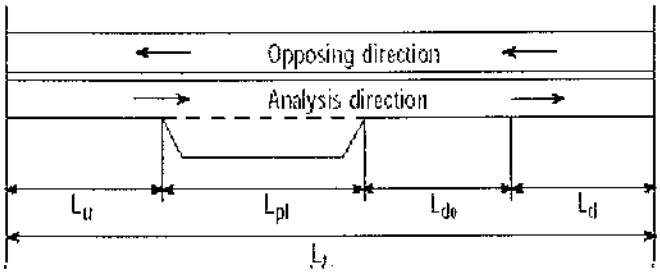
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		*Site Information*	
Analyst	*MKL*	Highway of Travel	*Foresthill Road - WB - Mitig.*
Agency or Company	*MRO Engineers, Inc.*	From/To	*Spring Garden to Todd Valley W*
Date Performed	*2/27/07*	Jurisdiction	*Placer County*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*Year 2030 Without Forest Ranch*

Project Description: *Foresthill Divide Community Plan*

Input Data

☑ Class I highway ☐ Class II highway



Total length of analysis segment, L_t (*mi*)	*1.7*
Length of two-lane highway upstream of the passing lane, L_u (*mi*)	*0.5*
Length of passing lane including tapers , L_{pl} (*mi*)	*0.8*
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	*48.6*
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	*61.1*
Level of service[1], LOS_d (from Directional Two-Lane Highway Segment Worksheet)	*C*
Average Travel Speed	
Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (*mi*) (Exhibit 20-23)	*1.70*
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (*mi*) $L_d=L_t-(L_u+L_{pl}+L_{de})$	*-1.30*
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 20-24)	*1.10*
Average travel speed including passing lane[2], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl}))$)	*51.8*
Percent Time-Spent-Following	
Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (*mi*)(Exhibit 20-23)	*7.80*
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (*mi*)$=L_t-(L_u+L_{pl}+L_{de})$	*-7.40*
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pl} (Exhibit 20-24)	*0.61*
Percent time-spent-following including passing lane[3], $PTSF_{pl}$(%) $PTSF_{pl}= PTSF_d[L_u+L_d+f_{pl}L_{pl}+((1+f_{pl})/2)L_{de}]/L_t$	*44.4*
Level of Service and Other Performance Measures[4]	
Level of service including passing lane LOS_{pl} (Exhibit 20-3 or 20-4)	*B*
Peak 15-min total travel time, TT_{15}(veh-h) $TT_{15}= VMT_{15}/ATS_{pl}$	*3.6*

Notes

1. If LOS_d=F, passing lane analysis cannot be performed.
2. If L_d <0, use alternative Equation 20-22.
3. If L_d<0, use alternative Equation 20-20
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.

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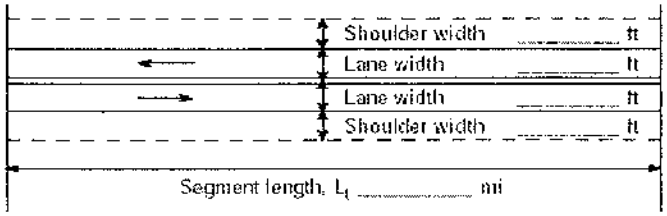
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - WB - Mitig.
Agency or Company	MRO Engineers, Inc.	From/To	Todd Valley W to Owl Hill Ct.
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	PM Peak Hour	Analysis Year	Year 2030 Without Forest Ranch

Project Description: Foresthill Divide Community Plan

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☐ Level ☐ Rolling

Grade Length 1.20 mi Up/down -3.0

Peak-hour factor, PHF 0.88

No-passing zone 50%

% Trucks and Buses, P_T 4 %

% Recreational vehicles, P_R 2%

Access points/ mi 4

Analysis direction vol., V_d 350veh/h

Opposing direction vol., V_o 430veh/h

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	1.2	5.0
Passenger-car equivalents for RVs, E_R (Exhibit 20-9 or 20-17)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.992	0.863
Grade adjustment factor [1], f_G (Exhibit 20-7 or 20-13)	1.00	1.00
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV}*f_G)$	401	568

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field measured speed[3], S_{FM}	mi/h	Base free-flow speed[3], $BFFS_{FM}$	60.0 mi/h
Observed volume[3], V_f	veh/h	Adj. for lane width and shoulder width,[3] f_{LS}(Exh 20-5)	0.0 mi/h
Free-flow speed, FFS_d $FFS=S_{FM}+0.00776(V_f/f_{HV})$	mi/h	Adj. for access points[3], f_A (Exhibit 20-5)	1.0 mi/h
Adjustment for no-passing zones, f_{np} (Exhibit 20-19)	1.6 mi/h	Free-flow speed, FFS_d $(FSS=BFFS-f_{LS}-f_A)$	59.0 mi/h
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	49.9 mi/h

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 20-10 or 20-16)	1.1	1.0
Passenger-car equivalents for RVs, E_R (Exhibit 20-10 or 20-16)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.996	1.000
Grade adjustment factor[1], f_G (Exhibit 20-8 or 20-14)	1.00	0.93
Directional flow rate[2], v_i(pc/h)$=V_i/(PHF*f_{HV}*f_G)$	399	523
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	44.9	
Adj. for no-passing zone, f_{np} (Exhibit. 20-20)	33.5	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	59.4	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	C
Volume to capacity ratio, $v/c=V_p/1{,}700$	0.24
Peak 15-min veh-miles of travel, VMT_{15} (veh- mi)$=0.25L_t(V/PHF)$	119
Peak-hour vehicle-miles of travel, VMT_{60}(veh- mi)$=V*L_t$	420
Peak 15-min total travel time, TT_{15}(veh-h)$=VMT_{15}/ATS$	2.4

Notes

1. If the highway is extended segment (level) or rolling terrain, fG=1.0 .
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only.
4. Exhibit 20-21 provides factors a and b.
5. Use alternative Equation 20-14 if some trucks operate at crawl speeds on a specific downgrade

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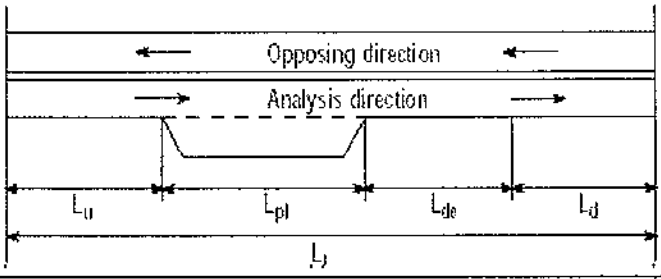
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway of Travel	Foresthill Road - WB - Mitig.
Agency or Company	MRO Engineers, Inc.	From/To	Todd Valley W to Owl Hill Ct.
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	PM Peak Hour	Analysis Year	Year 2030 Without Forest Ranch

Project Description: *Foresthill Divide Community Plan*

Input Data

☑ Class I highway ☐ Class II highway



Total length of analysis segment, L_t (*mi*)	1.2
Length of two-lane highway upstream of the passing lane, L_u (*mi*)	0.3
Length of passing lane including tapers , L_{pl} (*mi*)	0.6
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	49.9
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	59.4
Level of service[1], LOS_d (from Directional Two-Lane Highway Segment Worksheet)	C
Average Travel Speed	
Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (*mi*) (Exhibit 20-23)	1.70
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (*mi*) $L_d=L_t-(L_u+L_{pl}+L_{de})$	-1.40
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 20-24)	1.10
Average travel speed including passing lane[2], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl})))$	53.5
Percent Time-Spent-Following	
Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (*mi*)(Exhibit 20-23)	8.12
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (*mi*)$=L_t-(L_u+L_{pl}+L_{de})$	-7.82
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pl} (Exhibit 20-24)	0.61
Percent time-spent-following including passing lane[3], $PTSF_{pl}$(%) $PTSF_{pl}= PTSF_d[L_u+L_d+f_{pl}L_{pl}+((1+f_{pl})/2)L_{de}]/L_t$	42.1
Level of Service and Other Performance Measures[4]	
Level of service including passing lane LOS_{pl} (Exhibit 20-3 or 20-4)	B
Peak 15-min total travel time, TT_{15}(veh-h) $TT_{15}= VMT_{15}/ATS_{pl}$	2.2

Notes

1. If LOS_d=F, passing lane analysis cannot be performed.
2. If L_d <0, use alternative Equation 20-22.
3. If L_d<0, use alternative Equation 20-20.
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.

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Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0					4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	0.95					1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	0.96	1.00	0.98					1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00					1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.94					1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00					0.95	1.00	1.00
Satd. Flow (prot)	1770	1863	1525	1770	3258					1770	1863	1548
Flt Permitted	0.95	1.00	1.00	0.95	1.00					0.95	1.00	1.00
Satd. Flow (perm)	1770	1863	1525	1770	3258					1770	1863	1548
Volume (vph)	90	232	175	344	499	377	0	0	0	188	195	55
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	98	252	190	374	542	410	0	0	0	204	212	60
RTOR Reduction (vph)	0	0	121	0	82	0	0	0	0	0	0	51
Lane Group Flow (vph)	98	252	69	374	870	0	0	0	0	204	212	9
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Turn Type	Prot		Perm	Prot						Split		Perm
Protected Phases	7	4		3	8					6	6	
Permitted Phases			4									6
Actuated Green, G (s)	9.8	40.8	40.8	42.6	73.6					17.6	17.6	17.6
Effective Green, g (s)	8.8	39.8	39.8	41.6	72.6					16.6	16.6	16.6
Actuated g/C Ratio	0.08	0.36	0.36	0.38	0.66					0.15	0.15	0.15
Clearance Time (s)	3.0	3.0	3.0	3.0	3.0					3.0	3.0	3.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0					3.0	3.0	3.0
Lane Grp Cap (vph)	142	674	552	669	2150					267	281	234
v/s Ratio Prot	c0.06	0.14		c0.21	c0.29					c0.12	0.11	
v/s Ratio Perm			0.12									0.04
v/c Ratio	0.69	0.37	0.12	0.56	0.40					0.76	0.75	0.04
Uniform Delay, d1	49.3	25.9	23.5	27.0	8.7					44.8	44.7	39.9
Progression Factor	1.00	1.00	1.00	0.73	0.72					1.00	1.00	1.00
Incremental Delay, d2	13.5	1.6	0.5	1.0	0.6					12.2	10.9	0.1
Delay (s)	62.8	27.5	23.9	20.7	6.8					57.0	55.7	40.0
Level of Service	E	C	C	C	A					E	E	D
Approach Delay (s)		32.6			10.7			0.0			54.3	
Approach LOS		C			B			A			D	

Intersection Summary

HCM Average Control Delay	24.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	53.1%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑	↑↑↑		↰	↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	4.0
Lane Util. Factor		1.00	0.91		1.00	1.00
Frpb, ped/bikes		1.00	1.00		1.00	0.98
Flpb, ped/bikes		1.00	1.00		1.00	1.00
Frt		1.00	1.00		1.00	0.85
Flt Protected		1.00	1.00		0.95	1.00
Satd. Flow (prot)		1863	5085		1770	1548
Flt Permitted		1.00	1.00		0.95	1.00
Satd. Flow (perm)		1863	5085		1770	1548
Volume (vph)	0	435	1040	0	196	195
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	473	1130	0	213	212
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	473	1130	0	213	212
Confl. Peds. (#/hr)	5			5	5	5
Turn Type						Perm
Protected Phases		4	8		6	
Permitted Phases						6
Actuated Green, G (s)		84.2	84.2		18.8	18.8
Effective Green, g (s)		83.2	83.2		18.8	18.8
Actuated g/C Ratio		0.76	0.76		0.17	0.17
Clearance Time (s)		3.0	3.0		4.0	4.0
Vehicle Extension (s)		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)		1409	3846		303	265
v/s Ratio Prot		c0.25	0.22		0.12	
v/s Ratio Perm						0.14
v/c Ratio		0.34	0.29		0.70	0.80
Uniform Delay, d1		4.4	4.2		43.0	43.8
Progression Factor		0.96	0.47		1.00	1.00
Incremental Delay, d2		0.6	0.2		7.2	15.7
Delay (s)		4.8	2.1		50.2	59.5
Level of Service		A	A		D	E
Approach Delay (s)		4.8	2.1		54.8	
Approach LOS		A	A		D	

Intersection Summary			
HCM Average Control Delay	13.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.42		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	62.4%	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												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.0	4.0			
Lane Util. Factor	1.00	1.00			0.95			1.00	1.00			
Frpb, ped/bikes	1.00	1.00			0.99			1.00	0.96			
Flpb, ped/bikes	1.00	1.00			1.00			0.99	1.00			
Frt	1.00	1.00			0.96			1.00	0.85			
Flt Protected	0.95	1.00			1.00			0.95	1.00			
Satd. Flow (prot)	1770	1863			3357			1758	1525			
Flt Permitted	0.95	1.00			1.00			0.95	1.00			
Satd. Flow (perm)	1770	1863			3357			1758	1525			
Volume (vph)	140	451	0	0	835	320	190	5	231	0	0	0
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	152	490	0	0	908	348	207	5	251	0	0	0
RTOR Reduction (vph)	0	0	0	0	29	0	0	0	0	0	0	0
Lane Group Flow (vph)	152	490	0	0	1227	0	0	212	251	0	0	0
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Turn Type	Prot						Perm		Perm			
Protected Phases	7	4			8			2				
Permitted Phases							2		2			
Actuated Green, G (s)	13.3	81.6			65.3			22.4	22.4			
Effective Green, g (s)	12.3	80.6			64.3			21.4	21.4			
Actuated g/C Ratio	0.11	0.73			0.58			0.19	0.19			
Clearance Time (s)	3.0	3.0			3.0			3.0	3.0			
Vehicle Extension (s)	3.0	3.0			3.0			3.0	3.0			
Lane Grp Cap (vph)	198	1365			1962			342	297			
v/s Ratio Prot	c0.09	0.26			c0.37							
v/s Ratio Perm								0.12	0.16			
v/c Ratio	0.77	0.36			0.63			0.62	0.85			
Uniform Delay, d1	47.5	5.3			15.0			40.6	42.7			
Progression Factor	1.08	0.57			0.66			1.00	1.00			
Incremental Delay, d2	15.7	0.7			0.7			3.3	19.3			
Delay (s)	66.8	3.7			10.5			43.9	62.0			
Level of Service	E	A			B			D	E			
Approach Delay (s)		18.7			10.5			53.7			0.0	
Approach LOS		B			B			D			A	

Intersection Summary

HCM Average Control Delay	21.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	62.4%	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												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	1.00	1.00	0.95		1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00		1.00	0.99		1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.97		1.00	0.96		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	1863	1548	1770	3415		1770	3370		1770	3539	1548
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	1863	1548	1770	3415		1770	3370		1770	3539	1548
Volume (vph)	160	217	240	154	650	167	415	175	61	49	85	125
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	174	236	261	167	707	182	451	190	66	53	92	136
RTOR Reduction (vph)	0	0	209	0	21	0	0	32	0	0	0	0
Lane Group Flow (vph)	174	236	52	167	868	0	451	224	0	53	92	136
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Turn Type	Split		Perm	Split			Prot			Prot		Perm
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases			4									6
Actuated Green, G (s)	22.0	22.0	22.0	31.1	31.1		30.7	37.1		6.8	13.2	13.2
Effective Green, g (s)	22.0	22.0	22.0	30.1	30.1		29.7	36.1		5.8	12.2	12.2
Actuated g/C Ratio	0.20	0.20	0.20	0.27	0.27		0.27	0.33		0.05	0.11	0.11
Clearance Time (s)	4.0	4.0	4.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	687	373	310	484	934		478	1106		93	393	172
v/s Ratio Prot	0.05	0.13		0.09	c0.26		c0.25	0.08		0.03	0.03	
v/s Ratio Perm			0.17									0.09
v/c Ratio	0.25	0.63	0.17	0.35	0.93		0.94	0.20		0.57	0.23	0.79
Uniform Delay, d1	37.1	40.3	36.4	32.0	38.9		39.3	26.6		50.9	44.6	47.7
Progression Factor	0.88	0.86	1.32	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	0.8	7.2	1.1	0.4	15.0		27.4	0.1		7.8	0.3	21.4
Delay (s)	33.5	42.1	49.2	32.5	53.9		66.7	26.7		58.7	44.9	69.1
Level of Service	C	D	D	C	D		E	C		E	D	E
Approach Delay (s)		42.6			50.5			52.2			59.2	
Approach LOS		D			D			D			E	

Intersection Summary			
HCM Average Control Delay	49.9	HCM Level of Service	D
HCM Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	69.2%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0					4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	0.95					1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	0.97	1.00	0.98					1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00					1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.93					1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00					0.95	1.00	1.00
Satd. Flow (prot)	1770	1863	1530	1770	3239					1770	1863	1551
Flt Permitted	0.95	1.00	1.00	0.95	1.00					0.95	1.00	1.00
Satd. Flow (perm)	1770	1863	1530	1770	3239					1770	1863	1551
Volume (vph)	125	481	240	272	522	459	0	0	0	286	155	65
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	136	523	261	296	567	499	0	0	0	311	168	71
RTOR Reduction (vph)	0	0	150	0	154	0	0	0	0	0	0	56
Lane Group Flow (vph)	136	523	111	296	912	0	0	0	0	311	168	15
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Turn Type	Prot		Perm	Prot						Split		Perm
Protected Phases	7	4		3	8					6	6	
Permitted Phases			4									6
Actuated Green, G (s)	11.5	39.4	39.4	22.0	49.9					19.6	19.6	19.6
Effective Green, g (s)	10.5	38.4	38.4	21.0	48.9					18.6	18.6	18.6
Actuated g/C Ratio	0.12	0.43	0.43	0.23	0.54					0.21	0.21	0.21
Clearance Time (s)	3.0	3.0	3.0	3.0	3.0					3.0	3.0	3.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0					3.0	3.0	3.0
Lane Grp Cap (vph)	207	795	653	413	1760					366	385	321
v/s Ratio Prot	0.08	c0.28		c0.17	0.33					c0.18	0.09	
v/s Ratio Perm			0.17									0.05
v/c Ratio	0.66	0.66	0.17	0.72	0.52					0.85	0.44	0.05
Uniform Delay, d1	38.0	20.6	16.0	31.8	13.1					34.4	31.1	28.6
Progression Factor	1.00	1.00	1.00	1.02	1.12					1.00	1.00	1.00
Incremental Delay, d2	7.3	4.2	0.6	5.6	1.0					16.6	0.8	0.1
Delay (s)	45.3	24.8	16.5	38.0	15.7					51.0	31.9	28.7
Level of Service	D	C	B	D	B					D	C	C
Approach Delay (s)		25.5			20.5			0.0			42.3	
Approach LOS		C			C			A			D	

Intersection Summary			
HCM Average Control Delay	26.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	66.2%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑	↑↑↑		↰	↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	4.0
Lane Util. Factor		1.00	0.91		1.00	1.00
Frpb, ped/bikes		1.00	1.00		1.00	0.98
Flpb, ped/bikes		1.00	1.00		1.00	1.00
Frt		1.00	1.00		1.00	0.85
Flt Protected		1.00	1.00		0.95	1.00
Satd. Flow (prot)		1863	5085		1770	1551
Flt Permitted		1.00	1.00		0.95	1.00
Satd. Flow (perm)		1863	5085		1770	1551
Volume (vph)	0	762	1053	0	292	200
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	828	1145	0	317	217
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	828	1145	0	317	217
Confl. Peds. (#/hr)	5			5	5	5
Turn Type						Perm
Protected Phases		4	8		6	
Permitted Phases						6
Actuated Green, G (s)		62.6	62.6		20.4	20.4
Effective Green, g (s)		61.6	61.6		20.4	20.4
Actuated g/C Ratio		0.68	0.68		0.23	0.23
Clearance Time (s)		3.0	3.0		4.0	4.0
Vehicle Extension (s)		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)		1275	3480		401	352
v/s Ratio Prot		c0.44	0.23		c0.18	
v/s Ratio Perm						0.14
v/c Ratio		0.65	0.33		0.79	0.62
Uniform Delay, d1		8.1	5.8		32.8	31.3
Progression Factor		0.13	0.44		1.00	1.00
Incremental Delay, d2		1.9	0.1		10.2	3.2
Delay (s)		2.9	2.7		43.0	34.5
Level of Service		A	A		D	C
Approach Delay (s)		2.9	2.7		39.5	
Approach LOS		A	A		D	

Intersection Summary			
HCM Average Control Delay	10.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	126.5%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.0	4.0			
Lane Util. Factor	1.00	1.00			0.95			1.00	1.00			
Frpb, ped/bikes	1.00	1.00			0.99			1.00	0.97			
Flpb, ped/bikes	1.00	1.00			1.00			0.99	1.00			
Frt	1.00	1.00			0.95			1.00	0.85			
Flt Protected	0.95	1.00			1.00			0.95	1.00			
Satd. Flow (prot)	1770	1863			3303			1762	1530			
Flt Permitted	0.95	1.00			1.00			0.95	1.00			
Satd. Flow (perm)	1770	1863			3303			1762	1530			
Volume (vph)	250	759	0	0	693	400	360	10	655	0	0	0
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	272	825	0	0	753	435	391	11	712	0	0	0
RTOR Reduction (vph)	0	0	0	0	92	0	0	0	54	0	0	0
Lane Group Flow (vph)	272	825	0	0	1097	0	0	402	658	0	0	0
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Turn Type	Prot						Perm		Perm			
Protected Phases	7	4			8			2				
Permitted Phases							2		2			
Actuated Green, G (s)	14.0	47.0			30.0			37.0	37.0			
Effective Green, g (s)	13.0	46.0			29.0			36.0	36.0			
Actuated g/C Ratio	0.14	0.51			0.32			0.40	0.40			
Clearance Time (s)	3.0	3.0			3.0			3.0	3.0			
Vehicle Extension (s)	3.0	3.0			3.0			3.0	3.0			
Lane Grp Cap (vph)	256	952			1064			705	612			
v/s Ratio Prot	c0.15	0.44			c0.36							
v/s Ratio Perm								0.23	0.47			
v/c Ratio	1.06	0.87			1.03			0.57	1.08			
Uniform Delay, d1	38.5	19.3			30.5			21.0	27.0			
Progression Factor	1.02	1.02			0.65			1.00	1.00			
Incremental Delay, d2	66.7	8.2			17.7			1.1	58.3			
Delay (s)	106.0	28.0			37.6			22.1	85.3			
Level of Service	F	C			D			C	F			
Approach Delay (s)		47.3			37.6			62.5			0.0	
Approach LOS		D			D			E			A	

Intersection Summary			
HCM Average Control Delay	48.9	HCM Level of Service	D
HCM Volume to Capacity ratio	1.13		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	126.5%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	1.00	1.00	0.95		1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00		1.00	0.99		1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.97		1.00	0.94		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	1863	1551	1770	3404		1770	3279		1770	3539	1551
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	1863	1551	1770	3404		1770	3279		1770	3539	1551
Volume (vph)	420	664	310	73	348	101	490	345	235	180	195	255
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	457	722	337	79	378	110	533	375	255	196	212	277
RTOR Reduction (vph)	0	0	112	0	30	0	0	130	0	0	0	0
Lane Group Flow (vph)	457	722	225	79	458	0	533	500	0	196	212	277
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Turn Type	Split		Perm	Split			Prot			Prot		Perm
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases			4									6
Actuated Green, G (s)	29.0	29.0	29.0	11.0	11.0		23.0	23.9		13.1	14.0	14.0
Effective Green, g (s)	29.0	29.0	29.0	10.0	10.0		22.0	22.9		12.1	13.0	13.0
Actuated g/C Ratio	0.32	0.32	0.32	0.11	0.11		0.24	0.25		0.13	0.14	0.14
Clearance Time (s)	4.0	4.0	4.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	1106	600	500	197	378		433	834		238	511	224
v/s Ratio Prot	0.13	c0.39		0.04	c0.14		c0.30	0.19		0.11	0.06	
v/s Ratio Perm			0.22									0.18
v/c Ratio	0.41	1.20	0.45	0.40	1.21		1.23	0.60		0.82	0.41	1.24
Uniform Delay, d1	23.8	30.5	24.2	37.2	40.0		34.0	29.5		37.9	35.0	38.5
Progression Factor	0.92	0.96	0.94	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	0.3	96.6	0.9	1.3	117.1		122.7	1.2		20.1	0.5	138.7
Delay (s)	22.3	126.0	23.7	38.6	157.1		156.7	30.7		58.0	35.6	177.2
Level of Service	C	F	C	D	F		F	C		E	D	F
Approach Delay (s)		72.0			140.6			88.4			99.3	
Approach LOS		E			F			F			F	

Intersection Summary

HCM Average Control Delay	91.5	HCM Level of Service	F
HCM Volume to Capacity ratio	1.23		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	86.1%	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												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0					4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	0.95					1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	0.96	1.00	0.98					1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00					1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.94					1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00					0.95	1.00	1.00
Satd. Flow (prot)	1770	1863	1525	1770	3258					1770	1863	1548
Flt Permitted	0.95	1.00	1.00	0.95	1.00					0.95	1.00	1.00
Satd. Flow (perm)	1770	1863	1525	1770	3258					1770	1863	1548
Volume (vph)	90	232	175	344	499	377	0	0	0	188	195	55
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	98	252	190	374	542	410	0	0	0	204	212	60
RTOR Reduction (vph)	0	0	121	0	82	0	0	0	0	0	0	51
Lane Group Flow (vph)	98	252	69	374	870	0	0	0	0	204	212	9
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Turn Type	Prot		Perm	Prot						Split		Perm
Protected Phases	7	4		3	8					6	6	
Permitted Phases			4									6
Actuated Green, G (s)	9.8	40.8	40.8	42.6	73.6					17.6	17.6	17.6
Effective Green, g (s)	8.8	39.8	39.8	41.6	72.6					16.6	16.6	16.6
Actuated g/C Ratio	0.08	0.36	0.36	0.38	0.66					0.15	0.15	0.15
Clearance Time (s)	3.0	3.0	3.0	3.0	3.0					3.0	3.0	3.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0					3.0	3.0	3.0
Lane Grp Cap (vph)	142	674	552	669	2150					267	281	234
v/s Ratio Prot	c0.06	0.14		c0.21	c0.29					c0.12	0.11	
v/s Ratio Perm			0.12									0.04
v/c Ratio	0.69	0.37	0.12	0.56	0.40					0.76	0.75	0.04
Uniform Delay, d1	49.3	25.9	23.5	27.0	8.7					44.8	44.7	39.9
Progression Factor	1.00	1.00	1.00	0.77	0.86					1.00	1.00	1.00
Incremental Delay, d2	13.5	1.6	0.5	1.0	0.6					12.2	10.9	0.1
Delay (s)	62.8	27.5	23.9	21.8	8.0					57.0	55.7	40.0
Level of Service	E	C	C	C	A					E	E	D
Approach Delay (s)		32.6			11.9			0.0			54.3	
Approach LOS		C			B			A			D	

Intersection Summary

HCM Average Control Delay	25.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	53.1%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑	↑↑↑		↖	↗
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	4.0
Lane Util. Factor		1.00	0.91		1.00	1.00
Frpb, ped/bikes		1.00	1.00		1.00	0.98
Flpb, ped/bikes		1.00	1.00		1.00	1.00
Frt		1.00	1.00		1.00	0.85
Flt Protected		1.00	1.00		0.95	1.00
Satd. Flow (prot)		1863	5085		1770	1548
Flt Permitted		1.00	1.00		0.95	1.00
Satd. Flow (perm)		1863	5085		1770	1548
Volume (vph)	0	435	1040	0	196	195
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	473	1130	0	213	212
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	473	1130	0	213	212
Confl. Peds. (#/hr)	5			5	5	5
Turn Type						Perm
Protected Phases		4	8		6	
Permitted Phases						6
Actuated Green, G (s)		84.2	84.2		18.8	18.8
Effective Green, g (s)		83.2	83.2		18.8	18.8
Actuated g/C Ratio		0.76	0.76		0.17	0.17
Clearance Time (s)		3.0	3.0		4.0	4.0
Vehicle Extension (s)		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)		1409	3846		303	265
v/s Ratio Prot		c0.25	0.22		0.12	
v/s Ratio Perm						0.14
v/c Ratio		0.34	0.29		0.70	0.80
Uniform Delay, d1		4.4	4.2		43.0	43.8
Progression Factor		0.96	0.25		1.00	1.00
Incremental Delay, d2		0.6	0.2		7.2	15.7
Delay (s)		4.8	1.2		50.2	59.5
Level of Service		A	A		D	E
Approach Delay (s)		4.8	1.2		54.8	
Approach LOS		A	A		D	

Intersection Summary			
HCM Average Control Delay	13.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.42		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	62.4%	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												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.0	4.0			
Lane Util. Factor	1.00	1.00			0.95			1.00	1.00			
Frpb, ped/bikes	1.00	1.00			0.99			1.00	0.96			
Flpb, ped/bikes	1.00	1.00			1.00			0.99	1.00			
Frt	1.00	1.00			0.96			1.00	0.85			
Flt Protected	0.95	1.00			1.00			0.95	1.00			
Satd. Flow (prot)	1770	1863			3357			1758	1525			
Flt Permitted	0.95	1.00			1.00			0.95	1.00			
Satd. Flow (perm)	1770	1863			3357			1758	1525			
Volume (vph)	140	451	0	0	835	320	190	5	231	0	0	0
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	152	490	0	0	908	348	207	5	251	0	0	0
RTOR Reduction (vph)	0	0	0	0	29	0	0	0	0	0	0	0
Lane Group Flow (vph)	152	490	0	0	1227	0	0	212	251	0	0	0
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Turn Type	Prot						Perm		Perm			
Protected Phases	7	4			8			2				
Permitted Phases							2		2			
Actuated Green, G (s)	13.3	81.6			65.3			22.4	22.4			
Effective Green, g (s)	12.3	80.6			64.3			21.4	21.4			
Actuated g/C Ratio	0.11	0.73			0.58			0.19	0.19			
Clearance Time (s)	3.0	3.0			3.0			3.0	3.0			
Vehicle Extension (s)	3.0	3.0			3.0			3.0	3.0			
Lane Grp Cap (vph)	198	1365			1962			342	297			
v/s Ratio Prot	c0.09	0.26			c0.37							
v/s Ratio Perm								0.12	0.16			
v/c Ratio	0.77	0.36			0.63			0.62	0.85			
Uniform Delay, d1	47.5	5.3			15.0			40.6	42.7			
Progression Factor	1.08	0.57			0.29			1.00	1.00			
Incremental Delay, d2	15.7	0.7			1.2			3.3	19.3			
Delay (s)	66.8	3.7			5.5			43.9	62.0			
Level of Service	E	A			A			D	E			
Approach Delay (s)		18.7			5.5			53.7			0.0	
Approach LOS		B			A			D			A	

Intersection Summary			
HCM Average Control Delay	18.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	62.4%	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												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	1.00	1.00	0.95	1.00	0.97	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00	0.98	1.00	0.99		1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.96		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	1863	1548	1770	3539	1548	3433	3370		1770	3539	1548
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	1863	1548	1770	3539	1548	3433	3370		1770	3539	1548
Volume (vph)	160	217	240	154	650	167	415	175	61	49	85	125
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	174	236	261	167	707	182	451	190	66	53	92	136
RTOR Reduction (vph)	0	0	182	0	0	118	0	35	0	0	0	0
Lane Group Flow (vph)	174	236	79	167	707	64	451	221	0	53	92	136
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Turn Type	Split		Perm	Split		Perm	Prot			Prot		Perm
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases			4			8						6
Actuated Green, G (s)	33.5	33.5	33.5	27.8	27.8	27.8	18.9	28.9		6.8	16.8	16.8
Effective Green, g (s)	33.5	33.5	33.5	26.8	26.8	26.8	17.9	27.9		5.8	15.8	15.8
Actuated g/C Ratio	0.30	0.30	0.30	0.24	0.24	0.24	0.16	0.25		0.05	0.14	0.14
Clearance Time (s)	4.0	4.0	4.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	1046	567	471	431	862	377	559	855		93	508	222
v/s Ratio Prot	0.05	0.13		0.09	c0.20		c0.13	0.08		0.03	0.03	
v/s Ratio Perm			0.17			0.12						0.09
v/c Ratio	0.17	0.42	0.17	0.39	0.82	0.17	0.81	0.26		0.57	0.18	0.61
Uniform Delay, d1	28.0	30.5	28.0	34.7	39.3	32.8	44.4	32.8		50.9	41.4	44.2
Progression Factor	0.91	0.89	1.18	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	0.3	2.0	0.7	0.6	6.3	0.2	8.3	0.2		7.8	0.2	4.9
Delay (s)	25.8	29.1	33.9	35.3	45.6	33.0	52.7	32.9		58.7	41.6	49.2
Level of Service	C	C	C	D	D	C	D	C		E	D	D
Approach Delay (s)		30.1			41.8			45.6			48.5	
Approach LOS		C			D			D			D	

Intersection Summary

HCM Average Control Delay	40.6	HCM Level of Service	D
HCM Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	52.6%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0					4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	0.95					1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	0.97	1.00	0.98					1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00					1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.93					1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00					0.95	1.00	1.00
Satd. Flow (prot)	1770	1863	1530	1770	3239					1770	1863	1551
Flt Permitted	0.95	1.00	1.00	0.95	1.00					0.95	1.00	1.00
Satd. Flow (perm)	1770	1863	1530	1770	3239					1770	1863	1551
Volume (vph)	125	481	240	272	522	459	0	0	0	286	155	65
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	136	523	261	296	567	499	0	0	0	311	168	71
RTOR Reduction (vph)	0	0	150	0	154	0	0	0	0	0	0	56
Lane Group Flow (vph)	136	523	111	296	912	0	0	0	0	311	168	15
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Turn Type	Prot		Perm	Prot						Split		Perm
Protected Phases	7	4		3	8					6	6	
Permitted Phases			4									6
Actuated Green, G (s)	11.5	39.4	39.4	22.0	49.9					19.6	19.6	19.6
Effective Green, g (s)	10.5	38.4	38.4	21.0	48.9					18.6	18.6	18.6
Actuated g/C Ratio	0.12	0.43	0.43	0.23	0.54					0.21	0.21	0.21
Clearance Time (s)	3.0	3.0	3.0	3.0	3.0					3.0	3.0	3.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0					3.0	3.0	3.0
Lane Grp Cap (vph)	207	795	653	413	1760					366	385	321
v/s Ratio Prot	0.08	c0.28		c0.17	0.33					c0.18	0.09	
v/s Ratio Perm			0.17									0.05
v/c Ratio	0.66	0.66	0.17	0.72	0.52					0.85	0.44	0.05
Uniform Delay, d1	38.0	20.6	16.0	31.8	13.1					34.4	31.1	28.6
Progression Factor	1.00	1.00	1.00	1.02	1.12					1.00	1.00	1.00
Incremental Delay, d2	7.3	4.2	0.6	5.6	1.0					16.6	0.8	0.1
Delay (s)	45.3	24.8	16.5	38.0	15.6					51.0	31.9	28.7
Level of Service	D	C	B	D	B					D	C	C
Approach Delay (s)		25.5			20.5			0.0			42.3	
Approach LOS		C			C			A			D	

Intersection Summary

HCM Average Control Delay	26.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	66.2%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑	↑↑↑		↰	↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	4.0
Lane Util. Factor		1.00	0.91		1.00	1.00
Frpb, ped/bikes		1.00	1.00		1.00	0.98
Flpb, ped/bikes		1.00	1.00		1.00	1.00
Frt		1.00	1.00		1.00	0.85
Flt Protected		1.00	1.00		0.95	1.00
Satd. Flow (prot)		1863	5085		1770	1551
Flt Permitted		1.00	1.00		0.95	1.00
Satd. Flow (perm)		1863	5085		1770	1551
Volume (vph)	0	762	1053	0	292	200
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	828	1145	0	317	217
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	828	1145	0	317	217
Confl. Peds. (#/hr)	5			5	5	5
Turn Type						Perm
Protected Phases		4	8		6	
Permitted Phases						6
Actuated Green, G (s)		62.6	62.6		20.4	20.4
Effective Green, g (s)		61.6	61.6		20.4	20.4
Actuated g/C Ratio		0.68	0.68		0.23	0.23
Clearance Time (s)		3.0	3.0		4.0	4.0
Vehicle Extension (s)		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)		1275	3480		401	352
v/s Ratio Prot		c0.44	0.23		c0.18	
v/s Ratio Perm						0.14
v/c Ratio		0.65	0.33		0.79	0.62
Uniform Delay, d1		8.1	5.8		32.8	31.3
Progression Factor		0.13	0.44		1.00	1.00
Incremental Delay, d2		1.9	0.1		10.2	3.2
Delay (s)		2.9	2.7		43.0	34.5
Level of Service		A	A		D	C
Approach Delay (s)		2.9	2.7		39.5	
Approach LOS		A	A		D	

Intersection Summary			
HCM Average Control Delay	10.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	126.5%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.0	4.0			
Lane Util. Factor	1.00	1.00			0.95			1.00	1.00			
Frpb, ped/bikes	1.00	1.00			0.99			1.00	0.97			
Flpb, ped/bikes	1.00	1.00			1.00			0.99	1.00			
Frt	1.00	1.00			0.95			1.00	0.85			
Flt Protected	0.95	1.00			1.00			0.95	1.00			
Satd. Flow (prot)	1770	1863			3303			1762	1530			
Flt Permitted	0.95	1.00			1.00			0.95	1.00			
Satd. Flow (perm)	1770	1863			3303			1762	1530			
Volume (vph)	250	759	0	0	693	400	360	10	655	0	0	0
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	272	825	0	0	753	435	391	11	712	0	0	0
RTOR Reduction (vph)	0	0	0	0	92	0	0	0	54	0	0	0
Lane Group Flow (vph)	272	825	0	0	1097	0	0	402	658	0	0	0
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Turn Type	Prot						Perm		Perm			
Protected Phases	7	4			8			2				
Permitted Phases							2		2			
Actuated Green, G (s)	14.0	47.0			30.0			37.0	37.0			
Effective Green, g (s)	13.0	46.0			29.0			36.0	36.0			
Actuated g/C Ratio	0.14	0.51			0.32			0.40	0.40			
Clearance Time (s)	3.0	3.0			3.0			3.0	3.0			
Vehicle Extension (s)	3.0	3.0			3.0			3.0	3.0			
Lane Grp Cap (vph)	256	952			1064			705	612			
v/s Ratio Prot	c0.15	0.44			c0.36							
v/s Ratio Perm								0.23	0.47			
v/c Ratio	1.06	0.87			1.03			0.57	1.08			
Uniform Delay, d1	38.5	19.3			30.5			21.0	27.0			
Progression Factor	1.02	1.02			0.75			1.00	1.00			
Incremental Delay, d2	66.7	8.2			26.9			1.1	58.3			
Delay (s)	106.0	28.0			49.9			22.1	85.3			
Level of Service	F	C			D			C	F			
Approach Delay (s)		47.3			49.9			62.5			0.0	
Approach LOS		D			D			E			A	

Intersection Summary			
HCM Average Control Delay	53.2	HCM Level of Service	D
HCM Volume to Capacity ratio	1.13		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	126.5%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	1.00	1.00	0.95	1.00	0.97	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00	0.98	1.00	0.99		1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.94		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	1863	1551	1770	3539	1551	3433	3279		1770	3539	1551
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	1863	1551	1770	3539	1551	3433	3279		1770	3539	1551
Volume (vph)	420	664	310	73	348	101	490	345	235	180	195	255
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	457	722	337	79	378	110	533	375	255	196	212	277
RTOR Reduction (vph)	0	0	104	0	0	98	0	139	0	0	0	0
Lane Group Flow (vph)	457	722	233	79	378	12	533	491	0	196	212	277
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Turn Type	Split		Perm	Split		Perm	Prot			Prot		Perm
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases			4			8						6
Actuated Green, G (s)	33.3	33.3	33.3	11.0	11.0	11.0	18.7	19.6		13.1	14.0	14.0
Effective Green, g (s)	33.3	33.3	33.3	10.0	10.0	10.0	17.7	18.6		12.1	13.0	13.0
Actuated g/C Ratio	0.37	0.37	0.37	0.11	0.11	0.11	0.20	0.21		0.13	0.14	0.14
Clearance Time (s)	4.0	4.0	4.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	1270	689	574	197	393	172	675	678		238	511	224
v/s Ratio Prot	0.13	c0.39		0.04	c0.11		0.16	c0.19		0.11	0.06	
v/s Ratio Perm			0.22			0.07						0.18
v/c Ratio	0.36	1.05	0.41	0.40	0.96	0.07	0.79	0.72		0.82	0.41	1.24
Uniform Delay, d1	20.6	28.4	21.0	37.2	39.8	35.8	34.4	33.3		37.9	35.0	38.5
Progression Factor	0.90	0.95	0.92	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	0.2	32.9	0.6	1.3	35.3	0.2	6.1	3.8		20.1	0.5	138.7
Delay (s)	18.9	59.9	20.1	38.6	75.1	36.0	40.5	37.2		58.0	35.6	177.2
Level of Service	B	E	C	D	E	D	D	D		E	D	F
Approach Delay (s)		38.7			62.5			38.7			99.3	
Approach LOS		D			E			D			F	

Intersection Summary			
HCM Average Control Delay	52.7	HCM Level of Service	D
HCM Volume to Capacity ratio	1.00		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	79.6%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group