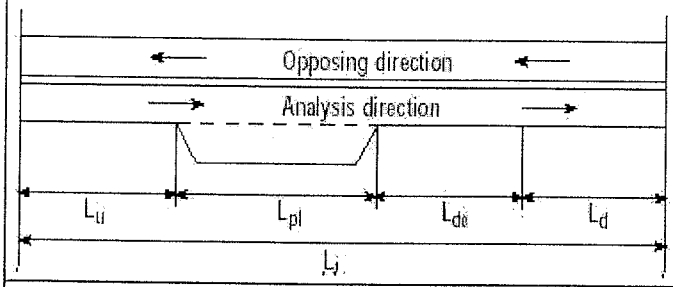
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

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 With 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)	*46.8*
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	*67.4*
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*) $L_d=L_t-(L_u+L_{pl}+L_{de})$	*-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)	*7.15*
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (*mi*)$=L_t-(L_u+L_{pl}+L_{de})$	*-7.15*
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], $PTSF_{pl}$(%) $PTSF_{pl}= PTSF_d[L_u+L_d+f_{pl}L_{pl}+((1+f_{pl})/2)L_{de}]/L_t$	*67.4*
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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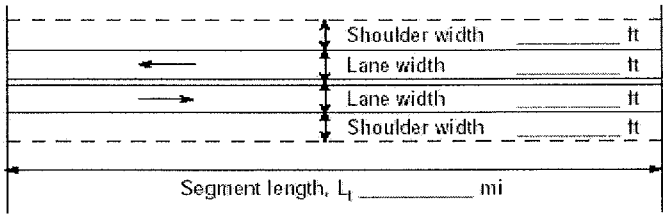
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKP	Highway / Direction of Travel	Foresthill Road - Eastbound
Agency or Company	MRO Engineers, Inc.	From/To	Todd Valley W to Owl Hill Ct.
Date Performed	10/22/07	Jurisdiction	Placer County
Analysis Time Period	PM Peak Hour	Analysis Year	Year 2030 With Forest Ranch

Project Description: *Foresthill Divide Community Plan*

Input Data



Analysis direction vol., V_d 598veh/h

Opposing direction vol., V_o 501veh/h

☑ 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

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	3.7	1.2
Passenger-car equivalents for RVs, E_R (Exhibit 20-9 or 20-17)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.948	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) $v_i=V_i/(PHF*f_{HV}*f_G)$	742	592

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)	1.1 mi/h	Free-flow speed, FFS_d ($FSS=BFFS-f_{LS}-f_A$)	59.3 mi/h
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	47.8 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	1.1
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)$=V_i/(PHF*f_{HV}*f_G)$	753	591
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	65.0	
Adj. for no-passing zone, f_{np} (Exhibit. 20-20)	19.2	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	75.8	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	D
Volume to capacity ratio, $v/c=V_p/1{,}700$	0.44
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)$=0.25L_t(V/PHF)$	211
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)$=V*L_t$	718
Peak 15-min total travel time, TT_{15}(veh-h)$=VMT_{15}/ATS$	4.4

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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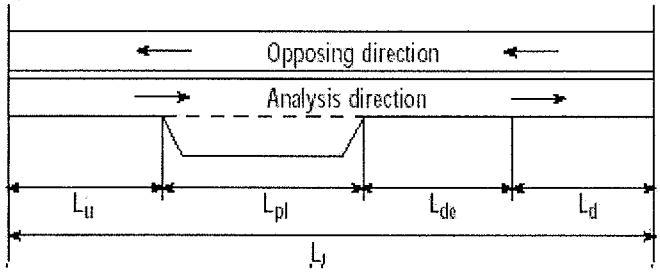
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	*MKP*	Highway of Travel	*Foresthill Road - Eastbound*
Agency or Company	*MRO Engineers, Inc.*	From/To	*Todd Valley W to Owl Hill Ct.*
Date Performed	*10/22/07*	Jurisdiction	*Placer County*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*Year 2030 With 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)	*47.8*
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	*75.8*
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*) $L_d=L_t-(L_u+L_{pl}+L_{de})$	*-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], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl}))$)	*52.6*
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)	*5.33*
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (*mi*)$=L_t-(L_u+L_{pl}+L_{de})$	*-5.23*
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], $PTSF_{pl}$(%) $PTSF_{pl}= PTSF_d[L_u+L_d+f_{pl}L_{pl}+((1+f_{pl})/2)L_{de}]/L_t$	*49.4*
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) $TT_{15}= VMT_{15}/ATS_{pl}$	*4.0*

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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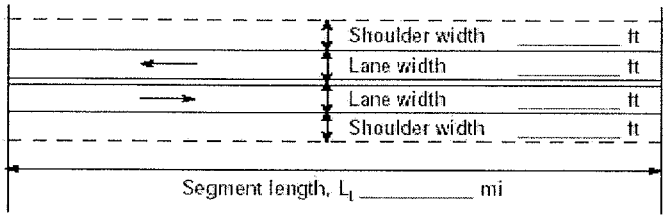
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*MKP*	Highway / Direction of Travel	*Foresthill Road - Westbound*
Agency or Company	*MRO Engineers, Inc.*	From/To	*Todd Valley W to Owl Hill Ct.*
Date Performed	*10/22/07*	Jurisdiction	*Placer County*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*Year 2030 With Forest Ranch*

Project Description: *Foresthill Divide Community Plan*

Input Data



Analysis direction vol., V_d *501*veh/h

Opposing direction vol., V_o *598*veh/h

☑ 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*

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	*1.2*	*3.7*
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*	*0.901*
Grade adjustment factor [1], f_G (Exhibit 20-7 or 20-13)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV}*f_G)$	*574*	*754*

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, $ATS=FFS-0.00776v_p-f_{np}$	*47.2 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*	*0.93*
Directional flow rate[2], v_i(pc/h)$=V_i/(PHF*f_{HV}*f_G)$	*572*	*728*
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	*58.4*	
Adj. for no-passing zone, f_{np} (Exhibit. 20-20)	*29.6*	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	*71.4*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	*D*
Volume to capacity ratio, $v/c=V_p/1{,}700$	*0.34*
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)$=0.25L_t(V/PHF)$	*171*
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)$=V*L_t$	*601*
Peak 15-min total travel time, TT_{15}(veh-h)$=VMT_{15}/ATS$	*3.6*

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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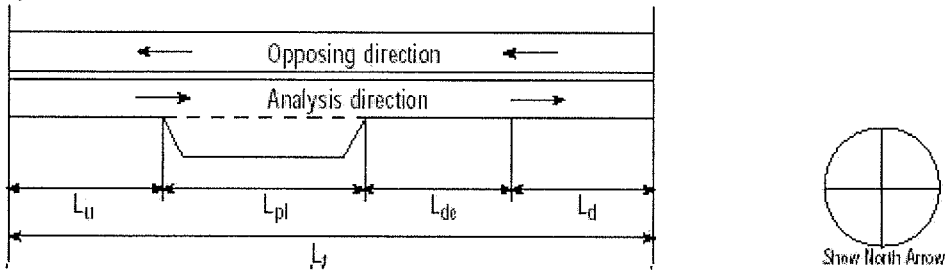
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	*MKP*	Highway of Travel	*Foresthill Road - Westbound*
Agency or Company	*MRO Engineers, Inc.*	From/To	*Todd Valley W to Owl Hill Ct.*
Date Performed	*10/22/07*	Jurisdiction	*Placer County*
Analysis Time Period	*PM Peak Hour*	Analysis Year	*Year 2030 With 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)	*47.2*
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	*71.4*
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*) $L_d=L_t-(L_u+L_{pl}+L_{de})$	*-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)	*6.72*
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (*mi*)$=L_t-(L_u+L_{pl}+L_{de})$	*-6.72*
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], $PTSF_{pl}$(%) $PTSF_{pl}= PTSF_d[L_u+L_d+f_{pl}L_{pl}+((1+f_{pl})/2)L_{de}]/L_t$	*71.4*
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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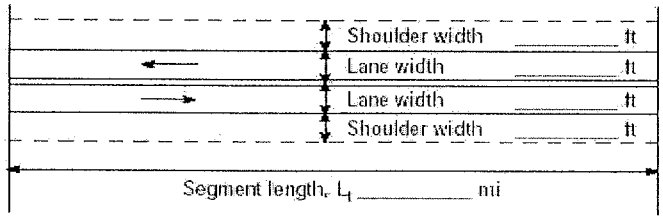
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

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 With 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 *347*veh/h

Opposing direction vol., V_o *993*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) $v_i=V_i/(PHF*f_{HV}*f_G)$	*583*	*1135*

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, $ATS=FFS-0.00776v_p-f_{np}$	*45.5 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)	*1.0*	*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*	*1.00*
Directional flow rate[2], v_i(pc/h)$=V_i/(PHF*f_{HV}*f_G)$	*394*	*1128*
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	*51.8*	
Adj. for no-passing zone, f_{np} (Exhibit. 20-20)	*19.3*	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	*56.8*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	*C*
Volume to capacity ratio, $v/c=V_p/1{,}700$	*0.34*
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)$=0.25L_t(V/PHF)$	*1065*
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)$=V*L_t$	*3748*
Peak 15-min total travel time, TT_{15}(veh-h)$=VMT_{15}/ATS$	*23.4*

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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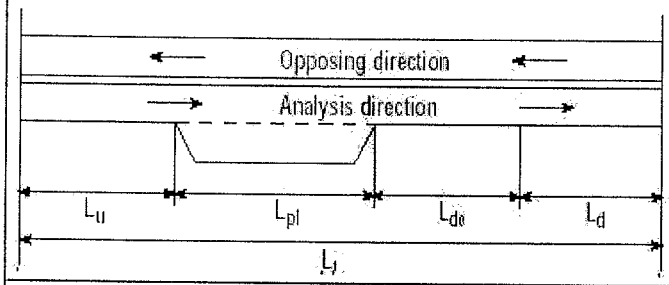
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	*MKL*	Highway of Travel	*Foresthill Road - 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 With 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)	*45.5*
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	*56.8*
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*) $L_d=L_t-(L_u+L_{pl}+L_{de})$	*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], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl}))$)	*49.0*
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)	*8.25*
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (*mi*)$=L_t-(L_u+L_{pl}+L_{de})$	*-6.55*
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], $PTSF_{pl}$(%) $PTSF_{pl}= PTSF_d[L_u+L_d+f_{pl}L_{pl}+((1+f_{pl})/2)L_{de}]/L_t$	*38.1*
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) $TT_{15}= VMT_{15}/ATS_{pl}$	*21.7*

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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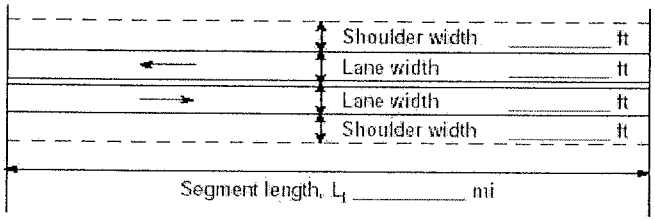
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - WB - Mitig.
Agency or Company	MRO Engineers, Inc.	From/To	Bridge to Spring Garden Road
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	AM Peak Hour	Analysis Year	Year 2030 With 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 2 %

% Recreational vehicles, P_R 2%

Access points/ *mi* 2

Analysis direction vol., V_d 993veh/h

Opposing direction vol., V_o 347veh/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) $v_i=V_i/(PHF*f_{HV}*f_G)$	1131	474

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)	1.5 mi/h	Free-flow speed, FFS_d $(FSS=BFFS-f_{LS}-f_A)$	59.5 mi/h
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	45.5 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)	1.0	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	1.00
Directional flow rate[2], v_i(pc/h)$=V_i/(PHF*f_{HV}*f_G)$	1128	394
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	76.4	
Adj. for no-passing zone, f_{np} (Exhibit. 20-20)	13.7	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	86.5	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	E
Volume to capacity ratio, $v/c=V_p/1{,}700$	0.67
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)$=0.25L_t(V/PHF)$	3047
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)$=V*L_t$	10724
Peak 15-min total travel time, TT_{15}(veh-h)$=VMT_{15}/ATS$	66.9

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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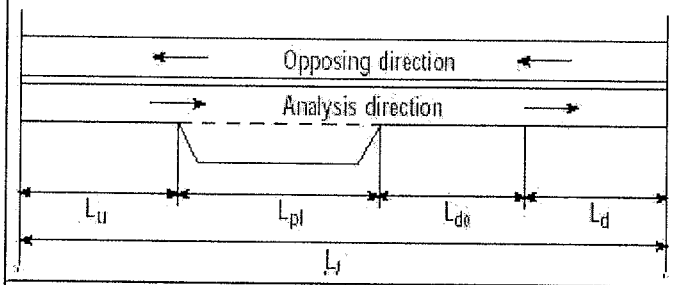
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	*MKL*	Highway of Travel	*Foresthill Road - 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 With 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*)	*1.6*
Length of passing lane including tapers , L_{pl} (*mi*)	*7.6*
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	*45.5*
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	*86.5*
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*) $L_d=L_t-(L_u+L_{pl}+L_{de})$	*-0.10*
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], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl}))$)	*49.4*
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)	*3.60*
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (*mi*)$=L_t-(L_u+L_{pl}+L_{de})$	*-2.00*
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], $PTSF_{pl}$(%) $PTSF_{pl}= PTSF_d[L_u+L_d+f_{pl}L_{pl}+((1+f_{pl})/2)L_{de}]/L_t$	*59.6*
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) $TT_{15}= VMT_{15}/ATS_{pl}$	*61.7*

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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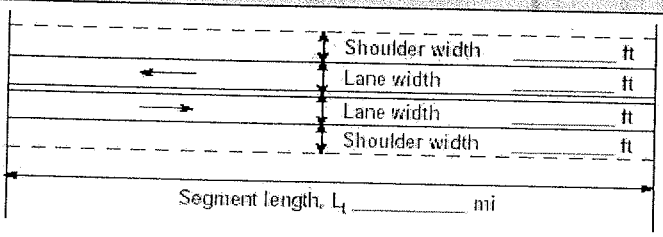
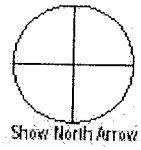
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - WB - Mitig.
Agency or Company	MRO Engineers, Inc.	From/To	Spring Garden to Todd Valley W
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	AM Peak Hour	Analysis Year	Year 2030 With 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 684veh/h

Opposing direction vol., V_o 405veh/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) $v_i=V_i/(PHF*f_{HV}*f_G)$	779	512

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)	1.8 mi/h	Free-flow speed, FFS_d $(FSS=BFFS-f_{LS}-f_A)$	58.8 mi/h
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	47.0 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)$=V_i/(PHF*f_{HV}*f_G)$	777	488
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	65.7	
Adj. for no-passing zone, f_{np} (Exhibit. 20-20)	26.0	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	81.7	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	E
Volume to capacity ratio, $v/c=V_p/1{,}700$	0.46
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)$=0.25L_t(V/PHF)$	330
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)$=V*L_t$	1163
Peak 15-min total travel time, TT_{15}(veh-h)$=VMT_{15}/ATS$	7.0

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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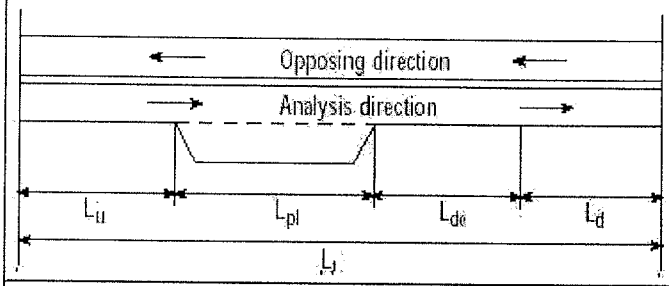
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	*MKL*	Highway of Travel	*Foresthill Road - 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 With 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)	*47.0*
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	*81.7*
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*) $L_d=L_t-(L_u+L_{pl}+L_{de})$	*-1.30*
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], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl}))$)	*50.4*
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)	*5.16*
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (*mi*)$=L_t-(L_u+L_{pl}+L_{de})$	*-4.76*
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], $PTSF_{pl}$(%) $PTSF_{pl}= PTSF_d[L_u+L_d+f_{pl}L_{pl}+((1+f_{pl})/2)L_{de}]/L_t$	*60.1*
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) $TT_{15}= VMT_{15}/ATS_{pl}$	*6.6*

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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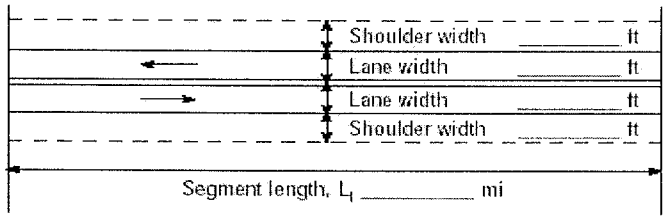
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKP	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	10/29/07	Jurisdiction	Placer County
Analysis Time Period	AM Peak Hour	Analysis Year	Year 2030 With 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 *571*veh/h

Opposing direction vol., V_o *509*veh/h

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	*1.1*	*3.7*
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*	*0.948*
Grade adjustment factor [1], f_G (Exhibit 20-7 or 20-13)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV}*f_G)$	*724*	*680*

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)	*1.3 mi/h*	Free-flow speed, FFS_d $(FSS=BFFS-f_{LS}-f_A)$	*59.0 mi/h*
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	*46.9 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*	*1.0*
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)$=V_i/(PHF*f_{HV}*f_G)$	*723*	*690*
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	*65.3*	
Adj. for no-passing zone, f_{np} (Exhibit. 20-20)	*24.7*	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	*77.9*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	*D*
Volume to capacity ratio, $v/c=V_p/1{,}700$	*0.43*
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)$=0.25L_t(V/PHF)$	*217*
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)$=V*L_t$	*685*
Peak 15-min total travel time, TT_{15}(veh-h)$=VMT_{15}/ATS$	*4.6*

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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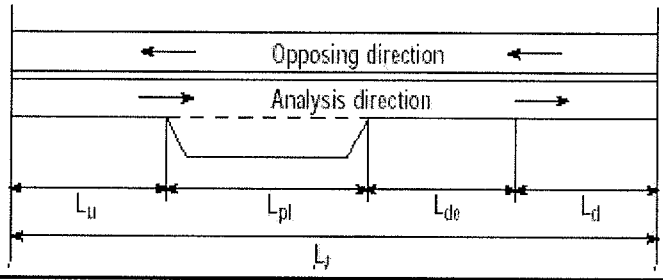
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	MKP	Highway of Travel	Foresthill Road - WB - Mitig.
Agency or Company	MRO Engineers, Inc.	From/To	Todd Valley W to Owl Hill Ct.
Date Performed	10/29/07	Jurisdiction	Placer County
Analysis Time Period	AM Peak Hour	Analysis Year	Year 2030 With 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)	46.9
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	77.9
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})	-1.40
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})))	50.5
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)	5.54
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})	-5.24
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	55.9
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}	4.3

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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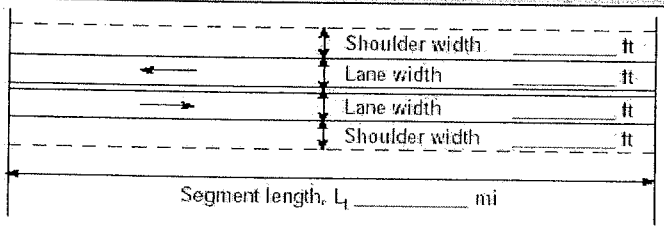
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - 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 With 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 1 %

% Recreational vehicles, P_R 2%

Access points/ *mi* 2

Analysis direction vol., V_d 1009veh/h

Opposing direction vol., V_o 405veh/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) $v_i=V_f/(PHF*f_{HV}*f_G)$	1264	461

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)	1.5 mi/h	Free-flow speed, FFS_d $(FSS=BFFS-f_{LS}-f_A)$	59.5 mi/h
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	44.6 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	1.1
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)$=V_f/(PHF*f_{HV}*f_G)$	1182	461
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	78.8	
Adj. for no-passing zone, f_{np} (Exhibit. 20-20)	14.3	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	89.1	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	E
Volume to capacity ratio, $v/c=V_p/1{,}700$	0.74
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)$=0.25L_t(V/PHF)$	3096
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)$=V*L_t$	10897
Peak 15-min total travel time, TT_{15}(veh-h)$=VMT_{15}/ATS$	69.4

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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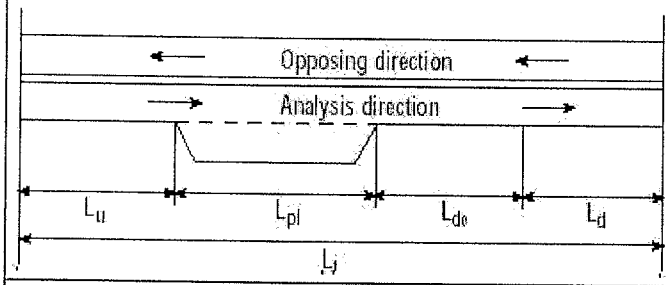
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	*MKL*	Highway of Travel	*Foresthill Road - 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 With 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)	*44.6*
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	*89.1*
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], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl}))$)	*48.3*
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], $PTSF_{pl}$(%) $PTSF_{pl}= PTSF_d[L_u+L_d+f_{pl}L_{pl}+((1+f_{pl})/2)L_{de}]/L_t$	*61.2*
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) $TT_{15}= VMT_{15}/ATS_{pl}$	*64.0*

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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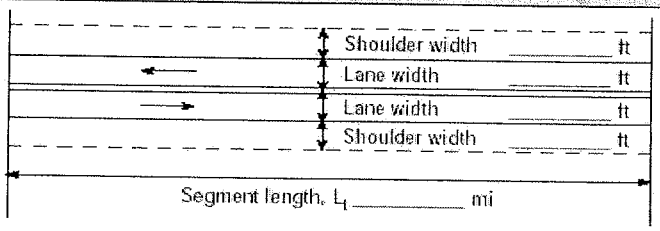
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - 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 With 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 30%

% Trucks and Buses , P_T 4 %

% Recreational vehicles, P_R 2%

Access points/ *mi* 2

Analysis direction vol., V_d 405veh/h

Opposing direction vol., V_o 1009veh/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) $v_i=V_i/(PHF*f_{HV}*f_G)$	537	1660

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)	0.5 mi/h	Free-flow speed, FFS_d $(FSS=BFFS-f_{LS}-f_A)$	59.5 mi/h
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	41.9 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)$=V_i/(PHF*f_{HV}*f_G)$	535	1369
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	63.2	
Adj. for no-passing zone, f_{np} (Exhibit. 20-20)	15.5	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	67.6	

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*)$=0.25L_t(V/PHF)$	1439
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)$=V*L_t$	4374
Peak 15-min total travel time, TT_{15}(veh-h)$=VMT_{15}/ATS$	34.3

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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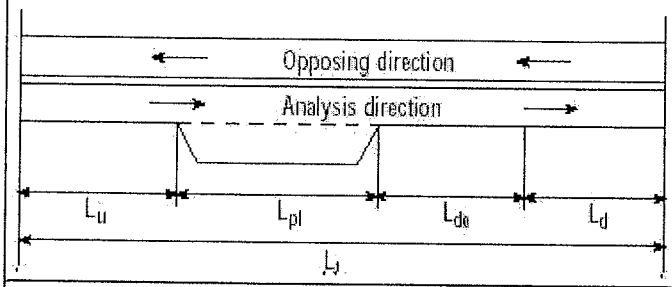
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

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	*PM Peak Hour*	Analysis Year	*Year 2030 With 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*)	*1.6*
Length of passing lane including tapers , L_{pl} (*mi*)	*7.6*
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	*41.9*
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	*67.6*
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*) $L_d=L_t-(L_u+L_{pl}+L_{de})$	*-0.10*
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], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl}))$)	*45.1*
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)	*7.02*
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (*mi*)$=L_t-(L_u+L_{pl}+L_{de})$	*-5.42*
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], $PTSF_{pl}$(%) $PTSF_{pl}= PTSF_d[L_u+L_d+f_{pl}L_{pl}+((1+f_{pl})/2)L_{de}]/L_t$	*45.6*
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) $TT_{15}= VMT_{15}/ATS_{pl}$	*31.9*

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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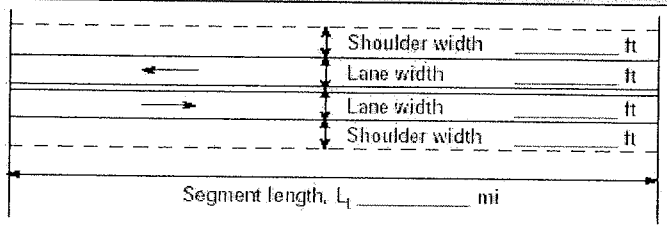
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

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 With 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 455veh/h

Opposing direction vol., V_o 676veh/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) $v_i=V_i/(PHF*f_{HV}*f_G)$	520	845

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)	0.9 mi/h	Free-flow speed, FFS_d $(FSS=BFFS-f_{LS}-f_A)$	58.8 mi/h
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	47.2 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)$=V_i/(PHF*f_{HV}*f_G)$	519	814
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	56.2	
Adj. for no-passing zone, f_{np} (Exhibit. 20-20)	25.1	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	66.0	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	D
Volume to capacity ratio, $v/c=V_p/1{,}700$	0.31
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)$=0.25L_t(V/PHF)$	220
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)$=V*L_t$	774
Peak 15-min total travel time, TT_{15}(veh-h)$=VMT_{15}/ATS$	4.7

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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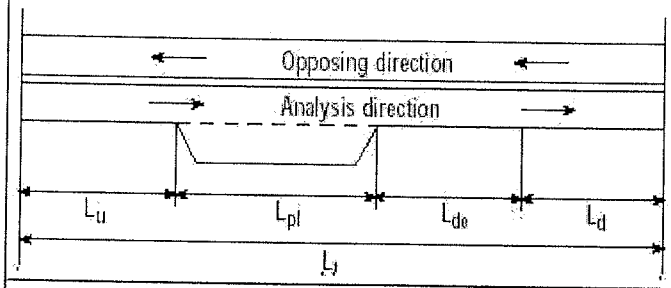
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway of Travel	Foresthill Road - 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 With 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)	*47.2*
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	*66.0*
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*) $L_d=L_t-(L_u+L_{pl}+L_{de})$	*-1.30*
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], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl})))$	*50.3*
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)	*7.15*
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (*mi*)$=L_t-(L_u+L_{pl}+L_{de})$	*-6.75*
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], $PTSF_{pl}$(%) $PTSF_{pl}= PTSF_d[L_u+L_d+f_{pl}L_{pl}+((1+f_{pl})/2)L_{de}]/L_t$	*48.0*
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) $TT_{15}= VMT_{15}/ATS_{pl}$	*4.4*

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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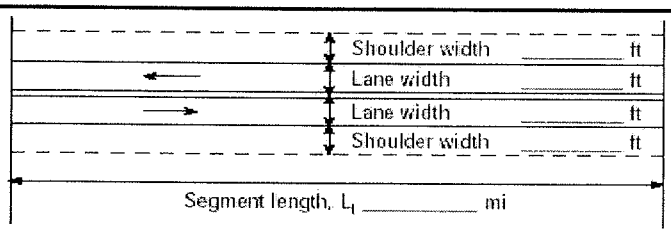
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKP	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	10/29/07	Jurisdiction	Placer County
Analysis Time Period	PM Peak Hour	Analysis Year	Year 2030 With 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 *501*veh/h

Opposing direction vol., V_o *598*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*	*3.7*
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*	*0.901*
Grade adjustment factor [1], f_G (Exhibit 20-7 or 20-13)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV}*f_G)$	*574*	*754*

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)	*1.1 mi/h*	Free-flow speed, FFS_d $(FSS=BFFS-f_{LS}-f_A)$	*59.0 mi/h*
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	*47.6 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, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.996*	*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)$=V_i/(PHF*f_{HV}*f_G)$	*572*	*728*
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	*58.4*	
Adj. for no-passing zone, f_{np} (Exhibit. 20-20)	*25.8*	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	*69.7*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	*D*
Volume to capacity ratio, $v/c=V_p/1{,}700$	*0.34*
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)$=0.25L_t(V/PHF)$	*171*
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)$=V*L_t$	*601*
Peak 15-min total travel time, TT_{15}(veh-h)$=VMT_{15}/ATS$	*3.6*

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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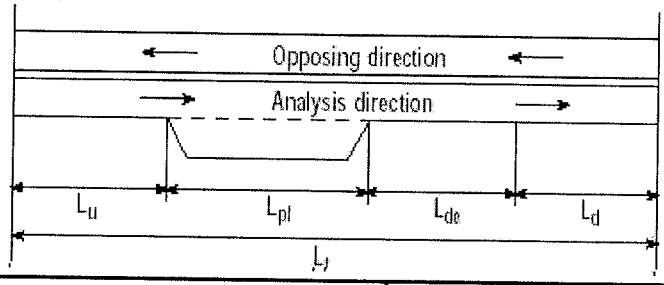
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	MKP	Highway of Travel	Foresthill Road - WB - Mitig.
Agency or Company	MRO Engineers, Inc.	From/To	Todd Valley W to Owl Hill Ct.
Date Performed	10/29/07	Jurisdiction	Placer County
Analysis Time Period	PM Peak Hour	Analysis Year	Year 2030 With 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)	47.6
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	69.7
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*) $L_d=L_t-(L_u+L_{pl}+L_{de})$	-1.40
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], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+ (2L_{de}/(1+f_{pl})))$	51.0
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)	6.72
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (*mi*)$=L_t-(L_u+L_{pl}+L_{de})$	-6.42
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], $PTSF_{pl}$(%) $PTSF_{pl}= PTSF_d[L_u+L_d+f_{pl}L_{pl}+((1+f_{pl})/2)L_{de}]/L_t$	49.5
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) $TT_{15}= VMT_{15}/ATS_{pl}$	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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MRO ENGINEERS

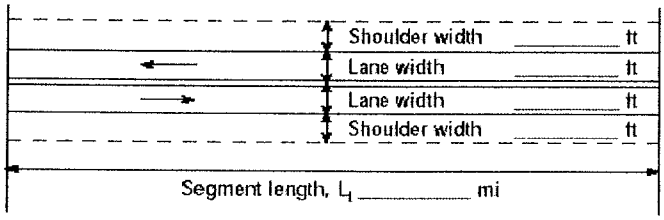
MODIFIED LEVEL OF SERVICE CRITERIA
LEVEL OF SERVICE CALCULATION WORKSHEETS
YEAR 2030 "WITH FOREST RANCH" SCENARIO

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	AM Peak Hour	Analysis Year	Year 2030 With 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 993veh/h

Opposing direction vol., V_o 347veh/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) $v_i=V_f/(PHF*f_{HV}*f_G)$	1131	474

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)	2.5 mi/h	Free-flow speed, FFS_d $(FSS=BFFS-f_{LS}-f_A)$	59.5 mi/h
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	44.6 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	1.00
Directional flow rate[2], v_i(pc/h)$=V_f/(PHF*f_{HV}*f_G)$	1128	394
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	76.4	
Adj. for no-passing zone, f_{np} (Exhibit. 20-20)	20.4	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	91.5	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	E
Volume to capacity ratio, $v/c=V_p/1{,}700$	0.67
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)$=0.25L_t(V/PHF)$	3047
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)$=V*L_t$	10724
Peak 15-min total travel time, TT_{15}(veh-h)$=VMT_{15}/ATS$	68.3

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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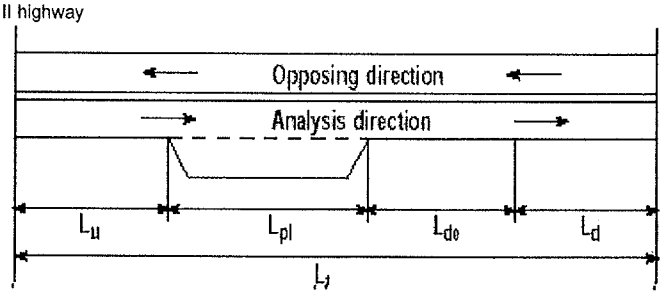
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

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 With Forest Ranch*

Project Description: *Foresthill Divide Community Plan*

Input Data

☑ Class I highway ☐ Class II highway



Show North Arrow

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*)	*1.8*
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	*44.6*
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	*91.5*
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*) $L_d=L_t-(L_u+L_{pl}+L_{de})$	*2.50*
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], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl})))$	*45.7*
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*)$=L_t-(L_u+L_{pl}+L_{de})$	*0.60*
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], $PTSF_{pl}$(%) $PTSF_{pl}= PTSF_d[L_u+L_d+f_{pl}L_{pl}+((1+f_{pl})/2)L_{de}]/L_t$	*79.9*
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) $TT_{15}= VMT_{15}/ATS_{pl}$	*66.7*

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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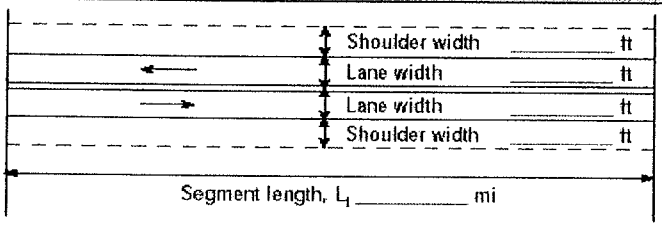
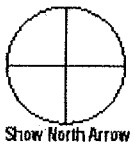
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - WB - Mitig.
Agency or Company	MRO Engineers, Inc.	From/To	Spring Garden to Todd Valley W
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	AM Peak Hour	Analysis Year	Year 2030 With 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 *684*veh/h

Opposing direction vol., V_o *405*veh/h

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	1.1	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) $v_i=V_i/(PHF*f_{HV}*f_G)$	779	512

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)	2.4 mi/h	Free-flow speed, FFS_d $(FSS=BFFS-f_{LS}-f_A)$	58.8 mi/h
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	46.4 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)$=V_i/(PHF*f_{HV}*f_G)$	777	488
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	65.7	
Adj. for no-passing zone, f_{np} (Exhibit. 20-20)	29.9	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	84.1	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	E
Volume to capacity ratio, $v/c=V_p/1{,}700$	0.46
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)$=0.25L_t(V/PHF)$	330
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)$=V*L_t$	1163
Peak 15-min total travel time, TT_{15}(veh-h)$=VMT_{15}/ATS$	7.1

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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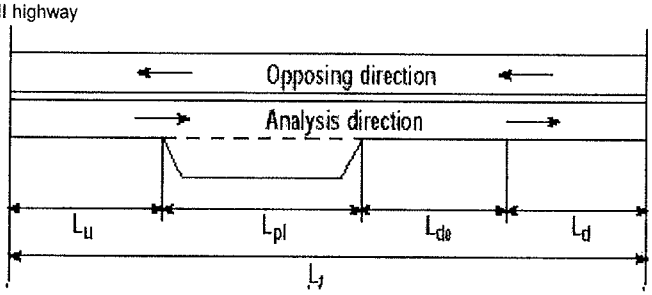
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

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 With Forest Ranch*

Project Description: *Foresthill Divide Community Plan*

Input Data

☑ Class I highway ☐ Class II highway



Show North Arrow

Total length of analysis segment, L_t (*mi*)	*1.7*
Length of two-lane highway upstream of the passing lane, L_u (*mi*)	*1.0*
Length of passing lane including tapers , L_{pl} (*mi*)	*0.2*
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	*46.4*
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	*84.1*
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], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl}))$)	*48.1*
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)	*5.16*
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (*mi*)$=L_t-(L_u+L_{pl}+L_{de})$	*-4.66*
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], $PTSF_{pl}$(%) $PTSF_{pl}= PTSF_d[L_u+L_d+f_{pl}L_{pl}+((1+f_{pl})/2)L_{de}]/L_t$	*71.4*
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) $TT_{15}= VMT_{15}/ATS_{pl}$	*6.9*

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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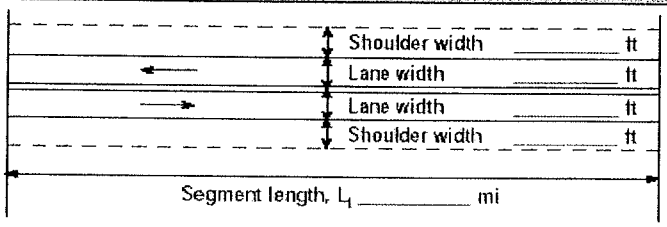
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - WB - Mitig.
Agency or Company	MRO Engineers, Inc.	From/To	Bridge to Spring Garden Road
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	PM Peak Hour	Analysis Year	Year 2030 With 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 405veh/h

Opposing direction vol., V_o 1009veh/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) $v_i=V_i/(PHF*f_{HV}*f_G)$	537	1660

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)	0.7 mi/h	Free-flow speed, FFS_d $(FSS=BFFS-f_{LS}-f_A)$	59.5 mi/h
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	41.8 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)	1.1	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)$=V_i/(PHF*f_{HV}*f_G)$	535	1369
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	63.2	
Adj. for no-passing zone, f_{np} (Exhibit. 20-20)	18.6	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	68.5	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	D
Volume to capacity ratio, $v/c=V_p/1{,}700$	0.32
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)$=0.25L_t(V/PHF)$	1439
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)$=V*L_t$	4374
Peak 15-min total travel time, TT_{15}(veh-h)$=VMT_{15}/ATS$	34.5

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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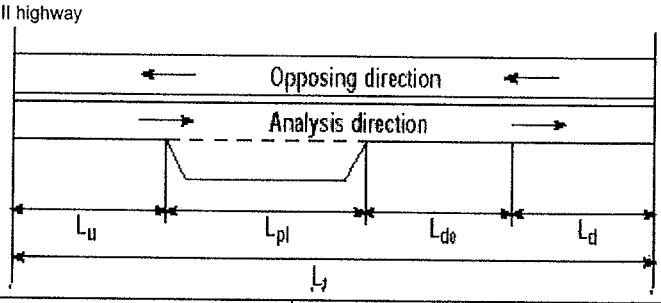
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

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 With 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*)	*1.8*
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	*41.8*
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	*68.5*
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*) $L_d=L_t-(L_u+L_{pl}+L_{de})$	*2.50*
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], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl})))$	*42.7*
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)	*7.02*
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (*mi*)$=L_t-(L_u+L_{pl}+L_{de})$	*-2.82*
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], $PTSF_{pl}$(%) $PTSF_{pl}= PTSF_d[L_u+L_d+f_{pl}L_{pl}+((1+f_{pl})/2)L_{de}]/L_t$	*56.7*
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) $TT_{15}= VMT_{15}/ATS_{pl}$	*33.7*

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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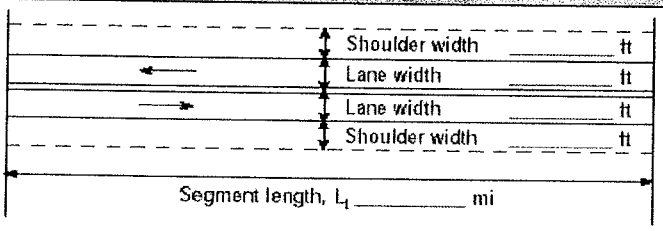
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - WB - Mitig.
Agency or Company	MRO Engineers, Inc.	From/To	Spring Garden to Todd Valley W
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	PM Peak Hour	Analysis Year	Year 2030 With 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 455veh/h

Opposing direction vol., V_o 676veh/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) $v_i=V_i/(PHF*f_{HV}*f_G)$	520	845

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)	1.3 mi/h	Free-flow speed, FFS_d $(FSS=BFFS-f_{LS}-f_A)$	58.8 mi/h
		Average travel speed, $ATS=FFS-0.00776v_p-f_{np}$	46.8 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)	1.1	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)$=V_i/(PHF*f_{HV}*f_G)$	519	814
Base percent time-spent-following[4], $BPTSF(\%)=100(1-e^{av_d^b})$	56.2	
Adj. for no-passing zone, f_{np} (Exhibit. 20-20)	28.9	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	67.4	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	D
Volume to capacity ratio, $v/c=V_p/1{,}700$	0.31
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)$=0.25L_t(V/PHF)$	220
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)$=V*L_t$	774
Peak 15-min total travel time, TT_{15}(veh-h)$=VMT_{15}/ATS$	4.7

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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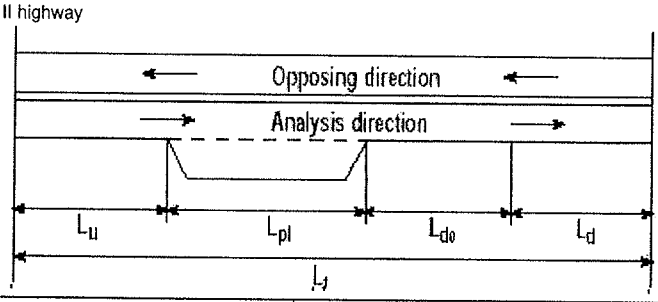
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway of Travel	Foresthill Road - 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 With 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*)	1.0
Length of passing lane including tapers , L_{pl} (*mi*)	0.2
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	46.8
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	67.4
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*) $L_d=L_t-(L_u+L_{pl}+L_{de})$	-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], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl})))$	48.4
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)	7.15
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (*mi*)$=L_t-(L_u+L_{pl}+L_{de})$	-6.65
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], $PTSF_{pl}$(%) $PTSF_{pl}= PTSF_d[L_u+L_d+f_{pl}L_{pl}+((1+f_{pl})/2)L_{de}]/L_t$	56.9
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) $TT_{15}= VMT_{15}/ATS_{pl}$	4.5

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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