Appendix 6

Operational Analysis Worksheets

Appendix 6

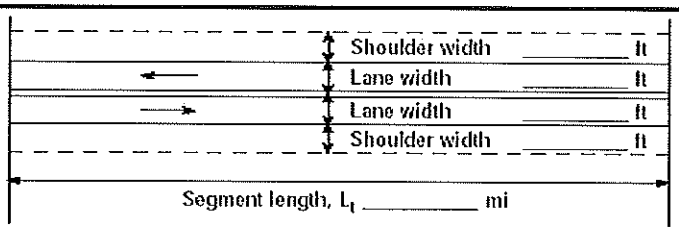
Existing Two-Lane Highway 2012

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*David Stoner*	Highway / Direction of Travel	*MT 16*
Agency or Company	*DOWL HKM*	From/To	*RP 0.6 to 20.0 NB*
Date Performed	*4/17/2012*	Jurisdiction	*Dawson/Richland County*
Analysis Time Period	*Peak Hour*	Analysis Year	*2012*

Project Description: *MT 16 / MT 200 Glendive to Fairview Corridor Planning Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Analysis direction vol., V_d	*135*veh/h	Grade Length	mi Up/down
Opposing direction vol., V_o	*139*veh/h	Peak-hour factor, PHF	*0.81*
Shoulder width ft	*8.0*	No-passing zone	*27%*
Lane Width ft	*12.0*	% Trucks and Buses , P_T	*27 %*
Segment Length mi	*19.4*	% Recreational vehicles, P_R	*4%*
		Access points *mi*	*5*/mi

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.6*	*1.6*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.861*	*0.861*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i/(PHF*f_{g,ATS}*f_{HV,ATS})$	*194*	*199*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*65.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, FFS=S_{FM}+0.00776(*v*/ $f_{HV,ATS}$)		Adj. for access points[4], f_A (Exhibit 15-8)	*1.3 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*2.5 mi/h*	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*63.8 mi/h*
		Average travel speed, ATS_d=FFS-0.00776($v_{d,ATS}$ + $v_{o,ATS}$) - $f_{np,ATS}$	*58.2 mi/h*
		Percent free flow speed, PFFS	*91.3 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.1*	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.974*	*0.974*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV,PTSF}*f_{g,PTSF})$	*171*	*176*
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	*18.8*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*42.2*	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}*(v_{d,PTSF}/v_{d,PTSF}+v_{o,PTSF})$	*39.6*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*B*
Volume to capacity ratio, *v/c*	*0.13*

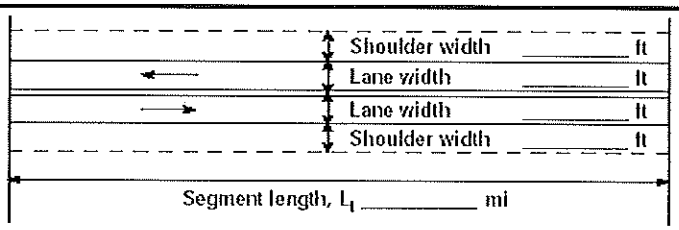
Capacity, $C_{d,ATS}$ (Equation 15-12) pc/h	*1464*
Capacity, $C_{d,PTSF}$ (Equation 15-13) pc/h	*1655*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*91.3*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*166.7*
Effective width, Wv (Eq. 15-29) ft	*34.50*
Effective speed factor, S_t (Eq. 15-30)	*4.79*
Bicycle level of service score, BLOS (Eq. 15-31)	*11.34*
Bicycle level of service (Exhibit 15-4)	*F*
Notes	
1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain. 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 and for v>200 veh/h. 4. For the analysis direction only 5. Exhibit 15-20 provides coefficients a and b for Equation 15-10. 6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.	

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*David Stoner*	Highway / Direction of Travel	*MT 16*
Agency or Company	*DOWL HKM*	From/To	*RP 0.6 to RP 12.4 SB*
Date Performed	*4/17/2012*	Jurisdiction	*Dawson/Richland County*
Analysis Time Period	*Peak Hour*	Analysis Year	*2012*

Project Description: *MT 16 / MT 200 Glendive to Fairview Corridor Planning Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Grade Length mi Up/down	
Peak-hour factor, PHF	*0.78*
No-passing zone	*20%*
% Trucks and Buses , P_T	*29 %*
% Recreational vehicles, P_R	*4%*
Access points *mi*	*7/mi*

Analysis direction vol., V_d	*139veh/h*
Opposing direction vol., V_o	*135veh/h*
Shoulder width ft	*8.0*
Lane Width ft	*12.0*
Segment Length mi	*11.8*

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.6*	*1.6*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.852*	*0.852*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i/(PHF*f_{g,ATS}*f_{HV,ATS})$	*209*	*203*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*65.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, $FFS=S_{FM}+0.00776(v/f_{HV,ATS})$		Adj. for access points[4], f_A (Exhibit 15-8)	*1.8 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*2.1 mi/h*	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*63.3 mi/h*
		Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS}+v_{o,ATS})-f_{np,ATS}$	*58.0 mi/h*
		Percent free flow speed, PFFS	*91.6 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.1*	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.972*	*0.972*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV,PTSF}*f_{g,PTSF})$	*183*	*178*
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	*20.0*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*38.4*	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}*(v_{d,PTSF}/v_{d,PTSF}+v_{o,PTSF})$	*39.5*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*B*
Volume to capacity ratio, *v/c*	*0.14*

Capacity, $C_{d,ATS}$ (Equation 15-12) pc/h	*1448*
Capacity, $C_{d,PTSF}$ (Equation 15-13) pc/h	*1652*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*91.6*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*178.2*
Effective width, Wv (Eq. 15-29) ft	*34.10*
Effective speed factor, S_f (Eq. 15-30)	*4.79*
Bicycle level of service score, BLOS (Eq. 15-31)	*13.06*
Bicycle level of service (Exhibit 15-4)	*F*

Notes

1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
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 and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

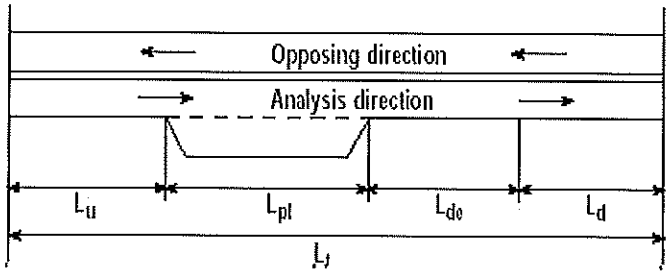
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	*David Stoner*	Highway of Travel	*MT 16*
Agency or Company	*DOWL HKM*	From/To	*RP 20.0 to Savage NB*
Date Performed	*4/17/2012*	Jurisdiction	*Dawson/Richland County*
Analysis Time Period	*Peak Hour*	Analysis Year	*2012*

Project Description: *MT 16 / MT 200 Glendive to Fairview Corridor Planning Study*

Input Data

☑ Class I highway ☐ Class II highway ☐ Class III highway




Show North Arrow

Shoulder width (ft)	*8.0*
Lane Width (ft)	*12.0*
Segment Length (mi)	*11.5*
Total length of analysis segment, L_t	*11.5*
Length of two-lane highway upstream of the passing lane, L_u	*0.0*
Length of passing lane including tapers , L_{pl}	*1.9*
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	*58.6*
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	*37.3*
Level of service[1], LOS_d (from Directional Two-Lane Highway Segment Worksheet)	*B*
Average Travel Speed	
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L_{de} (Exhibit 15-23)	*1.70*
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d $L_d=L_t-(L_u+L_{pl}+L_{de})$	*7.90*
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 15-28)	*1.08*
Average travel speed including passing lane[2], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+ (2L_{de}/(1+f_{pl,ATS}))$)	*59.7*
Percent free flow speed including passing lane, $PFFS_{pl} = (ATS_{pl}/ FFS)$	*93.6*
Percent Time-Spent-Following	
Length of the downstream highway segment within the effective length of passing lane for percent time-spent-following, L_{de} (Exhibit 15-23)	*13.00*
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, $L_d = L_t-(L_u+L_{pl}+L_{de})$	*-3.40*
Adj. factor for the effect of passing lane on percent time-spent-following, $f_{pl,PTSF}$(Exhibit 15-26)	*0.58*

Percent time-spent-following including passing lane[3], $PTSF_{pl}$(%) $PTSF_{pl} = PTSF_d[L_u+L_d+f_{pl,PTSF}L_{pl}+((1+f_{pl,PTSF})/2)L_{de}]/L_t$	*26.5*
Level of Service and Other Performance Measures[4]	
Level of service including passing lane LOS_{pl} (Exhibit 15-3)	*A*
Peak 15-min total travel time, TT_{15}(veh-h) $TT_{15} = VMT_{15}/ATS_{pl}$	*8.0*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*166.7*
Effective width, W_v (Eq. 15-29) ft	*34.50*
Effective speed factor, S_t (Eq. 15-30)	*4.79*
Bicycle level of service score, BLOS (Eq. 15-31)	*11.34*
Bicycle level of service (Exhibit 15-4)	*F*
Notes	
1. If LOS_d=F, passing lane analysis cannot be performed.	
2. If L_d <0, use alternative Equation 15-18.	
3. If L_d<0, use alternative Equation 15-16.	
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.	

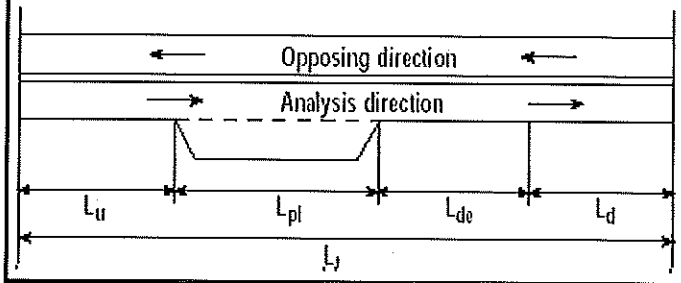
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	*David Stoner*	Highway of Travel	*MT 16*
Agency or Company	*DOWL HKM*	From/To	*RP 12.4 to RP 22.0 SB*
Date Performed	*4/17/2012*	Jurisdiction	*Dawson/Richland County*
Analysis Time Period	*Peak Hour*	Analysis Year	*2012*

Project Description: *MT 16 / MT 200 Glendive to Fairview Corridor Planning Study*

Input Data

☑ Class I highway ☐ Class II highway ☐ Class III highway



Shoulder width (ft)	*8.0*
Lane Width (ft)	*12.0*
Segment Length (mi)	*9.6*
Total length of analysis segment, L_t	*9.6*
Length of two-lane highway upstream of the passing lane, L_u	*0.0*
Length of passing lane including tapers , L_{pl}	*1.9*
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	*59.1*
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	*37.1*
Level of service[1], LOS_d (from Directional Two-Lane Highway Segment Worksheet)	*B*
Average Travel Speed	
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L_{de} (Exhibit 15-23)	*1.70*
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d $L_d=L_t-(L_u+L_{pl}+L_{de})$	*6.00*
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 15-28)	*1.09*
Average travel speed including passing lane[2], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+(2L_{de}/(1+f_{pl,ATS}))$)	*60.6*
Percent free flow speed including passing lane, $PFFS_{pl} = (ATS_{pl}/ FFS)$	*93.9*
Percent Time-Spent-Following	
Length of the downstream highway segment within the effective length of passing lane for percent time-spent-following, L_{de} (Exhibit 15-23)	*13.00*
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, $L_d = L_t-(L_u+L_{pl}+L_{de})$	*-5.30*
Adj. factor for the effect of passing lane on percent time-spent-following, $f_{pl,PTSF}$(Exhibit 15-26)	*0.58*

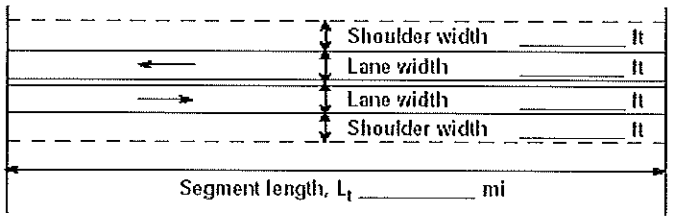
Percent time-spent-following including passing lane[3], $PTSF_{pl}$(%) $PTSF_{pl} = PTSF_d[L_u+L_d+f_{pl,PTSF}L_{pl}+((1+f_{pl,PTSF})/2)L_{de}]/L_t$	*25.2*
Level of Service and Other Performance Measures[4]	
Level of service including passing lane LOS_{pl} (Exhibit 15-3)	*A*
Peak 15-min total travel time, TT_{15}(veh-h) $TT_{15} = VMT_{15}/ATS_{pl}$	*7.1*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*178.2*
Effective width, W_v (Eq. 15-29) ft	*34.10*
Effective speed factor, S_t (Eq. 15-30)	*4.79*
Bicycle level of service score, BLOS (Eq. 15-31)	*13.06*
Bicycle level of service (Exhibit 15-4)	*F*
Notes	
1. If LOS_d=F, passing lane analysis cannot be performed.	
2. If L_d <0, use alternative Equation 15-18.	
3. If L_d<0, use alternative Equation 15-16.	
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.	

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*David Stoner*	Highway / Direction of Travel	*MT 16*
Agency or Company	*DOWL HKM*	From/To	*RP 22.0 to Savage SB*
Date Performed	*4/17/2012*	Jurisdiction	*Dawson/Richland County*
Analysis Time Period	*Peak Hour*	Analysis Year	*2012*

Project Description: *MT 16 / MT 200 Glendive to Fairview Corridor Planning Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Grade Length mi Up/down

Peak-hour factor, PHF *0.78*

No-passing zone *22%*

% Trucks and Buses , P_T *29 %*

% Recreational vehicles, P_R *4%*

Access points *mi* *5/mi*

Analysis direction vol., V_d *139veh/h*

Opposing direction vol., V_o *135veh/h*

Shoulder width ft *8.0*

Lane Width ft *12.0*

Segment Length mi *9.5*

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.6*	*1.6*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.852*	*0.852*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{g,ATS}*f_{HV,ATS})$	*209*	*203*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*65.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, $FFS=S_{FM}+0.00776(v/f_{HV,ATS})$		Adj. for access points[4], f_A (Exhibit 15-8)	*1.3 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*2.2 mi/h*	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*63.8 mi/h*
		Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS}+v_{o,ATS})-f_{np,ATS}$	*58.3 mi/h*
		Percent free flow speed, PFFS	*91.5 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.1*	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.972*	*0.972*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV,PTSF}*f_{g,PTSF})$	*183*	*178*
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	*20.0*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*39.7*	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}*(v_{d,PTSF}/v_{d,PTSF}+v_{o,PTSF})$	*40.1*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*B*
Volume to capacity ratio, *v/c*	*0.14*

Capacity, $C_{d,ATS}$ (Equation 15-12) pc/h	*1448*
Capacity, $C_{d,PTSF}$ (Equation 15-13) pc/h	*1652*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*91.5*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*178.2*
Effective width, Wv (Eq. 15-29) ft	*34.10*
Effective speed factor, S_t (Eq. 15-30)	*4.79*
Bicycle level of service score, BLOS (Eq. 15-31)	*13.06*
Bicycle level of service (Exhibit 15-4)	*F*
Notes	

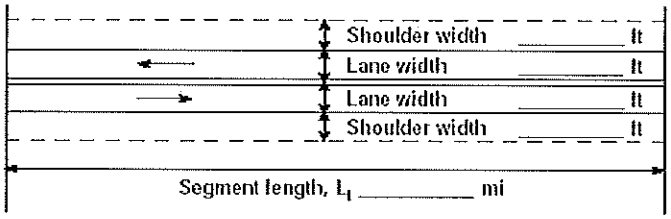
1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*David Stoner*	Highway / Direction of Travel	*MT 16*
Agency or Company	*DOWL HKM*	From/To	*Savage to Crane NB*
Date Performed	*4/17/2012*	Jurisdiction	*Dawson/Richland County*
Analysis Time Period	*Peak Hour*	Analysis Year	*2012*

Project Description: *MT 16 / MT 200 Glendive to Fairview Corridor Planning Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Grade Length mi Up/down

Analysis direction vol., V_d	*141*veh/h
Opposing direction vol., V_o	*171*veh/h
Shoulder width ft	*8.0*
Lane Width ft	*12.0*
Segment Length mi	*10.0*
Peak-hour factor, PHF	*0.87*
No-passing zone	*31%*
% Trucks and Buses , P_T	*23 %*
% Recreational vehicles, P_R	*4%*
Access points *mi*	*11*/mi

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.7*	*1.5*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.861*	*0.897*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i/(PHF*f_{g,ATS}*f_{HV,ATS})$	*188*	*219*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*69.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, $FFS=S_{FM}+0.00776(v/f_{HV,ATS})$		Adj. for access points[4], f_A (Exhibit 15-8)	*2.8 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*2.7 mi/h*	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*66.3 mi/h*
		Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS}+v_{o,ATS})-f_{np,ATS}$	*60.4 mi/h*
		Percent free flow speed, PFFS	*91.1 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.1*	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.978*	*0.978*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV,PTSF}*f_{g,PTSF})$	*166*	*201*
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	*18.3*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*43.4*	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}*(v_{d,PTSF}/v_{d,PTSF}+v_{o,PTSF})$	*37.9*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*B*
Volume to capacity ratio, *v/c*	*0.12*

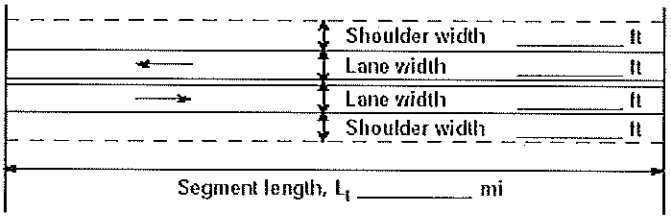
Capacity, $C_{d,ATS}$ (Equation 15-12) pc/h	*1525*
Capacity, $C_{d,PTSF}$ (Equation 15-13) pc/h	*1662*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*91.1*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*162.1*
Effective width, Ww (Eq. 15-29) ft	*33.90*
Effective speed factor, S_t (Eq. 15-30)	*4.79*
Bicycle level of service score, BLOS (Eq. 15-31)	*8.67*
Bicycle level of service (Exhibit 15-4)	*F*
Notes	
1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain. 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 and for v>200 veh/h. 4. For the analysis direction only 5. Exhibit 15-20 provides coefficients a and b for Equation 15-10. 6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.	

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*David Stoner*	Highway / Direction of Travel	*MT 16*
Agency or Company	*DOWL HKM*	From/To	*Savage to Crane SB*
Date Performed	*4/17/2012*	Jurisdiction	*Dawson/Richland County*
Analysis Time Period	*Peak Hour*	Analysis Year	*2012*

Project Description: *MT 16 / MT 200 Glendive to Fairview Corridor Planning Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Grade Length mi Up/down

Peak-hour factor, PHF *0.84*

No-passing zone *19%*

% Trucks and Buses , P_T *25 %*

% Recreational vehicles, P_R *4%*

Access points *mi* *11/mi*

Analysis direction vol., V_d *171veh/h*

Opposing direction vol., V_o *141veh/h*

Shoulder width ft *8.0*

Lane Width ft *12.0*

Segment Length mi *10.0*

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.5*	*1.6*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.889*	*0.870*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i/(PHF*f_{g,ATS}*f_{HV,ATS})$	*229*	*193*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*66.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS} (Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, $FFS=S_{FM}+0.00776(v/f_{HV,ATS})$		Adj. for access points[4], f_A (Exhibit 15-8)	*2.8 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*2.0 mi/h*	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*63.3 mi/h*
		Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS}+v_{o,ATS})-f_{np,ATS}$	*58.0 mi/h*
		Percent free flow speed, PFFS	*91.6 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-18 or 15-19)	*1.1*	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.976*	*0.976*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i (pc/h) $v_i=V_i/(PHF*f_{HV,PTSF}*f_{g,PTSF})$	*209*	*172*
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	*22.4*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*36.7*	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}*(v_{d,PTSF}/v_{d,PTSF}+v_{o,PTSF})$	*42.5*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*B*
Volume to capacity ratio, *v/c*	*0.15*

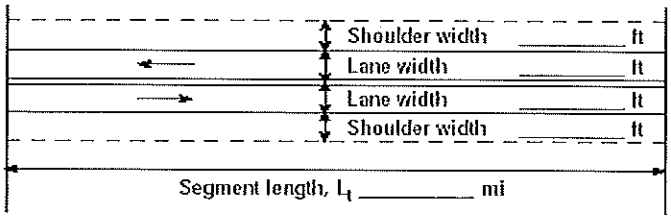
Capacity, $C_{d,ATS}$ (Equation 15-12) pc/h	*1479*
Capacity, $C_{d,PTSF}$ (Equation 15-13) pc/h	*1659*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*91.6*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*203.6*
Effective width, Wv (Eq. 15-29) ft	*28.00*
Effective speed factor, S_f (Eq. 15-30)	*4.79*
Bicycle level of service score, BLOS (Eq. 15-31)	*12.00*
Bicycle level of service (Exhibit 15-4)	*F*
Notes	
1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.	
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 and for v>200 veh/h.	
4. For the analysis direction only	
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.	
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.	

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	David Stoner	Highway / Direction of Travel	MT 16
Agency or Company	DOWL HKM	From/To	Crane to Sidney NB
Date Performed	4/17/2012	Jurisdiction	Dawson/Richland County
Analysis Time Period	Peak Hour	Analysis Year	2012

Project Description: *MT 16 / MT 200 Glendive to Fairview Corridor Planning Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Grade Length mi Up/down

Peak-hour factor, PHF 0.80

No-passing zone 24%

% Trucks and Buses , P_T 19 %

% Recreational vehicles, P_R 4%

Access points *mi* 12/mi

Analysis direction vol., V_d 151veh/h

Opposing direction vol., V_o 232veh/h

Shoulder width ft 8.0

Lane Width ft 12.0

Segment Length mi 8.9

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	1.5	1.4
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.913	0.929
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	1.00	1.00
Demand flow rate[2], v_i (pc/h) $v_i=V_i/(PHF*f_{g,ATS}*f_{HV,ATS})$	207	312

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	65.0 mi/h
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	0.0 mi/h
Free-flow speed, $FFS=S_{FM}+0.00776(v/f_{HV,ATS})$		Adj. for access points[4], f_A (Exhibit 15-8)	3.0 mi/h
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	1.9 mi/h	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	62.0 mi/h
		Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS}+v_{o,ATS})-f_{np,ATS}$	56.1 mi/h
		Percent free flow speed, PFFS	90.5 %

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	1.1	1.1
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.981	0.981
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	1.00	1.00
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV,PTSF}*f_{g,PTSF})$	192	296
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	23.2	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	37.7	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}*(v_{d,PTSF}/v_{d,PTSF}+v_{o,PTSF})$	38.0	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	B
Volume to capacity ratio, *v/c*	0.13

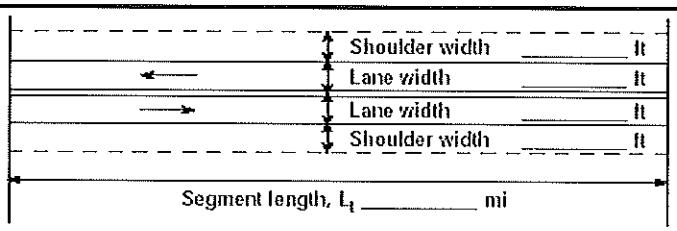
Capacity, $C_{d,ATS}$ (Equation 15-12) pc/h	*1579*
Capacity, $C_{d,PTSF}$ (Equation 15-13) pc/h	*1668*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*90.5*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*188.8*
Effective width, Wv (Eq. 15-29) ft	*32.90*
Effective speed factor, S_t (Eq. 15-30)	*4.79*
Bicycle level of service score, BLOS (Eq. 15-31)	*6.55*
Bicycle level of service (Exhibit 15-4)	*F*
Notes	
1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.	
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 and for v>200 veh/h.	
4. For the analysis direction only	
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.	
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.	

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*David Stoner*	Highway / Direction of Travel	*MT 16*
Agency or Company	*DOWL HKM*	From/To	*Crane to Sidney SB*
Date Performed	*4/17/2012*	Jurisdiction	*Dawson/Richland County*
Analysis Time Period	*Peak Hour*	Analysis Year	*2012*

Project Description: *MT 16 / MT 200 Glendive to Fairview Corridor Planning Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Analysis direction vol., V_d	*232*veh/h	Grade Length	mi Up/down
Opposing direction vol., V_o	*151*veh/h	Peak-hour factor, PHF	*0.87*
Shoulder width ft	*8.0*	No-passing zone	*22%*
Lane Width ft	*12.0*	% Trucks and Buses , P_T	*19 %*
Segment Length mi	*8.9*	% Recreational vehicles, P_R	*4%*
		Access points *mi*	*12*/mi

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.4*	*1.6*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.929*	*0.898*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i/(PHF*f_{g,ATS}*f_{HV,ATS})$	*287*	*193*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*69.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, $FFS=S_{FM}+0.00776(v/f_{HV,ATS})$		Adj. for access points[4], f_A (Exhibit 15-8)	*3.0 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*2.2 mi/h*	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*66.0 mi/h*
		Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS}+v_{o,ATS})-f_{np,ATS}$	*60.0 mi/h*
		Percent free flow speed, PFFS	*91.0 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.1*	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.981*	*0.981*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV,PTSF}*f_{g,PTSF})$	*272*	*177*
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	*27.9*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*36.8*	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}*(v_{d,PTSF}/v_{d,PTSF}+v_{o,PTSF})$	*50.2*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*C*
Volume to capacity ratio, *v/c*	*0.19*

Capacity, $C_{d,ATS}$ (Equation 15-12) pc/h	*1527*
Capacity, $C_{d,PTSF}$ (Equation 15-13) pc/h	*1668*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*91.0*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*266.7*
Effective width, Wv (Eq. 15-29) ft	*28.00*
Effective speed factor, S_f (Eq. 15-30)	*4.79*
Bicycle level of service score, BLOS (Eq. 15-31)	*8.22*
Bicycle level of service (Exhibit 15-4)	*F*

Notes

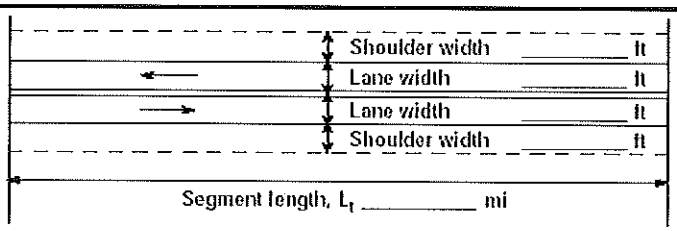
1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*David Stoner*	Highway / Direction of Travel	*MT 200*
Agency or Company	*DOWL HKM*	From/To	*Sidney to Fairview EB*
Date Performed	*4/17/2012*	Jurisdiction	*Dawson/Richland County*
Analysis Time Period	*Peak Hour*	Analysis Year	*2012*

Project Description: *MT 16 / MT 200 Glendive to Fairview Corridor Planning Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Grade Length mi Up/down

Peak-hour factor, PHF *0.83*

No-passing zone *17%*

% Trucks and Buses , P_T *17 %*

% Recreational vehicles, P_R *4%*

Access points *mi* *16/mi*

Analysis direction vol., V_d *257veh/h*

Opposing direction vol., V_o *254veh/h*

Shoulder width ft *8.0*

Lane Width ft *12.0*

Segment Length mi *9.9*

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.4*	*1.4*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.936*	*0.936*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i/(PHF*f_{g,ATS}*f_{HV,ATS})$	*331*	*327*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*69.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, $FFS=S_{FM}+0.00776(v/f_{HV,ATS})$		Adj. for access points[4], f_A (Exhibit 15-8)	*4.0 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*1.8 mi/h*	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*65.0 mi/h*
		Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS}+v_{o,ATS})-f_{np,ATS}$	*58.1 mi/h*
		Percent free flow speed, PFFS	*89.3 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.1*	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.983*	*0.983*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV,PTSF}*f_{g,PTSF})$	*315*	*311*
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	*33.8*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*34.3*	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}*(v_{d,PTSF}/v_{d,PTSF}+v_{o,PTSF})$	*51.1*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*C*
Volume to capacity ratio, *v/c*	*0.21*

Capacity, $C_{d,ATS}$ (Equation 15-12) pc/h	*1591*
Capacity, $C_{d,PTSF}$ (Equation 15-13) pc/h	*1672*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*89.3*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*309.6*
Effective width, Wv (Eq. 15-29) ft	*28.00*
Effective speed factor, S_t (Eq. 15-30)	*4.79*
Bicycle level of service score, BLOS (Eq. 15-31)	*7.15*
Bicycle level of service (Exhibit 15-4)	*F*

Notes

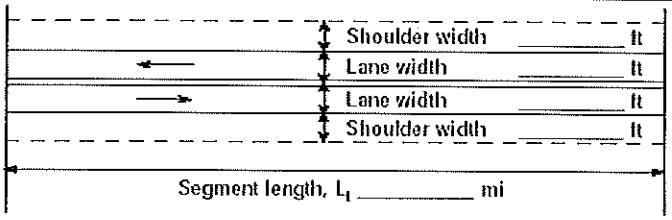
1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	David Stoner	Highway / Direction of Travel	MT 200
Agency or Company	DOWL HKM	From/To	Sidney to Fairview WB
Date Performed	4/17/2012	Jurisdiction	Dawson/Richland County
Analysis Time Period	Peak Hour	Analysis Year	2012

Project Description: MT 16 / MT 200 Glendive to Fairview Corridor Planning Study

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Grade Length mi Up/down

Peak-hour factor, PHF 0.86

No-passing zone 15%

% Trucks and Buses , P_T 25 %

% Recreational vehicles, P_R 4%

Access points mi 16/mi

Analysis direction vol., V_d 254veh/h

Opposing direction vol., V_o 257veh/h

Shoulder width ft 8.0

Lane Width ft 12.0

Segment Length mi 9.9

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	1.4	1.4
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.909	0.909
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	1.00	1.00
Demand flow rate[2], v_i (pc/h) $v_i=V_i/(PHF*f_{g,ATS}*f_{HV,ATS})$	325	329

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	66.0 mi/h
Total demand flow rate, both directions, v		Adj. for lane and shoulder width,[4] f_{LS} (Exhibit 15-7)	0.0 mi/h
Free-flow speed, $FFS=S_{FM}+0.00776(v/f_{HV,ATS})$		Adj. for access points[4], f_A (Exhibit 15-8)	4.0 mi/h
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	1.7 mi/h	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	62.0 mi/h
		Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS}+v_{o,ATS})-f_{np,ATS}$	55.3 mi/h
		Percent free flow speed, PFFS	89.1 %

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-18 or 15-19)	1.1	1.1
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.976	0.976
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	1.00	1.00
Directional flow rate[2], v_i (pc/h) $v_i=V_i/(PHF*f_{HV,PTSF}*f_{g,PTSF})$	303	306
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	33.2	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	32.4	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}*(v_{d,PTSF}/v_{d,PTSF}+v_{o,PTSF})$	49.3	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	B
Volume to capacity ratio, v/c	0.21

Capacity, $C_{d,ATS}$ (Equation 15-12) pc/h	*1545*
Capacity, $C_{d,PTSF}$ (Equation 15-13) pc/h	*1659*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*89.1*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*295.3*
Effective width, Wv (Eq. 15-29) ft	*28.00*
Effective speed factor, S_t (Eq. 15-30)	*4.79*
Bicycle level of service score, BLOS (Eq. 15-31)	*12.19*
Bicycle level of service (Exhibit 15-4)	*F*

Notes

1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
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 and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

Appendix 6

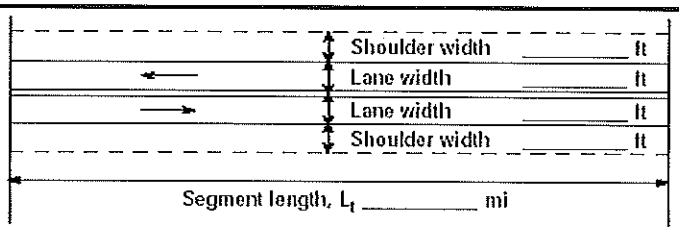
Projected Two-Lane Highway 2035 – Low Condition

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*David Stoner*	Highway / Direction of Travel	*MT 16*
Agency or Company	*DOWL HKM*	From/To	*RP 0.6 to 20.0 NB*
Date Performed	*4/17/2012*	Jurisdiction	*Dawson/Richland County*
Analysis Time Period	*Peak Hour*	Analysis Year	*2035 Low*

Project Description: *MT 16 / MT 200 Glendive to Fairview Corridor Planning Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Analysis direction vol., V_d	*242veh/h*	
Opposing direction vol., V_o	*249veh/h*	
Shoulder width ft	*8.0*	
Lane Width ft	*12.0*	
Segment Length mi	*19.4*	
Grade Length	mi	Up/down
Peak-hour factor, PHF		*0.81*
No-passing zone		*27%*
% Trucks and Buses , P_T		*27 %*
% Recreational vehicles, P_R		*4%*
Access points *mi*		*5/mi*

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.4*	*1.4*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.903*	*0.903*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i/(PHF*f_{g,ATS}*f_{HV,ATS})$	*331*	*340*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*65.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, $FFS=S_{FM}+0.00776(v/f_{HV,ATS})$		Adj. for access points[4], f_A (Exhibit 15-8)	*1.3 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*2.0 mi/h*	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*63.8 mi/h*
		Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS}+v_{o,ATS})-f_{np,ATS}$	*56.5 mi/h*
		Percent free flow speed, PFFS	*88.7 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.1*	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.974*	*0.974*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV,PTSF}*f_{g,PTSF})$	*307*	*316*
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	*34.5*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*40.7*	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}*(v_{d,PTSF}/v_{d,PTSF}+v_{o,PTSF})$	*54.6*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*C*
Volume to capacity ratio, *v/c*	*0.22*

Capacity, $C_{d,ATS}$ (Equation 15-12) pc/h	*1535*
Capacity, $C_{d,PTSF}$ (Equation 15-13) pc/h	*1655*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*88.7*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*298.8*
Effective width, Ww (Eq. 15-29) ft	*28.00*
Effective speed factor, S_f (Eq. 15-30)	*4.79*
Bicycle level of service score, BLOS (Eq. 15-31)	*13.66*
Bicycle level of service (Exhibit 15-4)	*F*

Notes

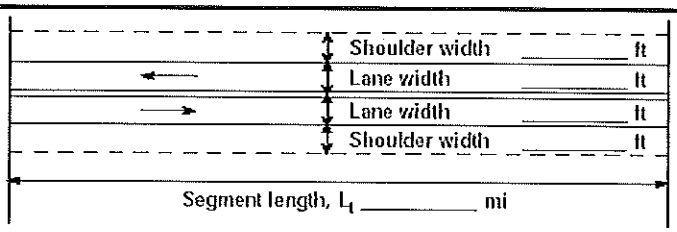
1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*David Stoner*	Highway / Direction of Travel	*MT 16*
Agency or Company	*DOWL HKM*	From/To	*RP 0.6 to RP 12.4 SB*
Date Performed	*4/17/2012*	Jurisdiction	*Dawson/Richland County*
Analysis Time Period	*Peak Hour*	Analysis Year	*2035 Low*

Project Description: *MT 16 / MT 200 Glendive to Fairview Corridor Planning Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Analysis direction vol., V_d	*249veh/h*	Grade Length	mi Up/down
Opposing direction vol., V_o	*242veh/h*	Peak-hour factor, PHF	*0.78*
Shoulder width ft	*8.0*	No-passing zone	*20%*
Lane Width ft	*12.0*	% Trucks and Buses , P_T	*29 %*
Segment Length mi	*11.8*	% Recreational vehicles, P_R	*4%*
		Access points *mi*	*7/mi*

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.4*	*1.4*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.896*	*0.896*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i/(PHF*f_{g,ATS}*f_{HV,ATS})$	*356*	*346*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*65.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, $FFS=S_{FM}+0.00776(v/f_{HV,ATS})$		Adj. for access points[4], f_A (Exhibit 15-8)	*1.8 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*1.7 mi/h*	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*63.3 mi/h*
		Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS}+v_{o,ATS})-f_{np,ATS}$	*56.1 mi/h*
		Percent free flow speed, PFFS	*88.7 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.1*	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.972*	*0.972*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV,PTSF}*f_{g,PTSF})$	*328*	*319*
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	*36.1*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*37.0*	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}*(v_{d,PTSF}/v_{d,PTSF}+v_{o,PTSF})$	*54.9*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*C*
Volume to capacity ratio, *v/c*	*0.23*

Capacity, $C_{d,ATS}$ (Equation 15-12) pc/h	*1523*
Capacity, $C_{d,PTSF}$ (Equation 15-13) pc/h	*1652*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*88.7*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*319.2*
Effective width, Ww (Eq. 15-29) ft	*28.00*
Effective speed factor, S_f (Eq. 15-30)	*4.79*
Bicycle level of service score, BLOS (Eq. 15-31)	*15.25*
Bicycle level of service (Exhibit 15-4)	*F*

Notes

1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
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 and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

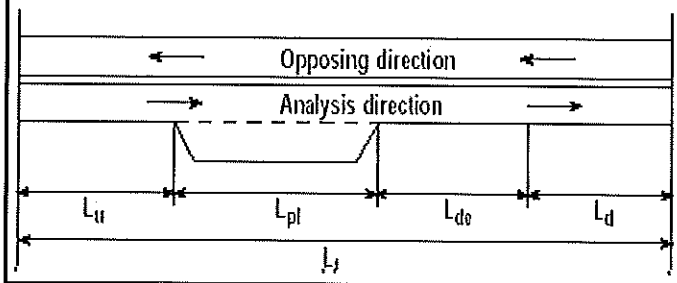
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	*David Stoner*	Highway of Travel	*MT 16*
Agency or Company	*DOWL HKM*	From/To	*RP 20.0 to Savage NB*
Date Performed	*4/17/2012*	Jurisdiction	*Dawson/Richland County*
Analysis Time Period	*Peak Hour*	Analysis Year	*2035 Low*

Project Description: *MT 16 / MT 200 Glendive to Fairview Corridor Planning Study*

Input Data

☑ Class I highway ☐ Class II highway ☐ Class III highway



Shoulder width (ft)	*8.0*
Lane Width (ft)	*12.0*
Segment Length (mi)	*11.5*
Total length of analysis segment, L_t	*11.5*
Length of two-lane highway upstream of the passing lane, L_u	*0.0*
Length of passing lane including tapers , L_{pl}	*1.9*
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	*56.8*
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	*53.0*
Level of service[1], LOS_d (from Directional Two-Lane Highway Segment Worksheet)	*C*
Average Travel Speed	
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L_{de} (Exhibit 15-23)	*1.70*
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d $L_d=L_t-(L_u+L_{pl}+L_{de})$	*7.90*
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 15-28)	*1.10*
Average travel speed including passing lane[2], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+ (2L_{de}/(1+f_{pl,ATS}))$)	*58.1*
Percent free flow speed including passing lane, $PFFS_{pl} = (ATS_{pl}/ FFS)$	*91.1*
Percent Time-Spent-Following	
Length of the downstream highway segment within the effective length of passing lane for percent time-spent-following, L_{de} (Exhibit 15-23)	*11.36*
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, $L_d = L_t-(L_u+ L_{pl}+ L_{de})$	*-1.76*
Adj. factor for the effect of passing lane on percent time-spent-following, $f_{pl,PTSF}$(Exhibit 15-26)	*0.60*

Percent time-spent-following including passing lane[3], $PTSF_{pl}$(%) $PTSF_{pl} = PTSF_d[L_u + L_d + f_{pl,PTSF}L_{pl} + ((1+f_{pl,PTSF})/2)L_{de}]/L_t$	*39.3*
Level of Service and Other Performance Measures[4]	
Level of service including passing lane LOS_{pl} (Exhibit 15-3)	*B*
Peak 15-min total travel time, TT_{15}(veh-h) $TT_{15} = VMT_{15}/ATS_{pl}$	*14.8*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*298.8*
Effective width, W_v (Eq. 15-29) ft	*28.00*
Effective speed factor, S_t (Eq. 15-30)	*4.79*
Bicycle level of service score, BLOS (Eq. 15-31)	*13.66*
Bicycle level of service (Exhibit 15-4)	*F*
Notes	
1. If LOS_d=F, passing lane analysis cannot be performed.	
2. If L_d <0, use alternative Equation 15-18.	
3. If L_d<0, use alternative Equation 15-16.	
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.	

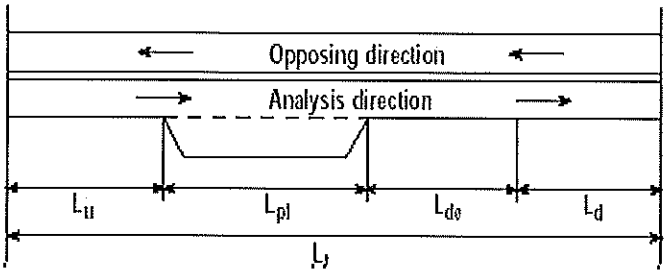
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	David Stoner	Highway of Travel	MT 16
Agency or Company	DOWL HKM	From/To	RP 12.4 to RP 22.0 SB
Date Performed	4/17/2012	Jurisdiction	Dawson/Richland County
Analysis Time Period	Peak Hour	Analysis Year	2035 Low

Project Description: *MT 16 / MT 200 Glendive to Fairview Corridor Planning Study*

Input Data

☑ Class I highway ☐ Class II highway ☐ Class III highway




Show North Arrow

Shoulder width (ft)	8.0
Lane Width (ft)	12.0
Segment Length (mi)	9.6
Total length of analysis segment, L_t	9.6
Length of two-lane highway upstream of the passing lane, L_u	0.0
Length of passing lane including tapers , L_{pl}	1.9
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	57.3
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	52.7
Level of service[1], LOS_d (from Directional Two-Lane Highway Segment Worksheet)	C
Average Travel Speed	
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L_{de} (Exhibit 15-23)	1.70
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d $L_d=L_t-(L_u+L_{pl}+L_{de})$	6.00
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 15-28)	1.10
Average travel speed including passing lane[2], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+ (2L_{de}/(1+f_{pl,ATS}))$)	58.9
Percent free flow speed including passing lane, $PFFS_{pl} = (ATS_{pl}/ FFS)$	91.3
Percent Time-Spent-Following	
Length of the downstream highway segment within the effective length of passing lane for percent time-spent-following, L_{de} (Exhibit 15-23)	10.62
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, $L_d = L_t-(L_u+ L_{pl}+ L_{de})$	-2.92
Adj. factor for the effect of passing lane on percent time-spent-following, $f_{pl,PTSF}$(Exhibit 15-26)	0.60

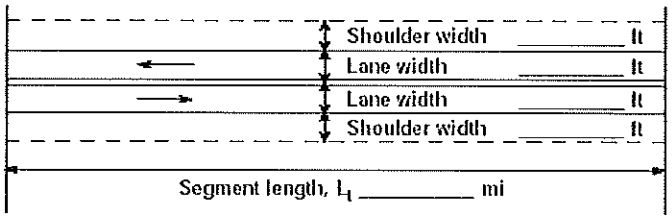
Percent time-spent-following including passing lane[3], $PTSF_{pl}$(%) $PTSF_{pl} = PTSF_d[L_u + L_d + f_{pl,PTSF}L_{pl} + ((1+f_{pl,PTSF})/2)L_{de}]/L_t$	*37.7*
Level of Service and Other Performance Measures[4]	
Level of service including passing lane LOS_{pl} (Exhibit 15-3)	*B*
Peak 15-min total travel time, TT_{15}(veh-h) $TT_{15} = VMT_{15}/ATS_{pl}$	*13.0*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*319.2*
Effective width, W_v (Eq. 15-29) ft	*28.00*
Effective speed factor, S_f (Eq. 15-30)	*4.79*
Bicycle level of service score, BLOS (Eq. 15-31)	*15.25*
Bicycle level of service (Exhibit 15-4)	*F*
Notes	
1. If LOS_d=F, passing lane analysis cannot be performed.	
2. If L_d <0, use alternative Equation 15-18.	
3. If L_d<0, use alternative Equation 15-16.	
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.	

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*David Stoner*	Highway / Direction of Travel	*MT 16*
Agency or Company	*DOWL HKM*	From/To	*RP 22.0 to Savage SB*
Date Performed	*4/17/2012*	Jurisdiction	*Dawson/Richland County*
Analysis Time Period	*Peak Hour*	Analysis Year	*2035 Low*

Project Description: *MT 16 / MT 200 Glendive to Fairview Corridor Planning Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Grade Length mi Up/down

Analysis direction vol., V_d	*249veh/h*
Opposing direction vol., V_o	*242veh/h*
Shoulder width ft	*8.0*
Lane Width ft	*12.0*
Segment Length mi	*9.5*
Peak-hour factor, PHF	*0.78*
No-passing zone	*22%*
% Trucks and Buses , P_T	*29 %*
% Recreational vehicles, P_R	*4%*
Access points *mi*	*5/mi*

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.4*	*1.4*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.896*	*0.896*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i/(PHF*f_{g,ATS}*f_{HV,ATS})$	*356*	*346*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*65.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, $FFS=S_{FM}+0.00776(v/f_{HV,ATS})$		Adj. for access points[4], f_A (Exhibit 15-8)	*1.3 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*1.8 mi/h*	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*63.8 mi/h*
		Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS}+v_{o,ATS})-f_{np,ATS}$	*56.5 mi/h*
		Percent free flow speed, PFFS	*88.7 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.1*	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.972*	*0.972*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV,PTSF}*f_{g,PTSF})$	*328*	*319*
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	*36.1*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*37.9*	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}*(v_{d,PTSF}/v_{d,PTSF}+v_{o,PTSF})$	*55.3*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*C*
Volume to capacity ratio, *v/c*	*0.23*

Capacity, $C_{d,ATS}$ (Equation 15-12) pc/h	*1523*
Capacity, $C_{d,PTSF}$ (Equation 15-13) pc/h	*1652*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*88.7*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*319.2*
Effective width, Wv (Eq. 15-29) ft	*28.00*
Effective speed factor, S_f (Eq. 15-30)	*4.79*
Bicycle level of service score, BLOS (Eq. 15-31)	*15.25*
Bicycle level of service (Exhibit 15-4)	*F*
Notes	

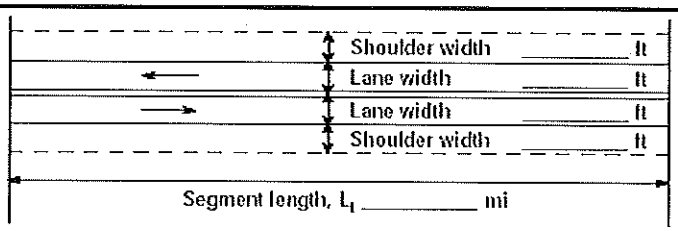
1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*David Stoner*	Highway / Direction of Travel	*MT 16*
Agency or Company	*DOWL HKM*	From/To	*Savage to Crane NB*
Date Performed	*4/17/2012*	Jurisdiction	*Dawson/Richland County*
Analysis Time Period	*Peak Hour*	Analysis Year	*2035 - Low*

Project Description: *MT 16 / MT 200 Glendive to Fairview Corridor Planning Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Grade Length mi Up/down

Peak-hour factor, PHF *0.87*

No-passing zone *31%*

% Trucks and Buses , P_T *23 %*

% Recreational vehicles, P_R *4%*

Access points *mi* *11/mi*

Analysis direction vol., V_d	*253veh/h*
Opposing direction vol., V_o	*307veh/h*
Shoulder width ft	*8.0*
Lane Width ft	*12.0*
Segment Length mi	*10.0*

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.4*	*1.3*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.916*	*0.935*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i/(PHF*f_{g,ATS}*f_{HV,ATS})$	*317*	*377*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*69.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, $FFS=S_{FM}+0.00776(v/f_{HV,ATS})$		Adj. for access points[4], f_A (Exhibit 15-8)	*2.8 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*2.1 mi/h*	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*66.3 mi/h*
		Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS}+v_{o,ATS})-f_{np,ATS}$	*58.8 mi/h*
		Percent free flow speed, PFFS	*88.7 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.1*	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.978*	*0.978*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV,PTSF}*f_{g,PTSF})$	*297*	*361*
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	*33.3*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*39.9*	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}*(v_{d,PTSF}/v_{d,PTSF}+v_{o,PTSF})$	*51.3*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*C*
Volume to capacity ratio, *v/c*	*0.20*

Capacity, $C_{d,ATS}$ (Equation 15-12) pc/h	*1590*
Capacity, $C_{d,PTSF}$ (Equation 15-13) pc/h	*1662*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*88.7*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*290.8*
Effective width, Wv (Eq. 15-29) ft	*28.00*
Effective speed factor, S_t (Eq. 15-30)	*4.79*
Bicycle level of service score, BLOS (Eq. 15-31)	*10.79*
Bicycle level of service (Exhibit 15-4)	*F*
Notes	

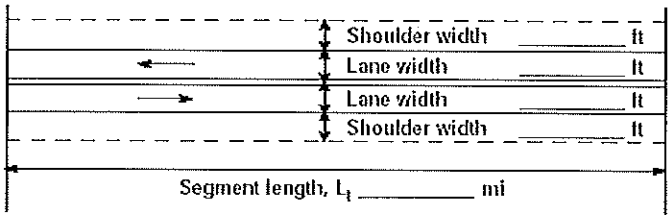
1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*David Stoner*	Highway / Direction of Travel	*MT 16*
Agency or Company	*DOWL HKM*	From/To	*Savage to Crane SB*
Date Performed	*4/17/2012*	Jurisdiction	*Dawson/Richland County*
Analysis Time Period	*Peak Hour*	Analysis Year	*2035 - Low*

Project Description: *MT 16 / MT 200 Glendive to Fairview Corridor Planning Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Grade Length mi Up/down

Peak-hour factor, PHF *0.84*

No-passing zone *19%*

% Trucks and Buses , P_T *25 %*

% Recreational vehicles, P_R *4%*

Access points *mi* *11/mi*

Analysis direction vol., V_d *307veh/h*

Opposing direction vol., V_o *253veh/h*

Shoulder width ft *8.0*

Lane Width ft *12.0*

Segment Length mi *10.0*

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.3*	*1.4*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.930*	*0.909*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i/(PHF*f_{g,ATS}*f_{HV,ATS})$	*393*	*331*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*66.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, $FFS=S_{FM}+0.00776(v/f_{HV,ATS})$		Adj. for access points[4], f_A (Exhibit 15-8)	*2.8 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*1.7 mi/h*	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*63.3 mi/h*
		Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS}+v_{o,ATS})-f_{np,ATS}$	*55.9 mi/h*
		Percent free flow speed, PFFS	*88.4 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.1*	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.976*	*0.976*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV,PTSF}*f_{g,PTSF})$	*375*	*309*
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	*38.7*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*33.9*	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}*(v_{d,PTSF}/v_{d,PTSF}+v_{o,PTSF})$	*57.3*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*C*
Volume to capacity ratio, *v/c*	*0.25*

Capacity, $C_{d,ATS}$ (Equation 15-12) pc/h	*1545*
Capacity, $C_{d,PTSF}$ (Equation 15-13) pc/h	*1659*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*88.4*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*365.5*
Effective width, Ww (Eq. 15-29) ft	*28.00*
Effective speed factor, S_f (Eq. 15-30)	*4.79*
Bicycle level of service score, BLOS (Eq. 15-31)	*12.29*
Bicycle level of service (Exhibit 15-4)	*F*

Notes

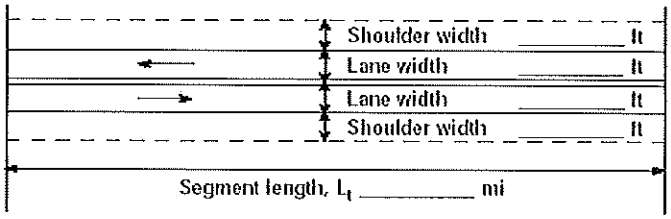
1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*David Stoner*	Highway / Direction of Travel	*MT 16*
Agency or Company	*DOWL HKM*	From/To	*Crane to Sidney NB*
Date Performed	*4/17/2012*	Jurisdiction	*Dawson/Richland County*
Analysis Time Period	*Peak Hour*	Analysis Year	*2035 - Low*

Project Description: *MT 16 / MT 200 Glendive to Fairview Corridor Planning Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Grade Length mi Up/down	
Peak-hour factor, PHF	*0.80*
No-passing zone	*24%*
% Trucks and Buses , P_T	*19 %*
% Recreational vehicles, P_R	*4%*
Access points *mi*	*12/mi*

Analysis direction vol., V_d	*271veh/h*
Opposing direction vol., V_o	*416veh/h*
Shoulder width ft	*8.0*
Lane Width ft	*12.0*
Segment Length mi	*8.9*

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.4*	*1.2*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.929*	*0.963*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i/(PHF*f_{g,ATS}*f_{HV,ATS})$	*365*	*540*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*65.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, $FFS=S_{FM}+0.00776(v/f_{HV,ATS})$		Adj. for access points[4], f_A (Exhibit 15-8)	*3.0 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*1.4 mi/h*	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*62.0 mi/h*
		Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS}+v_{o,ATS})-f_{np,ATS}$	*53.6 mi/h*
		Percent free flow speed, PFFS	*86.5 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.1*	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.981*	*1.000*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV,PTSF}*f_{g,PTSF})$	*345*	*520*
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	*41.1*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*27.9*	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}*(v_{d,PTSF}/v_{d,PTSF}+v_{o,PTSF})$	*52.2*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*C*
Volume to capacity ratio, *v/c*	*0.22*

Capacity, $C_{d,ATS}$ (Equation 15-12) pc/h	*1637*
Capacity, $C_{d,PTSF}$ (Equation 15-13) pc/h	*1700*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*86.5*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*338.8*
Effective width, Wv (Eq. 15-29) ft	*28.00*
Effective speed factor, S_f (Eq. 15-30)	*4.79*
Bicycle level of service score, BLOS (Eq. 15-31)	*8.34*
Bicycle level of service (Exhibit 15-4)	*F*

Notes

1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
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 and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

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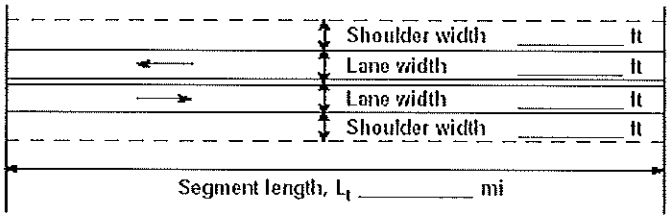
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*David Stoner*	Highway / Direction of Travel	*MT 16*
Agency or Company	*DOWL HKM*	From/To	*Crane to Sidney SB*
Date Performed	*4/17/2012*	Jurisdiction	*Dawson/Richland County*
Analysis Time Period	*Peak Hour*	Analysis Year	*2035 - Low*

Project Description: *MT 16 / MT 200 Glendive to Fairview Corridor Planning Study*

Input Data



Show North Arrow

☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Analysis direction vol., V_d	*416*veh/h
Opposing direction vol., V_o	*271*veh/h
Shoulder width ft	*8.0*
Lane Width ft	*12.0*
Segment Length mi	*8.9*
Grade Length mi Up/down	
Peak-hour factor, PHF	*0.87*
No-passing zone	*22%*
% Trucks and Buses , P_T	*19 %*
% Recreational vehicles, P_R	*4%*
Access points *mi*	*12*/mi

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.2*	*1.4*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.963*	*0.929*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i/(PHF*f_{g,ATS}*f_{HV,ATS})$	*497*	*335*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*69.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, $FFS=S_{FM}+0.00776(v/f_{HV,ATS})$		Adj. for access points[4], f_A (Exhibit 15-8)	*3.0 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*1.9 mi/h*	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*66.0 mi/h*
		Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS}+v_{o,ATS})-f_{np,ATS}$	*57.7 mi/h*
		Percent free flow speed, PFFS	*87.4 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.0*	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*1.000*	*0.981*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV,PTSF}*f_{g,PTSF})$	*478*	*317*
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	*47.4*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*28.7*	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}*(v_{d,PTSF}/v_{d,PTSF}+v_{o,PTSF})$	*64.7*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*C*
Volume to capacity ratio, *v/c*	*0.31*

Capacity, $C_{d,ATS}$ (Equation 15-12) pc/h	*1579*
Capacity, $C_{d,PTSF}$ (Equation 15-13) pc/h	*1668*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*87.4*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*478.2*
Effective width, Ww (Eq. 15-29) ft	*28.00*
Effective speed factor, S_f (Eq. 15-30)	*4.79*
Bicycle level of service score, BLOS (Eq. 15-31)	*8.51*
Bicycle level of service (Exhibit 15-4)	*F*

Notes

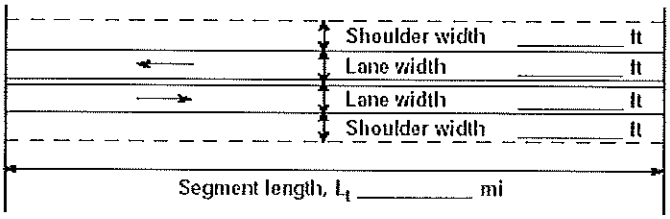
1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	David Stoner	Highway / Direction of Travel	MT 200
Agency or Company	DOWL HKM	From/To	Sidney to Fairview EB
Date Performed	4/17/2012	Jurisdiction	Dawson/Richland County
Analysis Time Period	Peak Hour	Analysis Year	2035 - Low

Project Description: *MT 16 / MT 200 Glendive to Fairview Corridor Planning Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Grade Length mi Up/down

Peak-hour factor, PHF 0.83

No-passing zone 17%

% Trucks and Buses , P_T 17 %

% Recreational vehicles, P_R 4%

Access points *mi* 16/mi

Analysis direction vol., V_d 529veh/h

Opposing direction vol., V_o 523veh/h

Shoulder width ft 8.0

Lane Width ft 12.0

Segment Length mi 9.9

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	1.1	1.1
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.983	0.983
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	1.00	1.00
Demand flow rate[2], v_i (pc/h) $v_i=V_i/(PHF*f_{g,ATS}*f_{HV,ATS})$	648	641

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	69.0 mi/h
Total demand flow rate, both directions, v		Adj. for lane and shoulder width,[4] f_{LS} (Exhibit 15-7)	0.0 mi/h
Free-flow speed, $FFS=S_{FM}+0.00776(v/f_{HV,ATS})$		Adj. for access points[4], f_A (Exhibit 15-8)	4.0 mi/h
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	1.3 mi/h	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	65.0 mi/h
		Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS}+v_{o,ATS})-f_{np,ATS}$	53.7 mi/h
		Percent free flow speed, PFFS	82.7 %

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-18 or 15-19)	1.0	1.0
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	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], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	1.00	1.00
Directional flow rate[2], v_i (pc/h) $v_i=V_i/(PHF*f_{HV,PTSF}*f_{g,PTSF})$	637	630
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	60.4	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	21.6	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}*(v_{d,PTSF}/v_{d,PTSF}+v_{o,PTSF})$	71.3	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	D
Volume to capacity ratio, *v/c*	0.39

Capacity, $C_{d,ATS}$ (Equation 15-12) pc/h	*1671*
Capacity, $C_{d,PTSF}$ (Equation 15-13) pc/h	*1700*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*82.7*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*637.3*
Effective width, Wv (Eq. 15-29) ft	*28.00*
Effective speed factor, S_t (Eq. 15-30)	*4.79*
Bicycle level of service score, BLOS (Eq. 15-31)	*7.52*
Bicycle level of service (Exhibit 15-4)	*F*
Notes	

1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
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 and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

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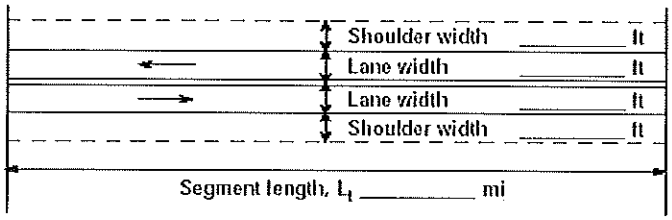
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*David Stoner*	Highway / Direction of Travel	*MT 200*
Agency or Company	*DOWL HKM*	From/To	*Sidney to Fairview WB*
Date Performed	*4/17/2012*	Jurisdiction	*Dawson/Richland County*
Analysis Time Period	*Peak Hour*	Analysis Year	*2035 - Low*

Project Description: *MT 16 / MT 200 Glendive to Fairview Corridor Planning Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Grade Length mi Up/down

Peak-hour factor, PHF *0.86*

No-passing zone *15%*

% Trucks and Buses , P_T *25 %*

% Recreational vehicles, P_R *4%*

Access points *mi* *16/mi*

Analysis direction vol., V_d *523veh/h*

Opposing direction vol., V_o *529veh/h*

Shoulder width ft *8.0*

Lane Width ft *12.0*

Segment Length mi *9.9*

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.1*	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.976*	*0.976*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i/(PHF*f_{g,ATS}*f_{HV,ATS})$	*623*	*630*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*66.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, $FFS=S_{FM}+0.00776(v/f_{HV,ATS})$		Adj. for access points[4], f_A (Exhibit 15-8)	*4.0 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*1.1 mi/h*	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*62.0 mi/h*
		Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS}+v_{o,ATS})-f_{np,ATS}$	*51.1 mi/h*
		Percent free flow speed, PFFS	*82.5 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*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], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV,PTSF}*f_{g,PTSF})$	*608*	*615*
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	*58.6*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*21.4*	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}*(v_{d,PTSF}/v_{d,PTSF}+v_{o,PTSF})$	*69.2*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*D*
Volume to capacity ratio, *v/c*	*0.38*

Capacity, $C_{d,ATS}$ (Equation 15-12) pc/h	*1659*
Capacity, $C_{d,PTSF}$ (Equation 15-13) pc/h	*1700*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*82.5*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*608.1*
Effective width, Ww (Eq. 15-29) ft	*28.00*
Effective speed factor, S_t (Eq. 15-30)	*4.79*
Bicycle level of service score, BLOS (Eq. 15-31)	*12.55*
Bicycle level of service (Exhibit 15-4)	*F*
Notes	

1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
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 and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

Appendix 6

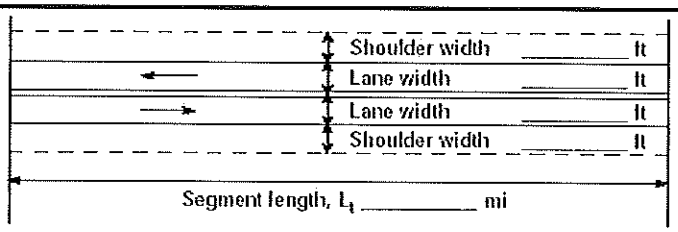
Projected Two-Lane Highway 2035 – High Condition

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*David Stoner*	Highway / Direction of Travel	*MT 16*
Agency or Company	*DOWL HKM*	From/To	*RP 0.6 to 20.0 NB*
Date Performed	*4/17/2012*	Jurisdiction	*Dawson/Richland County*
Analysis Time Period	*Peak Hour*	Analysis Year	*2035 High*

Project Description: *MT 16 / MT 200 Glendive to Fairview Corridor Planning Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Grade Length mi Up/down

Analysis direction vol., V_d	*321* veh/h
Opposing direction vol., V_o	*331* veh/h
Shoulder width ft	*8.0*
Lane Width ft	*12.0*
Segment Length mi	*19.4*
Peak-hour factor, PHF	*0.81*
No-passing zone	*27%*
% Trucks and Buses , P_T	*27 %*
% Recreational vehicles, P_R	*4%*
Access points *mi*	*5*/mi

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.3*	*1.3*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.925*	*0.925*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i/(PHF*f_{g,ATS}*f_{HV,ATS})$	*428*	*442*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*65.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS} (Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, $FFS=S_{FM}+0.00776(v/f_{HV,ATS})$		Adj. for access points[4], f_A (Exhibit 15-8)	*1.3 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*1.7 mi/h*	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*63.8 mi/h*
		Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS}+v_{o,ATS})-f_{np,ATS}$	*55.3 mi/h*
		Percent free flow speed, PFFS	*86.7 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-18 or 15-19)	*1.1*	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.974*	*1.000*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i (pc/h) $v_i=V_i/(PHF*f_{HV,PTSF}*f_{g,PTSF})$	*407*	*409*
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	*42.7*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*35.3*	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}*(v_{d,PTSF}/v_{d,PTSF}+v_{o,PTSF})$	*60.3*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*C*
Volume to capacity ratio, *v/c*	*0.27*

Capacity, $C_{d,ATS}$ (Equation 15-12) pc/h	*1573*
Capacity, $C_{d,PTSF}$ (Equation 15-13) pc/h	*1700*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*86.7*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*396.3*
Effective width, Wv (Eq. 15-29) ft	*28.00*
Effective speed factor, S_f (Eq. 15-30)	*4.79*
Bicycle level of service score, BLOS (Eq. 15-31)	*13.81*
Bicycle level of service (Exhibit 15-4)	*F*

Notes

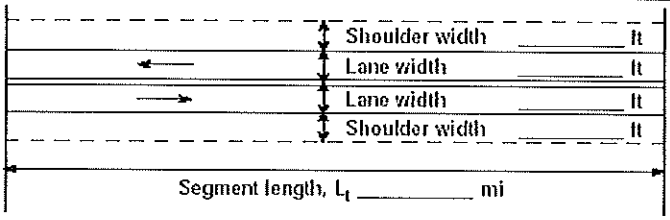
1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*David Stoner*	Highway / Direction of Travel	*MT 16*
Agency or Company	*DOWL HKM*	From/To	*RP 0.6 to RP 12.4 SB*
Date Performed	*4/17/2012*	Jurisdiction	*Dawson/Richland County*
Analysis Time Period	*Peak Hour*	Analysis Year	*2035 High*

Project Description: *MT 16 / MT 200 Glendive to Fairview Corridor Planning Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Analysis direction vol., V_d	*331veh/h*	Grade Length	mi Up/down
Opposing direction vol., V_o	*321veh/h*	Peak-hour factor, PHF	*0.78*
Shoulder width ft	*8.0*	No-passing zone	*20%*
Lane Width ft	*12.0*	% Trucks and Buses , P_T	*29 %*
Segment Length mi	*11.8*	% Recreational vehicles, P_R	*4%*
		Access points *mi*	*7/mi*

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.3*	*1.3*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.920*	*0.920*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i/(PHF*f_{g,ATS}*f_{HV,ATS})$	*461*	*447*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*65.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, $FFS=S_{FM}+0.00776(v/f_{HV,ATS})$		Adj. for access points[4], f_A (Exhibit 15-8)	*1.8 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*1.5 mi/h*	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*63.3 mi/h*
		Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS}+v_{o,ATS})-f_{np,ATS}$	*54.7 mi/h*
		Percent free flow speed, PFFS	*86.5 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*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], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV,PTSF}*f_{g,PTSF})$	*424*	*412*
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	*45.2*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*32.6*	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}*(v_{d,PTSF}/v_{d,PTSF}+v_{o,PTSF})$	*61.7*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*C*
Volume to capacity ratio, *v/c*	*0.29*

Capacity, $C_{d,ATS}$ (Equation 15-12) pc/h	*1564*
Capacity, $C_{d,PTSF}$ (Equation 15-13) pc/h	*1700*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*86.5*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*424.4*
Effective width, Wv (Eq. 15-29) ft	*28.00*
Effective speed factor, S_f (Eq. 15-30)	*4.79*
Bicycle level of service score, BLOS (Eq. 15-31)	*15.39*
Bicycle level of service (Exhibit 15-4)	*F*
Notes	
1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain. 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 and for v>200 veh/h. 4. For the analysis direction only 5. Exhibit 15-20 provides coefficients a and b for Equation 15-10. 6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.	

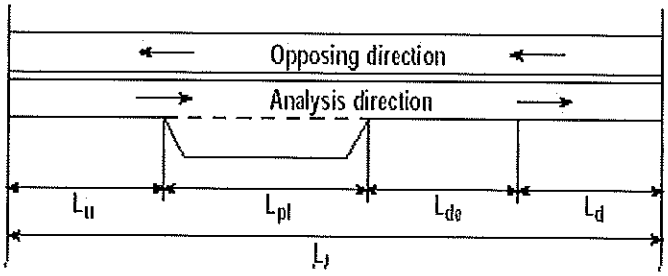
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	David Stoner	Highway of Travel	MT 16
Agency or Company	DOWL HKM	From/To	RP 20.0 to Savage NB
Date Performed	4/17/2012	Jurisdiction	Dawson/Richland County
Analysis Time Period	Peak Hour	Analysis Year	2035 High

Project Description: MT 16 / MT 200 Glendive to Fairview Corridor Planning Study

Input Data

☑ Class I highway ☐ Class II highway ☐ Class III highway



Shoulder width (ft)	8.0
Lane Width (ft)	12.0
Segment Length (mi)	11.5
Total length of analysis segment, L_t	11.5
Length of two-lane highway upstream of the passing lane, L_u	0.0
Length of passing lane including tapers , L_{pl}	1.9
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	55.5
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	59.2
Level of service[1], LOS_d (from Directional Two-Lane Highway Segment Worksheet)	C
Average Travel Speed	
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L_{de} (Exhibit 15-23)	1.70
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d $L_d=L_t-(L_u+L_{pl}+L_{de})$	7.90
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 15-28)	1.10
Average travel speed including passing lane[2], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+ (2L_{de}/(1+f_{pl,ATS}))$)	56.7
Percent free flow speed including passing lane, $PFFS_{pl} = (ATS_{pl}/ FFS)$	89.0
Percent Time-Spent-Following	
Length of the downstream highway segment within the effective length of passing lane for percent time-spent-following, L_{de} (Exhibit 15-23)	8.04
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, $L_d = L_t-(L_u+ L_{pl}+ L_{de})$	1.56
Adj. factor for the effect of passing lane on percent time-spent-following, $f_{pl,PTSF}$(Exhibit 15-26)	0.61

Percent time-spent-following including passing lane[3], $PTSF_{pl}$(%) $PTSF_{pl} = PTSF_d[L_u+L_d+f_{pl,PTSF}L_{pl}+((1+f_{pl,PTSF})/2)L_{de}]/L_t$	*47.3*
Level of Service and Other Performance Measures[4]	
Level of service including passing lane LOS_{pl} (Exhibit 15-3)	*B*
Peak 15-min total travel time, TT_{15}(veh-h) $TT_{15} = VMT_{15}/ATS_{pl}$	*20.1*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*396.3*
Effective width, W_v (Eq. 15-29) ft	*28.00*
Effective speed factor, S_t (Eq. 15-30)	*4.79*
Bicycle level of service score, BLOS (Eq. 15-31)	*13.81*
Bicycle level of service (Exhibit 15-4)	*F*
Notes	
1. If LOS_d=F, passing lane analysis cannot be performed.	
2. If L_d <0, use alternative Equation 15-18.	
3. If L_d<0, use alternative Equation 15-16.	
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.	

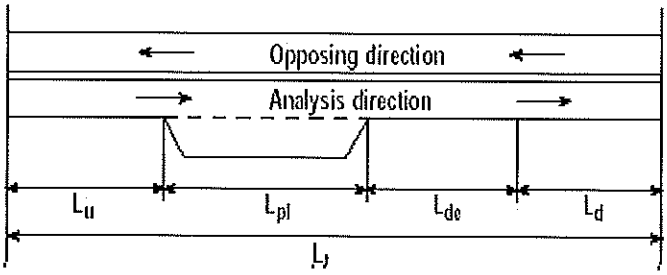
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	*David Stoner*	Highway of Travel	*MT 16*
Agency or Company	*DOWL HKM*	From/To	*RP 12.4 to RP 22.0 SB*
Date Performed	*4/17/2012*	Jurisdiction	*Dawson/Richland County*
Analysis Time Period	*Peak Hour*	Analysis Year	*2035 High*

Project Description: *MT 16 / MT 200 Glendive to Fairview Corridor Planning Study*

Input Data

☑ Class I highway ☐ Class II highway ☐ Class III highway



Shoulder width (ft)	*8.0*
Lane Width (ft)	*12.0*
Segment Length (mi)	*9.6*
Total length of analysis segment, L_t	*9.6*
Length of two-lane highway upstream of the passing lane, L_u	*0.0*
Length of passing lane including tapers , L_{pl}	*1.9*
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	*55.9*
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	*60.0*
Level of service[1], LOS_d (from Directional Two-Lane Highway Segment Worksheet)	*C*
Average Travel Speed	
Length of the downstream highway segment within the effective length of passing lane for average travel speed, L_{de} (Exhibit 15-23)	*1.70*
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d $L_d=L_t-(L_u+L_{pl}+L_{de})$	*6.00*
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 15-28)	*1.10*
Average travel speed including passing lane[2], $ATS_{pl} = (ATS_d * L_t) / (L_u+L_d+(L_{pl}/f_{pl})+ (2L_{de}/(1+f_{pl,ATS}))$)	*57.4*
Percent free flow speed including passing lane, $PFFS_{pl} = (ATS_{pl}/ FFS)$	*89.1*
Percent Time-Spent-Following	
Length of the downstream highway segment within the effective length of passing lane for percent time-spent-following, L_{de} (Exhibit 15-23)	*7.91*
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, $L_d = L_t-(L_u+ L_{pl}+ L_{de})$	*-0.21*
Adj. factor for the effect of passing lane on percent time-spent-following, $f_{pl,PTSF}$(Exhibit 15-26)	*0.61*

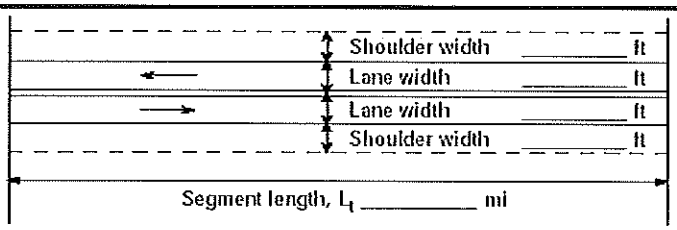
Percent time-spent-following including passing lane[3], $PTSF_{pl}$(%) $PTSF_{pl} = PTSF_d[L_u+L_d+f_{pl,PTSF}L_{pl}+((1+f_{pl,PTSF})/2)L_{de}]/L_t$	*45.7*
Level of Service and Other Performance Measures[4]	
Level of service including passing lane LOS_{pl} (Exhibit 15-3)	*B*
Peak 15-min total travel time, TT_{15}(veh-h) $TT_{15} = VMT_{15}/ATS_{pl}$	*17.7*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*424.4*
Effective width, W_v (Eq. 15-29) ft	*28.00*
Effective speed factor, S_t (Eq. 15-30)	*4.79*
Bicycle level of service score, BLOS (Eq. 15-31)	*15.39*
Bicycle level of service (Exhibit 15-4)	*F*
Notes	
1. If LOS_d=F, passing lane analysis cannot be performed.	
2. If L_d <0, use alternative Equation 15-18.	
3. If L_d<0, use alternative Equation 15-16.	
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.	

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*David Stoner*	Highway / Direction of Travel	*MT 16*
Agency or Company	*DOWL HKM*	From/To	*RP 22.0 to Savage SB*
Date Performed	*4/17/2012*	Jurisdiction	*Dawson/Richland County*
Analysis Time Period	*Peak Hour*	Analysis Year	*2035 High*

Project Description: *MT 16 / MT 200 Glendive to Fairview Corridor Planning Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Grade Length mi Up/down

Peak-hour factor, PHF *0.78*

No-passing zone *22%*

% Trucks and Buses , P_T *29 %*

% Recreational vehicles, P_R *4%*

Access points *mi* *5/mi*

Analysis direction vol., V_d *321veh/h*

Opposing direction vol., V_o *331veh/h*

Shoulder width ft *8.0*

Lane Width ft *12.0*

Segment Length mi *9.5*

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.3*	*1.3*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.920*	*0.920*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i/(PHF*f_{g,ATS}*f_{HV,ATS})$	*447*	*461*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*65.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, $FFS=S_{FM}+0.00776(v/f_{HV,ATS})$		Adj. for access points[4], f_A (Exhibit 15-8)	*1.3 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*1.5 mi/h*	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*63.8 mi/h*
		Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS}+v_{o,ATS})-f_{np,ATS}$	*55.2 mi/h*
		Percent free flow speed, PFFS	*86.5 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*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], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV,PTSF}*f_{g,PTSF})$	*412*	*424*
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	*43.7*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*33.2*	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}*(v_{d,PTSF}/v_{d,PTSF}+v_{o,PTSF})$	*60.1*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*C*
Volume to capacity ratio, *v/c*	*0.29*

Capacity, $C_{d,ATS}$ (Equation 15-12) pc/h	*1564*
Capacity, $C_{d,PTSF}$ (Equation 15-13) pc/h	*1700*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*86.5*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*411.5*
Effective width, Ww (Eq. 15-29) ft	*28.00*
Effective speed factor, S_t (Eq. 15-30)	*4.79*
Bicycle level of service score, BLOS (Eq. 15-31)	*15.38*
Bicycle level of service (Exhibit 15-4)	*F*

Notes

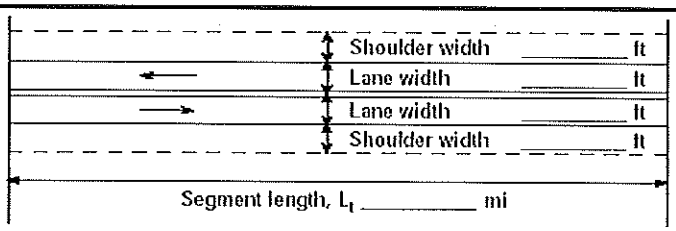
1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*David Stoner*	Highway / Direction of Travel	*MT 16*
Agency or Company	*DOWL HKM*	From/To	*Savage to Crane NB*
Date Performed	*4/17/2012*	Jurisdiction	*Dawson/Richland County*
Analysis Time Period	*Peak Hour*	Analysis Year	*2035 - High*

Project Description: *MT 16 / MT 200 Glendive to Fairview Corridor Planning Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Grade Length mi Up/down

Peak-hour factor, PHF *0.87*

No-passing zone *31%*

% Trucks and Buses , P_T *23 %*

% Recreational vehicles, P_R *4%*

Access points *mi* *11/mi*

Analysis direction vol., V_d *336veh/h*

Opposing direction vol., V_o *407veh/h*

Shoulder width ft *8.0*

Lane Width ft *12.0*

Segment Length mi *10.0*

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.3*	*1.2*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.935*	*0.956*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i/(PHF*f_{g,ATS}*f_{HV,ATS})$	*413*	*489*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*69.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, $FFS=S_{FM}+0.00776(v/f_{HV,ATS})$		Adj. for access points[4], f_A (Exhibit 15-8)	*2.8 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*1.7 mi/h*	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*66.3 mi/h*
		Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS}+v_{o,ATS})-f_{np,ATS}$	*57.5 mi/h*
		Percent free flow speed, PFFS	*86.8 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.1*	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.978*	*1.000*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV,PTSF}*f_{g,PTSF})$	*395*	*468*
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	*44.1*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*33.0*	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}*(v_{d,PTSF}/v_{d,PTSF}+v_{o,PTSF})$	*59.2*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*C*
Volume to capacity ratio, *v/c*	*0.25*

Capacity, $C_{d,ATS}$ (Equation 15-12) pc/h	*1625*
Capacity, $C_{d,PTSF}$ (Equation 15-13) pc/h	*1700*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*86.8*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*386.2*
Effective width, Wv (Eq. 15-29) ft	*28.00*
Effective speed factor, S_t (Eq. 15-30)	*4.79*
Bicycle level of service score, BLOS (Eq. 15-31)	*10.93*
Bicycle level of service (Exhibit 15-4)	*F*
Notes	

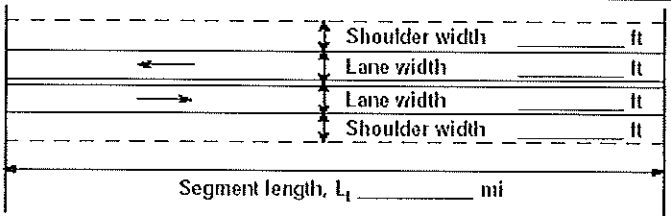
1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*David Stoner*	Highway / Direction of Travel	*MT 16*
Agency or Company	*DOWL HKM*	From/To	*Savage to Crane SB*
Date Performed	*4/17/2012*	Jurisdiction	*Dawson/Richland County*
Analysis Time Period	*Peak Hour*	Analysis Year	*2035 - High*

Project Description: *MT 16 / MT 200 Glendive to Fairview Corridor Planning Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Grade Length mi Up/down

Peak-hour factor, PHF *0.84*

No-passing zone *19%*

% Trucks and Buses , P_T *25 %*

% Recreational vehicles, P_R *4%*

Access points *mi* *11/mi*

Analysis direction vol., V_d *407veh/h*

Opposing direction vol., V_o *336veh/h*

Shoulder width ft *8.0*

Lane Width ft *12.0*

Segment Length mi *10.0*

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.2*	*1.3*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.952*	*0.930*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i/(PHF*f_{g,ATS}*f_{HV,ATS})$	*509*	*430*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*66.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, $FFS=S_{FM}+0.00776(v/f_{HV,ATS})$		Adj. for access points[4], f_A (Exhibit 15-8)	*2.8 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*1.5 mi/h*	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*63.3 mi/h*
		Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS}+v_{o,ATS})-f_{np,ATS}$	*54.5 mi/h*
		Percent free flow speed, PFFS	*86.1 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.0*	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*1.000*	*0.976*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV,PTSF}*f_{g,PTSF})$	*485*	*410*
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	*49.3*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*28.5*	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}*(v_{d,PTSF}/v_{d,PTSF}+v_{o,PTSF})$	*64.7*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*C*
Volume to capacity ratio, *v/c*	*0.32*

Capacity, $C_{d,ATS}$ (Equation 15-12) pc/h	*1581*
Capacity, $C_{d,PTSF}$ (Equation 15-13) pc/h	*1700*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*86.1*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*484.5*
Effective width, Wv (Eq. 15-29) ft	*28.00*
Effective speed factor, S_f (Eq. 15-30)	*4.79*
Bicycle level of service score, BLOS (Eq. 15-31)	*12.44*
Bicycle level of service (Exhibit 15-4)	*F*

Notes

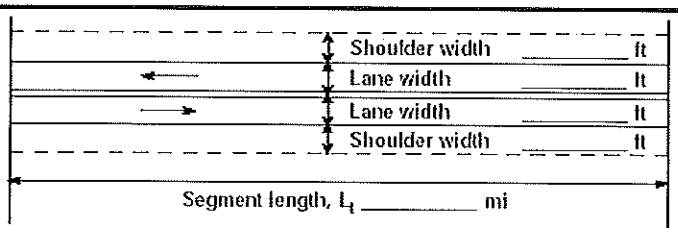
1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	David Stoner	Highway / Direction of Travel	MT 16
Agency or Company	DOWL HKM	From/To	Crane to Sidney NB
Date Performed	4/17/2012	Jurisdiction	Dawson/Richland County
Analysis Time Period	Peak Hour	Analysis Year	2035 - High

Project Description: *MT 16 / MT 200 Glendive to Fairview Corridor Planning Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Grade Length mi Up/down	
Peak-hour factor, PHF	0.80
No-passing zone	24%
% Trucks and Buses , P_T	19 %
% Recreational vehicles, P_R	4%
Access points *mi*	12/mi

Analysis direction vol., V_d	360veh/h
Opposing direction vol., V_o	552veh/h
Shoulder width ft	8.0
Lane Width ft	12.0
Segment Length mi	8.9

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	1.3	1.1
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.946	0.981
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	1.00	1.00
Demand flow rate[2], v_i (pc/h) $v_i=V_i/(PHF*f_{g,ATS}*f_{HV,ATS})$	476	703

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	65.0 mi/h
Total demand flow rate, both directions, v		Adj. for lane and shoulder width,[4] f_{LS} (Exhibit 15-7)	0.0 mi/h
Free-flow speed, $FFS=S_{FM}+0.00776(v/f_{HV,ATS})$		Adj. for access points[4], f_A (Exhibit 15-8)	3.0 mi/h
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	1.0 mi/h	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	62.0 mi/h
		Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS}+v_{o,ATS})-f_{np,ATS}$	51.9 mi/h
		Percent free flow speed, PFFS	83.7 %

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-18 or 15-19)	1.0	1.0
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	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], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	1.00	1.00
Directional flow rate[2], v_i (pc/h) $v_i=V_i/(PHF*f_{HV,PTSF}*f_{g,PTSF})$	450	690
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	50.2	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	23.5	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}*(v_{d,PTSF}/v_{d,PTSF}+v_{o,PTSF})$	59.5	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	C
Volume to capacity ratio, *v/c*	0.29

Capacity, $C_{d,ATS}$ (Equation 15-12) pc/h	*1668*
Capacity, $C_{d,PTSF}$ (Equation 15-13) pc/h	*1700*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*83.7*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*450.0*
Effective width, Ww (Eq. 15-29) ft	*28.00*
Effective speed factor, S_t (Eq. 15-30)	*4.79*
Bicycle level of service score, BLOS (Eq. 15-31)	*8.48*
Bicycle level of service (Exhibit 15-4)	*F*
Notes	

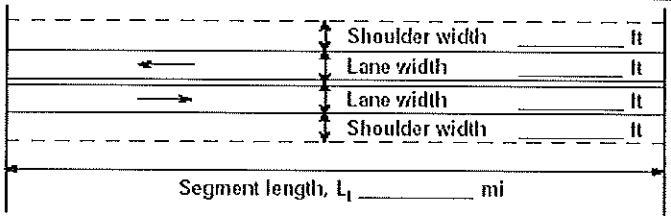
1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*David Stoner*	Highway / Direction of Travel	*MT 16*
Agency or Company	*DOWL HKM*	From/To	*Crane to Sidney SB*
Date Performed	*4/17/2012*	Jurisdiction	*Dawson/Richland County*
Analysis Time Period	*Peak Hour*	Analysis Year	*2035 - High*

Project Description: *MT 16 / MT 200 Glendive to Fairview Corridor Planning Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Grade Length mi Up/down

Peak-hour factor, PHF *0.87*

No-passing zone *22%*

% Trucks and Buses , P_T *19 %*

% Recreational vehicles, P_R *4%*

Access points *mi* *12/mi*

Analysis direction vol., V_d *552veh/h*

Opposing direction vol., V_o *360veh/h*

Shoulder width ft *8.0*

Lane Width ft *12.0*

Segment Length mi *8.9*

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.1*	*1.3*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.981*	*0.946*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i/(PHF*f_{g,ATS}*f_{HV,ATS})$	*647*	*437*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*69.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS} (Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, $FFS=S_{FM}+0.00776(v/f_{HV,ATS})$		Adj. for access points[4], f_A (Exhibit 15-8)	*3.0 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*1.6 mi/h*	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*66.0 mi/h*
		Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS}+v_{o,ATS})-f_{np,ATS}$	*56.0 mi/h*
		Percent free flow speed, PFFS	*84.8 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*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], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i (pc/h) $v_i=V_i/(PHF*f_{HV,PTSF}*f_{g,PTSF})$	*634*	*414*
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	*57.9*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*24.6*	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}*(v_{d,PTSF}/v_{d,PTSF}+v_{o,PTSF})$	*72.8*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*D*
Volume to capacity ratio, *v/c*	*0.40*

Capacity, $C_{d,ATS}$ (Equation 15-12) pc/h	*1608*
Capacity, $C_{d,PTSF}$ (Equation 15-13) pc/h	*1700*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*84.8*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*634.5*
Effective width, Wv (Eq. 15-29) ft	*28.00*
Effective speed factor, S_t (Eq. 15-30)	*4.79*
Bicycle level of service score, BLOS (Eq. 15-31)	*8.66*
Bicycle level of service (Exhibit 15-4)	*F*
Notes	

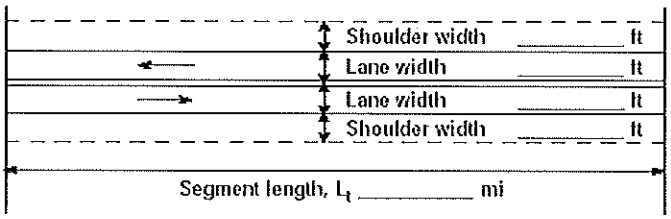
1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*David Stoner*	Highway / Direction of Travel	*MT 200*
Agency or Company	*DOWL HKM*	From/To	*Sidney to Fairview EB*
Date Performed	*4/17/2012*	Jurisdiction	*Dawson/Richland County*
Analysis Time Period	*Peak Hour*	Analysis Year	*2035 - High*

Project Description: *MT 16 / MT 200 Glendive to Fairview Corridor Planning Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Grade Length mi Up/down

Peak-hour factor, PHF *0.83*

No-passing zone *17%*

% Trucks and Buses , P_T *17 %*

% Recreational vehicles, P_R *4%*

Access points *mi* *16/mi*

Analysis direction vol., V_d *661veh/h*

Opposing direction vol., V_o *654veh/h*

Shoulder width ft *8.0*

Lane Width ft *12.0*

Segment Length mi *9.9*

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.1*	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.983*	*0.983*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i/(PHF*f_{g,ATS}*f_{HV,ATS})$	*810*	*802*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*69.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, $FFS=S_{FM}+0.00776(v/f_{HV,ATS})$		Adj. for access points[4], f_A (Exhibit 15-8)	*4.0 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*0.7 mi/h*	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*65.0 mi/h*
		Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS}+v_{o,ATS})-f_{np,ATS}$	*51.8 mi/h*
		Percent free flow speed, PFFS	*79.7 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*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], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV,PTSF}*f_{g,PTSF})$	*796*	*788*
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	*68.8*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*17.1*	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}*(v_{d,PTSF}/v_{d,PTSF}+v_{o,PTSF})$	*77.4*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*D*
Volume to capacity ratio, *v/c*	*0.48*

Capacity, $C_{d,ATS}$ (Equation 15-12) pc/h	*1671*
Capacity, $C_{d,PTSF}$ (Equation 15-13) pc/h	*1700*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*79.7*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*796.4*
Effective width, Wv (Eq. 15-29) ft	*28.00*
Effective speed factor, S_t (Eq. 15-30)	*4.79*
Bicycle level of service score, BLOS (Eq. 15-31)	*7.63*
Bicycle level of service (Exhibit 15-4)	*F*

Notes

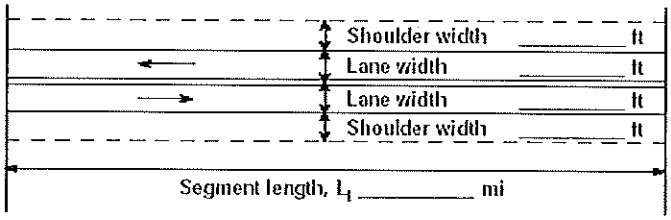
1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*David Stoner*	Highway / Direction of Travel	*MT 200*
Agency or Company	*DOWL HKM*	From/To	*Sidney to Fairview WB*
Date Performed	*4/17/2012*	Jurisdiction	*Dawson/Richland County*
Analysis Time Period	*Peak Hour*	Analysis Year	*2035 - High*

Project Description: *MT 16 / MT 200 Glendive to Fairview Corridor Planning Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Grade Length mi Up/down

Analysis direction vol., V_d	*654veh/h*
Opposing direction vol., V_o	*661veh/h*
Shoulder width ft	*8.0*
Lane Width ft	*12.0*
Segment Length mi	*9.9*
Peak-hour factor, PHF	*0.86*
No-passing zone	*15%*
% Trucks and Buses , P_T	*25 %*
% Recreational vehicles, P_R	*4%*
Access points *mi*	*16/mi*

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.1*	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.976*	*0.976*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i/(PHF*f_{g,ATS}*f_{HV,ATS})$	*779*	*788*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*66.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, $FFS=S_{FM}+0.00776(v/f_{HV,ATS})$		Adj. for access points[4], f_A (Exhibit 15-8)	*4.0 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*0.7 mi/h*	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*62.0 mi/h*
		Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS}+v_{o,ATS})-f_{np,ATS}$	*49.2 mi/h*
		Percent free flow speed, PFFS	*79.3 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*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], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV,PTSF}*f_{g,PTSF})$	*760*	*769*
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	*67.5*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*17.0*	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}*(v_{d,PTSF}/v_{d,PTSF}+v_{o,PTSF})$	*75.9*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*D*
Volume to capacity ratio, *v/c*	*0.47*

Capacity, $C_{d,ATS}$ (Equation 15-12) pc/h	*1659*
Capacity, $C_{d,PTSF}$ (Equation 15-13) pc/h	*1700*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*79.3*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*760.5*
Effective width, Wv (Eq. 15-29) ft	*28.00*
Effective speed factor, S_t (Eq. 15-30)	*4.79*
Bicycle level of service score, BLOS (Eq. 15-31)	*12.67*
Bicycle level of service (Exhibit 15-4)	*F*

Notes

1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
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 and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

Appendix 6

Projected Four-Lane Highway 2035 – Low Condition

Direction 1 = Northbound/Eastbound Direction

Direction 2 = Southbound/Westbound Direction

MULTILANE HIGHWAYS WORKSHEET(Direction 1)

☒

General Information

Analyst	David Stoner
Agency or Company	DOWL HKM
Date Performed	5/1/2012
Analysis Time Period	Peak Hour

Site Information

Highway/Direction to Travel	MT 16
From/To	Glendive to Savage
Jurisdiction	Dawson/Richland County
Analysis Year	2035 - Low

Project Description MT 16 / MT 200 Glendive to Fairview Corridor Planning Study

☐ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	242	Peak-Hour Factor, PHF	0.81
AADT(veh/h)		%Trucks and Buses, P_T	25
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.889

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	0
Median Type, M	
FFS (measured)	60.0
Base Free-Flow Speed, BFFS	

Calc Speed Adj and FFS

f_{LW} (mi/h)	
f_{LC} (mi/h)	
f_A (mi/h)	
f_M (mi/h)	
FFS (mi/h)	60.0

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	168
Speed, S (mi/h)	60.0
D (pc/mi/ln)	2.8
LOS	A

Design

Design (N)

Required Number of Lanes, N	
Flow Rate, v_p (pc/h)	
Max Service Flow Rate (pc/h/ln)	
Design LOS	

Bicycle Level of Service

Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*149.4*
Effective width, W_v (Eq. 15-29) ft	*24.00*
Effective speed factor, S_t (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*13.91*
Bicycle level of service (Exhibit 15-4)	*F*

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MULTILANE HIGHWAYS WORKSHEET(Direction 2)

[X]

General Information

Analyst	David Stoner
Agency or Company	DOWL HKM
Date Performed	5/1/2012
Analysis Time Period	Peak Hour

Site Information

Highway/Direction to Travel	MT 16
From/To	Glendive to Savage
Jurisdiction	Dawson/Richland County
Analysis Year	2035 - Low

Project Description MT 16 / MT 200 Glendive to Fairview Corridor Planning Study

☐ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	249	Peak-Hour Factor, PHF	0.78
AADT(veh/h)		%Trucks and Buses, P_T	25
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.889

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	0
Median Type, M	
FFS (measured)	60.0
Base Free-Flow Speed, BFFS	

Calc Speed Adj and FFS

f_{LW} (mi/h)	
f_{LC} (mi/h)	
f_A (mi/h)	
f_M (mi/h)	
FFS (mi/h)	60.0

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	179
Speed, S (mi/h)	60.0
D (pc/mi/ln)	3.0
LOS	A

Design

Design (N)

Required Number of Lanes, N	
Flow Rate, v_p (pc/h)	
Max Service Flow Rate (pc/h/ln)	
Design LOS	

Bicycle Level of Service

Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*159.6*
Effective width, W_v (Eq. 15-29) ft	*24.00*
Effective speed factor, S_t (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*13.95*
Bicycle level of service (Exhibit 15-4)	*F*

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MULTILANE HIGHWAYS WORKSHEET(Direction 1)

[X]

General Information

Analyst	David Stoner
Agency or Company	DOWL HKM
Date Performed	5/1/2012
Analysis Time Period	Peak Hour

Site Information

Highway/Direction to Travel	MT 16
From/To	Savage to Crane
Jurisdiction	Dawson/Richland County
Analysis Year	2035 - Low

Project Description MT 16 / MT 200 Glendive to Fairview Corridor Planning Study

☐ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	253	Peak-Hour Factor, PHF	0.87
AADT(veh/h)		%Trucks and Buses, P_T	23
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.897

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	0
Median Type, M	
FFS (measured)	60.0
Base Free-Flow Speed, BFFS	

Calc Speed Adj and FFS

f_{LW} (mi/h)	
f_{LC} (mi/h)	
f_A (mi/h)	
f_M (mi/h)	
FFS (mi/h)	60.0

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	162
Speed, S (mi/h)	60.0
D (pc/mi/ln)	2.7
LOS	A

Design

Design (N)

Required Number of Lanes, N	
Flow Rate, v_p (pc/h)	
Max Service Flow Rate (pc/h/ln)	
Design LOS	

Bicycle Level of Service

Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*145.4*
Effective width, W_v (Eq. 15-29) ft	*24.00*
Effective speed factor, S_t (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*12.39*
Bicycle level of service (Exhibit 15-4)	*F*

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MULTILANE HIGHWAYS WORKSHEET(Direction 2)

☒

General Information

Analyst	David Stoner
Agency or Company	DOWL HKM
Date Performed	5/1/2012
Analysis Time Period	Peak Hour

Site Information

Highway/Direction to Travel	MT 16
From/To	Savage to Crane
Jurisdiction	Dawson/Richland County
Analysis Year	2035 - Low

Project Description MT 16 / MT 200 Glendive to Fairview Corridor Planning Study

☐ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	307	Peak-Hour Factor, PHF	0.84
AADT(veh/h)		%Trucks and Buses, P_T	25
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.889

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	0
Median Type, M	
FFS (measured)	60.0
Base Free-Flow Speed, BFFS	

Calc Speed Adj and FFS

f_{LW} (mi/h)	
f_{LC} (mi/h)	
f_A (mi/h)	
f_M (mi/h)	
FFS (mi/h)	60.0

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	205
Speed, S (mi/h)	60.0
D (pc/mi/ln)	3.4
LOS	A

Design

Design (N)

Required Number of Lanes, N	
Flow Rate, v_p (pc/h)	
Max Service Flow Rate (pc/h/ln)	
Design LOS	

Bicycle Level of Service

Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*182.7*
Effective width, W_v (Eq. 15-29) ft	*24.00*
Effective speed factor, S_t (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*14.02*
Bicycle level of service (Exhibit 15-4)	*F*

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MULTILANE HIGHWAYS WORKSHEET(Direction 1)

[x]

General Information

Analyst	David Stoner
Agency or Company	DOWL HKM
Date Performed	5/1/2012
Analysis Time Period	Peak Hour

Site Information

Highway/Direction to Travel	MT 16
From/To	Crane to Sidney
Jurisdiction	Dawson/Richland County
Analysis Year	2035 - Low

Project Description MT 16 / MT 200 Glendive to Fairview Corridor Planning Study

☐ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	271	Peak-Hour Factor, PHF	0.80
AADT(veh/h)		%Trucks and Buses, P_T	19
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.913

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	0
Median Type, M	
FFS (measured)	60.0
Base Free-Flow Speed, BFFS	

Calc Speed Adj and FFS

f_{LW} (mi/h)	
f_{LC} (mi/h)	
f_A (mi/h)	
f_M (mi/h)	
FFS (mi/h)	60.0

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	185
Speed, S (mi/h)	60.0
D (pc/mi/ln)	3.1
LOS	A

Design

Design (N)

Required Number of Lanes, N	
Flow Rate, v_p (pc/h)	
Max Service Flow Rate (pc/h/ln)	
Design LOS	

Bicycle Level of Service

Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*169.4*
Effective width, W_v (Eq. 15-29) ft	*24.00*
Effective speed factor, S_t (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*9.73*
Bicycle level of service (Exhibit 15-4)	*F*

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MULTILANE HIGHWAYS WORKSHEET(Direction 2)

[x]

General Information

Analyst	David Stoner
Agency or Company	DOWL HKM
Date Performed	5/1/2012
Analysis Time Period	Peak Hour

Site Information

Highway/Direction to Travel	MT 16
From/To	Crane to Sidney
Jurisdiction	Dawson/Richland County
Analysis Year	2035 - Low

Project Description MT 16 / MT 200 Glendive to Fairview Corridor Planning Study

☐ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	416	Peak-Hour Factor, PHF	0.87
AADT(veh/h)		%Trucks and Buses, P_T	19
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.913

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	0
Median Type, M	
FFS (measured)	60.0
Base Free-Flow Speed, BFFS	

Calc Speed Adj and FFS

f_{LW} (mi/h)	
f_{LC} (mi/h)	
f_A (mi/h)	
f_M (mi/h)	
FFS (mi/h)	60.0

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	261
Speed, S (mi/h)	60.0
D (pc/mi/ln)	4.3
LOS	A

Design

Design (N)

Required Number of Lanes, N	
Flow Rate, v_p (pc/h)	
Max Service Flow Rate (pc/h/ln)	
Design LOS	

Bicycle Level of Service

Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*239.1*
Effective width, W_v (Eq. 15-29) ft	*24.00*
Effective speed factor, S_t (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*9.91*
Bicycle level of service (Exhibit 15-4)	*F*

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MULTILANE HIGHWAYS WORKSHEET(Direction 1)

[X]

General Information

Analyst	David Stoner
Agency or Company	DOWL HKM
Date Performed	5/1/2012
Analysis Time Period	Peak Hour

Site Information

Highway/Direction to Travel	MT 16
From/To	Sidney to Fairview
Jurisdiction	Dawson/Richland County
Analysis Year	2035 - Low

Project Description MT 16 / MT 200 Glendive to Fairview Corridor Planning Study

☐ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	529	Peak-Hour Factor, PHF	0.83
AADT(veh/h)		%Trucks and Buses, P_T	17
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.922

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	0
Median Type, M	
FFS (measured)	60.0
Base Free-Flow Speed, BFFS	

Calc Speed Adj and FFS

f_{LW} (mi/h)	
f_{LC} (mi/h)	
f_A (mi/h)	
f_M (mi/h)	
FFS (mi/h)	60.0

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	345
Speed, S (mi/h)	60.0
D (pc/mi/ln)	5.8
LOS	A

Design

Design (N)

Required Number of Lanes, N	
Flow Rate, v_p (pc/h)	
Max Service Flow Rate (pc/h/ln)	
Design LOS	

Bicycle Level of Service

Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*318.7*
Effective width, W_v (Eq. 15-29) ft	*24.00*
Effective speed factor, S_t (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*8.82*
Bicycle level of service (Exhibit 15-4)	*F*

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MULTILANE HIGHWAYS WORKSHEET(Direction 2)

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General Information

Analyst	David Stoner
Agency or Company	DOWL HKM
Date Performed	5/1/2012
Analysis Time Period	Peak Hour

Site Information

Highway/Direction to Travel	MT 16
From/To	Sidney to Fairview
Jurisdiction	Dawson/Richland County
Analysis Year	2035 - Low

Project Description MT 16 / MT 200 Glendive to Fairview Corridor Planning Study

☐ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	523	Peak-Hour Factor, PHF	0.86
AADT(veh/h)		%Trucks and Buses, P_T	25
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.889

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	0
Median Type, M	
FFS (measured)	60.0
Base Free-Flow Speed, BFFS	

Calc Speed Adj and FFS

f_{LW} (mi/h)	
f_{LC} (mi/h)	
f_A (mi/h)	
f_M (mi/h)	
FFS (mi/h)	60.0

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	342
Speed, S (mi/h)	60.0
D (pc/mi/ln)	5.7
LOS	A

Design

Design (N)

Required Number of Lanes, N	
Flow Rate, v_p (pc/h)	
Max Service Flow Rate (pc/h/ln)	
Design LOS	

Bicycle Level of Service

Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*304.1*
Effective width, W_v (Eq. 15-29) ft	*24.00*
Effective speed factor, S_t (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*14.27*
Bicycle level of service (Exhibit 15-4)	*F*

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Appendix 6

Projected Four-Lane Highway 2035 – High Condition

Direction 1 = Northbound/Eastbound Direction

Direction 2 = Southbound/Westbound Direction

MULTILANE HIGHWAYS WORKSHEET(Direction 1)

☒

General Information

Analyst	David Stoner
Agency or Company	DOWL HKM
Date Performed	5/1/2012
Analysis Time Period	Peak Hour

Site Information

Highway/Direction to Travel	MT 16
From/To	Glendive to Savage
Jurisdiction	Dawson/Richland County
Analysis Year	2035 - High

Project Description MT 16 / MT 200 Glendive to Fairview Corridor Planning Study

☐ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	321	Peak-Hour Factor, PHF	0.81
AADT(veh/h)		%Trucks and Buses, P_T	25
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.889

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	0
Median Type, M	
FFS (measured)	60.0
Base Free-Flow Speed, BFFS	

Calc Speed Adj and FFS

f_{LW} (mi/h)	
f_{LC} (mi/h)	
f_A (mi/h)	
f_M (mi/h)	
FFS (mi/h)	60.0

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	222
Speed, S (mi/h)	60.0
D (pc/mi/ln)	3.7
LOS	A

Design

Design (N)

Required Number of Lanes, N	
Flow Rate, v_p (pc/h)	
Max Service Flow Rate (pc/h/ln)	
Design LOS	

Bicycle Level of Service

Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*198.1*
Effective width, W_v (Eq. 15-29) ft	*24.00*
Effective speed factor, S_f (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*14.06*
Bicycle level of service (Exhibit 15-4)	*F*

MULTILANE HIGHWAYS WORKSHEET(Direction 2)

[X]

General Information

Analyst	David Stoner
Agency or Company	DOWL HKM
Date Performed	5/1/2012
Analysis Time Period	Peak Hour

Site Information

Highway/Direction to Travel	MT 16
From/To	Glendive to Savage
Jurisdiction	Dawson/Richland County
Analysis Year	2035 - High

Project Description MT 16 / MT 200 Glendive to Fairview Corridor Planning Study

☐ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	331	Peak-Hour Factor, PHF	0.78
AADT(veh/h)		%Trucks and Buses, P_T	25
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.889

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	0
Median Type, M	
FFS (measured)	60.0
Base Free-Flow Speed, BFFS	

Calc Speed Adj and FFS

f_{LW} (mi/h)	
f_{LC} (mi/h)	
f_A (mi/h)	
f_M (mi/h)	
FFS (mi/h)	60.0

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	238
Speed, S (mi/h)	60.0
D (pc/mi/ln)	4.0
LOS	A

Design

Design (N)

Required Number of Lanes, N	
Flow Rate, v_p (pc/h)	
Max Service Flow Rate (pc/h/ln)	
Design LOS	

Bicycle Level of Service

Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*212.2*
Effective width, W_v (Eq. 15-29) ft	*24.00*
Effective speed factor, S_t (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*14.09*
Bicycle level of service (Exhibit 15-4)	*F*

MULTILANE HIGHWAYS WORKSHEET(Direction 1)

☒

General Information

Analyst	David Stoner
Agency or Company	DOWL HKM
Date Performed	5/1/2012
Analysis Time Period	Peak Hour

Site Information

Highway/Direction to Travel	MT 16
From/To	Savage to Crane
Jurisdiction	Dawson/Richland County
Analysis Year	2035 - High

Project Description MT 16 / MT 200 Glendive to Fairview Corridor Planning Study

☐ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	336	Peak-Hour Factor, PHF	0.87
AADT(veh/h)		%Trucks and Buses, P_T	23
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.897

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	0
Median Type, M	
FFS (measured)	60.0
Base Free-Flow Speed, BFFS	

Calc Speed Adj and FFS

f_{LW} (mi/h)	
f_{LC} (mi/h)	
f_A (mi/h)	
f_M (mi/h)	
FFS (mi/h)	60.0

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	215
Speed, S (mi/h)	60.0
D (pc/mi/ln)	3.6
LOS	A

Design

Design (N)

Required Number of Lanes, N	
Flow Rate, v_p (pc/h)	
Max Service Flow Rate (pc/h/ln)	
Design LOS	

Bicycle Level of Service

Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*193.1*
Effective width, W_v (Eq. 15-29) ft	*24.00*
Effective speed factor, S_t (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*12.54*
Bicycle level of service (Exhibit 15-4)	*F*

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MULTILANE HIGHWAYS WORKSHEET(Direction 2)

☒

General Information

Analyst	David Stoner
Agency or Company	DOWL HKM
Date Performed	5/1/2012
Analysis Time Period	Peak Hour

Site Information

Highway/Direction to Travel	MT 16
From/To	Savage to Crane
Jurisdiction	Dawson/Richland County
Analysis Year	2035 - High

Project Description MT 16 / MT 200 Glendive to Fairview Corridor Planning Study

☐ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	407	Peak-Hour Factor, PHF	0.84
AADT(veh/h)		%Trucks and Buses, P_T	25
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.889

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	0
Median Type, M	
FFS (measured)	60.0
Base Free-Flow Speed, BFFS	

Calc Speed Adj and FFS

f_{LW} (mi/h)	
f_{LC} (mi/h)	
f_A (mi/h)	
f_M (mi/h)	
FFS (mi/h)	60.0

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	272
Speed, S (mi/h)	60.0
D (pc/mi/ln)	4.5
LOS	A

Design

Design (N)

Required Number of Lanes, N	
Flow Rate, v_p (pc/h)	
Max Service Flow Rate (pc/h/ln)	
Design LOS	

Bicycle Level of Service

Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*242.3*
Effective width, W_v (Eq. 15-29) ft	*24.00*
Effective speed factor, S_f (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*14.16*
Bicycle level of service (Exhibit 15-4)	*F*

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MULTILANE HIGHWAYS WORKSHEET(Direction 1)

☒

General Information

Analyst	David Stoner
Agency or Company	DOWL HKM
Date Performed	5/1/2012
Analysis Time Period	Peak Hour

Site Information

Highway/Direction to Travel	MT 16
From/To	Crane to Sidney
Jurisdiction	Dawson/Richland County
Analysis Year	2035 - High

Project Description MT 16 / MT 200 Glendive to Fairview Corridor Planning Study

☐ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	360	Peak-Hour Factor, PHF	0.80
AADT(veh/h)		%Trucks and Buses, P_T	19
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.913

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	0
Median Type, M	
FFS (measured)	60.0
Base Free-Flow Speed, BFFS	

Calc Speed Adj and FFS

f_{LW} (mi/h)	
f_{LC} (mi/h)	
f_A (mi/h)	
f_M (mi/h)	
FFS (mi/h)	60.0

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	246
Speed, S (mi/h)	60.0
D (pc/mi/ln)	4.1
LOS	A

Design

Design (N)

Required Number of Lanes, N	
Flow Rate, v_p (pc/h)	
Max Service Flow Rate (pc/h/ln)	
Design LOS	

Bicycle Level of Service

Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*225.0*
Effective width, W_v (Eq. 15-29) ft	*24.00*
Effective speed factor, S_t (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*9.88*
Bicycle level of service (Exhibit 15-4)	*F*

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MULTILANE HIGHWAYS WORKSHEET(Direction 2)

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General Information

Analyst	David Stoner
Agency or Company	DOWL HKM
Date Performed	5/1/2012
Analysis Time Period	Peak Hour

Site Information

Highway/Direction to Travel	MT 16
From/To	Crane to Sidney
Jurisdiction	Dawson/Richland County
Analysis Year	2035 - High

Project Description MT 16 / MT 200 Glendive to Fairview Corridor Planning Study

☐ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	552	Peak-Hour Factor, PHF	0.87
AADT(veh/h)		%Trucks and Buses, P_T	19
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.913

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	0
Median Type, M	
FFS (measured)	60.0
Base Free-Flow Speed, BFFS	

Calc Speed Adj and FFS

f_{LW} (mi/h)	
f_{LC} (mi/h)	
f_A (mi/h)	
f_M (mi/h)	
FFS (mi/h)	60.0

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	347
Speed, S (mi/h)	60.0
D (pc/mi/ln)	5.8
LOS	A

Design

Design (N)

Required Number of Lanes, N	
Flow Rate, v_p (pc/h)	
Max Service Flow Rate (pc/h/ln)	
Design LOS	

Bicycle Level of Service

Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*317.2*
Effective width, W_v (Eq. 15-29) ft	*24.00*
Effective speed factor, S_f (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*10.05*
Bicycle level of service (Exhibit 15-4)	*F*

MULTILANE HIGHWAYS WORKSHEET(Direction 1)

[X]

General Information

Analyst	David Stoner
Agency or Company	DOWL HKM
Date Performed	5/1/2012
Analysis Time Period	Peak Hour

Site Information

Highway/Direction to Travel	MT 16
From/To	Sidney to Fairview
Jurisdiction	Dawson/Richland County
Analysis Year	2035 - High

Project Description MT 16 / MT 200 Glendive to Fairview Corridor Planning Study

☐ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	661	Peak-Hour Factor, PHF	0.83
AADT(veh/h)		%Trucks and Buses, P_T	17
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.922

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	0
Median Type, M	
FFS (measured)	60.0
Base Free-Flow Speed, BFFS	

Calc Speed Adj and FFS

f_{LW} (mi/h)	
f_{LC} (mi/h)	
f_A (mi/h)	
f_M (mi/h)	
FFS (mi/h)	60.0

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	432
Speed, S (mi/h)	60.0
D (pc/mi/ln)	7.2
LOS	A

Design

Design (N)

Required Number of Lanes, N	
Flow Rate, v_p (pc/h)	
Max Service Flow Rate (pc/h/ln)	
Design LOS	

Bicycle Level of Service

Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*398.2*
Effective width, W_v (Eq. 15-29) ft	*24.00*
Effective speed factor, S_t (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*8.93*
Bicycle level of service (Exhibit 15-4)	*F*

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MULTILANE HIGHWAYS WORKSHEET(Direction 2)

[X]

General Information

Analyst	David Stoner
Agency or Company	DOWL HKM
Date Performed	5/1/2012
Analysis Time Period	Peak Hour

Site Information

Highway/Direction to Travel	MT 16
From/To	Sidney to Fairview
Jurisdiction	Dawson/Richland County
Analysis Year	2035 - High

Project Description MT 16 / MT 200 Glendive to Fairview Corridor Planning Study

☐ Oper.(LOS) ☐ Des. (N) ☐ Plan. (vp)

Flow Inputs

Volume, V (veh/h)	654	Peak-Hour Factor, PHF	0.86
AADT(veh/h)		%Trucks and Buses, P_T	25
Peak-Hour Prop of AADT (veh/d)		%RVs, P_R	0
Peak-Hour Direction Prop, D		General Terrain:	Level
DDHV (veh/h)		Grade Length (mi)	0.00
Driver Type Adjustment	1.00	Up/Down %	0.00
		Number of Lanes	2

Calculate Flow Adjustments

f_p	1.00	E_R	1.2
E_T	1.5	f_{HV}	0.889

Speed Inputs

Lane Width, LW (ft)	12.0
Total Lateral Clearance, LC (ft)	12.0
Access Points, A (A/mi)	0
Median Type, M	
FFS (measured)	60.0
Base Free-Flow Speed, BFFS	

Calc Speed Adj and FFS

f_{LW} (mi/h)	
f_{LC} (mi/h)	
f_A (mi/h)	
f_M (mi/h)	
FFS (mi/h)	60.0

Operations

Operational (LOS)

Flow Rate, v_p (pc/h/ln)	427
Speed, S (mi/h)	60.0
D (pc/mi/ln)	7.1
LOS	A

Design

Design (N)

Required Number of Lanes, N	
Flow Rate, v_p (pc/h)	
Max Service Flow Rate (pc/h/ln)	
Design LOS	

Bicycle Level of Service

Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*380.2*
Effective width, W_v (Eq. 15-29) ft	*24.00*
Effective speed factor, S_t (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*14.39*
Bicycle level of service (Exhibit 15-4)	*F*

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