APPENDIX J

2025 No Build Ramp Analysis

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	SSS	Freeway/Dir of Travel	Route 128 NB
Agency or Company	McMahon	Junction	Rt 128 NB to Highland Ave EB
Date Performed	8/8/07	Jurisdiction	
Analysis Time Period	AM	Analysis Year	2025 No Build

Project Description: Route 128 Add-a-Lane

Inputs

Upstream Adj Ramp	Terrain: Level	Downstream Adj Ramp
☐ Yes ☐ On		☑ Yes ☑ On
☑ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 55.0 mph S_{FR} = 35.0 mph	L_{down} = 885 ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 550 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	9300	0.90	Level	2	0	0.990	1.00	10437
Ramp	900	0.90	Level	2	0	0.990	1.00	1010
UpStream								
DownStream	550	0.90	Level	2	0	0.990	1.00	617

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 5120 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	10437	9000	Yes
V_{12}	5120	4400:All	Yes
$V_{FO} = V_F - V_R$	9427	9000	Yes
V_R	1010	2000	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = 48.3 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

D_s = 0.519 (Exhibit 25-19)

S_R= 48.3 mph (Exhibit 25-19)

S_0= 53.9 mph (Exhibit 25-19)

S = 51.0 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2	SSS	Freeway/Dir of Travel	Route 128 NB
Agency or Company	McMahon	Junction	Highland Ave EB to Route 128 N
Date Performed	11/27/07	Jurisdiction	
Analysis Time Period	AM	Analysis Year	2025 No Build

Project Description Route 128 Add-a-Lane

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{up} = ft
V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp
☑ Yes ☐ On
☐ No ☑ Off
L_{down} = 560 ft
V_D = 150 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	$v=V/PHF\ f_{HV}\ f_p$
Freeway	8400	0.90	Level	2	0	0.990	1.00	9427
Ramp	550	0.90	Level	2	0	0.990	1.00	617
UpStream								
DownStream	150	0.90	Level	2	0	0.990	1.00	168

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.141 using Equation 4

V_{12}= 1326 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10044	See Exhibit 25-7	Yes
V_{R12}	1943	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 20.3 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.348 (Exibit 25-19)

S_R= 50.5 mph (Exhibit 25-19)

S_0= 38.0 mph (Exhibit 25-19)

S= 39.9 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	SSS	Freeway/Dir of Travel	Route 128 NB
Agency or Company	McMahon	Junction	Rt 128 NB to Highland Ave WB
Date Performed	11/27/07	Jurisdiction	
Analysis Time Period	AM	Analysis Year	2025 No Build

Project Description: Route 128 Add-a-Lane

Inputs

Upstream Adj Ramp	Terrain: Level	Downstream Adj Ramp
☑ Yes ☑ On		☐ Yes ☐ On
☐ No ☐ Off		☑ No ☐ Off
L_{up} = 560 ft		L_{down} = ft
Vu = 550 veh/h	S_{FF} = 55.0 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	8950	0.90	Level	2	0	0.990	1.00	10044
Ramp	150	0.90	Level	2	0	0.990	1.00	168
UpStream	550	0.90	Level	2	0	0.990	1.00	617
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 4474 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	10044	9000	Yes
V_{12}	4474	4400:All	Yes
$V_{FO} = V_F - V_R$	9876	9000	Yes
V_R	168	2000	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = 42.7 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

D_s = 0.443 (Exhibit 25-19)

S_R= 49.2 mph (Exhibit 25-19)

S_0= 53.4 mph (Exhibit 25-19)

S = 51.4 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2	SSS	Freeway/Dir of Travel	Route 128 NB
Agency or Company	McMahon	Junction	Highland Ave WB to Rt 128 NB
Date Performed	11/27/07	Jurisdiction	
Analysis Time Period	AM	Analysis Year	2025 No Build

Project Description Route 128 Add-a-Lane

Inputs

Upstream Adj Ramp
☑ Yes ☐ On
☐ No ☑ Off
L_{up} = 610 ft
V_u = 150 veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ft
V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	8800	0.90	Level	2	0	0.990	1.00	9876
Ramp	450	0.90	Level	2	0	0.990	1.00	505
UpStream	150	0.90	Level	2	0	0.990	1.00	168
DownStream								

Merge Areas

Estimation of v_{12}

$$V_{12} = V_F (P_{FM})$$

L_{EQ} = (Equation 25-2 or 25-3)
P_{FM}= 0.155 using Equation 4
V_{12}= 1528 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10381	See Exhibit 25-7	Yes
V_{R12}	2033	4600:All	No

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$$

D_R = 21.1 (pc/ m/ln)
LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.351 (Exibit 25-19)
S_R= 50.4 mph (Exhibit 25-19)
S_0= 37.2 mph (Exhibit 25-19)
S= 39.2 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = using Equation
V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$$

D_R = (pc/ m/ln)
LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)
S_R= mph (Exhibit 25-19)
S_0= mph (Exhibit 25-19)
S = mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	SSS	Freeway/Dir of Travel	Route 128 SB
Agency or Company	McMahon	Junction	Rt 128 SB to Highland Ave EB
Date Performed	11/27/07	Jurisdiction	
Analysis Time Period	AM	Analysis Year	2025 No Build

Project Description: Route 128 Add-a-Lane

Inputs

Upstream Adj Ramp	Terrain: Level	Downstream Adj Ramp
☑ Yes ☑ On		☐ Yes ☐ On
☐ No ☐ Off		☑ No ☐ Off
L_{up} = 730 ft		L_{down} = ft
Vu = 400 veh/h	S_{FF} = 55.0 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	7300	0.90	Level	2	0	0.990	1.00	8192
Ramp	1550	0.90	Level	2	0	0.990	1.00	1739
UpStream	400	0.90	Level	2	0	0.990	1.00	449
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 4553 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	8192	9000	No
V_{12}	4553	4400:All	Yes
$V_{FO} = V_F - V_R$	6453	9000	No
V_R	1739	2000	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = 43.4 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

D_s = 0.585 (Exhibit 25-19)

S_R= 47.4 mph (Exhibit 25-19)

S_0= 57.1 mph (Exhibit 25-19)

S = 51.3 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst2	SSS	Freeway/Dir of Travel	Route 128 SB
Agency or Company	McMahon	Junction	Highland Ave EB to Rt 128 SB
Date Performed	11/27/07	Jurisdiction	
Analysis Time Period	AM	Analysis Year	2025 No Build

Project Description Route 129 Add-a-Lane

Site Information

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 905 ft

V_u = 1550 veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	5750	0.90	Level	2	0	0.990	1.00	6453
Ramp	150	0.90	Level	2	0	0.990	1.00	168
UpStream	1550	0.90	Level	2	0	0.990	1.00	1739
DownStream								

Merge Areas

Estimation of v_{12}

$$V_{12} = V_F (P_{FM})$$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.197 using Equation 4

V_{12}= 1270 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	6621	See Exhibit 25-7	No
V_{R12}	1438	4600:All	No

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$$

D_R = 16.6 (pc/ m/ln)

LOS = B (Exhibit 25-4)

Speed Estimation

M_S = 0.337 (Exibit 25-19)

S_R= 50.6 mph (Exhibit 25-19)

S_0= 46.7 mph (Exhibit 25-19)

S= 47.5 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	SSS	Freeway/Dir of Travel	Route 128 SB
Agency or Company	McMahon	Junction	Rt 128 SB to Highland Ave WB
Date Performed	11/27/07	Jurisdiction	
Analysis Time Period	AM	Analysis Year	2025 No Build

Project Description Route 128 Add-a-Lane

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☐ Yes ☐ On		☑ Yes ☑ On
☑ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 55.0 mph S_{FR} = 35.0 mph	L_{down} = 545 ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 400 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	7700	0.90	Level	2	0	0.990	1.00	8641
Ramp	800	0.90	Level	2	0	0.990	1.00	898
UpStream								
DownStream	400	0.90	Level	2	0	0.990	1.00	449

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 4274 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	8641	9000	No
V_{12}	4274	4400:All	No
$V_{FO} = V_F - V_R$	7743	9000	No
V_R	898	2000	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = 41.0 (pc/ mi /ln)

LOS= E (Exhibit 25-4)

Speed Estimation

D_s = 0.509 (Exhibit 25-19)

S_R= 48.4 mph (Exhibit 25-19)

S_0= 55.7 mph (Exhibit 25-19)

S = 51.8 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2	SSS	Freeway/Dir of Travel	Route 128 SB
Agency or Company	McMahon	Junction	Highland Ave WB to Rt 128 SB
Date Performed	11/27/07	Jurisdiction	
Analysis Time Period	AM	Analysis Year	2025 No Build

Project Description Route 128 Add-a-Lane

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 545 ft

V_u = 800 veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	6900	0.90	Level	2	0	0.990	1.00	7743
Ramp	400	0.90	Level	2	0	0.990	1.00	449
UpStream	800	0.90	Level	2	0	0.990	1.00	898
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.162 using Equation 4

V_{12}= 1252 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	8192	See Exhibit 25-7	No
V_{R12}	1701	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 18.5 (pc/ m/ln)

LOS = B (Exhibit 25-4)

Speed Estimation

M_S = 0.342 (Exibit 25-19)

S_R= 50.5 mph (Exhibit 25-19)

S_0= 42.8 mph (Exhibit 25-19)

S= 44.2 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	SSS	Freeway/Dir of Travel	Route 128 NB
Agency or Company	McMahon	Junction	Rt 128 NB to Highland Ave EB
Date Performed	11/27/07	Jurisdiction	
Analysis Time Period	PM	Analysis Year	2025 No Build

Project Description Route 128 Add-a-Lane

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☐ Yes ☐ On		☑ Yes ☑ On
☑ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 55.0 mph S_{FR} = 35.0 mph	L_{down} = 885 ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 800 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	7100	0.90	Level	2	0	0.990	1.00	7968
Ramp	600	0.90	Level	2	0	0.990	1.00	673
UpStream								
DownStream	800	0.90	Level	2	0	0.990	1.00	898

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 3854 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	7968	9000	No
V_{12}	3854	4400:All	No
$V_{FO} = V_F - V_R$	7295	9000	No
V_R	673	2000	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = 37.4 (pc/ mi /ln)

LOS= E (Exhibit 25-4)

Speed Estimation

D_s = 0.489 (Exhibit 25-19)

S_R= 48.6 mph (Exhibit 25-19)

S_0= 56.2 mph (Exhibit 25-19)

S = 52.3 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2	SSS	Freeway/Dir of Travel	Route 128 NB
Agency or Company	McMahon	Junction	Highland Ave EB to Rt 128 NB
Date Performed	11/27/07	Jurisdiction	
Analysis Time Period	PM	Analysis Year	2025 No Build

Project Description Route 128 Add-a-Lane

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{up} = ft
Vu = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph
Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp
☑ Yes ☐ On
☐ No ☑ Off
L_{down} = 560 ft
VD = 150 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	6500	0.90	Level	2	0	0.990	1.00	7294
Ramp	800	0.90	Level	2	0	0.990	1.00	898
UpStream								
DownStream	150	0.90	Level	2	0	0.990	1.00	168

Merge Areas | Diverge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)
P_{FM}= 0.106 using Equation 4
V_{12}= 770 pc/h

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = using Equation
V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	8192	See Exhibit 25-7	No
V_{R12}	1668	4600:All	No

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 18.1 (pc/ m/ln)
LOS = B (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)
LOS= (Exhibit 25-4)

Speed Estimation

M_S = 0.342 (Exibit 25-19)
S_R= 50.6 mph (Exhibit 25-19)
S_0= 42.7 mph (Exhibit 25-19)
S= 44.1 mph (Exhibit 25-14)

Speed Estimation

D_s = (Exhibit 25-19)
S_R= mph (Exhibit 25-19)
S_0= mph (Exhibit 25-19)
S = mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	SSS	Freeway/Dir of Travel	Route 128 NB
Agency or Company	McMahon	Junction	Rt 128 NB to Highland Ave WB
Date Performed	11/27/07	Jurisdiction	
Analysis Time Period	PM	Analysis Year	2025 No Build

Project Description Route 128 Add-a-Lane

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☑ Yes ☑ On		☐ Yes ☐ On
☐ No ☐ Off		☑ No ☐ Off
L_{up} = 560 ft		L_{down} = ft
Vu = 800 veh/h	S_{FF} = 55.0 mph S_{FR} = 35.0 mph Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	7300	0.90	Level	2	0	0.990	1.00	8192
Ramp	150	0.90	Level	2	0	0.990	1.00	168
UpStream	800	0.90	Level	2	0	0.990	1.00	898
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 3666 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	8192	9000	No
V_{12}	3666	4400:All	No
$V_{FO} = V_F - V_R$	8024	9000	No
V_R	168	2000	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$

D_R = 35.8 (pc/ mi /ln)

LOS= E (Exhibit 25-4)

Speed Estimation

D_s = 0.443 (Exhibit 25-19)

S_R= 49.2 mph (Exhibit 25-19)

S_0= 55.4 mph (Exhibit 25-19)

S = 52.5 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2	SSS	Freeway/Dir of Travel	Route 128 NB
Agency or Company	McMahon	Junction	Highland Ave WB to Rt 128 NB
Date Performed	11/27/07	Jurisdiction	
Analysis Time Period	PM	Analysis Year	2025 No Build

Project Description Route 128 Add-a-Lane

Inputs

Upstream Adj Ramp
☑ Yes ☐ On
☐ No ☑ Off
L_{up} = 610 ft
Vu = 150 veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ft
VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	7150	0.90	Level	2	0	0.990	1.00	8024
Ramp	1500	0.90	Level	2	0	0.990	1.00	1683
UpStream	150	0.90	Level	2	0	0.990	1.00	168
DownStream								

Merge Areas

Estimation of v_{12}

$$V_{12} = V_F (P_{FM})$$

L_{EQ} = (Equation 25-2 or 25-3)
P_{FM}= 0.007 using Equation 4
V_{12}= 60 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	9707	See Exhibit 25-7	Yes
V_{R12}	1743	4600:All	No

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$$

D_R = 18.3 (pc/ m/ln)
LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.343 (Exibit 25-19)
S_R= 50.5 mph (Exhibit 25-19)
S_0= 38.4 mph (Exhibit 25-19)
S= 40.1 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = using Equation
V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$$

D_R = (pc/ m/ln)
LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)
S_R= mph (Exhibit 25-19)
S_0= mph (Exhibit 25-19)
S = mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	SSS	Freeway/Dir of Travel	Route 128 SB
Agency or Company	McMahon	Junction	Rt 128 SB to Highland Ave EB
Date Performed	11/27/07	Jurisdiction	
Analysis Time Period	PM	Analysis Year	2025 No Build

Project Description Route 128 Add-a-Lane

Inputs

Upstream Adj Ramp	Terrain Level	Downstream Adj Ramp
☑ Yes ☑ On		☐ Yes ☐ On
☐ No ☐ Off		☑ No ☐ Off
L_{up} = 730 ft	S_{FF} = 55.0 mph S_{FR} = 35.0 mph	L_{down} = ft
Vu = 400 veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	9050	0.90	Level	2	0	0.990	1.00	10156
Ramp	700	0.90	Level	2	0	0.990	1.00	786
UpStream	400	0.90	Level	2	0	0.990	1.00	449
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 4871 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	10156	9000	Yes
V_{12}	4871	4400:All	Yes
$V_{FO} = V_F - V_R$	9370	9000	Yes
V_R	786	2000	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086 V_{12} - 0.009 L_D$

D_R = 46.1 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

D_s = 0.499 (Exhibit 25-19)

S_R= 48.5 mph (Exhibit 25-19)

S_0= 53.9 mph (Exhibit 25-19)

S = 51.2 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2	SSS	Freeway/Dir of Travel	Route 128 SB
Agency or Company	McMahon	Junction	Highland Ave EB to Rt 128 SB
Date Performed	11/27/07	Jurisdiction	
Analysis Time Period	PM	Analysis Year	2025 No Build

Project Description Route 128 Add-a-Lane

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 905 ft

Vu = 700 veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

VD = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	8100	0.90	Level	2	0	0.990	1.00	9090
Ramp	300	0.90	Level	2	0	0.990	1.00	337
UpStream	700	0.90	Level	2	0	0.990	1.00	786
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= 0.176 using Equation 4

V_{12}= 1597 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	9427	See Exhibit 25-7	Yes
V_{R12}	1934	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 20.4 (pc/ m/ln)

LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.348 (Exibit 25-19)

S_R= 50.5 mph (Exhibit 25-19)

S_0= 39.8 mph (Exhibit 25-19)

S= 41.6 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation

V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)

LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S = mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information		Site Information	
Analyst	SSS	Freeway/Dir of Travel	Route 128 SB
Agency or Company	McMahon	Junction	Rt 128 SB to Highland Ave WB
Date Performed	11/27/07	Jurisdiction	
Analysis Time Period	PM	Analysis Year	2025 No Build

Project Description: Route 128 Add-a-Lane

Inputs

Upstream Adj Ramp	Terrain: Level	Downstream Adj Ramp
☐ Yes ☐ On		☑ Yes ☑ On
☑ No ☐ Off		☐ No ☐ Off
L_{up} = ft	S_{FF} = 55.0 mph S_{FR} = 35.0 mph	L_{down} = 545 ft
Vu = veh/h	Sketch (show lanes, L_A, L_D, V_R, V_f)	VD = 650 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	9100	0.90	Level	2	0	0.990	1.00	10212
Ramp	700	0.90	Level	2	0	0.990	1.00	786
UpStream								
DownStream	650	0.90	Level	2	0	0.990	1.00	729

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM}= using Equation

V_{12}= pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}		See Exhibit 25-7	
V_{R12}		4600:All	

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = (pc/ mi /ln)

LOS = (Exhibit 25-4)

Speed Estimation

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

S= mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} =0.436 using Equation 8

V_{12} = 4896 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$	10212	9000	Yes
V_{12}	4896	4400:All	Yes
$V_{FO} = V_F - V_R$	9426	9000	Yes
V_R	786	2000	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = 46.4 (pc/ mi /ln)

LOS= F (Exhibit 25-4)

Speed Estimation

D_s = 0.499 (Exhibit 25-19)

S_R= 48.5 mph (Exhibit 25-19)

S_0= 53.9 mph (Exhibit 25-19)

S = 51.2 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst2	SSS	Freeway/Dir of Travel	Route 128 SB
Agency or Company	McMahon	Junction	Highland Ave WB to Rt 128
Date Performed	11/27/07	Jurisdiction	
Analysis Time Period	PM	Analysis Year	2025 No Build

Project Description Route 128 Add-a-Lane

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{up} = ft
V_u = veh/h

Terrain Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph
Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp
☑ Yes ☐ On
☐ No ☑ Off
L_{down} = 730 ft
V_D = 700 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	Truck	%Rv	f_{HV}	f_p	v=V/PHF f_{HV} f_p
Freeway	8400	0.90	Level	2	0	0.990	1.00	9427
Ramp	650	0.90	Level	2	0	0.990	1.00	729
UpStream								
DownStream	700	0.90	Level	2	0	0.990	1.00	786

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)
P_{FM}= 0.127 using Equation 4
V_{12}= 1194 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
V_{FO}	10156	See Exhibit 25-7	Yes
V_{R12}	1923	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 20.1 (pc/ m/ln)
LOS = F (Exhibit 25-4)

Speed Estimation

M_S = 0.348 (Exibit 25-19)
S_R= 50.5 mph (Exhibit 25-19)
S_0= 37.6 mph (Exhibit 25-19)
S= 39.5 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = using Equation
V_{12} = pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$V_{FI}=V_F$		See Exhibit 25-14	
V_{12}		4400:All	
$V_{FO} = V_F - V_R$		See Exhibit 25-14	
V_R		See Exhibit 25-3	

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.009\ L_D$

D_R = (pc/ m/ln)
LOS= (Exhibit 25-4)

Speed Estimation

D_s = (Exhibit 25-19)
S_R= mph (Exhibit 25-19)
S_0= mph (Exhibit 25-19)
S = mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	TC	Freeway/Dir of Travel	Route 128/I-95 NB
Agency or Company	McMahon	Junction	Rt 128 NB to Rt 9 EB-Ds
Date Performed		Jurisdiction	
Analysis Time Period	AM Peak Hour	Analysis Year	2025 No Build/Full Cloverleaf

Project Description I-95/Route 128 at Route 9 IJR

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{up} = ft
V_u = veh/h

Terrain: Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph
Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp
☑ Yes ☑ On
☐ No ☐ Off
L_{down} = 900 ft
V_D = 486 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	8700	0.92	Level	3	0	0.985	1.00	9598
Ramp	616	0.92	Level	3	0	0.985	1.00	680
UpStream								
DownStream	486	0.92	Level	3	0	0.985	1.00	536

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$
L_{EQ} = (Equation 25-2 or 25-3)
P_{FM} = using Equation (Exhibit 25-5)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$
D_R = (pc/mi/ln)
LOS = (Exhibit 25-4)

Speed Determination

M_S = (Exibit 25-19)
S_R= mph (Exhibit 25-19)
S_0= mph (Exhibit 25-19)
S = mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = 0.436 using Equation (Exhibit 25-12)
V_{12} = 4568 pc/h
V_3 or V_{av34} 2515 pc/h (Equation 25-15 or 25-16)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	9598	Exhibit 25-14	9000	Yes
$V_{FO} = V_F - V_R$	8918	Exhibit 25-14	9000	No
V_R	680	Exhibit 25-3	2000	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4568	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.0009\ L_D$
D_R = 38.0 (pc/mi/ln)
LOS = F (Exhibit 25-4)

Speed Determination

D_s = 0.489 (Exhibit 25-19)
S_R= 48.6 mph (Exhibit 25-19)
S_0= 54.4 mph (Exhibit 25-19)
S = 51.5 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	TC	Freeway/Dir of Travel	Route 128/I-95 NB
Agency or Company	McMahon	Junction	Rt 9 WB to Rt 128 NB-Us
Date Performed		Jurisdiction	
Analysis Time Period	AM Peak Hour	Analysis Year	2025 No Build/Full Cloverleaf

Project Description I-95/Route 128 at Route 9 IJR

Inputs

Upstream Adj Ramp
☑ Yes ☐ On
☐ No ☑ Off
L_{up} = 845 ft
V_u = 958 veh/h

Terrain: Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ft
V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	7612	0.92	Level	3	0	0.985	1.00	8398
Ramp	1125	0.92	Level	3	0	0.985	1.00	1241
UpStream	958	0.92	Level	3	0	0.985	1.00	1057
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)
P_{FM} = 0.196 using Equation (Exhibit 25-5)
V_{12} = 1650 pc/h
V_3 or V_{av34} 3374 pc/h (Equation 25-4 or 25-5)
Is V_3 or V_{av34} > 2,700 pc/h? ☑ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No
If Yes,V_{12a} = 2998 pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	9639	Exhibit 25-7		Yes

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4239	Exhibit 25-7	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 35.3 (pc/mi/ln)
LOS = F (Exhibit 25-4)

Speed Determination

M_S = 0.562 (Exibit 25-19)
S_R= 47.7 mph (Exhibit 25-19)
S_0= 46.1 mph (Exhibit 25-19)
S = 46.8 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = using Equation (Exhibit 25-12)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.0009\ L_D$

D_R = (pc/mi/ln)
LOS = (Exhibit 25-4)

Speed Determination

D_s = (Exhibit 25-19)
S_R= mph (Exhibit 25-19)
S_0= mph (Exhibit 25-19)
S = mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	TC	Freeway/Dir of Travel	Route 128/I95 SB
Agency or Company	McMahon	Junction	Rt 9 EB to Rt 128 SB-Us
Date Performed		Jurisdiction	
Analysis Time Period	AM Peak Hour	Analysis Year	2025 No Build/Full Cloverleaf

Project Description I-95/Route 128 at Route 9 IJR

Inputs

Upstream Adj Ramp
☑ Yes ☐ On
☐ No ☑ Off
L_{up} = 845 ft
V_u = 877 veh/h

Terrain: Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ft
V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	7524	0.92	Level	3	0	0.985	1.00	8301
Ramp	676	0.92	Level	3	0	0.985	1.00	746
UpStream	877	0.92	Level	3	0	0.985	1.00	968
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)
P_{FM} = 0.258 using Equation (Exhibit 25-5)
V_{12} = 2145 pc/h
V_3 or V_{av34} 3078 pc/h (Equation 25-4 or 25-5)
Is V_3 or V_{av34} > 2,700 pc/h? ☑ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No
If Yes,V_{12a} = 2901 pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	9047	Exhibit 25-7		Yes

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3647	Exhibit 25-7	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$

D_R = 30.9 (pc/mi/ln)
LOS = F (Exhibit 25-4)

Speed Determination

M_S = 0.441 (Exibit 25-19)
S_R= 49.3 mph (Exhibit 25-19)
S_0= 46.1 mph (Exhibit 25-19)
S = 47.3 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = using Equation (Exhibit 25-12)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086 V_{12} - 0.0009 L_D$

D_R = (pc/mi/ln)
LOS = (Exhibit 25-4)

Speed Determination

D_s = (Exhibit 25-19)
S_R= mph (Exhibit 25-19)
S_0= mph (Exhibit 25-19)
S = mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	TC	Freeway/Dir of Travel	Route 128/I-95 SB
Agency or Company	McMahon	Junction	Rt 128 SB to Rt 9 WB-Ds
Date Performed		Jurisdiction	
Analysis Time Period	AM Peak Hour	Analysis Year	2025 No Build/Full Cloverleaf

Project Description I-95/Route 128 at Route 9 IJR

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{up} = ft
V_u = veh/h

Terrain: Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph
Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp
☑ Yes ☑ On
☐ No ☐ Off
L_{down} = 505 ft
V_D = 480 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	8641	0.92	Level	3	0	0.985	1.00	9533
Ramp	720	0.92	Level	3	0	0.985	1.00	794
UpStream								
DownStream	480	0.92	Level	3	0	0.985	1.00	530

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$
L_{EQ} = (Equation 25-2 or 25-3)
P_{FM} = using Equation (Exhibit 25-5)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$
D_R = (pc/mi/ln)
LOS = (Exhibit 25-4)

Speed Determination

M_S = (Exibit 25-19)
S_R= mph (Exhibit 25-19)
S_0= mph (Exhibit 25-19)
S = mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = 0.436 using Equation (Exhibit 25-12)
V_{12} = 4604 pc/h
V_3 or V_{av34} 2464 pc/h (Equation 25-15 or 25-16)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	9533	Exhibit 25-14	9000	Yes
$V_{FO} = V_F - V_R$	8739	Exhibit 25-14	9000	No
V_R	794	Exhibit 25-3	2000	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4604	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.0009\ L_D$
D_R = 39.0 (pc/mi/ln)
LOS = F (Exhibit 25-4)

Speed Determination

D_s = 0.499 (Exhibit 25-19)
S_R= 48.5 mph (Exhibit 25-19)
S_0= 54.6 mph (Exhibit 25-19)
S = 51.5 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	TC	Freeway/Dir of Travel	Route 128/I95 SB
Agency or Company	McMahon	Junction	Rt 128 NB to Rt 9 EB-Ds
Date Performed		Jurisdiction	
Analysis Time Period	PM Peak Hour	Analysis Year	2025 No Build/Full Cloverleaf

Project Description I-95/Route 128 at Route 9 IJR

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{up} = ft
V_u = veh/h

Terrain: Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph
Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp
☑ Yes ☑ On
☐ No ☐ Off
L_{down} = 900 ft
V_D = 752 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	9250	0.92	Level	3	0	0.985	1.00	10205
Ramp	507	0.92	Level	3	0	0.985	1.00	559
UpStream								
DownStream	752	0.92	Level	3	0	0.985	1.00	830

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$
L_{EQ} = (Equation 25-2 or 25-3)
P_{FM} = using Equation (Exhibit 25-5)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$
D_R = (pc/mi/ln)
LOS = (Exhibit 25-4)

Speed Determination

M_S = (Exibit 25-19)
S_R= mph (Exhibit 25-19)
S_0= mph (Exhibit 25-19)
S = mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = 0.436 using Equation (Exhibit 25-12)
V_{12} = 4765 pc/h
V_3 or V_{av34} 2720 pc/h (Equation 25-15 or 25-16)
Is V_3 or V_{av34} > 2,700 pc/h? ☑ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes,V_{12a} = 4805 pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	10205	Exhibit 25-14	9000	Yes
$V_{FO} = V_F - V_R$	9646	Exhibit 25-14	9000	Yes
V_R	559	Exhibit 25-3	2000	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4765	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.0009\ L_D$
D_R = 40.0 (pc/mi/ln)
LOS = F (Exhibit 25-4)

Speed Determination

D_s = 0.478 (Exhibit 25-19)
S_R= 48.8 mph (Exhibit 25-19)
S_0= 53.7 mph (Exhibit 25-19)
S = 51.3 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	TC	Freeway/Dir of Travel	Route 128/I-95 NB
Agency or Company	McMahon	Junction	Rt 9 WB ro Rt 128 NB-Us
Date Performed		Jurisdiction	
Analysis Time Period	PM Peak Hour	Analysis Year	2025 No Build/Full Cloverleaf

Project Description I-95/Route 128 at Route 9 IJR

Inputs

Upstream Adj Ramp
☑ Yes ☐ On
☐ No ☑ Off
L_{up} = 845 ft
V_u = 704 veh/h

Terrain: Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ft
V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	8791	0.92	Level	3	0	0.985	1.00	9699
Ramp	1036	0.92	Level	3	0	0.985	1.00	1143
UpStream	704	0.92	Level	3	0	0.985	1.00	777
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)
P_{FM} = 0.209 using Equation (Exhibit 25-5)
V_{12} = 2024 pc/h
V_3 or V_{av34} 3837 pc/h (Equation 25-4 or 25-5)
Is V_3 or V_{av34} > 2,700 pc/h? ☑ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No
If Yes,V_{12a} = 4299 pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	10842	Exhibit 25-7		Yes

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	5442	Exhibit 25-7	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$

D_R = 44.8 (pc/mi/ln)
LOS = F (Exhibit 25-4)

Speed Determination

M_S = 1.192 (Exibit 25-19)
S_R= 39.5 mph (Exhibit 25-19)
S_0= 46.1 mph (Exhibit 25-19)
S = 42.5 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = using Equation (Exhibit 25-12)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.0009\ L_D$

D_R = (pc/mi/ln)
LOS = (Exhibit 25-4)

Speed Determination

D_s = (Exhibit 25-19)
S_R= mph (Exhibit 25-19)
S_0= mph (Exhibit 25-19)
S = mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	TC	Freeway/Dir of Travel	Route 128/I-95 SB
Agency or Company	McMahon	Junction	Rt 128 SB to Rt 9 EB-Ds
Date Performed		Jurisdiction	
Analysis Time Period	PM Peak Hour	Analysis Year	2025 No Build/Full Cloverleaf

Project Description I-95/Route 128 at Route 9 IJR

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{up} = ft
V_u = veh/h

Terrain: Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph
Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp
☑ Yes ☑ On
☐ No ☐ Off
L_{down} = 845 ft
V_D = 941 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	8936	0.92	Level	3	0	0.985	1.00	9859
Ramp	777	0.92	Level	3	0	0.985	1.00	857
UpStream								
DownStream	941	0.92	Level	3	0	0.985	1.00	1038

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$
L_{EQ} = (Equation 25-2 or 25-3)
P_{FM} = using Equation (Exhibit 25-5)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$
D_R = (pc/mi/ln)
LOS = (Exhibit 25-4)

Speed Determination

M_S = (Exibit 25-19)
S_R= mph (Exhibit 25-19)
S_0= mph (Exhibit 25-19)
S = mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = 0.474 using Equation (Exhibit 25-12)
V_{12} = 5125 pc/h
V_3 or V_{av34} 4734 pc/h (Equation 25-15 or 25-16)
Is V_3 or V_{av34} > 2,700 pc/h? ☑ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No
If Yes,V_{12a} = 7159 pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	9859	Exhibit 25-14	6750	Yes
$V_{FO} = V_F - V_R$	9002	Exhibit 25-14	6750	Yes
V_R	857	Exhibit 25-3	2000	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	5125	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.0009\ L_D$
D_R = 60.5 (pc/mi/ln)
LOS = F (Exhibit 25-4)

Speed Determination

D_s = 0.505 (Exhibit 25-19)
S_R= 48.4 mph (Exhibit 25-19)
S_0= 53.7 mph (Exhibit 25-19)
S = 49.8 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	TC	Freeway/Dir of Travel	Route 128/I-95 SB
Agency or Company	McMahon	Junction	Rt 128 SB to Rt 9 EB-Us
Date Performed		Jurisdiction	
Analysis Time Period	PM Peak Hour	Analysis Year	2025 No Build/Full Cloverleaf

Project Description I-95/Route 128 at Route 9 IJR

Inputs

Upstream Adj Ramp
☑ Yes ☑ On
☐ No ☐ Off
L_{up} = 590 ft
V_u = 607 veh/h

Terrain: Level
S_{FF} = 55.0 mph S_{FR} = 35.0 mph
Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ft
V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	8936	0.92	Level	3	0	0.985	1.00	9859
Ramp	777	0.92	Level	3	0	0.985	1.00	857
UpStream	607	0.92	Level	3	0	0.985	1.00	670
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$
L_{EQ} = (Equation 25-2 or 25-3)
P_{FM} = using Equation (Exhibit 25-5)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$
D_R = (pc/mi/ln)
LOS = (Exhibit 25-4)

Speed Determination

M_S = (Exibit 25-19)
S_R= mph (Exhibit 25-19)
S_0= mph (Exhibit 25-19)
S = mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = 2880.17 (Equation 25-8 or 25-9)
P_{FD} = 1.000 using Equation (Exhibit 25-12)
V_{12} = 9859 pc/h
V_3 or V_{av34} 0 pc/h (Equation 25-15 or 25-16)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	9859	Exhibit 25-14	6750	Yes
$V_{FO} = V_F - V_R$	9002	Exhibit 25-14	6750	Yes
V_R	857	Exhibit 25-3	2000	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	9859	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.0009\ L_D$
D_R = 83.7 (pc/mi/ln)
LOS = F (Exhibit 25-4)

Speed Determination

D_s = 0.505 (Exhibit 25-19)
S_R= 48.4 mph (Exhibit 25-19)
S_0= 60.3 mph (Exhibit 25-19)
S = 48.4 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	TC	Freeway/Dir of Travel	Route 128/I-95 SB
Agency or Company	McMahon	Junction	Rt 9 EB to Rt 128 SB-Us
Date Performed		Jurisdiction	
Analysis Time Period	PM Peak Hour	Analysis Year	2025 No Build/Full Cloverleaf

Project Description I-95/Route 128 at Route 9 IJR

Inputs

Upstream Adj Ramp
☑ Yes ☐ On
☐ No ☑ Off
L_{up} = 845 ft
V_u = 777 veh/h

Terrain: Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ft
V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	8159	0.92	Level	3	0	0.985	1.00	9002
Ramp	941	0.92	Level	3	0	0.985	1.00	1038
UpStream	777	0.92	Level	3	0	0.985	1.00	857
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)
P_{FM} = 0.222 using Equation (Exhibit 25-5)
V_{12} = 1997 pc/h
V_3 or V_{av34} 3502 pc/h (Equation 25-4 or 25-5)
Is V_3 or V_{av34} > 2,700 pc/h? ☑ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No
If Yes,V_{12a} = 3602 pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	10040	Exhibit 25-7		Yes

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4640	Exhibit 25-7	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$

D_R = 38.6 (pc/mi/ln)
LOS = F (Exhibit 25-4)

Speed Determination

M_S = 0.695 (Exibit 25-19)
S_R= 46.0 mph (Exhibit 25-19)
S_0= 46.1 mph (Exhibit 25-19)
S = 46.0 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = using Equation (Exhibit 25-12)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086 V_{12} - 0.0009 L_D$

D_R = (pc/mi/ln)
LOS = (Exhibit 25-4)

Speed Determination

D_s = (Exhibit 25-19)
S_R= mph (Exhibit 25-19)
S_0= mph (Exhibit 25-19)
S = mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	TC	Freeway/Dir of Travel	Route 128/I-95 SB
Agency or Company	McMahon	Junction	Rt 128 SB to Rt 9 WB-Ds
Date Performed		Jurisdiction	
Analysis Time Period	PM Peak Hour	Analysis Year	2025 No Build/Full Cloverleaf

Project Description I-95/Route 128 at Route 9 IJR

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{up} = ft
V_u = veh/h

Terrain: Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph
Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp
☑ Yes ☑ On
☐ No ☐ Off
L_{down} = 505 ft
V_D = 607 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	8630	0.92	Level	3	0	0.985	1.00	9521
Ramp	301	0.92	Level	3	0	0.985	1.00	332
UpStream								
DownStream	607	0.92	Level	3	0	0.985	1.00	670

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$
L_{EQ} = (Equation 25-2 or 25-3)
P_{FM} = using Equation (Exhibit 25-5)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes,V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ V_{12} - 0.00627\ L_A$
D_R = (pc/mi/ln)
LOS = (Exhibit 25-4)

Speed Determination

M_S = (Exibit 25-19)
S_R= mph (Exhibit 25-19)
S_0= mph (Exhibit 25-19)
S = mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$
L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = 0.436 using Equation (Exhibit 25-12)
V_{12} = 4338 pc/h
V_3 or V_{av34} 2591 pc/h (Equation 25-15 or 25-16)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No
If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	9521	Exhibit 25-14	9000	Yes
$V_{FO} = V_F - V_R$	9189	Exhibit 25-14	9000	Yes
V_R	332	Exhibit 25-3	2000	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	4338	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\ V_{12} - 0.0009\ L_D$
D_R = 36.7 (pc/mi/ln)
LOS = F (Exhibit 25-4)

Speed Determination

D_s = 0.458 (Exhibit 25-19)
S_R= 49.0 mph (Exhibit 25-19)
S_0= 54.1 mph (Exhibit 25-19)
S = 51.7 mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	TC	Freeway/Dir of Travel	Route 128/I-95 SB
Agency or Company	McMahon	Junction	Rt 9 WB to Rt 128 SB-Ds
Date Performed		Jurisdiction	
Analysis Time Period	PM Peak Hour	Analysis Year	2025 No Build/Full Cloverleaf

Project Description I-95/Route 128 at Route 9 IJR

Inputs

Upstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{up} = ft
V_u = veh/h

Terrain: Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp
☑ Yes ☐ On
☐ No ☑ Off
L_{down} = 590 ft
V_D = 777 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	8329	0.92	Level	3	0	0.985	1.00	9189
Ramp	607	0.92	Level	3	0	0.985	1.00	670
UpStream								
DownStream	777	0.92	Level	3	0	0.985	1.00	857

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)
P_{FM} = 0.322 using Equation (Exhibit 25-5)
V_{12} = 2959 pc/h
V_3 or V_{av34} 3115 pc/h (Equation 25-4 or 25-5)
Is V_3 or V_{av34} > 2,700 pc/h? ☑ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No
If Yes,V_{12a} = 3789 pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	9859	Exhibit 25-7		Yes

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4459	Exhibit 25-7	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$

D_R = 36.2 (pc/mi/ln)
LOS = F (Exhibit 25-4)

Speed Determination

M_S = 0.617 (Exibit 25-19)
S_R= 47.0 mph (Exhibit 25-19)
S_0= 46.1 mph (Exhibit 25-19)
S = 46.5 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = using Equation (Exhibit 25-12)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086 V_{12} - 0.0009 L_D$

D_R = (pc/mi/ln)
LOS = (Exhibit 25-4)

Speed Determination

D_s = (Exhibit 25-19)
S_R= mph (Exhibit 25-19)
S_0= mph (Exhibit 25-19)
S = mph (Exhibit 25-15)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	TC	Freeway/Dir of Travel	Route 128/I-95 SB
Agency or Company	McMahon	Junction	Rt 9 WB to Rt 128 SB-Us
Date Performed		Jurisdiction	
Analysis Time Period	PM Peak Hour	Analysis Year	2025 No Build/Full Cloverleaf

Project Description I-95/Route 128 at Route 9 IJR

Inputs

Upstream Adj Ramp
☑ Yes ☐ On
☐ No ☑ Off
L_{up} = 505 ft
V_u = 301 veh/h

Terrain: Level

S_{FF} = 55.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D,V_R,V_f)

Downstream Adj Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = ft
V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	8329	0.92	Level	3	0	0.985	1.00	9189
Ramp	607	0.92	Level	3	0	0.985	1.00	670
UpStream	301	0.92	Level	3	0	0.985	1.00	332
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)
P_{FM} = 0.322 using Equation (Exhibit 25-5)
V_{12} = 2959 pc/h
V_3 or V_{av34} 3115 pc/h (Equation 25-4 or 25-5)
Is V_3 or V_{av34} > 2,700 pc/h? ☑ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No
If Yes,V_{12a} = 3789 pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	9859	Exhibit 25-7		Yes

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4459	Exhibit 25-7	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$

D_R = 36.2 (pc/mi/ln)
LOS = F (Exhibit 25-4)

Speed Determination

M_S = 0.617 (Exibit 25-19)
S_R= 47.0 mph (Exhibit 25-19)
S_0= 46.1 mph (Exhibit 25-19)
S = 46.5 mph (Exhibit 25-14)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)
P_{FD} = using Equation (Exhibit 25-12)
V_{12} = pc/h
V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)
Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No
Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No
If Yes,V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086 V_{12} - 0.0009 L_D$

D_R = (pc/mi/ln)
LOS = (Exhibit 25-4)

Speed Determination

D_s = (Exhibit 25-19)
S_R= mph (Exhibit 25-19)
S_0= mph (Exhibit 25-19)
S = mph (Exhibit 25-15)